QUAID-E-AZAM SOLAR POWER (PVT.) LTD

REQUEST FOR PROPOSAL(RFP)

Procurement of Goods & Services

For

Remote SCADA Monitoring System Extension

QUAID-E-AZAM SOLAR POWER (PVT.) LTD
Government of the Punjab

Issued by:

Chief Executive Officer
Quaid-e-Azam Solar Power (Pvt.) Ltd.

83-A, E/I Main Boulevard Gulberg III,
Lahore, Pakistan
Tel: +92-42 35790363
Fax: +92-42 35790366
Website: www.qasolar.com
For queries: procurement@qasolar.com

Invitation for Bids

1. Quaid-e-Azam Solar Power (Pvt) Limited (QASPPL) is a wholly owned power generation company of the Government of Punjab and was established under the Companies Ordinance, 1984. The generation plant of QASP is located in Quaid-e-Azam Solar Park, Cholistan, Bahawalpur.

2. QASPPL intends to hire the services of a firm/company/JV/legal entity for the Extension of its SCADA monitoring system of 100MWp Power Plant installed at Bahawalpur and supply the following items:

Sr.	Item	Qty	Bid Security
1.	Remote SCADA Monitoring System Extension as detailed in Section IV *"Technical Specifications"*	01 Lot	*PKR 100,000* (within 5% of estimated Budget)

3. QASPPL invites sealed bids from eligible bidders, manufacturers, authorized Sales & Service Dealers for the supply of above mentioned items.

4. Bidding shall be conducted through Open Competitive Bidding (Single Stage-Double Envelope) procedures specified in the Punjab Procurement Rules ("PPR 2014"), as amended from time to time, and is open to all eligible bidders as defined in the bidding document

5. Interested eligible bidders may obtain bidding documents and further information from the Head office of Quaid-e-Azam Solar Power (Pvt) Ltd at 83-E1, Gulberg-III, Lahore or may download the same from www.qasolar.com or www.ppra.punjab.gov.pk.

6. The provisions in the Instructions to Bidders and in the General Conditions of Contract are the provisions of the Bidding Documents.

7. Pre-Bid Clarification meeting with bidders shall be held on **06-Sep-2017** at QASPPL office. The prospective bidders are requested to get themselves registered by submitting the emails at procurement@qasolar.com.

8. Sealed Bids must be delivered to the above office **on or before 11:00 a.m. on 20-Sep-2017** and must be accompanied by a **Bid Security as mentioned above** in the form of CDR, Pay Order, Demand Draft, or Banker's Cheque from a Scheduled Bank of Pakistan.

9. **Bids will be opened in the presence of bidders' representatives who choose to attend at 11:30 a.m. in the Office of Quaid-e-Azam Solar power (Pvt) Limited, on the same date.**

10. The bidders are requested to give their best and final prices as no negotiations are expected.

11. Taxes will be deducted as per applicable government rules. NTN and Sales Tax registration certificate must be provided. Bidder must quote inclusive of all applicable taxes.

12. For obtaining any further information or clarifications, please contact the person named below:

Deputy Manager Project
procurement@qasolar.com
Quaid-e-Azam Solar Power (Pvt.) Ltd.
83-E1, Gulberg III, Lahore.
+92 42 35790363-5 ext: 118
Fax: +92 42 35790366

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Part-I
Section I. Instructions to Bidders

A. Introduction

1. Invitation to Bids

1.1 The Procuring Agency named in the Bid Data Sheet intends to invite sealed bids for the procurement of Good & Services for *Remote SCADA Monitoring System Extension*.

2. Eligible Bidders

2.1 This Invitation for Bids is open to all suppliers (firm/company/JV/legal entity), except as provided hereinafter.

2.2 Bidders should not be associated, or have been associated in the past, directly or indirectly, with a firm or any of its affiliates which have been engaged by the Procuring Agency to provide consulting services for the preparation of the design, specifications, and other documents to be used for the procurement of the goods to be purchased under this Invitation for Bids.

2.3 Government-owned enterprises may participate only if they are legally and financially autonomous, if they operate under commercial law, and if they are not a dependent agency of the Government.

2.4 Bidders shall not be under a declaration of blacklisting by any Government department or Punjab Procurement Regulatory Authority (PPRA).

3. Eligible Goods and Services

3.1 All goods and related services to be supplied under the contract shall have their origin in eligible source countries as per Pakistani Laws, and all expenditures made under the contract will be limited to such goods and services.

3.2 For purposes of this clause, "origin" means the place where the goods are mined, grown, or produced, or the place from which the related services are supplied. Goods are produced when, through manufacturing, processing, or substantial and major assembly of components, a commercially-recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.

3.3 The origin of goods and services is distinct from the nationality of the Bidder.

4. Cost of Bidding

4.1 The Bidder shall bear all costs associated with the preparation and submission of its bid, and the Procuring Agency named in the Bid

Data Sheet, hereinafter referred to as "the Purchaser," will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

B. The Bidding Documents

5. Content of Bidding Documents

5.1 The goods required, bidding procedures, and contract terms are prescribed in the bidding documents. In addition to the Invitation for Bids, the bidding documents include:

(a) Instructions to Bidders (ITB)
(b) Bid Data Sheet
(c) Schedule of Requirements
(d) Technical Specifications
(e) Bid Submission Form
(f) Manufacturer's Authorization Form
(g) Price Schedules
(h) Contract Form
(i) Performance Security Form
(j) General Conditions of Contract (GCC)
(k) Special Conditions of Contract (SCC)

5.2 The Bidder is expected to examine all instructions, forms, terms, and specifications in the bidding documents. Failure to furnish all information required by the bidding documents or to submit a bid not substantially responsive to the bidding documents in every respect will be at the Bidder's risk and may result in the rejection of its bid.

6. Clarification of Bidding Documents

6.1 A prospective Bidder requiring any clarification of the bidding documents may notify the Purchaser in writing or by email at the Purchaser's address indicated in ITB Clause 19.1. The Purchaser will respond in writing to any request for clarification of the bidding documents which it receives no later than three (3) days prior to the deadline for the submission of bids prescribed in the Bid Data Sheet. Written copies of the Purchaser's response (including an explanation of the query but without identifying the source of inquiry) will be sent to all prospective bidders that have received the bidding documents.

7. Amendment of Bidding Documents

7.1 At any time prior to the deadline for submission of bids, the Purchaser, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, may modify the bidding documents by amendment.

7.2 All prospective bidders that have received the bidding documents will be notified of the amendment in writing or by email, and will be bidding on them.

7.3 In order to allow prospective bidders reasonable time in which to take the amendment into account in preparing their bids, the Purchaser, at its discretion, may extend the deadline for the submission of bids.

C. Preparation of Bids

8. Language of Bid

8.1 The bid prepared by the Bidder, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Purchaser shall be written in the language specified in the Bid Data Sheet. Supporting documents and printed literature furnished by the Bidder may be in same language.

9. Documents Comprising the Bid

9.1 The bid prepared by the Bidder shall comprise the following components:

(a) a Bid Form and a Price Schedule completed in accordance with ITB Clauses 10, 11, and 12;

(b) documentary evidence established in accordance with ITB Clause 13 that the Bidder is eligible to bid and is qualified to perform the contract if its bid is accepted;

(c) documentary evidence established in accordance with ITB Clause 14 that the goods and ancillary services to be supplied by the Bidder are eligible goods and services and conform to the bidding documents; and

(d) bid security furnished in accordance with ITB Clause 15.

10. Bid Form

10.1 The Bidder shall complete the Bid Form and the appropriate Price Schedule furnished in the bidding documents, indicating the goods to be supplied, a brief description of the goods, their country of origin, quantity, and prices.

11. Bid Prices

11.1 The Bidder shall indicate on the appropriate Price Schedule the unit prices (where applicable) and total bid price of the goods it proposes to supply under the contract.

11.2 Prices indicated on the Price Schedule shall be **delivered duty paid (DDP) prices**.

11.4 The Bidder's separation of price components in accordance with ITB Clause 11.2 above will be solely for the purpose of facilitating the comparison of bids by the Purchaser and will not in any way limit the Purchaser's right to contract on any of the terms offered.

11.5 Prices quoted by the Bidder shall be fixed during the Bidder's performance of the contract and not subject to variation on any account, unless otherwise specified in the Bid Data Sheet. A bid submitted with an **adjustable price quotation** will be treated as nonresponsive and will be rejected, pursuant to ITB Clause 24.

12. Bid Currencies

12.1 Prices shall be quoted in **Pak Rupees** unless otherwise specified in the Bid Data Sheet.

13. Documents Establishing Bidder's Eligibility and Qualification

13.1 Pursuant to ITB Clause 9, the Bidder shall furnish, as part of its bid, documents establishing the Bidder's eligibility to bid and its qualifications to perform the contract if its bid is accepted.

13.2 The documentary evidence of the Bidder's eligibility to bid shall establish to the Purchaser's satisfaction that the Bidder, at the time of submission of its bid, is eligible as defined under ITB Clause 2.

13.3 The documentary evidence of the Bidder's qualifications to perform the contract if its bid is accepted shall establish to the Purchaser's satisfaction:

(a) that, in the case of a Bidder offering to supply goods & services under the contract which the Bidder did not manufacture or otherwise produce, the Bidder has been duly authorized by the goods' Manufacturer or producer to supply the in Pakistan;

(b) that the Bidder has the financial, technical, and production capability necessary to perform the contract;

(d) that the Bidder meets the qualification criteria listed in the Bid Data Sheet.

14. Documents Establishing Goods' Eligibility and Conformity to Bidding Documents

14.1 Pursuant to ITB Clause 9, the Bidder shall furnish, as part of its bid, documents establishing the eligibility and conformity to the bidding documents of all goods and services which the Bidder proposes to supply under the contract.

14.2 The documentary evidence of the eligibility of the goods and services shall consist of a statement in the Price Schedule of the country of origin of the goods and services offered which may be

confirmed by a **certificate of origin** issued at the time of shipment.

14.3 The documentary evidence of conformity of the goods and services to the bidding documents may be in the form of literature, drawings, and data, and shall consist of:

(a) a detailed description of the essential technical and performance characteristics of the goods;

(b) a list giving full particulars, including available sources and current prices of spare parts, special tools, etc., necessary for the proper and continuing functioning of the goods for a period to be specified in the Bid Data Sheet, following commencement of the use of the goods by the Purchaser; and

(c) an item-by-item compliance on the Purchaser's Technical Specifications demonstrating **substantial responsiveness** of the goods and services to those specifications, or a statement of deviations and exceptions to the provisions of the Technical Specifications.

14.4 For purposes of the compliance pursuant to ITB Clause 14.3(c) above, the Bidder shall note that standards for workmanship, material, and equipment, as well as references to brand names or catalogue numbers designated by the Purchaser in its Technical Specifications, are intended to be descriptive only and not restrictive. The Bidder may substitute alternative standards, brand names, and/or catalogue numbers in its bid, provided that it demonstrates to the Purchaser's satisfaction that the substitutions ensure substantial equivalence to those designated in the Technical Specifications.

15. Bid Security

15.1 Pursuant to ITB Clause 9, the Bidder shall furnish, as part of its bid, a bid security in the amount specified in the Bid Data Sheet.

15.2 The bid security is required to protect the Purchaser against the risk of Bidder's conduct which would warrant the security's forfeiture, pursuant to ITB Clause 15.7.

15.3 The bid security shall be in Pak. Rupees and shall be in one of the following forms:

(b) Bank call-deposit (CDR), Demand Draft (DD), Pay Order (PO) or Banker's cheque valid for thirty (60) days beyond the validity of bid.

15.4 Any bid not secured in accordance with ITB Clauses 15.1 and 15.3 will be rejected by the Purchaser as nonresponsive, pursuant to ITB Clause 24.

15.5 Unsuccessful bidders' bid security will be discharged or returned as promptly as possible but not later than thirty (60) days after the expiration of the period of bid validity prescribed by the Purchaser pursuant to ITB Clause 16.

15.6 The successful Bidder's bid security will be discharged upon the Bidder signing the contract, pursuant to ITB Clause 32, and furnishing the performance security, pursuant to ITB Clause 33.

15.7 The bid security may be forfeited:

(a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Bid Form; or

(b) in the case of a successful Bidder, if the Bidder fails:

(i) to sign the contract in accordance with ITB Clause 32; **or**

(ii) to furnish performance security in accordance with ITB Clause 33.

16. Period of Validity of Bids

16.1 Bids shall remain valid for the period specified in the Bid Data Sheet after the date of bid opening prescribed by the Purchaser, pursuant to ITB Clause 19. A bid valid for a shorter period shall be rejected by the Purchaser as nonresponsive.

16.2 In exceptional circumstances, the Purchaser may solicit the Bidder's consent to an extension of the period of validity. The request and the responses thereto shall be made in writing (or by email). The bid security provided under ITB Clause 15 shall also be suitably extended. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request will not be required nor permitted to modify its bid, except as provided in ITB Clause 16.3.

16.3 In the case of fixed price contracts, if the award is delayed by a period exceeding sixty (60) days beyond the expiry of the initial bid validity, the contract price will be adjusted by a factor specified in the request for extension.

17. Format and Signing of Bid

17.1 The Bidder shall prepare an original and the number of copies of the bid indicated in the Bid Data Sheet, clearly marking each "ORIGINAL BID" and "COPY OF BID," as appropriate. In the event of any discrepancy between them, the original shall govern.

17.2 The original and the copy or copies of the bid shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to bind the Bidder to the contract. All pages of the bid, except for un-amended printed literature, shall be initialed by the person or persons signing the bid.

17.3 Any interlineation, erasures, or overwriting shall be valid only if they are initialed by the person or persons signing the bid.

17.4 The Bidder shall furnish information as described in the Form of Bid on commissions or gratuities, if any, paid or to be paid to agents relating to this Bid, and to contract execution if the Bidder is awarded the contract.

D. Submission of Bids

18. Sealing and Marking of Bids

18.1 The Bidder shall seal the original and each copy of the bid in separate envelopes, duly marking the envelopes as "ORIGINAL" and "COPY." The envelopes shall then be sealed in an outer envelope.

18.2 The inner and outer envelopes shall:

(a) be addressed to the Purchaser at the address given in the Bid Data Sheet; and

(b) bear the title of procurement Activity indicated in the Bid Data Sheet, the Invitation for Bids (IFB) title and number indicated in the Bid Data Sheet, and a statement: "DO NOT OPEN BEFORE," to be completed with the time and the date specified in the Bid Data Sheet, pursuant to ITB Clause 2.2.

18.3 The inner envelopes shall also indicate the name and address of the Bidder to enable the bid to be returned unopened in case it is declared "late".

18.4 If the outer envelope is not sealed and marked as required by ITB Clause 18.2, the Purchaser will assume no responsibility for the bid's misplacement or premature opening.

19. Deadline for Submission of Bids

19.1 Bids must be received by the Purchaser at the address specified under ITB Clause 18.2 no later than the time and date specified in the Bid Data Sheet.

19.2 The Purchaser may, at its discretion, extend this deadline for the submission of bids by amending the bidding documents in accordance with ITB Clause 7, in which case all rights and obligations of the Purchaser and bidders previously subject to the deadline will thereafter be subject to the deadline as extended.

20. Late Bids

20.1 Any bid received by the Purchaser after the deadline for submission of bids prescribed by the Purchaser pursuant to ITB Clause 19 will be rejected and returned unopened to the Bidder.

21. Modification and Withdrawal of Bids

21.1 The Bidder may modify or withdraw its bid after the bid's submission, provided that written notice of the modification, including substitution or withdrawal of the bids, is received by the Purchaser prior to the deadline prescribed for submission of bids.

21.2 The Bidder's modification or withdrawal notice shall be prepared, sealed, marked, and dispatched in accordance with the provisions of ITB Clause 18. A withdrawal notice may also be sent by email, but followed by a signed confirmation copy, postmarked not later than the deadline for submission of bids.

21.3 No bid may be modified after the deadline for submission of bids.

21.4 No bid may be withdrawn in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Bid Form. Withdrawal of a bid during this interval may result in the Bidder's forfeiture of its bid security, pursuant to the ITB Clause 15.7.

E. Opening and Evaluation of Bids

22. Opening of Bids by the Purchaser

22.1 The Purchaser will open all bids in the presence of bidders' representatives who choose to attend, at the time, on the date, and at the place specified in the Bid Data Sheet. The bidders' representatives who are present shall sign an attendance sheet evidencing their presence.

22.2 The bidders' names, bid modifications or withdrawals, bid prices, discounts, and the presence or absence of requisite bid security and such other details as the Purchaser, at its discretion, may consider appropriate, will be announced at the opening. No bid shall be

rejected at bid opening, except for late bids, which shall be returned unopened to the Bidder pursuant to ITB Clause 20.

22.3 Bids (and modifications sent pursuant to ITB Clause 21.2) that are not opened and read out at bid opening shall not be considered further for evaluation, irrespective of the circumstances. Withdrawn bids will be returned unopened to the bidders.

22.4 The Purchaser will prepare minutes of the bid opening.

23. Clarification of Bids

23.1 During evaluation of the bids, the Purchaser may, at its discretion, ask the Bidder for a clarification of its bid. The request for clarification and the response shall be in writing, and no change in the prices or substance of the bid shall be sought, offered, or permitted.

24. Preliminary Examination

24.1 The Purchaser will examine the bids to determine whether they are complete, whether any computational errors have been made, whether required sureties have been furnished, whether the documents have been properly signed, and whether the bids are generally in order.

24.2 Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail, and the total price shall be corrected. If the Supplier does not accept the correction of the errors, its bid will be rejected, and its bid security may be forfeited. If there is a discrepancy between words and figures, the amount in words will prevail.

24.3 The Purchaser may waive any minor informality, nonconformity, or irregularity in a bid which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any Bidder.

24.4 Prior to the detailed evaluation, pursuant to ITB Clause 25 the Purchaser will determine the substantial responsiveness of each bid to the bidding documents. For purposes of these Clauses, a substantially responsive bid is one which conforms to all the terms and conditions of the bidding documents without material deviations. Deviations from, or objections or reservations to critical provisions, **such as** those concerning **Applicable Law** (GCC Clause 30), will be deemed to be a material deviation. The Purchaser's determination of a bid's responsiveness is to be based

on the contents of the bid itself without recourse to extrinsic evidence.

24.5 If a bid is not substantially responsive, it will be rejected by the Purchaser and may not subsequently be made responsive by the Bidder by correction of the nonconformity.

25. Qualification & Evaluation of Bids

25.1 In the absence of **prequalification**, the Purchaser will determine to its satisfaction whether the Bidder is qualified to perform the contract satisfactorily, in accordance with the criteria listed in Bid Data Sheet.

25.2 The determination will take into account the Bidder's financial, technical, and production capabilities. It will be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB Clause 25.3, as well as such other information as the Purchaser deems necessary and appropriate.

25.3 The Purchaser will **technically evaluate** and compare the bids which have been determined to be substantially responsive, pursuant to ITB Clause 25.3, as per Technical Specifications required

25.4 The Purchaser's **financial evaluation** of a bid will be on delivered duty paid (DDP) price inclusive of prevailing taxes and duties.

25.5 **Quality & Cost-based Selection:**
The following merit point system for weighing evaluation factors can be applied **if specified** in the Bid Data Sheet. The number of points allocated to each factor shall be specified in the Bid Data Sheet.

The bid scoring the highest number of points will be deemed to be the lowest evaluated bid.

26. Contacting the Purchaser

26.1 Subject to ITB Clause 23, no Bidder shall contact the Purchaser on any matter relating to its bid, from the time of the bid opening to the time evaluation report is made public i.e. 10 days before the contract is awarded. If the Bidder wishes to bring additional information or has grievance to the notice of the Purchaser, it should do so in writing.

26.2 Any effort by a Bidder to influence the Purchaser during bid evaluation, or bid comparison may result in the rejection of the Bidder's bid.

F. Award of Contract

28. Award Criteria

28.1 Subject to ITB Clause 30, the Purchaser will award the contract to the successful Bidder whose bid has been determined to be substantially responsive and has been determined to be the lowest evaluated bid, provided further that the Bidder is determined to be qualified to perform the contract satisfactorily.

29. Purchaser's Right to Vary Quantities at Time of Award

29.1 The Purchaser reserves the right at the time of contract award to increase or decrease, by the percentage indicated in the Bid Data Sheet, the quantity of goods and services originally specified in the Schedule of Requirements without any change in unit price or other terms and conditions.

30. Purchaser's Right to Accept or Reject All Bids

30.1 The Purchaser reserves the right to accept or reject all bids, and to annul the bidding process at any time prior to contract award, without thereby incurring any liability to the Bidder or bidders or any obligation to inform the Bidder or bidders of the grounds for the Purchaser's action.

31. Notification of Award

31.1 Prior to the expiration of the period of bid validity, the Purchaser will notify the successful Bidder in writing by registered letter or by email, to be confirmed in writing by registered letter, that its bid has been accepted.

31.2 The notification of award will constitute the formation of the Contract.

31.3 Upon the successful Bidder's furnishing of the performance security pursuant to ITB Clause 33, the Purchaser will promptly notify each unsuccessful Bidder and will discharge its bid security, pursuant to ITB Clause 15.

32. Signing of Contract

32.1 At the same time as the Purchaser notifies the successful Bidder that its bid has been accepted, the Purchaser will send the Bidder the Contract Form provided in the bidding documents, incorporating all agreements between the parties.

32.2 Within seven (07) days of receipt of the Contract Form, the successful Bidder shall sign and date the contract and return it to the Purchaser.

33 Performance Security

33.1 Within fourteen (14) days of the receipt of notification of award from the Purchaser, the successful Bidder shall furnish the performance security in accordance with the Conditions of

Contract, in the Performance Security Form provided in the bidding documents, or in another form acceptable to the Purchaser.

33.2 Failure of the successful Bidder to comply with the requirement of ITB Clause 32 or ITB Clause 33.1 shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security, in which event the Purchaser may make the award to the next lowest evaluated Bidder or call for new bids.

34. Corrupt or Fraudulent Practices

34.1 The Procuring Agency requires that Bidders, Suppliers, and Contractors observe the highest standard of ethics during the procurement and execution of contracts. For the purposes of this provision, the terms set forth below are defined as follows:

(i) "corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution; and

(ii) "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Procuring Agency,

(iii) "collusive practice" is an arrangement among bidders (prior to or after bid submission) designed to establish bid prices at artificial, non-competitive levels for any wrongful gains, and to deprive the Procuring Agency of the benefits of free and open competition;

(b) The Procuring Agency will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;

(c) The Procuring Agency will sanction a firm, in accordance with prevailing Blacklisting procedures under Punjab Procurement Rules 2014, if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a Bank-financed contract.

34.2 Furthermore, Bidders shall be aware of the provision stated in sub-clause 5.4 and sub-clause 24.1 of the General Conditions of Contract.

35. Joint Venture

In case a Bidder is a Joint Venture (JV) it shall be qualified on the following terms:

(a) At least one of the partners of joint venture shall satisfy the relevant experience criteria as per Bid Data Sheet and Bidding Documents.

(b) All firms comprising the joint venture shall be legally constituted and shall meet the eligibility requirement of Bid Data Sheet.

(c) All partners of the joint venture shall at all times and under all circumstances be liable jointly and severally to Employer for the execution of the entire Contract in accordance with the Contract terms and conditions and a statement to this effect shall be included in the authorization mentioned under para (f) below.

(d) The Form of Bid, and in the case of successful bidder, the Form of Contract Agreement, shall be signed so as to be legally binding on all partners.

(e) One of the joint venture partners shall be nominated as being in-charge and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the joint venture partners.

(f) The partner-in-charge shall be authorized to incur liabilities, receive payments and receive instructions for and on behalf of any or all partners of the joint venture.

(g) A copy of the duly executed agreement entered into by the joint venture partners shall be submitted with the bid stating the conditions under which it will function, its period of duration, the persons authorized to represent and obligate it and which persons will be directly responsible for due performance of the Contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint

venture partner without prior written consent of the Employer.

Part-I
Section II. Bid Data Sheet

The following specific data for the goods to be procured shall complement, supplement, or amend the provisions in the Instructions to Bidders (ITB) Part One. Whenever there is a conflict, the provisions herein shall prevail over those in ITB.

Introduction	
ITB 1.1	Name of Procuring Agency: **Quaid-e-Azam Solar Power (Pvt.) Limited**.
ITB 1.1	Name of Project: **100MWp Quaid-e-Azam Solar Power Project at Bahawalpur**
ITB 1.1	Name of Contract: **Procurement of Goods & Services for Installation of Remote SCADA Monitoring System Extension**
ITB 4.1	Name of Purchaser: **Quaid-e-Azam Solar Power (Pvt.) Limited**.
ITB 6.1	For clarification purposes, the Employer's address is: **83-A, E/I Main Boulevard Gulberg III, Lahore, Pakistan** **Tel: +92-42 35790363-5, Ext: 118** **Fax: +92-42 35790366** **Website: www.qasolar.com** **For queries: procurement@qasolar.com** Pre-Bid Clarification meeting with bidders shall be held on **06-Sep-2017** at QASPPL office. The prospective bidders are requested to get themselves registered by submitting the email at the address mentioned above. Requests for clarification shall be received by the Employer no Later than ***08-Sep-2017.*** The response shall be uploaded on www.qasolar.com with emails to registered bidders by 12-Sep-2017
ITB 8.1	Language of the bid – English

Bid Price and Currency	
ITB 11.2	The price quoted shall be Delivered Duty Paid at the following locations in accordance with the Schedule of Requirements including the delivery charges: [*Bahawalpur, Punjab*]

ITB 11.5	The price shall be in Pak Rupees and shall be fixed.

Preparation and Submission of Bids	
ITB 13.2 (a)	a. Certificate of Incorporation of bidder's firm showing its location and the date of registration etc. b. NTN and GST Registration Certificates
ITB 13.3 (b)	Audited Balance Sheet or Bank Statement for the last two financial years (up to June 2016).
ITB 13.3 (d)	**Qualification requirements**. In addition to ITB 13.1, ITB 13.2, and ITB 13.3 (b), the potential bidder must also fulfill the following: - a) The Bidder must be a **Manufacturer** or an **Authorized Dealer** for sales & service continuously from last one-year. b) **Technical Brochures** of Equipment quoted, mentioning its specifications, manufacture's model, product number, and country of origin. c) The bidder must have at least one local certified /authorized **after sales support set-up**. d) **Authority Letter** from the Bidder Company authorizing the relevant person to represent the company. e) If an Agent submits bids on behalf of more than one Manufacturer, unless each such bid is accompanied by a separate Bid Form for each bid, and a bid security, when required, for each bid, and a valid authorized dealership certificate from the respective Manufacturer, all such bids will be rejected as nonresponsive.

<table>
<tr><td>ITB 14.3 (b)</td><td>A certificate from the dealer that all spare parts of the equipment to be supplied are easily available in Pakistan in the local market or from company owned outlets in Pakistan.</td></tr>
<tr><td>ITB 15.1</td><td>Amount of Bid Security:

<table>
<tr><th>Sr.</th><th>Item</th><th>Bid Security</th></tr>
<tr><td>1.</td><td>Remote SCADA Monitoring System as detailed in Section IV “Technical Specifications“</td><td>PKR 100,000
(within 5% of Estimated Price)</td></tr>
</table>

Bids shall be in the prescribed format, sealed and accompanied by the Bid Security in the form of Call Deposit, Bank Draft, or Pay Order in favor of Quaid-e-Azam Solar Power (Pvt) Limited having its validity 90 days from the date of opening of bid.</td></tr>
<tr><td>ITB 16.1</td><td>Bid Validity Period: 90 days after the date of opening of bid.</td></tr>
<tr><td>ITB 17.1</td><td>Number of Copies:
Technical Bid:
One (01) Original along with One (01) Soft Copy in CD/DVD.
Financial Bid:
One (01) Original to be provided in sealed envelope.</td></tr>
<tr><td>ITB 18.2 (a)</td><td>Address for Bid Submission:

Chief Executive Officer
Quaid-e-Azam Solar Power (Pvt.) Ltd.

83-A, E/I Main Boulevard Gulberg III, Lahore, Pakistan
Tel: +92-42 35790363-5
Fax: +92-42 35790366</td></tr>
<tr><td>ITB 18.2 (b)</td><td>IFB Title and Number: Procurement of Goods & Services for Remote SCADA Monitoring System Extension</td></tr>
<tr><td>ITB 19.1</td><td>Deadline for Bid Submission: 11:00 am 20-Sep-2017</td></tr>
<tr><td>ITB 22.1</td><td>Time, Date, and Place for Bid Opening: 11:30 am, 20-Sep-2017

Time, Date for Financial Bid opening to be notified to Technically compliant bidders after technical evaluation.</td></tr>
</table>

<table>
<tr><th colspan="2">Bid Evaluation</th></tr>
<tr><td>ITB 25.3</td><td>Bids of Prospective bidders meeting the following criteria shall be opened for financial evaluation.

<table>
<tr><th>Criteria</th><th>YES</th><th>NO</th></tr>
<tr><td>Company or Local JV Partner is Sales Tax & PRA Registered</td><td></td><td></td></tr>
<tr><td>Company or its Local JV Partner Not Backlisted by Government of Pakistan and Government of Punjab. Affidavit to be attached.</td><td></td><td></td></tr>
<tr><td>Experience (20MW +) Solar Power Plant Monitoring</td><td></td><td></td></tr>
<tr><td>Overall Installed Monitoring Capacity Greater than 5GW</td><td></td><td></td></tr>
<tr><td>Compliance to technical SOW of Section IV: Technical Specifications</td><td></td><td></td></tr>
</table>

Financial Criteria

Lump Sum Price against SOW price Schedule.
Lowest Bidder meeting the qualification criteria shall be awarded the Contract.</td></tr>
<tr><td></td><td></td></tr>
</table>

Contract Award	
ITB 29.1	Percentage for quantity increase or decrease: 15 % of total contract value

Part-I
Section III. Schedule of Requirements

The delivery schedule expressed as weeks stipulates hereafter a delivery date which is the date of delivery required.

TABLE 1 DELIVERY SCHEDULE

Sr.	**Location**	**Item**	**Qty**	**Delivery Period** from the date of Notification of Award
1.	Quaid-e-Azam Solar Park, Near Lal Suhaanra, Bahawalpur, Punjab, Pakistan	Remote SCADA Monitoring System Extension as detailed in Section IV "*Scope of Work"* including Engineering, Approvals, CIP Delivery, Installation, Testing & Commissioning.	01 Lot	**90 days**

Note. The above scope shall be installed at the location mentioned above complete in all respects with installation, training, testing & commissioning.

Part-I
Section IV. Technical Specifications

Remote SCADA Monitoring System Extension

BROAD SPECIFICATIONS:

1. Project Brief

Title of the Consultancy Services Agreement: *"Proposal for Installation of Remote SCADA Monitoring System at 100MWp DC Solar Power Plant Project at Bahawalpur, Punjab, Pakistan."*

Client/Employer: Quaid-e-Azam Solar Power (Pvt.) Ltd.

Location: Lal Sohanra, Bahawalpur, Pakistan

Quaid-e-Azam Solar Power (Pvt.) Ltd., has successfully completed the 100 MW Solar Power Plant in Quaid-e-Azam Solar Park TBEA Xinjiang SunOasis Co. Ltd. The construction phase of the contract stands completed with declaration of COD on 14th of July, 2015 and the O&M period starts thenceforward.

2. Objective for the development of Remote SCADA Monitoring System

The objective for the development of remote SCADA monitoring system, is to develop a remote monitoring system that is able to benchmark power plants performance, define KPIs, schedule power plant O&M activities, and generate daily, weekly and monthly reports. The system should be able to forecast power and integrate data from the existing SCADA monitoring and sensory equipment such weather station, inverter and substation equipment etc.

3. Scope of Work

Installing additional monitoring software on the existing SCADA with a historian and data logger comprising of the following functionalities at Quaid-e-Azam Solar Power Plant:

1. A SCADA system software for monitoring and analysing runtime data of 100 MW solar power plant including substation parameters (switching status, transformer temperature etc.).
2. SCADA system GUI should have help tools and tutorial explaining clearly the functions that the operator must check during operation with screen shots. The

successful bidder shall provide detailed hands on training on how to generate reports and analyse plant performance using the SCADA system.

3. The SCADA system must have an alarm management system indicating PV area and substation alarms (power plant components, fire alarm, failure on components, AC unit failure, etc.) from the operator perspective, including the log with adjustable Alarm filters in GUI clearly indicating severity of the alarm (Colour Coded) and Ticket generation provision, including an alarm dictionary.
4. The SCADA system shall have user assigning and administration functionalities.
5. The SCADA system shall have web based remote monitoring functionality with provision of remote access of at least 10 users with configurable access levels.
6. The SCADA software must clearly show and explain how the different system can be re-parameter (e.g.: new email or telephone number for the O&M staff receiving the alert notification, Alarm thresholds etc.).
7. The SCADA System shall have redundancy of data and software for the life time of the plant.
8. The SCADA System shall have modular functionality with 10% spare slots for easy extension in future.
9. The SCADA System must include and clearly show a function to provide easily daily, weekly, monthly and annual report (export of historical data) to analyse trends and allow performance improvements by the operator i.e. is should have a dropdown menu and historical data can be extracted for any range and time.
10. The remote monitoring of the PV Power plant must clearly be shown in order to provide access to all required information for reporting but also for remote fault finding during operation along with fault logs.
11. The system shall have task assigning and scheduling functionality.
12. The SCADA System shall have string comparison, analysis functions. The values shall be freely adjustable as percentage value of difference. In case of under-performance of any string, the operator shall be notified automatically and error to be logged with clear identification of under-performing string, showing its location on a map indicating PV area.
13. The SCADA system shall indicate underperforming inverters. along with their internal operating temperatures.
14. The monitoring system shall have access to energy meters. The meter data should be stored by the SCADA system and shall be accessed via remote monitoring system.
15. The displayed values of different entities on the HMI/GUI need to be verified and matched with the actual values which are originating from PV area and substation.
16. Permanent online access to the PV power plant monitoring system through a secure portal (VPN) and this data will be displayed in the head office (Lahore). Workstation at Head Office of QA Solar Power to be provided as part of scope.
17. The SCADA system shall have indicative soiling loss monitoring.
18. The data will comprise, apart from electrical parameters of the PV plant, such as currents, voltages, irradiation values. Also, information as for the kind and period of reductions in performance such as curtailment by the grid operator.

19. The SCADA system shall be able to produce graphs with adjustable Scale all parameters and scale shall be properly labelled.
20. The SCADA System shall be able do perform Analysis with fundamental parameters for system output and sub-systems such as weather station, string, SCB, UPS, ATS panel, Inverter and Transformer etc. It shall also have PV Area and Substation quality parameters monitoring including but not limited to:
    - Performance Ratio
    - Plant KWh/KWp production
    - Plant availability
    - Inverter efficiency and temperature
    - Power loss due to high temperature
    - Power loss due to soiling indicator
    - Plant power factor
    - Plant outage due to Utility Network un-availability
    - Plant degradation
    - Transformer Winding and Oil temperatures
21. 24/7 Remote monitoring shall be provided with a central server setup for permanent data storage of the plant. Data shall be provided continuously for all measuring channels (Minimum after every 15 minutes through secure Ftp server).
22. A server shall be provided at site location with storage capacity of at least 90 days for all channels (Equipment's).
23. Software backup drivers and setup with training of on how to install in case of a system crash will be provided with tutorials and manuals.
24. Backup software to be provided in English language
25. The remote system shall have different access levels.
26. All software instructions, labels, installation manual, alarm dictionary, source code and training shall be in English language.
27. Monitor and record grid failures and energy loss. Automatic generation of Grid Failure report including but not limited to following.
    a. Cause of Failure (e.g. Low/High Voltage, Remote grid Failure etc)
    b. No. of Inverters Shutdown.
    c. Recovery Time.
    d. Calculation of Power Loss (considering Irradiance and the formula by Agreed with Energy Purchaser.)
28. New SCADA Monitoring System must be capable to originate auto system generated forecast reports for Energy/Power forecast on daily, weekly, monthly and yearly basis as per weather data, ambient site conditions and other prevailing data of the plant.
29. The SCADA Monitoring System should monitor and record all DC parameters similar to monitoring and recording of AC Parameters. This monitoring of DC parameters should include Gross DC generation for each hour, Array availability data for each hour, Changes in operating status, Scheduled Outages, Maintenance Outages with Forced and Partial forced Outages; Dispatch Instructions; the cause and duration of each Non-Project Event (NPMV) and similar other parameters. All these parameters should be made available for

viewing and downloading by the Purchaser and the System Operator through real-time, redundancy-enabled V-SAT or other suitable communication system.

30. Commissioning of following Panels installed in the Control Room of Power Plant in coordination with NR Electric
    a. Weather forecast and Data Processing Server Panel.
    b. AGC and AVC Control Server Panel.
    c. Power Prediction Server Panel.

4. Supporting Technical Documents/Drawings

The Bidder shall review the following supporting documents in detail to understand the existing SCADA system in detail. Also, Bidder may request for site visit in writing to the contact person mentioned Data Sheet.

i) H194-E-D-0035-Rev8-Main Single Line Diagram
ii) H194-I-D-0225-Rev2-The Technical Protocol of Comprehensive Automation System.
iii) H194-I-D-0007-Rev2-Comprehensive Automated Monitoring Network Diagram of Precinct.
iv) H194-I-D-0008-Rev2-Comprehensive Automated Monitoring Network Diagram of PV Area
v) H194-I-D-0197-Rev2-Overall Fibre Optic Cable Block Diagram
vi) H194-I-D-0232-Rev3-SCADA Signals List.
vii) H194-I-D-0222-Rev1-The Weather Forecast and Data Processing Server Panel Manufacture Drawing.
viii) H194-I-D-0194-Rev1-The Weather Forecast and Data Processing Server Panel Front View Layout.
ix) H194-I-D-0218-Rev1-AGC and AVC Control Server Panel Manufacture Drawing
x) H194-I-D-0152-Rev2-AGC and AVC Control Server Panel Terminal Wiring Diagram.
xi) H194-I-D-0151-Rev1-AGC and AVC Control Server Panel Front View Layout
xii) Functional Diagram of **PCS-9700R,** AGC & AVC Control Panel.
i) H194-I-D-0217-Rev2-Power Prediction Server Panel Manufacturer Drawing.
ii) H194-I-D-0150-Rev2-Power Prediction Server Panel Terminal Wiring Diagram
iii) H194-I-D-0240-Rev1-Power Prediction Server Panel Front View Layout.
iv) Functional Diagram of **PCS-9700F,** Power Forecast System Panel.

5. Execution Plan

The Bidder shall provide a project plan indicating clearly the timeline required for the activities to be performed in the project on a Gantt chart. All deliverables should be clearly mentioned.

The bidder shall provide a monthly progress report showing progress of the project achieved.

Part-I
Section V. Bidding Forms

1. Bid Submission Form

Date: _____
No: _____

To
[Client Address]

Having examined the bidding documents including Addenda Nos. *[insert numbers]*, the receipt of which is hereby duly acknowledged, we, the undersigned, offer to supply and deliver *[description of goods and services]* in conformity with the said bidding documents for the sum of *[total bid amount in words and figures]* or such other sums as may be ascertained in accordance with the Schedule of Prices attached herewith and made part of this Bid.

We undertake, if our Bid is accepted, to deliver the goods in accordance with the delivery schedule specified in the Schedule of Requirements.

If our Bid is accepted, we will obtain the **guarantee of a bank in a sum equivalent to 5% percent of the Contract Price** for the due performance of the Contract, in the form prescribed by the Purchaser.

We agree to abide by this Bid for a period of 90 days from the date fixed for Bid opening under Clause 22 of the Instructions to Bidders, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

Until a formal Contract is prepared and executed, this Bid, together with your written acceptance thereof and your notification of award, shall constitute a binding Contract between us.

Commissions or gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution if we are awarded the contract, are listed below:

Name and address of agent	Amount and Currency	Purpose of Commission or gratuity
_____	_____	_____
_____	_____	_____
_____	_____	_____

(if none, state "none")

We understand that you are not bound to accept the lowest or any bid you may receive.

Dated this _____ day of _____ 20_____.

_____ _____

[signature] *[in the capacity of]*

Duly authorized to sign Bid for and on behalf of _____

2. Manufacturer's Authorization Form

[See Clause 13.3 (a) of the Instructions to Bidders.]

To: *[name of the Purchaser]*

WHEREAS *[name of the Manufacturer]* who are established and reputable manufacturers of *[name and/or description of the goods]* having factories at *[address of factory]*

do hereby authorize *[name and address of Agent]* to submit a bid, and subsequently negotiate and sign the Contract with you against IFB No. *[reference of the Invitation to Bid]* for the above goods manufactured by us.

We hereby extend our full guarantee and warranty as per Clause 15 of the General Conditions of Contract for the goods offered for supply by the above firm against this Invitation for Bids.

_____

[signature for and on behalf of Manufacturer]

Note: This letter of authority should be on the letterhead of the Manufacturer and should be signed by a person competent and having the power of attorney to bind the Manufacturer. It should be included by the Bidder in its bid.

3. Price Schedules

Remote SCADA Monitoring System Extension

Sr.	Item/Description	Brand/Model /Origin	Unit / Qty	Unit Price (Rs.)
1.	Setup Cost of SCADA Monitoring System Extension Inclusive of a. Software Cost b. Hardware Cost c. Installation & Commissioning Services Fee. d. Commissioning of Control Panels. e. Training Fee.		01 Lot	
2.	Software License Fee for Year-01		01 Year	
			Total	

Note:

1. In case of discrepancy between unit price and total, the unit price shall prevail.
2. The prices shall be inclusive of all applicable taxes. Bidder to get themselves aware of all applicable taxes as per applicable tax laws and quote accordingly.
3. Financial Bids having Prices schedule not provided in the prescribed format shown above, shall be rejected.
4. The supplier has to provide the following free of cost:
   i. Technical and Operation Manual.
   ii. At site, complete training of Purchaser's nominated staff regarding maintenance and operation of Goods.
   iii. 24-7 online after Sales support for System Software.

Part-II
Section I. Contract Forms

1. Contract Form

THIS AGREEMENT made the _____ day of _____ 20_____ between *[name of Purchaser]* (hereinafter called "the Purchaser") of the one part and *[name of Supplier]* of (hereinafter called "the Supplier") of the other part:

WHEREAS the Purchaser invited bids for certain goods and ancillary services, viz., *[brief description of goods and services]* and has accepted a bid by the Supplier for the supply of those goods and services in the sum of *[contract price in words and figures]* (hereinafter called "the Contract Price").

NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz.:
(a) the Bid Form and the Price Schedule submitted by the Bidder;
(b) the Schedule of Requirements;
(c) the Technical Specifications;
(d) the General Conditions of Contract;
(e) the Special Conditions of Contract; and
(f) the Purchaser's Notification of Award.

3. In consideration of the payments to be made by the Purchaser to the Supplier as hereinafter mentioned, the Supplier hereby covenants with the Purchaser to provide the goods and services and to remedy defects therein in conformity in all respects with the provisions of the Contract

4. The Purchaser hereby covenants to pay the Supplier in consideration of the provision of the goods and services and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the contract at the times and in the manner prescribed by the contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with their respective laws the day and year first above written.

Signed, sealed, delivered by _____ the _____ (for the Purchaser)

Signed, sealed, delivered by _____ the _____ (for the Supplier)

2. Performance Security Form

To:

[*Client Address*]

WHEREAS *[name of Supplier]* (hereinafter called "the Supplier") has undertaken, in pursuance of Contract No. *[reference number of the contract]* dated _____ 20_____ to supply *[description of goods and services]* (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Supplier shall furnish you with a bank guarantee by a reputable bank for the sum specified therein as security for compliance with the Supplier's performance obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the Supplier a guarantee:

THEREFORE WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Supplier, up to a total of *[amount of the guarantee in words and figures]*, and we undertake to pay you, upon your first written demand declaring the Supplier to be in default under the Contract and without cavil or argument, any sum or sums within the limits of *[amount of guarantee]* as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the _____ day of _____20_____.

Signature and seal of the Guarantors

_____

[name of bank or financial institution]

_____

[address]

_____

[date]

Part-II
Section II. General Conditions of Contract

1. Definitions

1.1 In this Contract, the following terms shall be interpreted as indicated:

(a) "The Contract" means the agreement entered into between the Purchaser and the Supplier, as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.

(b) "The Contract Price" means the price payable to the Supplier under the Contract for the full and proper performance of its contractual obligations.

(c) "The Goods" means all of the equipment, machinery, and/or other materials which the Supplier is required to supply to the Purchaser under the Contract.

(d) "The Services" means those services ancillary to the supply of the Goods, such as transportation and insurance, and any other incidental services, such as installation, commissioning, provision of technical assistance, training, and other such obligations of the Supplier covered under the Contract.

(e) "GCC" means the General Conditions of Contract contained in this section.

(f) "SCC" means the Special Conditions of Contract.

(g) "The Purchaser" means the organization purchasing the Goods, as named in SCC.

(h) "The Purchaser's country" is Islamic Republic of Pakistan.

(i) "The Supplier" means the individual or firm supplying the Goods and Services under this Contract.

(j) "The Project Site," where applicable, means the place or places named in SCC.

(k) "Day" means calendar day.

2. Application	2.1	These General Conditions shall apply to the extent that they are not superseded by provisions of other parts of the Contract.
3. Country of Origin	3.2	For purposes of this Clause, "origin" means the place where the Goods were mined, grown, or produced, or from which the Services are supplied. Goods are produced when, through manufacturing, processing, or substantial and major assembly of components, a commercially recognized new product results that is substantially different in basic characteristics or in purpose or utility from its components.
	3.3	The origin of Goods and Services is distinct from the nationality of the Supplier.
4. Standards	4.1	The Goods supplied under this Contract shall conform to the standards mentioned in the Technical Specifications, and, when no applicable standard is mentioned, to the authoritative standards appropriate to the Goods' country of origin. Such standards shall be the latest issued by the concerned institution.
5. Use of Contract Documents and Information; Inspection and Audit by the Bank	5.1	The Supplier shall not, without the Purchaser's prior written consent, disclose the Contract, or any provision thereof, or any specification, plan, drawing, pattern, sample, or information furnished by or on behalf of the Purchaser in connection therewith, to any person other than a person employed by the Supplier in the performance of the Contract. Disclosure to any such employed person shall be made in confidence and shall extend only so far as may be necessary for purposes of such performance.
	5.2	The Supplier shall not, without the Purchaser's prior written consent, make use of any document or information enumerated in GCC Clause 5.1 except for purposes of performing the Contract.
	5.3	Any document, other than the Contract itself, enumerated in GCC Clause 5.1 shall remain the property of the Purchaser and shall be returned (all copies) to the Purchaser on completion of the Supplier's performance under the Contract if so required by the Purchaser.
	5.4	The Supplier shall permit the Procuring Agency to inspect the Supplier's accounts and records relating to the performance of the Supplier and to have them audited by auditors appointed by the Procuring Agency, if so required by the Procuring Agency.

6. Patent Rights

6.1 The Supplier shall indemnify the Purchaser against all third-party claims of infringement of patent, trademark, or industrial design rights arising from use of the Goods or any part thereof.

7. Performance Security

7.1 Within ten (10) days of receipt of the notification of Contract award, the successful Bidder shall furnish to the Purchaser the performance security in the amount specified in SCC.

7.2 The proceeds of the performance security shall be payable to the Purchaser as compensation for any loss resulting from the Supplier's failure to complete its obligations under the Contract.

7.3 The performance security shall be denominated in the currency of the Contract acceptable to the Purchaser and shall be in one of the following forms:

(a) a bank guarantee or an irrevocable letter of credit issued by a reputable bank located in Pakistan, in the form provided in the bidding documents or another form acceptable to the Purchaser; or

(b) a cashier's or certified check.

7.4 The performance security will be discharged by the Purchaser and returned to the Supplier not later than thirty (30) days following the date of completion of the Supplier's performance obligations under the Contract, including any warranty obligations, unless specified otherwise in SCC.

8. Inspections and Tests

8.1 The Purchaser or its representative shall have the right to inspect and/or to test the Goods to confirm their conformity to the Contract specifications at no extra cost to the Purchaser. SCC and the Technical Specifications shall specify what inspections and tests the Purchaser requires and where they are to be conducted. The Purchaser shall notify the Supplier in writing, in a timely manner, of the identity of any representatives retained for these purposes.

8.2 The inspections and tests may be conducted on the premises of the Supplier or its subcontractor(s), at point of delivery, and/or at the Goods' final destination. If conducted on the premises of the Supplier or its subcontractor(s), all reasonable facilities and assistance, including access to drawings and production data, shall be furnished to the inspectors at no charge to the Purchaser.

8.3 Should any inspected or tested Goods fail to conform to the Specifications, the Purchaser may reject the Goods, and the Supplier shall either replace the rejected Goods or make alterations necessary to meet specification requirements free of cost to the Purchaser.

8.4 The Purchaser's right to inspect, test and, where necessary, reject the Goods after the Goods' arrival in Pakistan shall in no way be limited or waived by reason of the Goods having previously been inspected, tested, and passed by the Purchaser or its representative prior to the Goods' shipment from the country of origin.

8.5 Nothing in GCC Clause 8 shall in any way release the Supplier from any warranty or other obligations under this Contract.

9. Packing

9.1 The Supplier shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to their final destination, as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit, and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the Goods' final destination and the absence of heavy handling facilities at all points in transit.

9.2 The packing, marking, and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract, including additional requirements, if any, specified in SCC, and in any subsequent instructions ordered by the Purchaser.

10. Delivery and Documents

10.1 Delivery of the Goods shall be made by the Supplier in accordance with the terms specified in the Schedule of Requirements. The details of shipping and/or other documents to be furnished by the Supplier are specified in SCC.

10.2 Documents to be submitted by the Supplier are specified in SCC.

11. Insurance

11.1 The Goods supplied under the Contract shall be delivered duty paid (DDP) under which risk is transferred to the buyer after having been delivered, hence insurance coverage is sellers responsibility.

12. Transportation

12.1 The Supplier is required under the Contact to transport the Goods to a specified place of destination within the Purchaser's country, transport to such place of destination in the Purchaser's country,

including insurance and storage, as shall be specified in the Contract, shall be arranged by the Supplier, and related costs shall be included in the Contract Price.

13. Incidental Services

13.1 The Supplier may be required to provide any or all of the following services, including additional services, if any, specified in SCC:

(a) performance or supervision of on-site assembly and/or start-up of the supplied Goods;

(b) furnishing of tools required for assembly and/or maintenance of the supplied Goods;

(c) furnishing of a detailed operations and maintenance manual for each appropriate unit of the supplied Goods;

(d) performance or supervision or maintenance and/or repair of the supplied Goods, for a period of time agreed by the parties, provided that this service shall not relieve the Supplier of any warranty obligations under this Contract; and

(e) training of the Purchaser's personnel, at the Supplier's plant and/or on-site, in assembly, start-up, operation, maintenance, and/or repair of the supplied Goods.

13.2 Prices charged by the Supplier for incidental services, if not included in the Contract Price for the Goods, shall be agreed upon in advance by the parties and shall not exceed the prevailing rates charged for other parties by the Supplier for similar services.

14. Spare Parts

14.1 As specified in SCC, the Supplier may be required to provide any or all of the following materials, notifications, and information pertaining to spare parts manufactured or distributed by the Supplier:

(a) such spare parts as the Purchaser may elect to purchase from the Supplier, provided that this election shall not relieve the Supplier of any warranty obligations under the Contract; and

(b) in the event of termination of production of the spare parts:

(i) advance notification to the Purchaser of the pending termination, in sufficient time to permit the Purchaser to procure needed requirements; and

(ii) following such termination, furnishing at no cost to the Purchaser, the blueprints, drawings, and specifications of the spare parts, if requested.

15. Warranty

15.1 The Supplier warrants that the Goods supplied under the Contract are new, unused, of the most recent or current models, and that they incorporate all recent improvements in design and materials unless provided otherwise in the Contract. The Supplier further warrants that all Goods supplied under this Contract shall have no defect, arising from design, materials, or workmanship (except when the design and/or material is required by the Purchaser's specifications) or from any act or omission of the Supplier, that may develop under normal use of the supplied Goods in the conditions prevailing in the country of final destination.

15.2 This warranty shall remain valid for twenty-four (24) months after the Goods, or any portion thereof as the case may be, have been delivered to and accepted at the final destination indicated in the Contract, or for thirty (30) months after the date of shipment from the port or place of loading in the source country, whichever period concludes earlier, unless specified otherwise in SCC.

15.3 The Purchaser shall promptly notify the Supplier in writing of any claims arising under this warranty.

15.4 Upon receipt of such notice, the Supplier shall, within the period specified in SCC and with all reasonable speed, repair or replace the defective Goods or parts thereof, without costs to the Purchaser.

15.5 If the Supplier, having been notified, fails to remedy the defect(s) within the period specified in SCC, within a reasonable period, the Purchaser may proceed to take such remedial action as may be necessary, at the Supplier's risk and expense and without prejudice to any other rights which the Purchaser may have against the Supplier under the Contract.

16. Payment

16.1 The method and conditions of payment to be made to the Supplier under this Contract shall be specified in SCC.

16.2 The Supplier's request(s) for payment shall be made to the Purchaser in writing, accompanied by an invoice describing, as appropriate, the Goods delivered and Services performed, and by documents submitted pursuant to GCC Clause 10, and upon fulfillment of other obligations stipulated in the Contract.

16.3 Payments shall be made promptly by the Purchaser, but in no case later than thirty (30) days after submission of an invoice or claim by the Supplier, subject to completion of works to the satisfaction of the Purchaser.

16.4 The currency of payment is Pak. Rupees.

17. Prices

17.1 Prices charged by the Supplier for Goods delivered and Services performed under the Contract shall not vary from the prices quoted by the Supplier in its bid, with the exception of any price adjustments authorized in SCC or in the Purchaser's request for bid validity extension, as the case may be.

18. Change Orders

18.1 The Purchaser may at any time, by a written order given to the Supplier pursuant to GCC Clause 31, make changes within the general scope of the Contract in any one or more of the following:

(a) drawings, designs, or specifications, where Goods to be furnished under the Contract are to be specifically manufactured for the Purchaser;

(b) the method of shipment or packing;
(c) the place of delivery; and/or

(d) the Services to be provided by the Supplier.

18.2 If any such change causes an increase or decrease in the cost of, or the time required for, the Supplier's performance of any provisions under the Contract, an equitable adjustment shall be made in the Contract Price or delivery schedule, or both, and the Contract shall accordingly be amended. Any claims by the Supplier for adjustment under this clause must be asserted within thirty (30) days from the date of the Supplier's receipt of the Purchaser's change order.

19. Contract Amendments

19.1 Subject to GCC Clause 18, no variation in or modification of the terms of the Contract shall be made except by written amendment signed by the parties.

20. Assignment

20.1 The Supplier shall not assign, in whole or in part, its obligations to perform under this Contract, except with the Purchaser's prior written consent.

21. Subcontracts

21.1 The Supplier shall notify the Purchaser in writing of all subcontracts awarded under this Contract if not already specified in the bid. Such notification, in the original bid or later, shall not

relieve the Supplier from any liability or obligation under the Contract.

21.2 Subcontracts must comply with the provisions of GCC Clause 3.

22. Delays in the Supplier's Performance

22.1 Delivery of the Goods and performance of Services shall be made by the Supplier in accordance with the time schedule prescribed by the Purchaser in the Schedule of Requirements.

22.2 If at any time during performance of the Contract, the Supplier or its subcontractor(s) should encounter conditions impeding timely delivery of the Goods and performance of Services, the Supplier shall promptly notify the Purchaser in writing of the fact of the delay, its likely duration and its cause(s). As soon as practicable after receipt of the Supplier's notice, the Purchaser shall evaluate the situation and may at its discretion extend the Supplier's time for performance, with or without liquidated damages, in which case the extension shall be ratified by the parties by amendment of Contract.

22.3 Except as provided under GCC Clause 25, a delay by the Supplier in the performance of its delivery obligations shall render the Supplier liable to the imposition of liquidated damages pursuant to GCC Clause 23, unless an extension of time is agreed upon pursuant to GCC Clause 22.2 without the application of liquidated damages.

23. Liquidated Damages

23.1 Subject to GCC Clause 25, if the Supplier fails to deliver any or all of the Goods or to perform the Services within the period(s) specified in the Contract, the Purchaser shall, without prejudice to its other remedies under the Contract, deduct from the Contract Price, as liquidated damages, a sum equivalent to the percentage specified in SCC of the delivered price of the delayed Goods or unperformed Services for each week or part thereof of delay until actual delivery or performance, up to a maximum deduction of the percentage specified in SCC. Once the maximum is reached, the Purchaser may consider termination of the Contract pursuant to GCC Clause 24.

24. Termination for Default

24.1 The Purchaser, without prejudice to any other remedy for breach of Contract, by written notice of default sent to the Supplier, may terminate this Contract in whole or in part:

(a) if the Supplier fails to deliver any or all of the Goods within the period(s) specified in the Contract, or within any

extension thereof granted by the Purchaser pursuant to GCC Clause 22; or

(b) if the Supplier fails to perform any other obligation(s) under the Contract.

(c) if the Supplier, in the judgment of the Purchaser has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this clause:

"corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution.

"fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Procuring Agency, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Procuring Agency of the benefits of free and open competition.

24.2 In the event the Purchaser terminates the Contract in whole or in part, pursuant to GCC Clause 24.1, the Purchaser may procure, upon such terms and in such manner as it deems appropriate, Goods or Services similar to those undelivered, and the Supplier shall be liable to the Purchaser for any excess costs for such similar Goods or Services. However, the Supplier shall continue performance of the Contract to the extent not terminated.

25. Force Majeure

25.1 Notwithstanding the provisions of GCC Clauses 22, 23, and 24, the Supplier shall not be liable for forfeiture of its performance security, liquidated damages, or termination for default if and to the extent that its delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.

25.2 For purposes of this clause, "Force Majeure" means an event beyond the control of the Supplier and not involving the Supplier's fault or negligence and not foreseeable. Such events may include, but are not restricted to, acts of the Purchaser in its sovereign capacity, wars or revolutions, fires, floods, epidemics, quarantine restrictions, and freight embargoes.

25.3 If a Force Majeure situation arises, the Supplier shall promptly notify the Purchaser in writing of such condition and the cause thereof. Unless otherwise directed by the Purchaser in writing, the Supplier shall continue to perform its obligations under the Contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.

26. Termination for Insolvency

26.1 The Purchaser may at any time terminate the Contract by giving written notice to the Supplier if the Supplier becomes bankrupt or otherwise insolvent. In this event, termination will be without compensation to the Supplier, provided that such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to the Purchaser.

27. Termination for Convenience

27.1 The Purchaser, by written notice sent to the Supplier, may terminate the Contract, in whole or in part, at any time for its convenience. The notice of termination shall specify that termination is for the Purchaser's convenience, the extent to which performance of the Supplier under the Contract is terminated, and the date upon which such termination becomes effective.

27.2 The Goods that are complete and ready for shipment within thirty (30) days after the Supplier's receipt of notice of termination shall be accepted by the Purchaser at the Contract terms and prices. For the remaining Goods, the Purchaser may elect:

(a) to have any portion completed and delivered at the Contract terms and prices; and/or

(b) to cancel the remainder and pay to the Supplier an agreed amount for partially completed Goods and Services and for materials and parts previously procured by the Supplier.

28. Resolution of Disputes

28.1 The Purchaser and the Supplier shall make every effort to resolve amicably by direct informal negotiation any disagreement or dispute arising between them under or in connection with the Contract.

28.2 If, after thirty (30) days from the commencement of such informal negotiations, the Purchaser and the Supplier have been unable to resolve amicably a Contract dispute, either party may require that the dispute be referred for resolution to the formal mechanisms specified in SCC. These mechanisms may include, but are not

restricted to, conciliation mediated by a third party, adjudication in an agreed and/or arbitration.

29. Governing Language

29.1 The Contract shall be written in the language specified in SCC. Subject to GCC Clause 30, the version of the Contract written in the specified language shall govern its interpretation. All correspondence and other documents pertaining to the Contract which are exchanged by the parties shall be written in the same language.

30. Applicable Law

30.1 The Contract shall be interpreted in accordance with the laws of Islamic Republic of Pakistan.

31. Notices

31.1 Any notice given by one party to the other pursuant to this Contract shall be sent to the other party in writing or by fax and confirmed in writing to the other party's address specified in SCC.

31.2 A notice shall be effective when delivered or on the notice's effective date, whichever is later.

32. Taxes and Duties

32.1 Supplier shall be entirely responsible for all taxes, duties, license fees, etc., incurred until delivery of the contracted Goods to the Purchaser.

Part-II
Section III. Special Conditions of Contract

The following Special Conditions of Contract shall supplement the General Conditions of Contract. Whenever there is a conflict, the provisions herein shall prevail over those in the General Conditions of Contract. The corresponding clause number of the GCC is indicated in parentheses.

1. Definitions (GCC Clause 1)

GCC 1.1 (g)—The Purchaser is: ***Quaid-e-Azam Solar Power (Pvt.) Ltd***.

GCC 1.1 (h)—The Purchaser's country is: Islamic Republic of Pakistan

GCC 1.1 (i)—The Supplier is: [Detail]

GCC 1.1 (j)—The Project Site is: **Quaid-e-Azam Solar Park, Near Lal-Suharna, Bahawalpur.**

2. Country of Origin (GCC Clause 3)

3. Performance Security (GCC Clause 7)

GCC 7.1—The amount of performance security, as a percentage of the Contract Price, shall be *5%* (Five per cent of the contract price) in the shape of non recourse, irrevocable and unconditional bank guarantee from scheduled bank of Pakistan on the prescribed format attached with the bidding document.

4. Inspections and Tests (GCC Clause 8)

GCC 8.6—

Inspection and tests prior to delivery of goods and at final acceptance are:-

i) For being Brand New, bearing relevant reference numbers of the equipment (Certificate from supplier)
ii) For Physical Fitness having No Damages (Certificate from supplier)
iii) For the Country of Origin as quoted by the Supplier (Certificate from manufacturer)
iv) For conformance to specifications and performance parameters, through Prior to delivery inspection (Inspection Report by Purchaser)
v) For successful operation at site after complete installation, testing and commissioning of the equipment (Installation, Testing and Commissioning Report by Purchaser).

5. Delivery and Documents (GCC Clause 10)

GCC 10.3— Upon shipment, the Supplier shall notify the Purchaser the full details of the shipment, including Contract number, description of Goods, quantity and usual transport document. The Supplier shall mail the following documents to the Purchaser:

(i) Copies of the Supplier's invoice showing Goods' description, quantity, unit price, and total amount;
(ii) Original and two copies of the usual transport document (for example, a negotiable bill of lading, a non-negotiable sea waybill, an inland waterway document, an air waybill, a railway consignment note, a road consignment note, or a multimodal transport document) which the buyer may require to take the goods;
(iii) Copies of the packing list identifying contents of each package;
(iv) Insurance Certificate;
(v) Manufacturer's or Supplier's Valid Warranty Certificate;
(vi) Inspection Certificate issued by the Nominated Inspection Agency (if any), and the Supplier's Factory Inspection Report; and
(vii) Certificate of Origin.
(viii) The above documents would be required even if the equipment has already been imported and is available with the supplier ex-stock

6. Insurance (GCC Clause 11)

GCC 11.1— The Goods supplied under the Contract shall be Delivered Duty Paid (DDP) under which risk is transferred to the Buyer after having been delivered. Hence insurance coverage is seller's responsibility. Since the Insurance is seller's responsibility they may arrange appropriate coverage.

7. Incidental Services (GCC Clause 13)

GCC 13.1—Incidental services to be provided are:

A) At site complete training of Purchaser's nominated staff regarding maintenance and operation of Goods.
B) At site preventive maintenance on quarterly basis by the bidder's qualified staff for one year, starting from final acceptance of goods.

The rate must include cost for all kinds of labor, inputs and material required for above, and all applicable government taxes and levies. In case a separate rate is not provided by the bidder for the above items, it shall be deemed to have been covered in the overall quoted cost.

8. Warranty (GCC Clause 15)

GCC 15.2—In accordance with the provisions, the warranty period shall be 24 months (parts and labor warranty) from date of Handing Over (Final Acceptance) of the Goods whichever occurs earlier. The Supplier shall, in addition, comply with the performance and/or consumption guarantees specified under the Contract. If, for reasons attributable to the Supplier, these guarantees are not attained in whole or in part, the Supplier shall, at its discretion, either:

(a) Make such changes, modifications, and/or additions to the Goods or any part thereof as may be necessary in order to attain the contractual guarantees specified in the Contract at its own cost and expense and to carry out further performance tests in accordance with SCC 4,

or

(b) Pay liquidated damages to the Purchaser with respect to the failure to meet the contractual guarantees. The rate of these liquidated damages shall be 0.1 % of the contract price per day. The maximum amount of liquidated damages for the whole of the goods or part thereof shall be 5% of the contract price.

or

(c) Replacement of the whole unit at site including transportation, installation, testing & commissioning etc in case of major defect at his own cost.

GCC 15.4 & 15.5—the period for correction of defects in the warranty period is 72 hours.

9. Payment (GCC Clause 16)

GCC 16.1—The method and conditions of payment to be made to the Supplier under this Contract shall be as follows:

Payment for Goods supplied:

Payment shall be made in Pak. Rupees in the following manner or as mutually agreed at the time of Contract.

(i) **Payment against Goods & Services**: Upon completion of Goods & Services the Seller shall submit an Invoice which shall be paid within thirty (30) days of receipt of the Goods at site after performing the requisite inspection and tests as mentioned in SCC 4.

12. Prices (GCC Clause 17)

GCC 17.1—Prices shall be: Fixed.

13. Liquidated Damages (GCC Clause 23)

GCC 23.1—Applicable rate: 0.1 % of contract price per day
Maximum deduction: 5 % of contract price

14. Resolution of Disputes (GCC Clause 28)

GCC 28.3—The dispute resolution mechanism to be applied pursuant to GCC Clause 28.2 shall be as follows:

In the case of a dispute between the Purchaser and the Supplier, the dispute shall be referred to adjudication or arbitration in accordance with the Pakistan Arbitration Act, 1940.

15. Governing Language (GCC Clause 29)

GCC 29.1—The Governing Language shall be: English.

16. Applicable Law (GCC Clause 30)

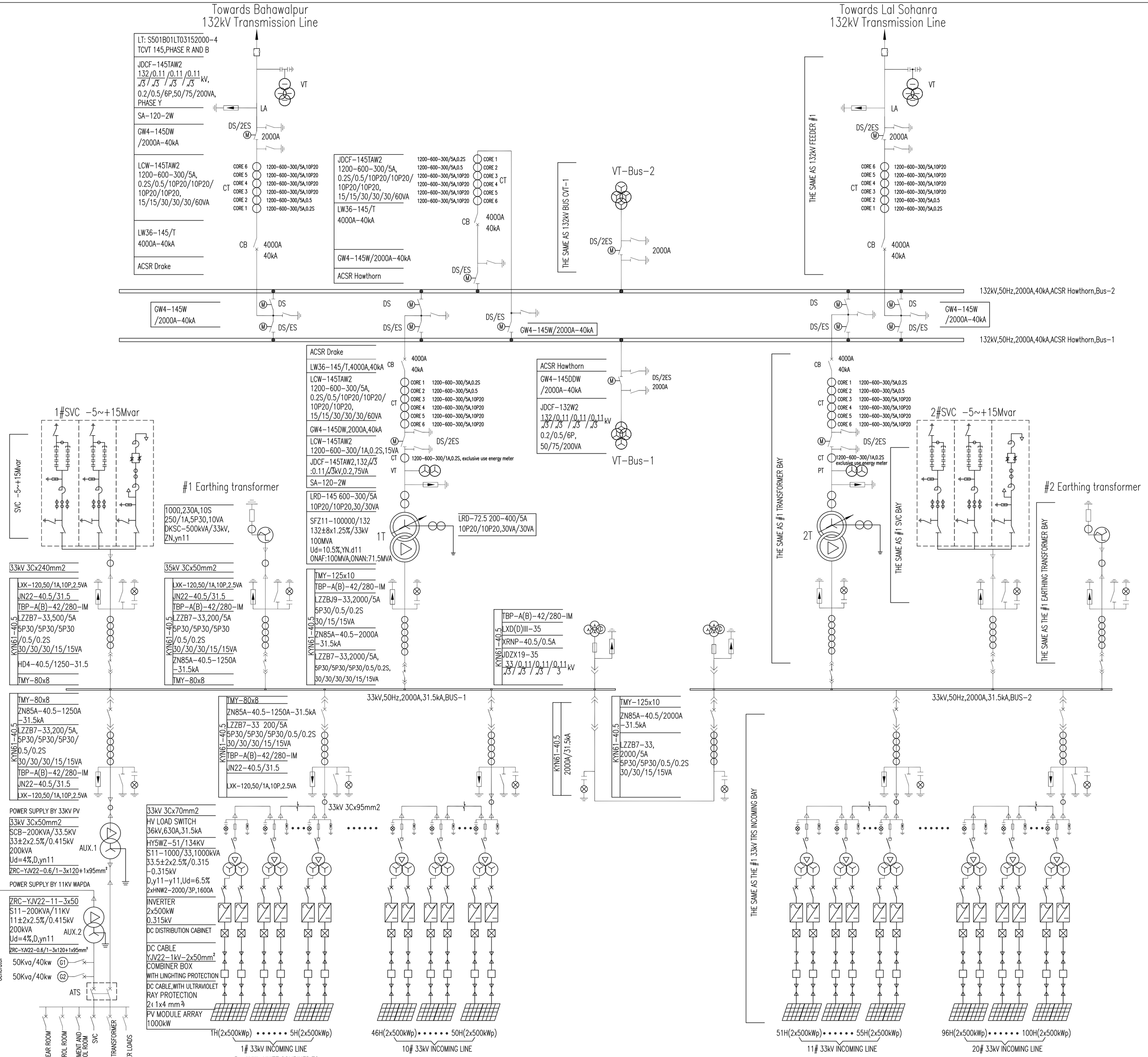
GCC 30.1-The Contract shall be interpreted in accordance with the laws of Islamic Republic of Pakistan which includes the following legislation:

The Employment of Children (ECA) Act 1991
The Bonded Labour System (Abolition) Act of 1992
The Factories Act 1934

17. Notices (GCC Clause 31)

GCC 31.1—Purchaser's address for notice purposes – 3rd Floor, 83-E-1, Gulberg III, Lahore.

—Supplier's address for notice purposes:



LEGEND

No.	SYMBOL	DESCRIPTION	QUANTITY
1		145kV CIRCUIT BREAKER, 40kA, 50Hz,4000A	5
2		145kV DISCONNECTING SWITCH, 40kA, 50Hz,2000A,WITHOUT EARTHING SWITCH	4
3		145kV DISCONNECTING SWITCH, 40kA, 50Hz,2000A,WITH ONE EARTHING SWITCH	6
4		145kV DISCONNECTING SWITCH, 40kA, 50Hz,2000A,WITH TWO EARTHING SWITCHES	6
5		CURRENT TRANSFORMER CORE	15
6		145kV COUPLING CAPACITOR,VOLTAGE TRANSFORMER 6000pf,50Hz,WITH CARRIER ACCESSORIES	14
7		CONVENTIONAL SURGE ARRESTER	12
8		132 / 33 kV,100MVA POWER TRANSFORMER,WITH ON-LOAD TAP CHANGER AND NATURE CT	2
9		40.5kV SWITCHGEAR	21
10		CABLE AND CABLE TERMINATIONS	
11		BOX TYPE STEP UP TRANSFORMEA	100
12		INVERTER	200
13		EARTHING TRANSFORMER AND RESISTANCE	2
14		DC DISTRIBUTION CABINET	200
15		COMBINER BOX	1300
16		PV MODULE ARRAY	395120
17		ATS	1
18		DXN-T / VOLTAGE INDICATOR	
19		**200kVA AUXILIARY TRANFORMER** AUX1:SC-200/33; AUX2:S11-M-200/11	1;1
20	G	**DIESEL GENERATOR** 50KVA/40KW,50Hz/3P-415Vac	2
21		**LT: S501B01LT03152000-4** TCVT 145	4

Note:
1. The substation is 100MW solar power step-up station made up of two 100MVA main transformer
2. 33kv class adopt sectionalized single-bus configuration and 132Kv class adopt double bus
3. There are 20 incoming lines in 33Kv class and 2 outgoing lines in 132Kv class

REV. / (版本)	DATE / (日期)	ISSUE PURPOSE / (修改目的)	PREPARED/ (设计)	CHECKED / (校核)	APPROVED / (批准)
8	22/11/2016	Issued for built	FUYALEI	WU CHENGJUN	QIAOWEI
7	30/09/2015	Issued for built	FUYALEI	WU CHENGJUN	QIAOWEI
6	07/07/2015	Issued for built	FUYALEI	WU CHENGJUN	QIAOWEI
5	06/04/2015	Issued for information	FUYALEI	WU CHENGJUN	QIAOWEI
4	22/12/2014	Issued for approval	FUYALEI	WU CHENGJUN	QIAOWEI
3	19/11/2014	Issued for approval	FUYALEI	WU CHENGJUN	QIAOWEI
2	30/10/2014	Issued for approval	FUYALEI	WU CHENGJUN	QIAOWEI
1	07/10/2014	Issued for approval	FUYALEI	WU CHENGJUN	QIAOWEI
0	30/8/2014	Issued for approval	FUYALEI	WU CHENGJUN	QIAOWEI
C	5/7/2014	Issued for approval	FUYALEI	WU CHENGJUN	QIAOWEI

PROJECT / (项目名称): 100 MW PV POWER PLANT AT QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主): QUAID-E-AZAM SOLAR POWER Pvt. (Ltd)

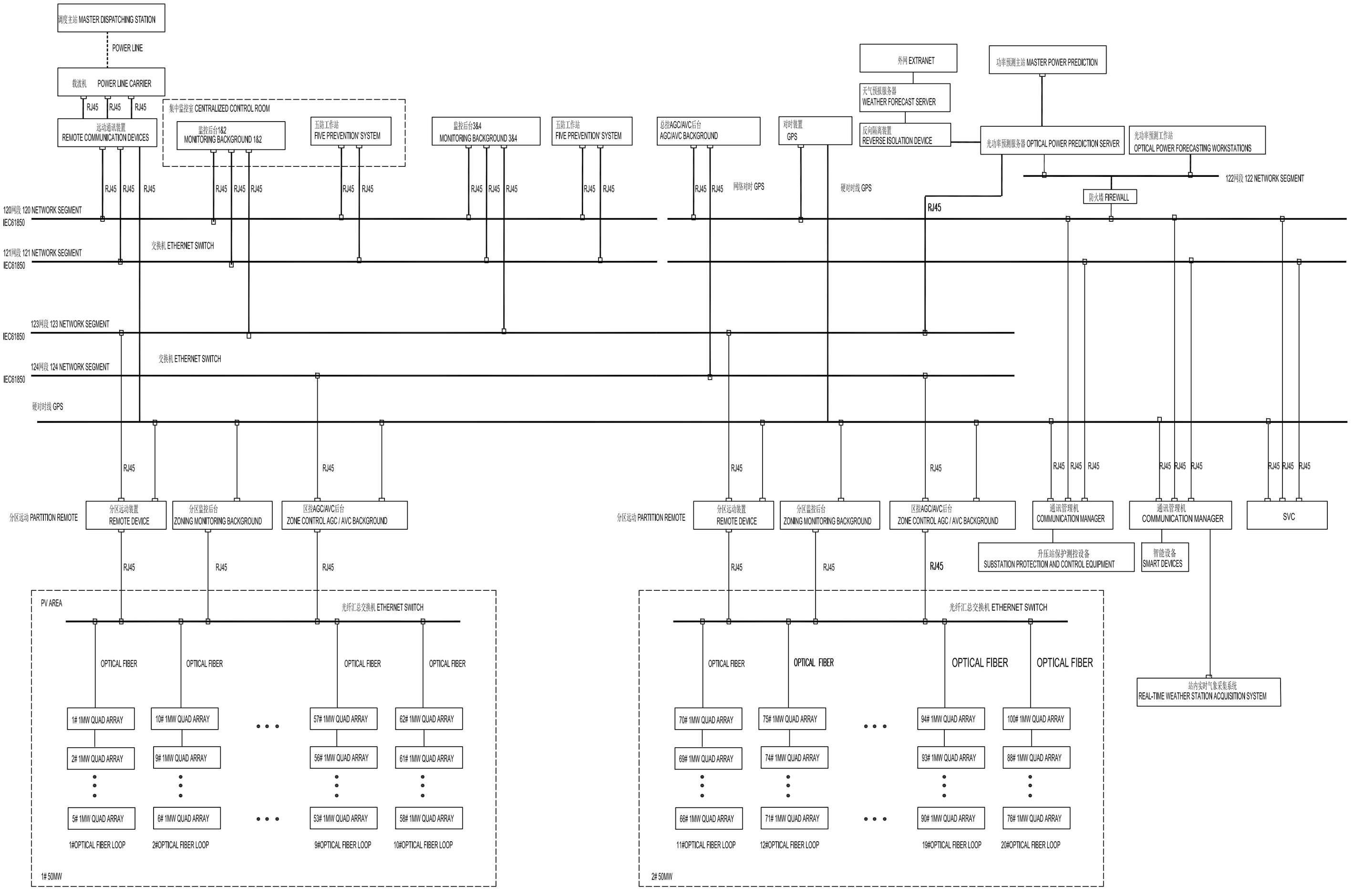
EPC / (EPC单位): TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问): ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称): Main single line diagram 主接线图

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号)	SHEET
NTS	H194	H194-E-D-0035/H194-E0101-02	1/1

ORIGINAL A1



REFERENCE DRAWINGS & DOCUMENTS:

DRAWING & DOCUMENT TITLE	DRAWING & DOCUMENT NO.
COMPREHENSIVE AUTOMATED MONITORING NETWORK DIAGRAM OF PV AREA	H1944-D-0007/H194-I0101-06

LEGEND

LEGEND	NAME
XXXX	DEVICE OR FUNCTION
[ ]	INSTALLED IN OTHER ROOM

NAME	Qty.
SERVER CABINETS	3
SERVERS	4
WORK/ENGINEERING STATIONS	4
PRINTERS	4

NOTES

1. ALL THE EQUIPMENTS ARE INSTALLED IN LOCAL CONTROL ROOM AND RELAY ROOM.
2. MONITORING BACKGROUND 1&2 ARE INSTALLED IN CENTRALIZED CONTROL ROOM
3. ZONING MONITORING BACKGROUND CONTROL AND MONITORING PV EQUIPMENTS ,SUCH AS INVERTER, TRANSFORMER, COMBINER BOX
4. REMOTE DEVICE COLLECT ALL KINDS OF INFORMATION ABOUT PV, AUTOMATIC TRANSMISSION TO SUBSTATION BACKGROUND, IT IS A KIND OF RTU
5. FIVE PREVENTION' SYSTEM CONSISTS MAINLY OF SERVERS, SOFTWARE, COMPUTER-KEYS, CHARGED COMMUNICATION CONTROLLER, CODED LOCKS, ETC, AND ACHIEVES INTEGRATED OPERATION BLOCKING FUNCTION FOR THE WHOLE STATION EQUIPMENTS.
6. 120/121/122/123/124 IS DIFFERENT IP FOR ETHERNET SWITCH.
7. ZONING MONITORING BACKGROUND IS INSTALLED ON THE TABLE OF THE LOCAL CONTROL ROOM.

REV. / (版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改内容或范围)	PREPARED / (设计)	CHECKED / (校对)	APPROVED / (审核)
2	18.04.2015	ISSUE FOR AS BUILT	HU KE	LIU XIAO HONG	QIAO WEI
1	1.10.2014	ISSUE FOR INFORMATION	HU KE	LIU XIAO HONG	QIAO WEI
0	17.9.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI
D	20.8.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI
C	24.7.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI
B	18.6.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI
A	28.5.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR POWER Pvt. (Ltd)

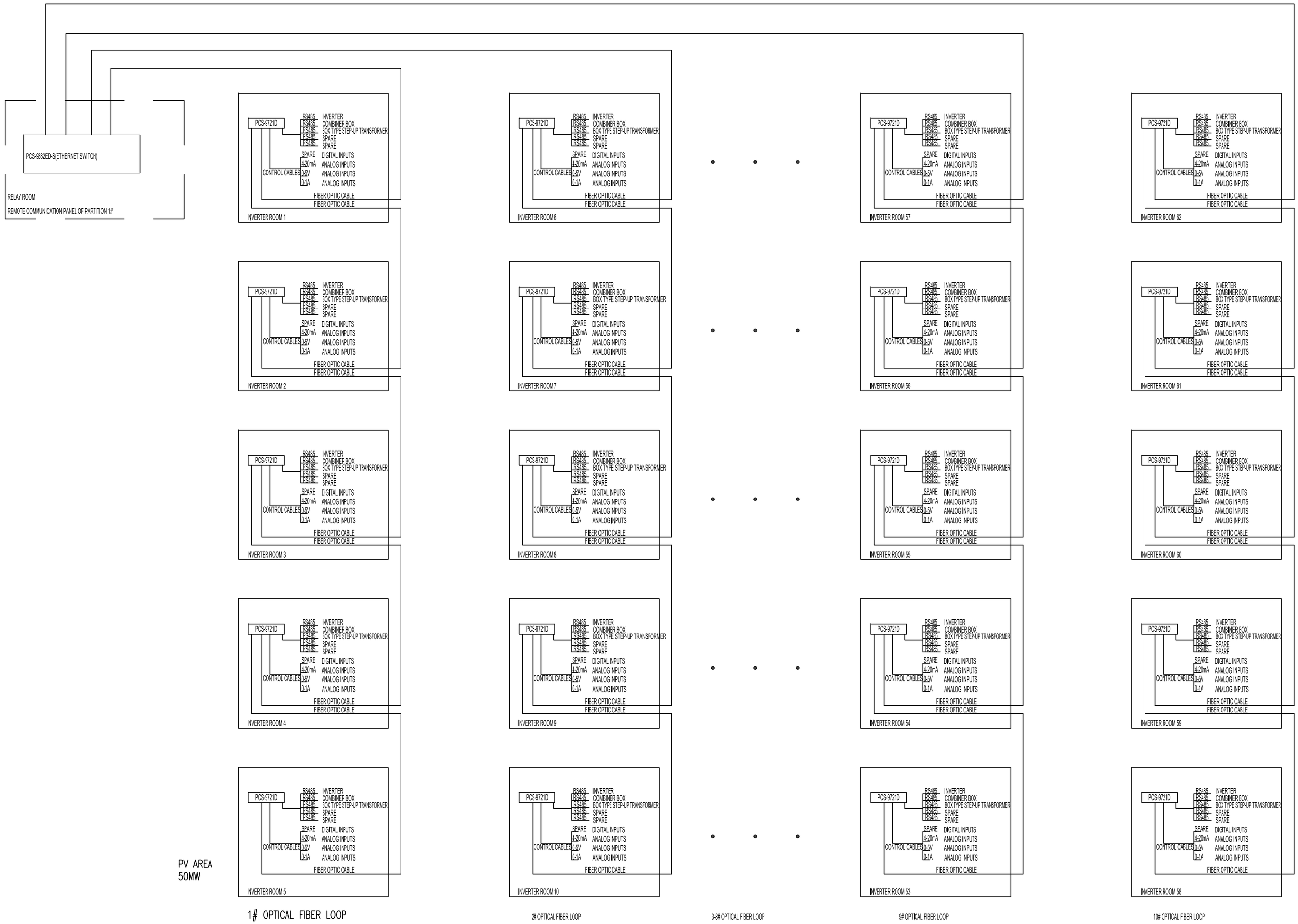
EPC / (EPC 单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
COMPREHENSIVE AUTOMATED MONITORING NETWORK DIAGRAM OF PRECINCT

SCALE / (比例)	PROJECT NO.	DRAWING NO.	SHEET, / (Ch.)
NTS	H194	H194-I-D-0007/H194-I0101-06	1 OF 1

ORIGINAL A2-1



REFERENCE DRAWINGS & DOCUMENTS:	
DRAWING & DOCUMENT TITLE	DRAWING & DOCUMENT NO.
COMPREHENSIVE AUTOMATED MONITORING NETWORK DIAGRAM OF PRECINCT	H1944-D-0007/H194-I0101-06
33KV HIGH VOLTAGE CABLE LAYOUT RUN DRAWING	H194-E-D-0030/H194-E0405-01

NOTES:

1.THIS DRAWING SHOWS 50MW QUAD ARRAY, ANOTHER 50 MW THE SAME AS THIS.

2. THE PATH OF FIBER OPTIC CABLES IS ALONG WITH 33KV CABLES.

	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改内容或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (审核)
2	18.4.2015	ISSUE FOR AS BUILT	HU KE	LIU XIAO HONG	QIAO WEI
1	17.9.2014	ISSUE FOR INFORMATION	HU KE	LIU XIAO HONG	QIAO WEI
0	20.8.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI
C	14.8.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI
B	15.7.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI
A	28.5.2014	ISSUE FOR APPROVAL	HU KE	LIU XIAO HONG	QIAO WEI

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

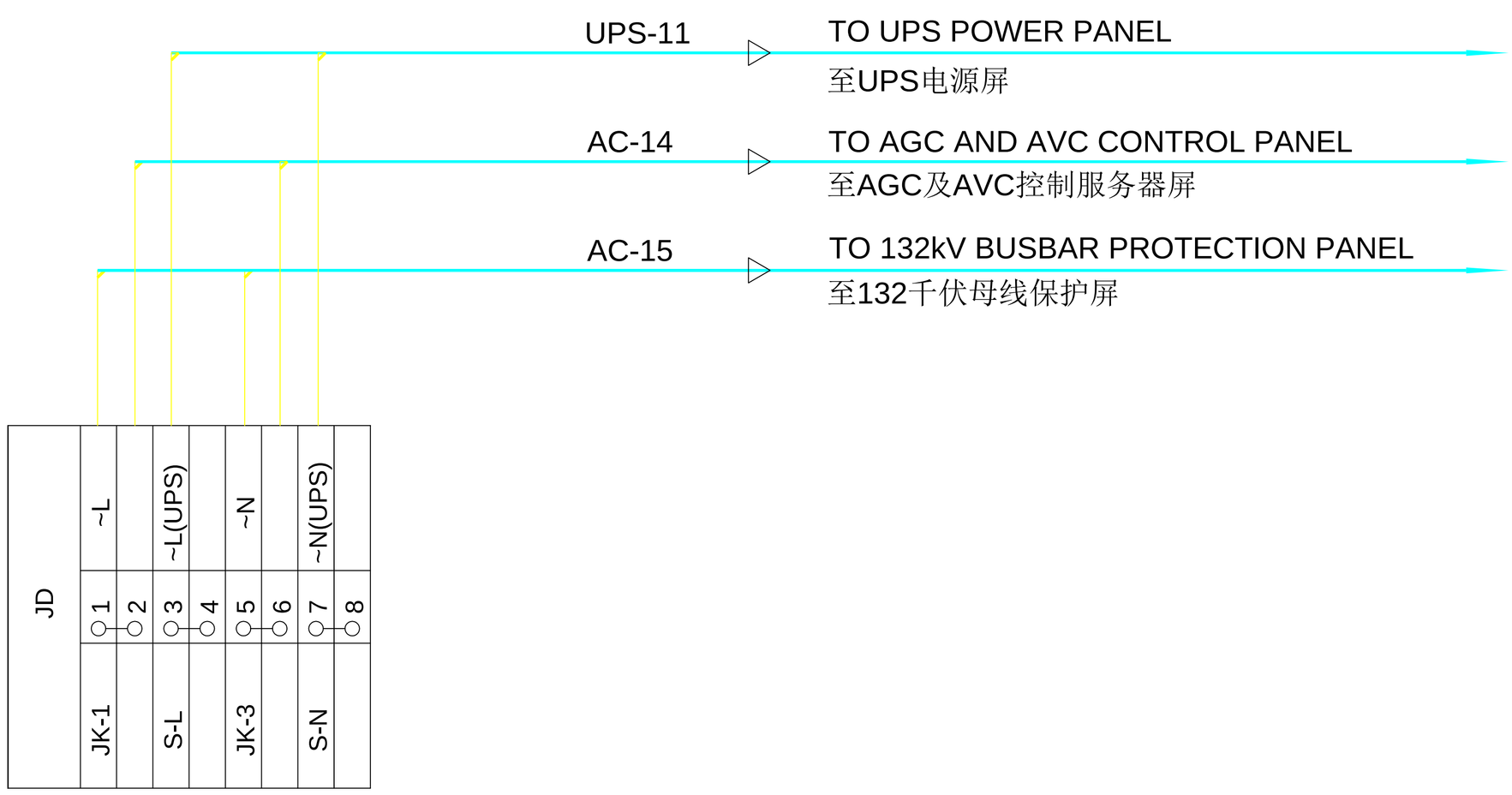
EPC / (EPC 单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
COMPREHENSIVE AUTOMATED MONITORING NETWORK DIAGRAM OF PV AREA

SCALE / (比例)	PROJECT NO.	DRAWING NO.	SHEET. / (Ch.)
NTS	H194	H194-I-D-0008/H194-I0101-07	1 OF 1

ORIGINAL SIZE A2-1



REFERENCE DRAWINGS & DOCUMENTS: / (参考图纸及文件)

DRAWING & DOCUMENT TITLE / (图纸和文件名称)	DRAWING & DOCUMENT NO. / (Ch.)
POWER PREDICTION SERVER PANEL FRONT VIEW LAYOUT	H194-I-D-0240/H194-I0110-02
UPS POWER SUPPLY PANEL TERMINAL ROW WIRING DIAGRAM	H194-I-D-0146/H194-I0109-10
AGC AND AVC CONTROL SERVER PANEL TERMINAL WIRING DIAGRAM	H194-I-D-0152/H194-I0110-05
132KV BUSBAR PROTECTION PANEL LEFT TERMINAL DIAGRAM	H194-I-D-0077/H194-I0105-04

REV./(版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (批准)
2	5.10.2015	ISSUE FOR AS BUILT	ZHANG CHANGJUN	HU KE	LIU XIAOHON
1	18.04.2015	ISSUE FOR AS BUILT	ZHANG CHANGJUN	HU KE	LIU XIAOHON
0	24.10.2014	ISSUE FOR INFORMATION	ZHANG CHANGJUN	HU KE	LIU XIAOHON
B	18.10.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHON
A	26.09.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHON

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

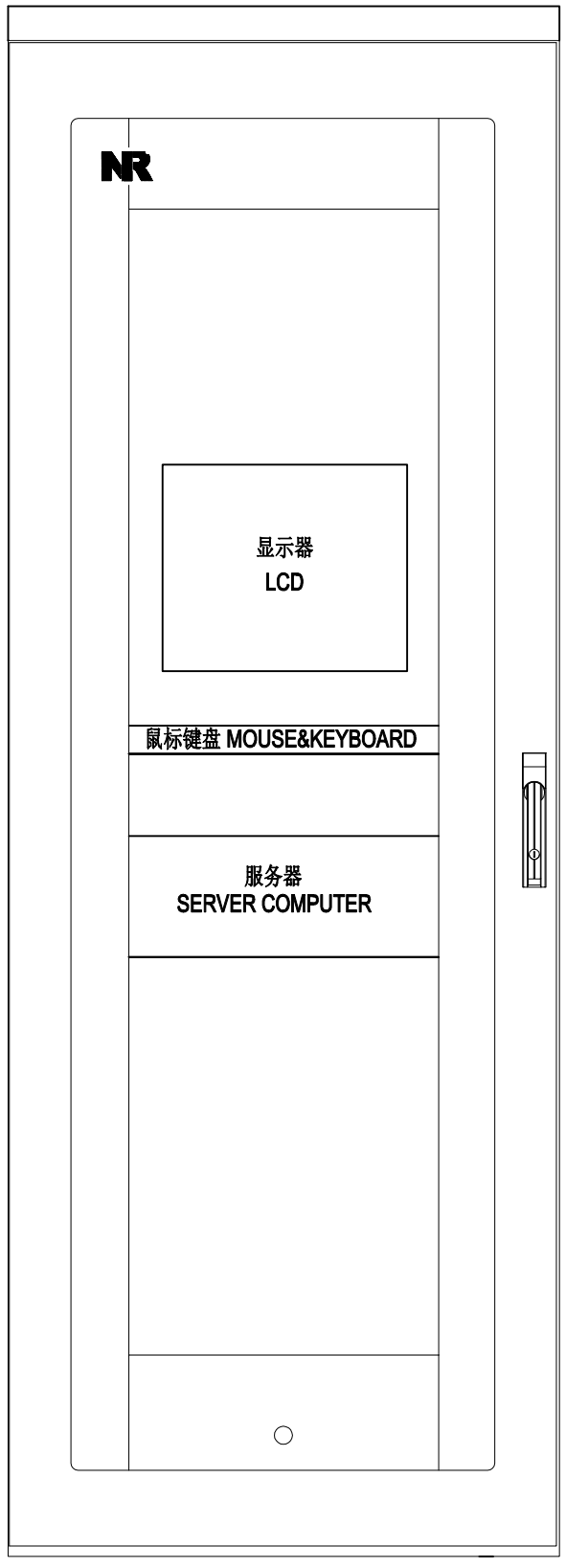
EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

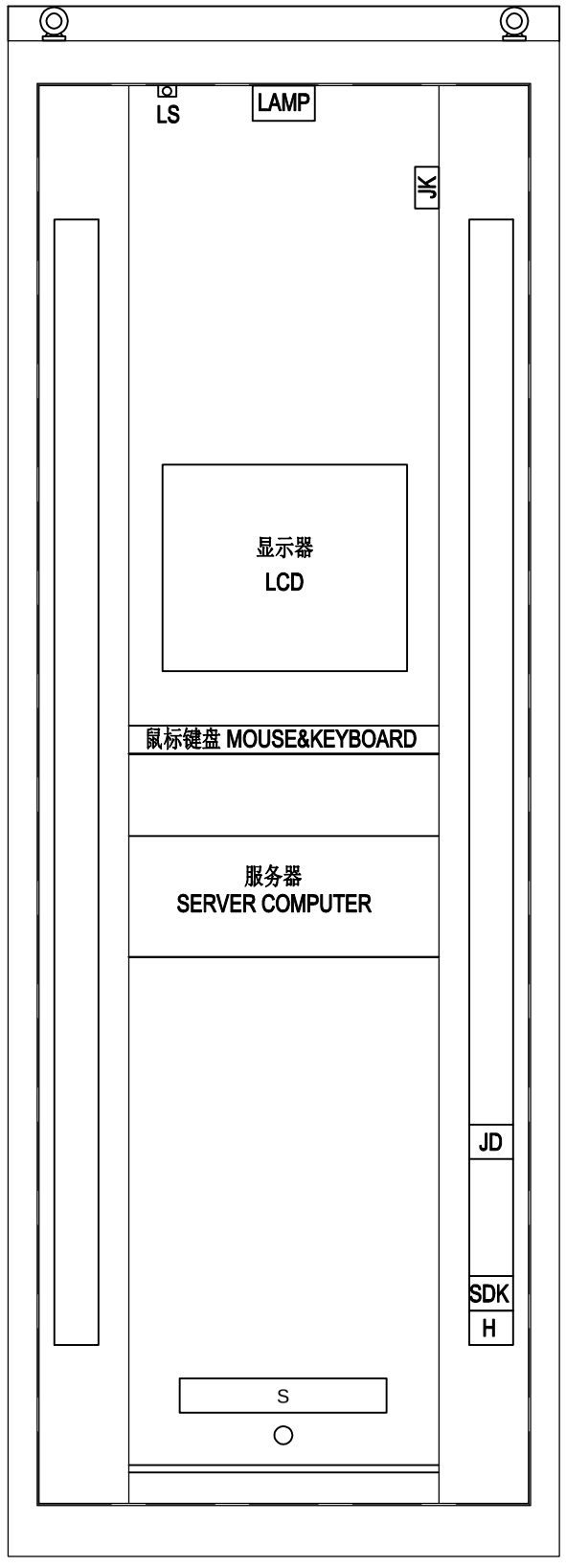
DRAWING TITLE / (图纸名称):
POWER PREDICTION SERVER PANEL TERMINAL WIRING DIAGRAM
功率预测服务器屏端子排图

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0150/H194-I0110-03	1 OF 1

ORIGINAL
A3



正视
Front View



背视
Rear View

MATERIAL TAKE OFF (MTO) / (材料清册)

序号 No.	符号 SYMBOL	名称 DESCRIPTION	型号 TYPE	数量 QTY.
1		服务器 SERVER COMPUTER	NEC GT110e	1
2		显示器 LCD		1
3		鼠标键盘层 Mouse&Keyboard		1
4	JK	交流开关 AC MCB	2P-C-16A	1
5	H	加热器 HEATER	150W	1
6	SDK	温湿度控制器 HUMIDIFIER	YD-HTC	1
7	S	交流电源插座 AC OUTLET	TZ-Y/TJ-08-43E-32	1
8	LS	LIMIT SWITCH		1
9	LAMP	LIGHTING LAMP		1

NOTES

1. ALL LABLES IN THE PANEL SHOULD BE IN ENGLISH.
2. LIGHT INSTALLED IN PANEL FOR ILLUMINATION.
3. CUBICLE EQUIPPED WITH CROSS-SECTION OF NOT LESS THAN 100mm^2 COPPER GROUNDING.

REV./(版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (批准)
1	18.04.2015	ISSUE FOR AS BUILT	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
0	19.11.2014	ISSUE FOR INFORMATION	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
C	06.11.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
B	26.10.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
A	26.09.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHONG

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR POWER Pvt. (Ltd)

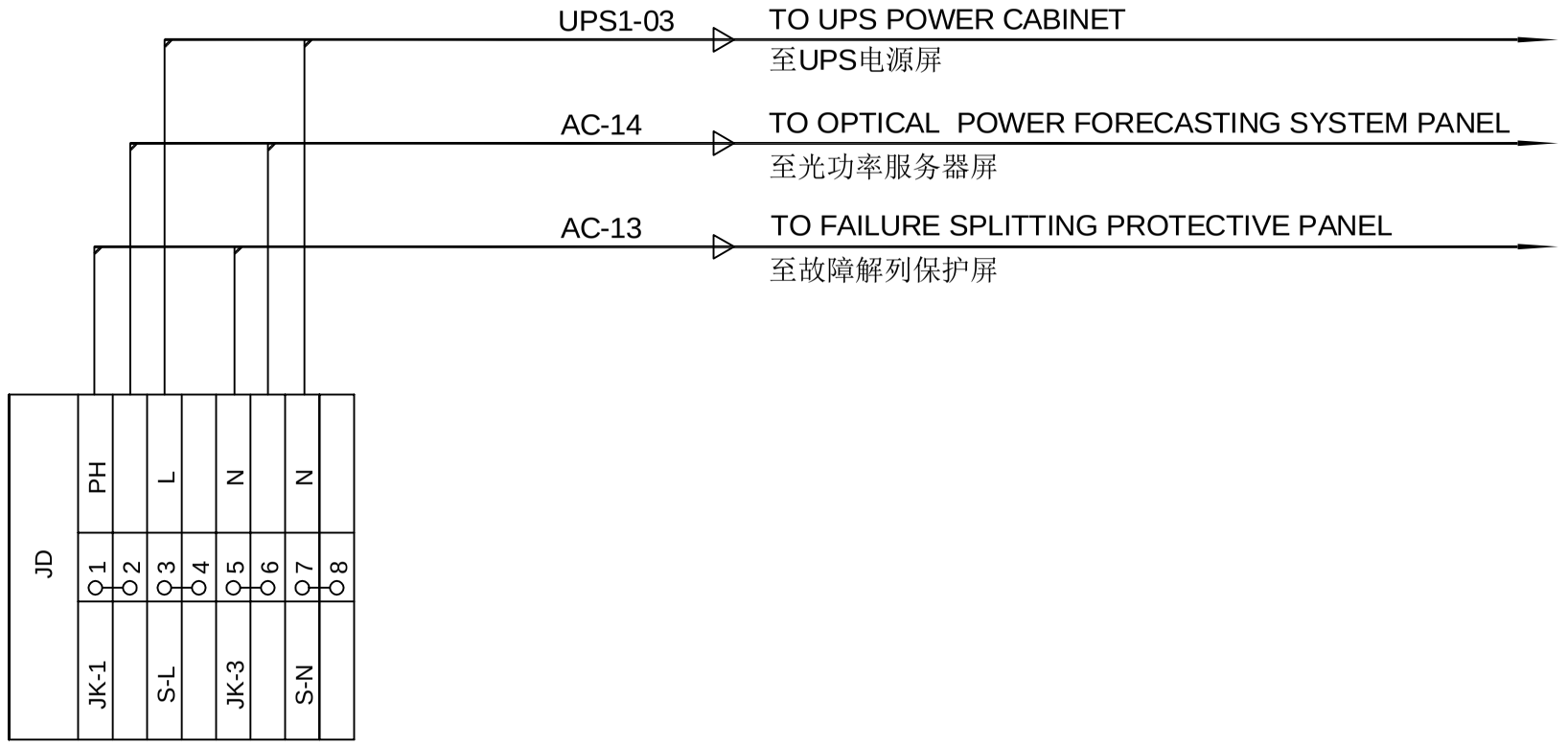
EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
AGC AND AVC CONTROL SERVER PANEL FRONT VIEW LAYOUT
AGC及AVC控制服务器屏屏面布置图

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0151/H194-I0110-04	1 OF 1

ORIGINAL A3



REFERENCE DRAWINGS & DOCUMENTS: / (参考图纸及文件)

DRAWING & DOCUMENT TITLE / (图纸和文件名称)	DRAWING & DOCUMENT NO. / (Ch.)
AGC AND AVC CONTROL SERVER PANEL FRONT VIEW LAYOUT	H194-I-D-0151/H194-I0110-04
UPS POWER SUPPLY PANEL TERMINAL ROW WIRING DIAGRAM	H194-I-D-0146/H194-I0109-10
POWE PREDICTION SERVER PANEL TERMINAL WIRING DIAGRAM	H194-I-D-0150/H194-I0110-03
FAILURE SPLITTING PROTECTIVE PANEL FRONT VIEW LAYOUT	H194-I-D-0153/H194-I0110-06

REV./(版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (批准)
2	18.04.2015	ISSUE FOR AS BUILT	ZHANG CHANGJUN	HU KE	LIU XIAOHON
1	10.11.2014	ISSUE FOR INFORMATION	ZHANG CHANGJUN	HU KE	LIU XIAOHON
0	27.10.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHON
B	19.10.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHON
A	26.09.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHON

PROJECT /(项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT /(业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

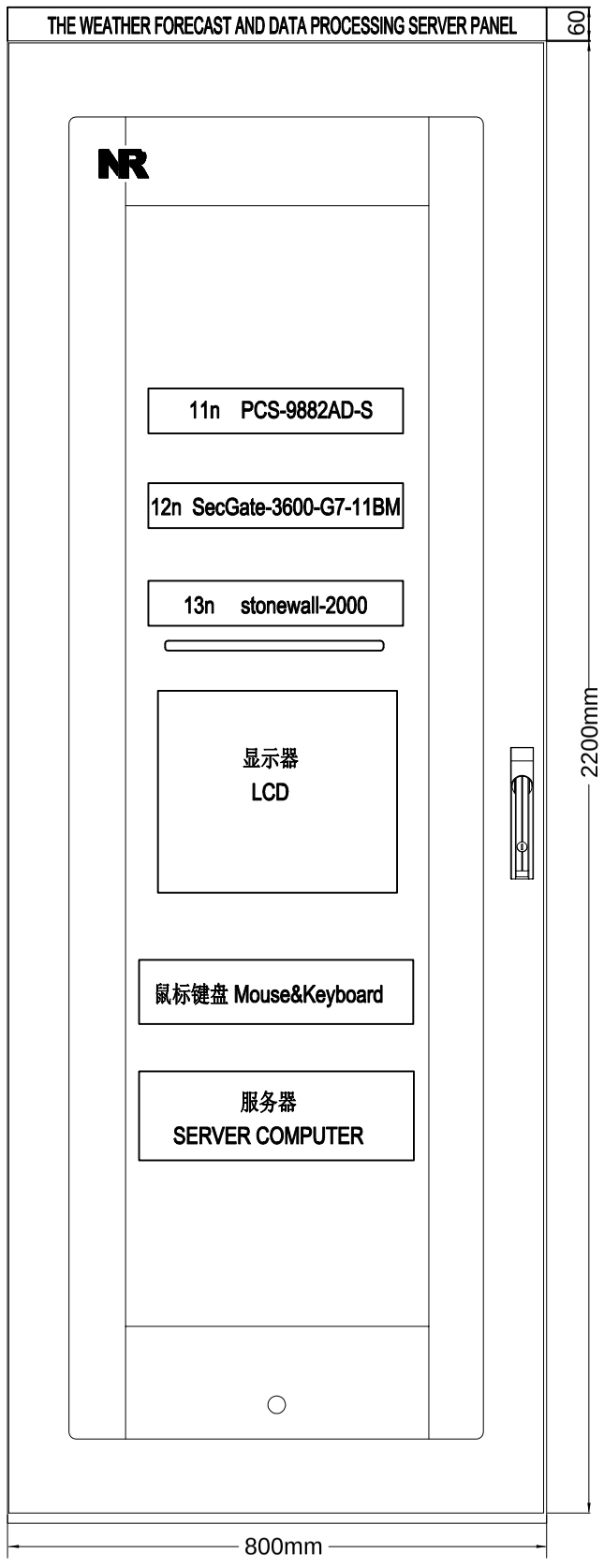
EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

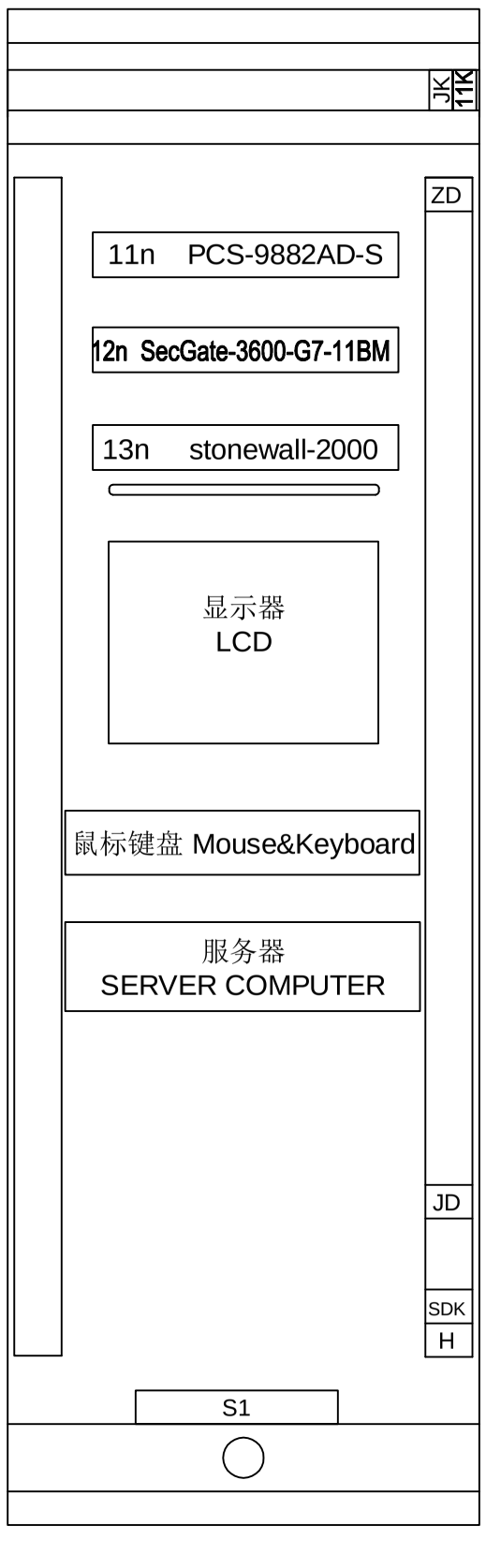
DRAWING TITLE / (图纸名称):
AGC AND AVC CONTROL SERVER PANEL TERMINAL WIRING DIAGRAM
AGC及AVC控制服务器屏端子排图

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0152/H194-I0110-05	1 OF 1

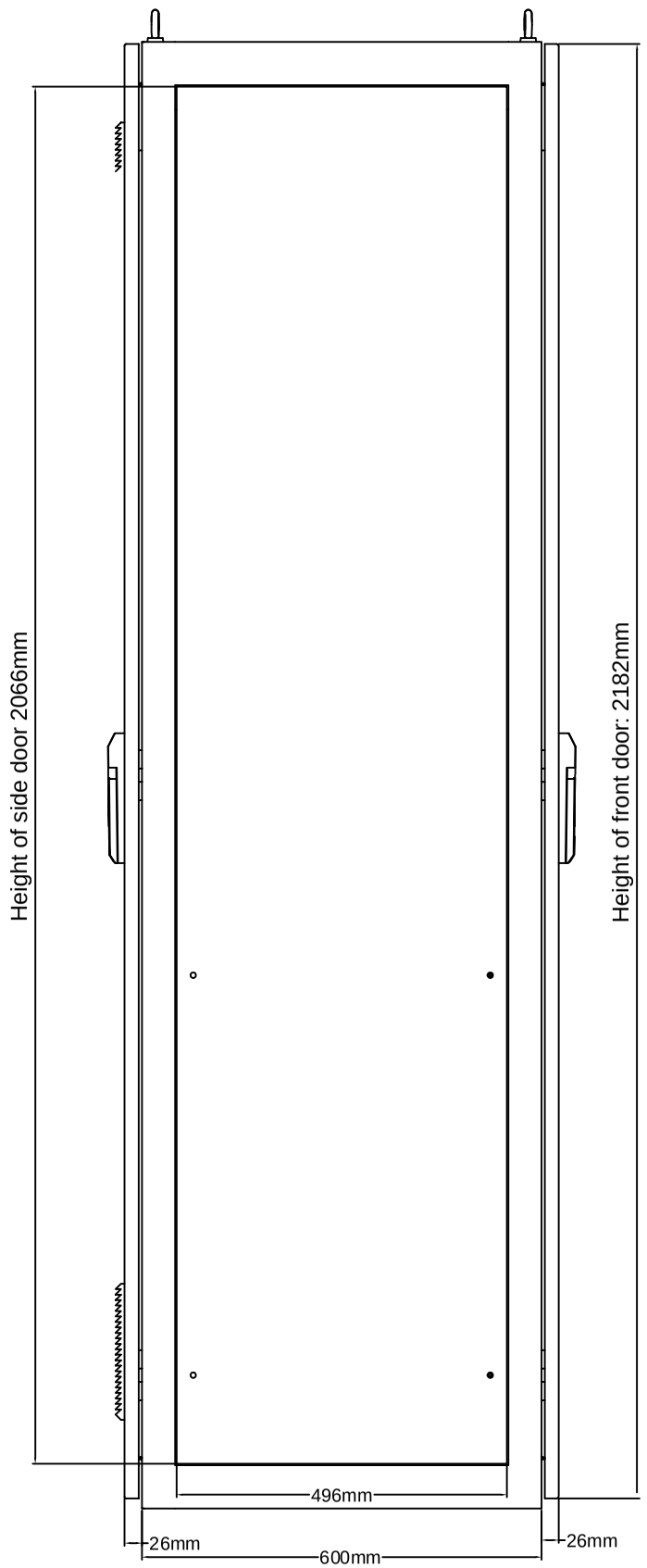
ORIGINAL A3



正视
FRONT VIEW



背视
REAR VIEW



侧视
SIDE VIEW

REFERENCE DRAWINGS & DOCUMENTS: / (参考图纸及文件)

DRAWING & DOCUMENT TITLE / (图纸和文件名称)	DRAWING & DOCUMENT NO. / (Ch.)
THE WEATHER FORECAST AND DATA PROCESSING SERVER TERMINAL ROW WIRING DIAGRAM	H194-I-D-0195/H194-I0114-09
THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL MANUFACTURE DRAWING	H194-I-D-0222/H194-I0114-13

MATERIAL TAKE OFF (MTO) / (材料清册)

ITEM / (编号)	DESIGNATION / (名称)	DESCRIPTION / (规格参数)	Q-ty	WEIGHT kg	NOTE / (备注)
1	SERVER COMPUTER 服务器	NEC GT110e	1		
2	LCD 显示器		1		
3	Mouse&Keyboard 鼠标键盘层		1		
4	ETHERNET SWITCH 以太网交换机	PCS-9882AD-S	1		11n
5	FIREWALL 防火墙	SecGate-3600-G7-11BM	1		12n
6	REVERSE SECURITY ISOLATION 反向安全隔离	stonewall-2000	1		13n
7	AC OUTLET 交流电源插座	TZ-Y/TJ-08-43E-32	1		S1
8	HUMIDIFIER 温湿度控制器	YD-HTC	1		SDK
9	AC MCB 交流开关	S201-C4	1		JK
10	HEATER 加热器	DJR-100W	1		H
11	DC SUPPLY MCB 直流电源空开	S202M-C4DC	1		11K
12	TERMINAL FOR DC POWER SUPPLY CIRCUIT				ZD
13	TERMINAL FOR AC POWER SUPPLY CIRCUIT				JD

NOTES / (说明)

1. ALL LABLES IN THE PANEL SHOULD BE IN ENGLISH.
屏柜内所有标识采用英文。
2. PANEL HAVE DOOR OPERATED LIGHT FOR INTERIOR ILLUMINATION.
屏内适当位置安装门控照明灯。
3. PANEL SHALL BE PROVIDED WITH GROUND COPPER BAR OF NOT LESS THAN 100 mm^2 .
屏柜装有截面不小于100mm^2的接地铜排。

REV. / (版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (批准)
1	18.04.2015	ISSUE FOR AS BUILT	TANG LI	HU KE	LIU XIAOHONG
0	18.11.2014	ISSUE FOR INFORMATION	TANG LI	HU KE	LIU XIAOHONG
B	06.11.2014	ISSUE FOR APPROVAL	TANG LI	HU KE	LIU XIAOHONG
A	18.08.2014	ISSUE FOR APPROVAL	TANG LI	HU KE	LIU XIAOHONG

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

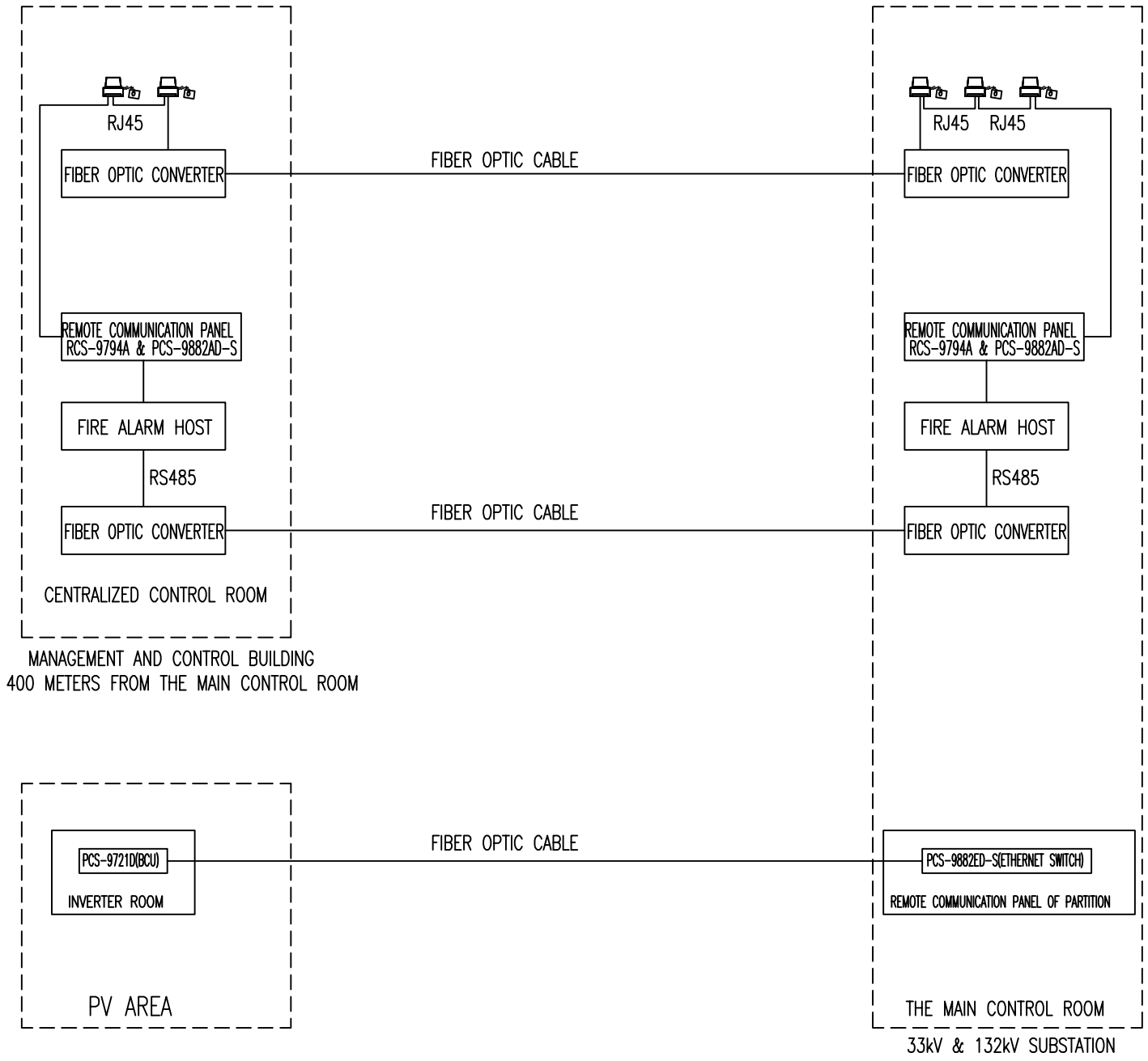
EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL FRONT VIEW LAYOUT

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0194/H194-I0114-08	1 OF 1

ORIGINAL A3



REFERENCE DRAWINGS & DOCUMENTS: /	
DRAWING & DOCUMENT TITLE /	DRAWING & DOCUMENT NO. / (Ch.)
COMPREHENSIVE AUTOMATED MONITORING NETWORK DIAGRAM OF PV AREA	H194-I-D-0008/H194-I0101-07
COMPREHENSIVE AUTOMATED MONITORING NETWORK DIAGRAM OF PRECINCT	H194-I-D-0007/H194-I0101-06

LEGEND

LEGEND	NAME
	INSTALLED IN OTHER ROOM
	COMPUTER
BCU	BAY CONTROL UNIT

REV./(版本)	DATE/(日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED/(设计)	CHECKED/(校核)	APPROVED/(批准)
2	18.4.2015	ISSUE FOR AS BUILT	HU KE	JING YI TAN	LIU XIAOHONG
1	17.9.2014	ISSUE FOR INFORMATION	HU KE	JING YI TAN	LIU XIAOHONG
0	27.8.2014	ISSUE FOR APPROVAL	HU KE	JING YI TAN	LIU XIAOHONG
A	14.8.2014	ISSUE FOR APPROVAL	HU KE	JING YI TAN	LIU XIAOHONG

PROJECT/

100 MW PV POWER PLANT AT QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT/ (业主):
QUAID-E-AZAM SOLAR POWER Pvt. (Ltd)

EPC/ (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT/ (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE/ (图纸名称):
OVERALL FIBER OPTIC CABLE BLOCK DIAGRAM

SCALE/ (比例)	PROJECT NO.	DRAWING NO./ (图号):	SHEET
NTS	H194	H194-I-D-0197/H194-I0114-11	1 OF 1

ORIGINAL A3

POWER PREDICTION SERVER PANEL MANUFACTURER DRAWING

REV./(版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (批准)
2	1.11.2015	ISSUE FOR AS BUILT	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
1	18.04.2015	ISSUE FOR AS BUILT	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
0	10.11.2014	ISSUE FOR INFORMATION	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
C	15.10.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
B	26.09.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
A	26.08.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHONG

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
POWER PREDICTION SERVER PANEL
MANUFACTURER DRAWING

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0217/H194-I0110-17	1 OF 1

ORIGINAL A3

POWER PREDICTION SERVER PANEL MANUFACTURER DRAWING CATALOG

NO. 序号	DRAWING NO. 图　　号	NAME 0F DRAWING 图　　名	QTY. 张数
1	H194-I-D-0217/H194-I0110-17 (1 OF 9)	INDEX	1
2	H194-I-D-0217/H194-I0110-17 (2 OF 9)	LEGEND	1
3	H194-I-D-0217/H194-I0110-17 (3 OF 9)	LAYOUT	1
4	H194-I-D-0217/H194-I0110-17 (4 OF 9)	BILL OF MATERIALS	1
5	H194-I-D-0217/H194-I0110-17 (5 OF 9)	PROTECTION PANEL STRUCTURE	1
6	H194-I-D-0217/H194-I0110-17 (6 OF 9)	PROTECTION PANEL DETAILS	1
7	H194-I-D-0217/H194-I0110-17 (7 OF 9)	AC POWER SUPPLY	1
8	H194-I-D-0217/H194-I0110-17 (8 OF 9)	MCB REAR WIRING DIAGRAM	1
9	H194-I-D-0217/H194-I0110-17 (9 OF 9)	WIRING DIAGRAM OF TERMINAL	1

REV./(版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (批准)
2	1.11.2015	*ISSUE FOR AS BUILT*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
1	18.04.2015	*ISSUE FOR AS BUILT*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
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C	15.10.2014	*ISSUE FOR APPROVAL*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
B	26.09.2014	*ISSUE FOR APPROVAL*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
A	26.08.2014	*ISSUE FOR APPROVAL*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
POWER PREDICTION SERVER PANEL
MANUFACTURER DRAWING

INDEX

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0217/H194-I0110-17	1 OF 9

ORIGINAL A3

SYMBOL	DESCRIPTION
+	POSITIVE POLARITY
-	NEGATIVE POLARITY
N	NEUTRAL
	GROUND
	CONDUCTOR, LINE TRANSMISSION PATH
	CABLE
	NON-DISCONNECTOR TERMINAL
	DISCONNECT WITH TEST PLUGS TERMINAL
	KNIFE DISCONNECT TERMINAL
	MAKE CONTACT
	BREAK CONTACT
	CHANGEOVER CONTACT
	FAN
	MINIATURE CIRCUIT BREAKER
	HEATER

SYMBOL	DESCRIPTION
	LAMP
	SOCKET
	RELAY COIL (1 COIL)
	RELAY COIL(1 ACTIVE COIL AND 1 RESET COIL)
	LATCHING RELAY
	DIRECT CURRENT CONVERTER
	ALTERNATING CURRENT / DIRECT CURRENT CONVERTER
	TRANSDUCER
	RJ45 ETHERNET PORT
	COAXIAL CABLE PORT
	FIBER OPTICAL PORT
	OPERATED BY PUSHING
	OPERATED BY TURNING WITH SPRING RETURN
	OPERATED BY TURNING
	FUSE

SYMBOL	DESCRIPTION
	WINDING
	THREE PHASE WINDING STAR
	THREE PHASE WINDING DELTA
	DIODE
	OPTOCOUPLER
M	OPERATED BY MOTOR
	RESISTER
	LIGHTNING ARRESTER
	SHUNT REACTOR
	CAPACITOR
	CIRCUIT BREAKER
	TEST BLOCK

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2	1.11.2015	*ISSUE FOR AS BUILT*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
1	18.04.2015	*ISSUE FOR AS BUILT*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
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QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

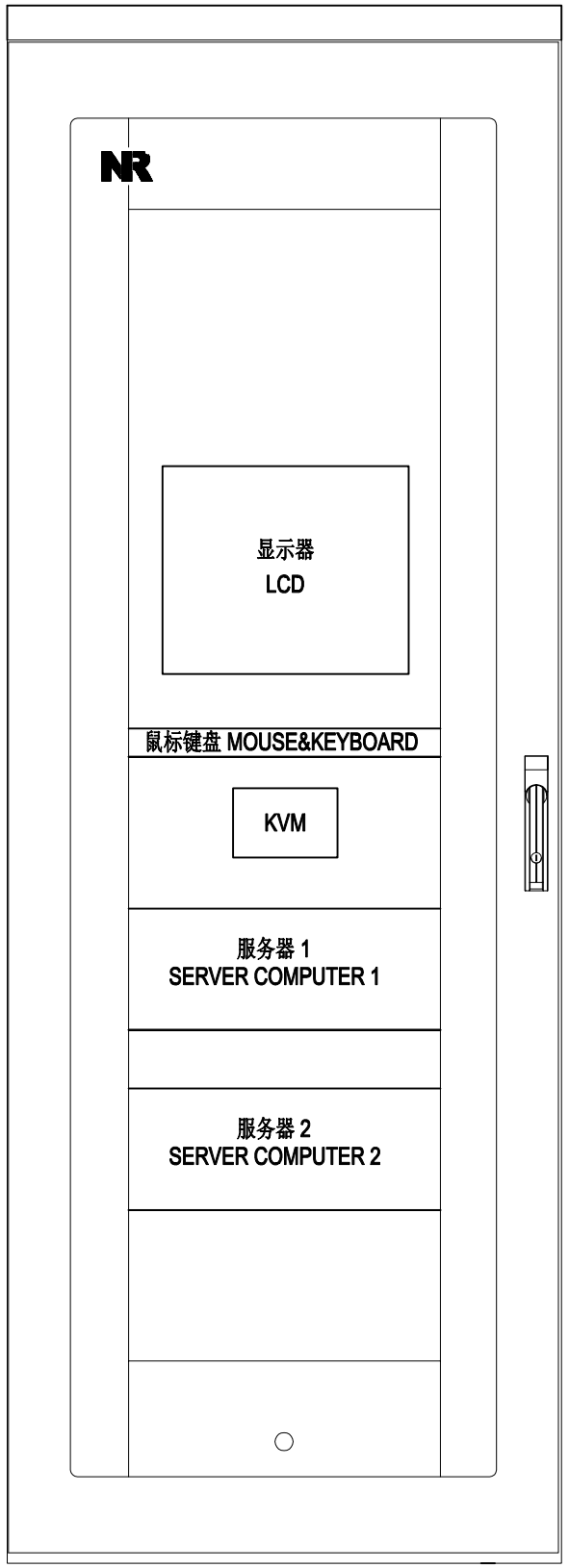
CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
POWER PREDICTION SERVER PANEL
MANUFACTURER DRAWING

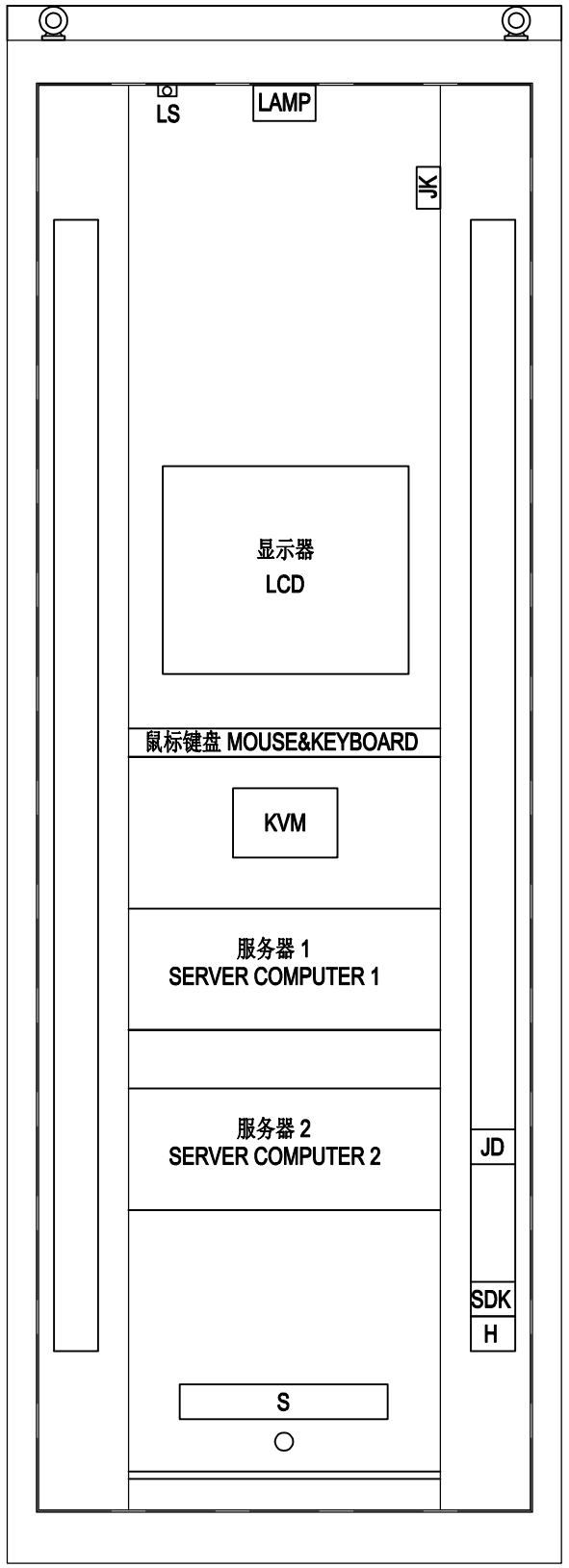
LEGEND

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0217/H194-I0110-17	2 OF 9

ORIGINAL A3



正视
Front View



背视
Rear View

NOTES

1. ALL LABLES IN THE PANEL SHOULD BE IN ENGLISH.
2. LIGHT INSTALLED IN PANEL FOR ILLUMINATION.
3. CUBICLE EQUIPPED WITH CROSS-SECTION OF NOT LESS THAN 100mm^2 COPPER GROUNDING.

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PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
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POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
POWER PREDICTION SERVER PANEL
MANUFACTURER DRAWING

LAYOUT

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
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ORIGINAL A3

序号 No.	符号 SYMBOL	名称 DESCRIPTION	型号 TYPE	数量 QTY.	厂家 MAKER	备注 REMARK
1		服务器 SERVER COMPUTER	NEC GT110e	2		
2		显示器 LCD		1		17寸上架液晶
3	KVM	KVM	ATEN-CS84U	1		
4		鼠标键盘层 MOUSE&KEYBOARD		1		
5	JK	交流开关 AC MCB	S201-C4	1		
6	H	加热器 HEATER	DJR-100W	1		
7	SDK	温湿度控制器 HUMIDIFIER	YD-HTC	1		
8	S	交流电源插座 AC OUTLET	TZ-C01	1		
9	KVM	KVM切换器 KVM	ATEN-CS84U	1		
10	LS	LIMIT SWITCH		1		
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						

REV./(版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (批准)
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B	26.09.2014	*ISSUE FOR APPROVAL*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG
A	26.08.2014	*ISSUE FOR APPROVAL*	ZHANG CHANGJUN	HU KE	LIU XIAOHONG

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

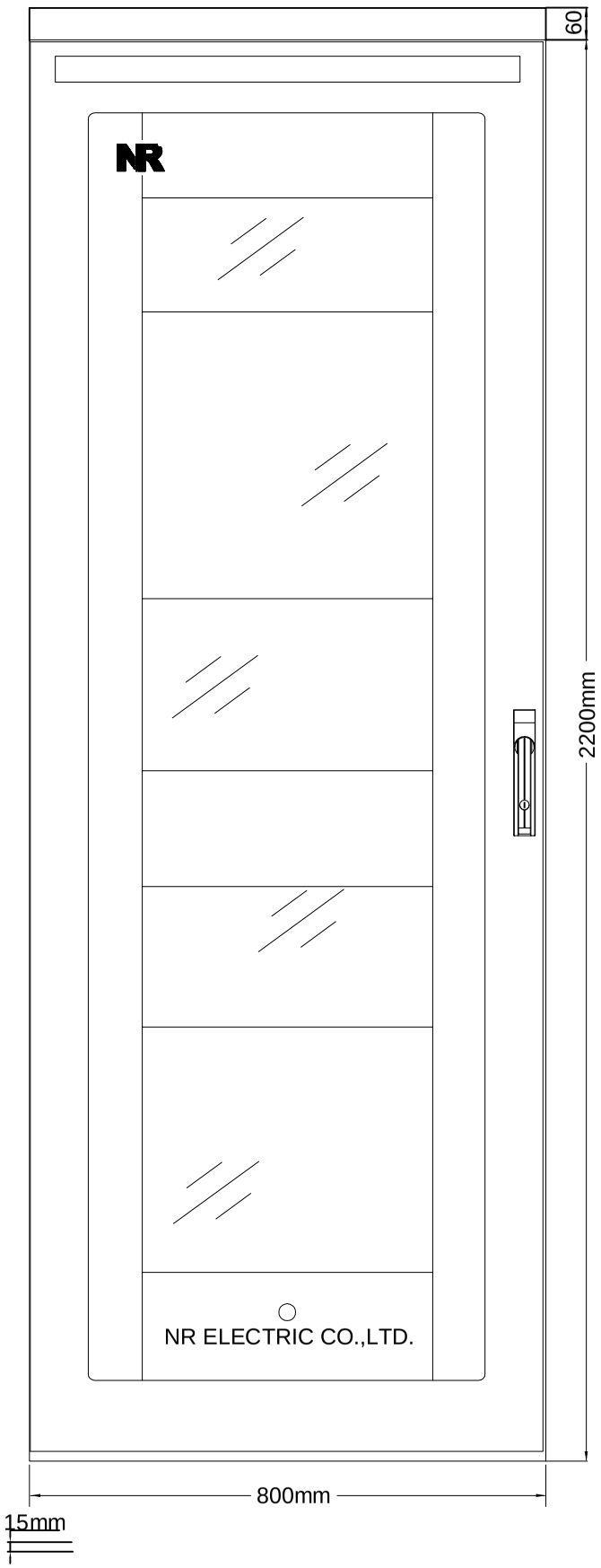
DRAWING TITLE / (图纸名称):
POWER PREDICTION SERVER PANEL
MANUFACTURER DRAWING

BILL OF MATERIALS

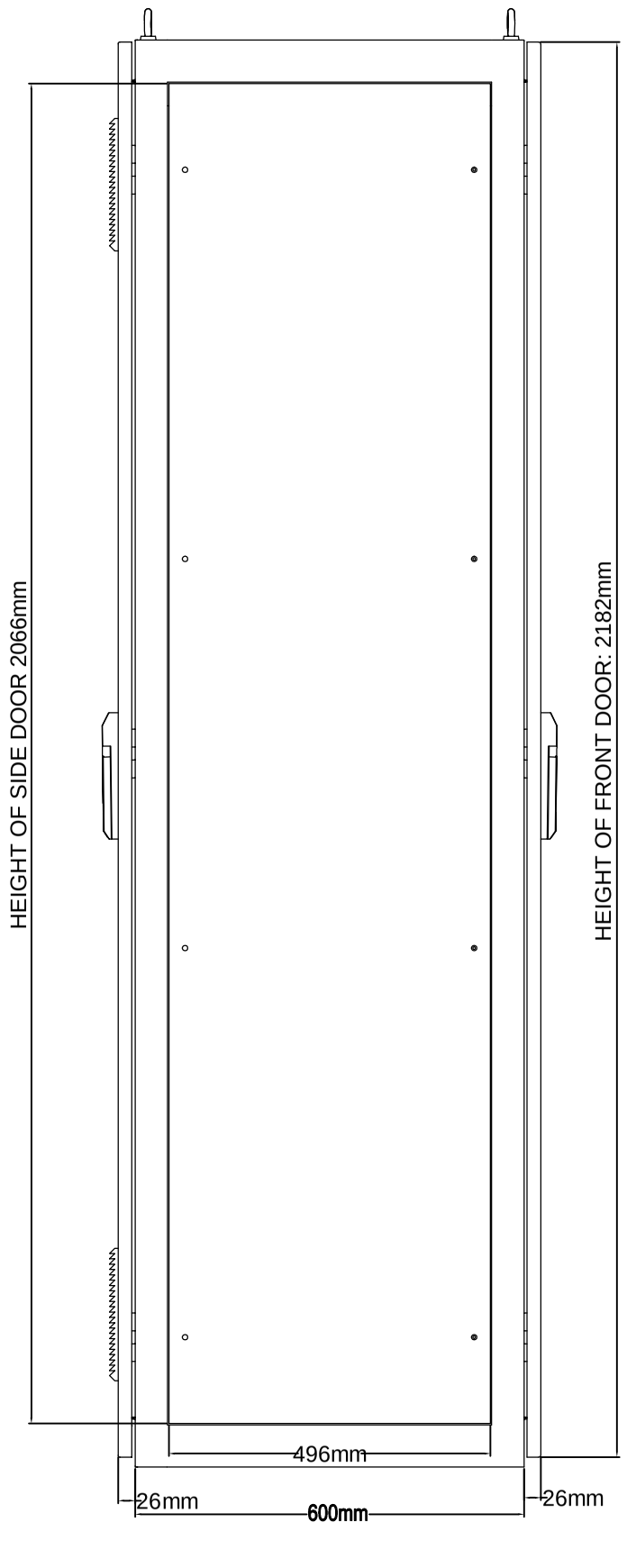
SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0217/H194-I0110-17	4 OF 9

ORIGINAL A3

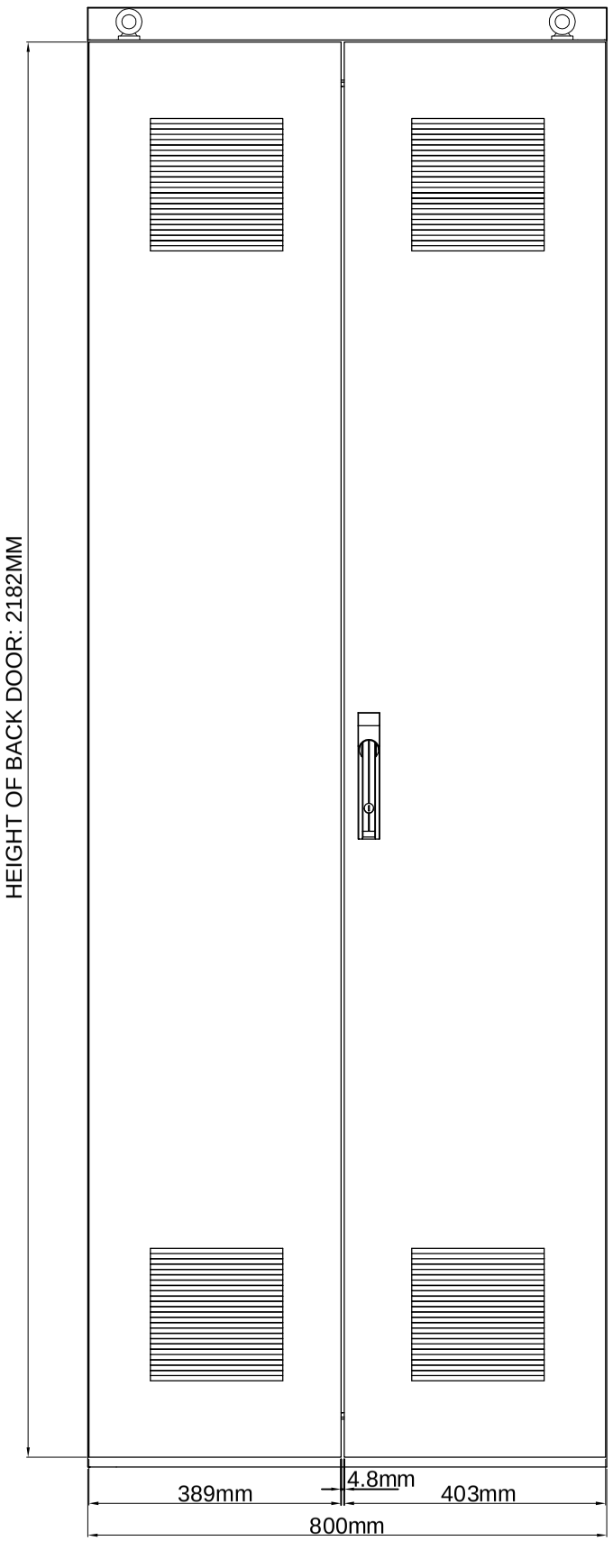
FRONT VIEW



SIDE VIEW



REAR VIEW



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PROJECT /(项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT /(业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

EPC /(EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT /(顾问):
ILF CONSULTING ENGINEERS

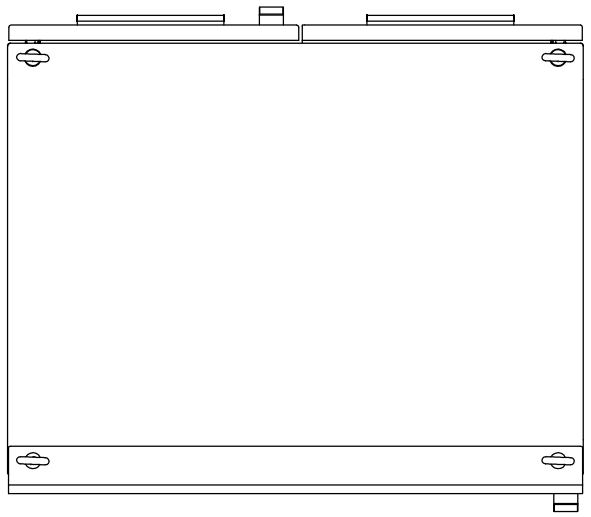
DRAWING TITLE / (图纸名称):
POWER PREDICTION SERVER PANEL
MANUFACTURER DRAWING

PROTECTION PANEL STRUCTURE

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0217/H194-I0110-17	5 OF 9

ORIGINAL A3

PANEL ROOF



FRONT

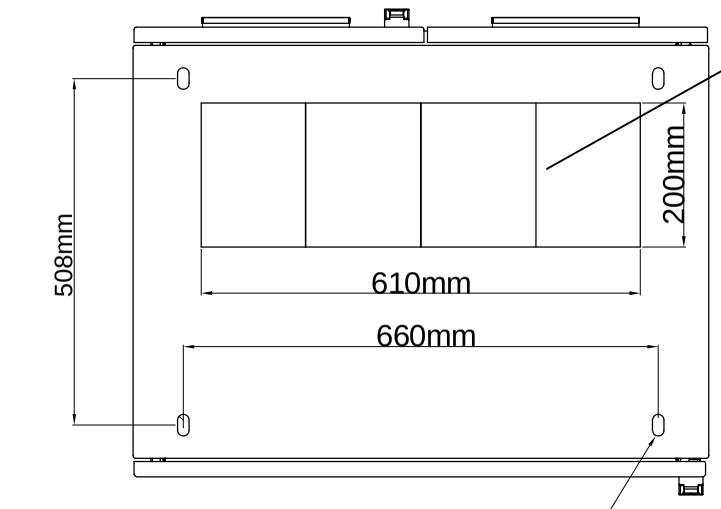
PANEL MECHANICAL CHARACTERISTICS:

ITEM	DESCRIPTION	PARAMETER
1	TYPE	NR-G03
2	DIMENSION	2260(H)×800(W)×600(D) mm
3	COLOR	EXTERIOR:RAL7035; INTERIOR:RAL7035
4	PROTECTION DEGREE	IP54
5	MATERIAL	SHEET STEEL
6	PLATE THICKNESS	COLUMN2.5mm REST:2mm
7	MOUNTING	**FLOOR MOUNTING,BOTTOM ENTRY OF POWER AND MULTI-CORE CABLES**
8	**WEIGHT(APPROXIMATE)**	200Kg
9	EARTH BAR	COPPER STRIP: 485(L)×25(W)×4(D)MM
10	ILLUMINATION	DOOR-CONTROLLED LAMP,40W
11	NAME PLATE	POWER PREDICTION SERVER PANEL

NOTE

1. THE CABLE ENTRY IS FROM BOTTOM OF THE CABINET.

FOUNDATION DETAILS



FRONT

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ILF CONSULTING ENGINEERS

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PROTECTION PANEL DETAILS

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
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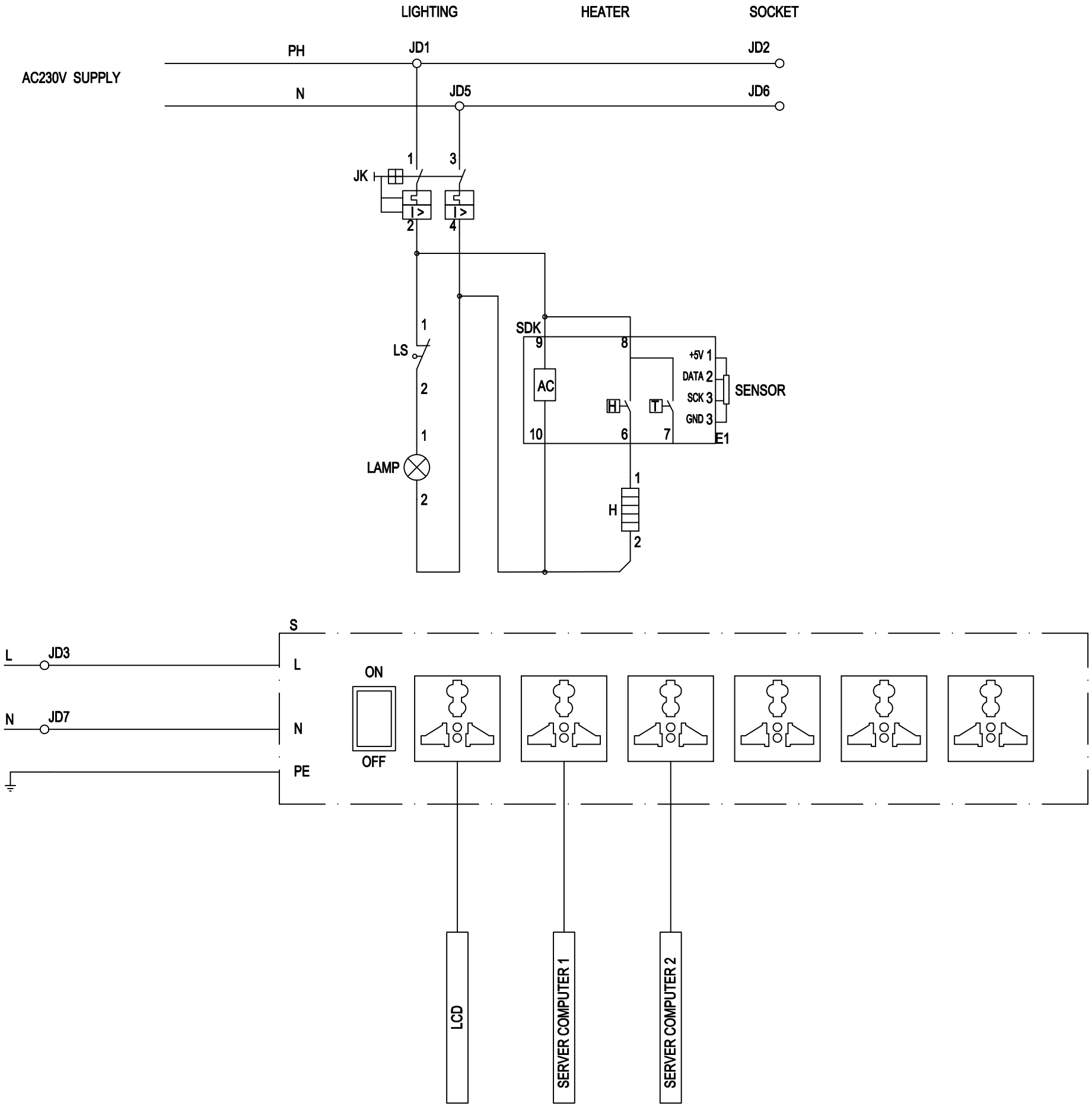
ORIGINAL A3



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AC POWER SUPPLY

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
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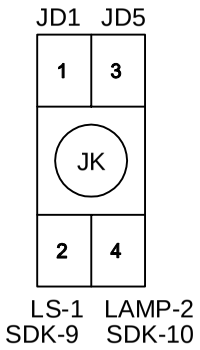
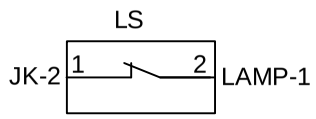
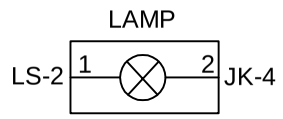
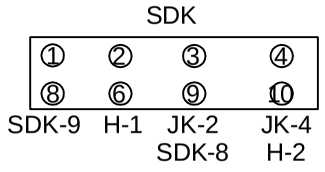
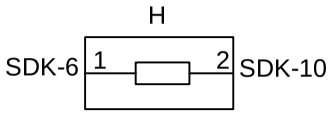
ORIGINAL A3

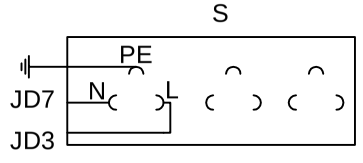












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CONSULTANT / (顾问):
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POWER PREDICTION SERVER PANEL
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MCB REAR WIRING DIAGRAM

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
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JD		
JK-1	1	PH
	2	
S-L	3	L
	4	
JK-3	5	N
	6	
S-N	7	N
	8	

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WIRING DIAGRAM OF TERMINAL

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
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ORIGINAL A3

AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING

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ORIGINAL A3

AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING CATALOG

NO. 序号	DRAWING NO. 图　　号	NAME OF DRAWING 图　　名	QTY. 张数
1	H194-I-D-0218/H194-I0110-18 (1 OF 9)	INDEX	1
2	H194-I-D-0218/H194-I0110-18 (2 OF 9)	LEGEND	1
3	H194-I-D-0218/H194-I0110-18 (3 OF 9)	LAYOUT	1
4	H194-I-D-0218/H194-I0110-18 (4 OF 9)	BILL OF MATERIALS	1
5	H194-I-D-0218/H194-I0110-18 (5 OF 9)	PROTECTION PANEL STRUCTURE	1
6	H194-I-D-0218/H194-I0110-18 (6 OF 9)	PROTECTION PANEL DETAILS	1
7	H194-I-D-0218/H194-I0110-18 (7 OF 9)	AC POWER SUPPLY	1
8	H194-I-D-0218/H194-I0110-18 (8 OF 9)	MCB REAR WIRING DIAGRAM	1
9	H194-I-D-0218/H194-I0110-18 (9 OF 9)	WIRING DIAGRAM OF TERMINAL	1

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INDEX

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
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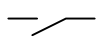
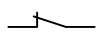
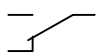
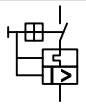
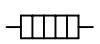
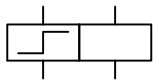
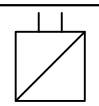
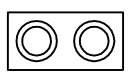
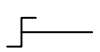
ORIGINAL A3

SYMBOL	DESCRIPTION
+	POSITIVE POLARITY
-	NEGATIVE POLARITY
N	NEUTRAL
	GROUND
	CONDUCTOR, LINE TRANSMISSION PATH
	CABLE
	NON-DISCONNECTOR TERMINAL
	DISCONNECT WITH TEST PLUGS TERMINAL
	KNIFE DISCONNECT TERMINAL
	MAKE CONTACT
	BREAK CONTACT
	CHANGEOVER CONTACT
	FAN
	MINIATURE CIRCUIT BREAKER
	HEATER

SYMBOL	DESCRIPTION
	LAMP
	SOCKET
	RELAY COIL (1 COIL)
	RELAY COIL(1 ACTIVE COIL AND 1 RESET COIL)
	LATCHING RELAY
	DIRECT CURRENT CONVERTER
	ALTERNATING CURRENT / DIRECT CURRENT CONVERTER
	TRANSDUCER
	RJ45 ETHERNET PORT
	COAXIAL CABLE PORT
	FIBER OPTICAL PORT
	OPERATED BY PUSHING
	OPERATED BY TURNING WITH SPRING RETURN
	OPERATED BY TURNING
	FUSE

SYMBOL	DESCRIPTION
	WINDING
	THREE PHASE WINDING STAR
	THREE PHASE WINDING DELTA
	DIODE
	OPTOCOUPLER
	OPERATED BY MOTOR
	RESISTER
	LIGHTNING ARRESTER
	SHUNT REACTOR
	CAPACITOR
	CIRCUIT BREAKER
	TEST BLOCK

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LEGEND

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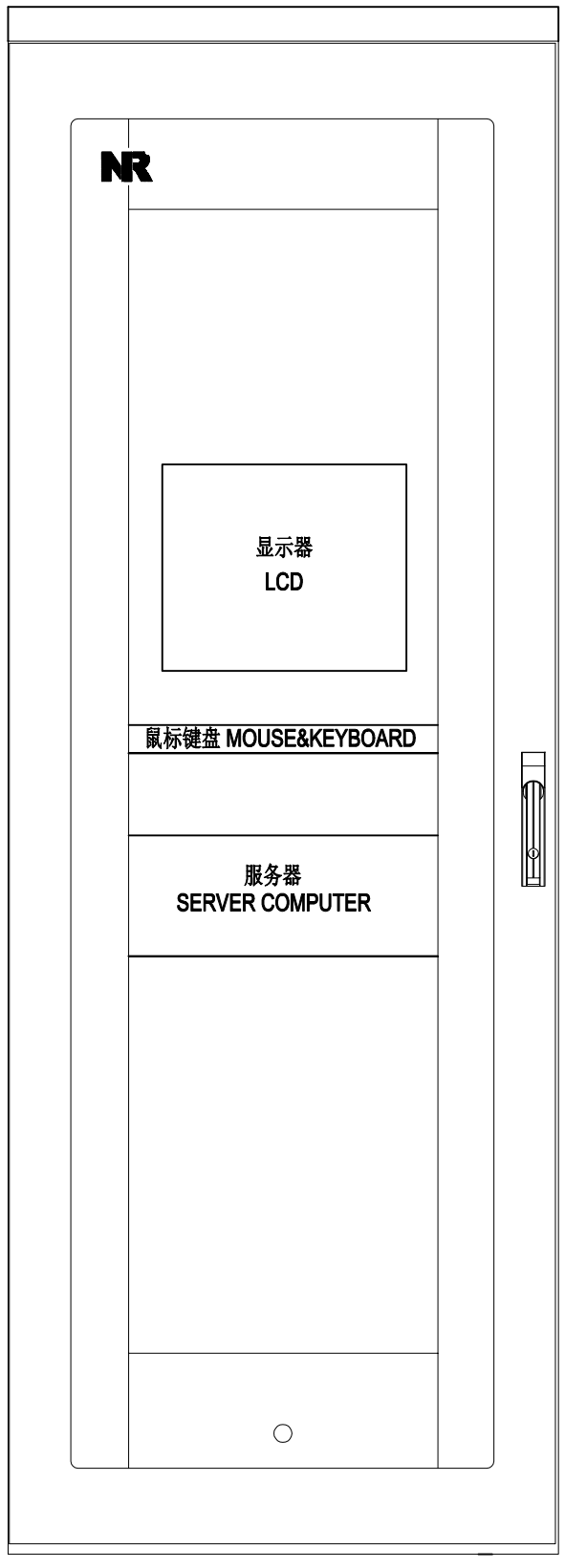
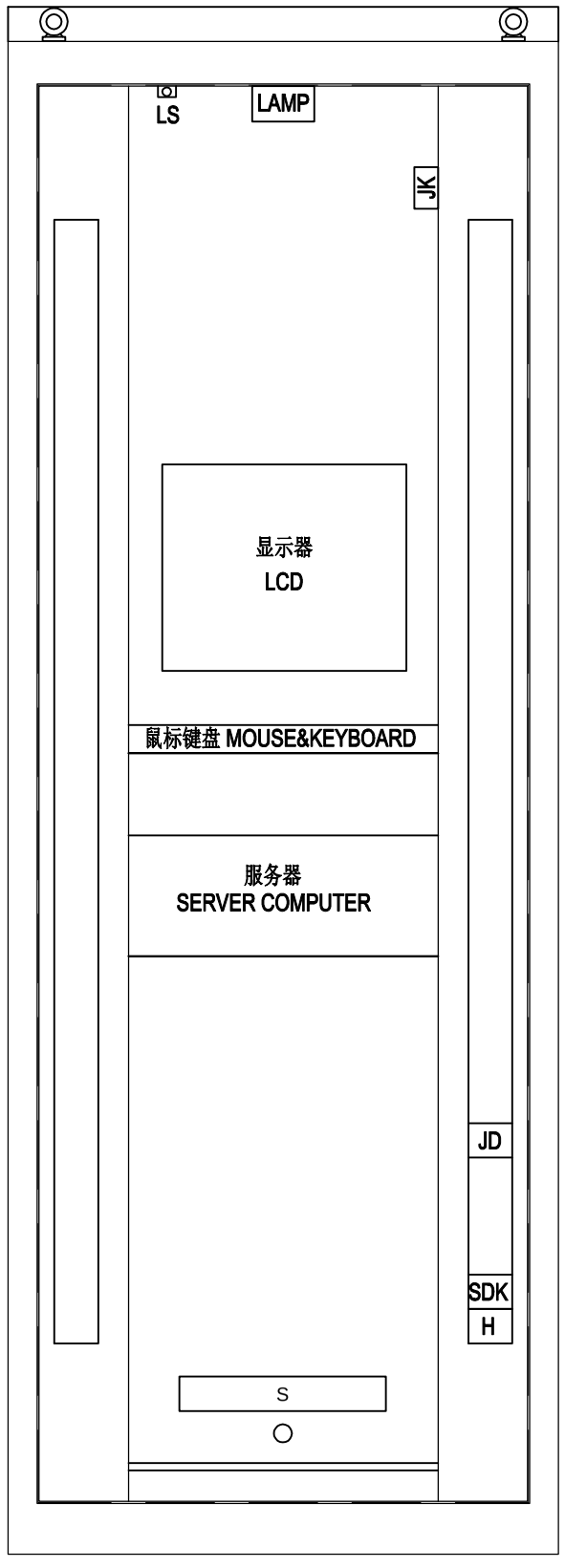


正视
Front View



背视
Rear View

NOTES

1. ALL LABLES IN THE PANEL SHOULD BE IN ENGLISH.
2. LIGHT INSTALLED IN PANEL FOR ILLUMINATION.
3. CUBICLE EQUIPPED WITH CROSS-SECTION OF NOT LESS THAN 100mm^2 COPPER GROUNDING.

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A	26.08.2014	*ISSUE FOR APPROVAL*	ZHANG CHANGJUN	HU KE	LIU XIAOHON

PROJECT /(项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT /(业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING

LAYOUT

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0218/H194-I0110-18	3 OF 9

ORIGINAL A3

序号 No.	符号 SYMBOL	名称 DESCRIPTION	型号 TYPE	数量 QTY.	厂家 MAKER	备注 REMARK
1		服务器 SERVER COMPUTER	NEC GT110e	1		
2		显示器 LCD		1		17寸上架液晶
3		鼠标键盘层 Mouse&Keyboard		1		
4	JK	交流开关 AC MCB	2P-C-16A	1		
5	H	加热器 HEATER	150W	1		
6	SDK	温湿度控制器 HUMIDIFIER	TH-D-11	1		
7	S	交流电源插座 AC OUTLET	TZ-Y/TJ-08-43E-32	1		
8	LS	LIMIT SWITCH		1		
9	LAMP	LIGHTING LAMP		1		

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CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

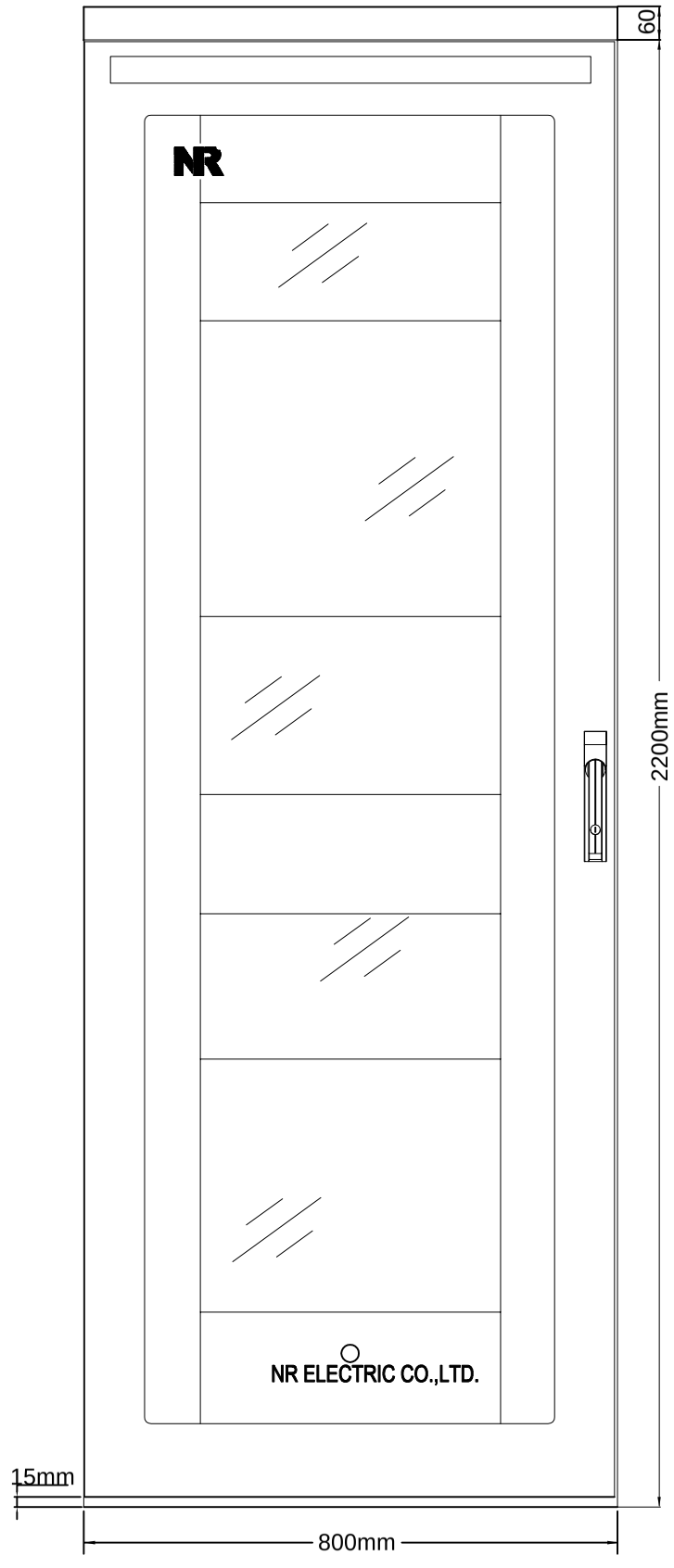
DRAWING TITLE / (图纸名称):
AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING

BILL OF MATERIALS

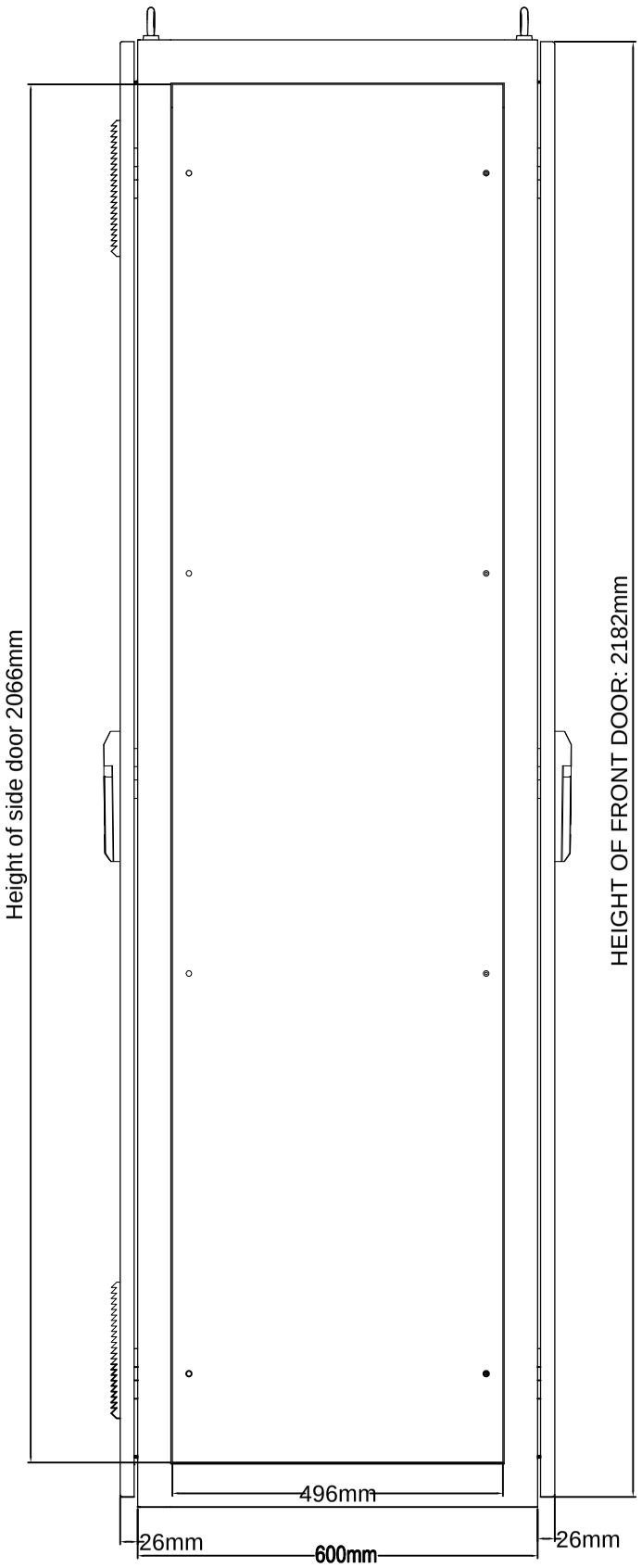
SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0218/H194-I0110-18	4 OF 9

ORIGINAL A3

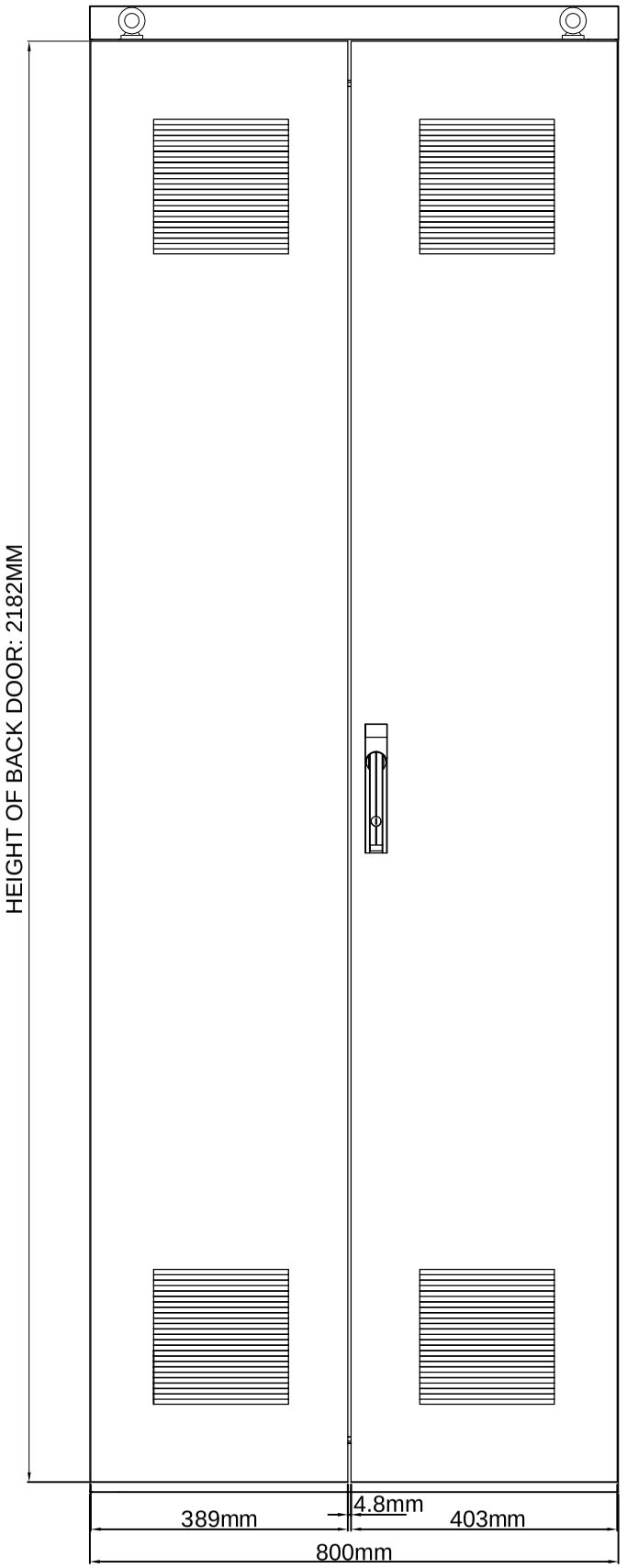
FRONT VIEW



SIDE VIEW



REAR VIEW



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DRAWING TITLE / (图纸名称):

AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING

PROTECTION PANEL STRUCTURE

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0218/H194-I0110-18	5 OF 9

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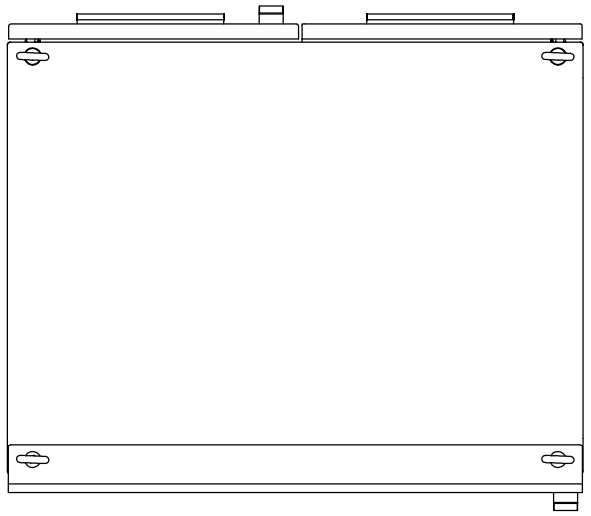
PANEL ROOF



FRONT

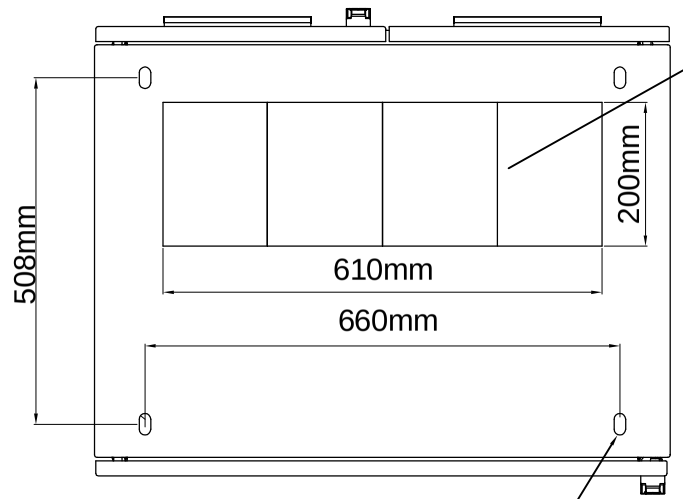
PANEL MECHANICAL CHARACTERISTICS:

ITEM	DESCRIPTION	PARAMETER
1	TYPE	NR-G03
2	DIMENSION	2260(H)×800(W)×600(D) mm
3	COLOR	EXTERIOR:RAL7035; INTERIOR:RAL7035
4	PROTECTION DEGREE	IP54
5	MATERIAL	SHEET STEEL
6	PLATE THICKNESS	COLUMN2.5mm Rest: 2mm
7	MOUNTING	**FLOOR MOUNTING,BOTTOM ENTRY OF POWER AND MULTI-CORE CABLES**
8	**WEIGHT(APPROXIMATE)**	200Kg
9	EARTH BAR	COPPER STRIP: 485(L)×25(W)×4(D)MM
10	ILLUMINATION	DOOR-CONTROLLED LAMP,40W
11	NAME PLATE	AGC AND AVC CONTROL SERVER PANEL

NOTE

1. THE CABLE ENTRY IS FROM BOTTOM OF THE CABINET.

FOUNDATION DETAILS



FRONT

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QUAID-E-AZAM SOLAR PARK BAHAWALPUR

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EPC / (EPC单位):
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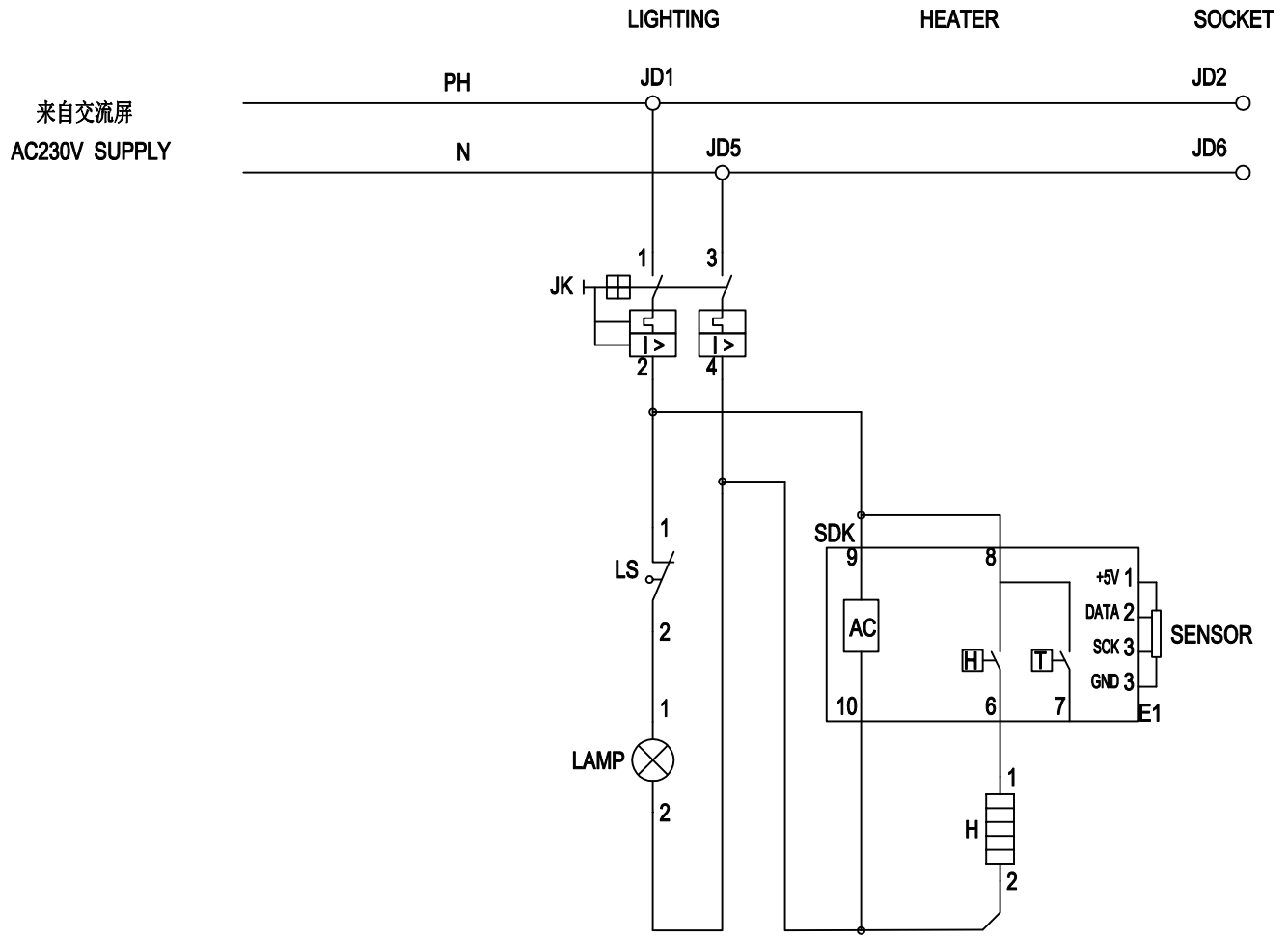
CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

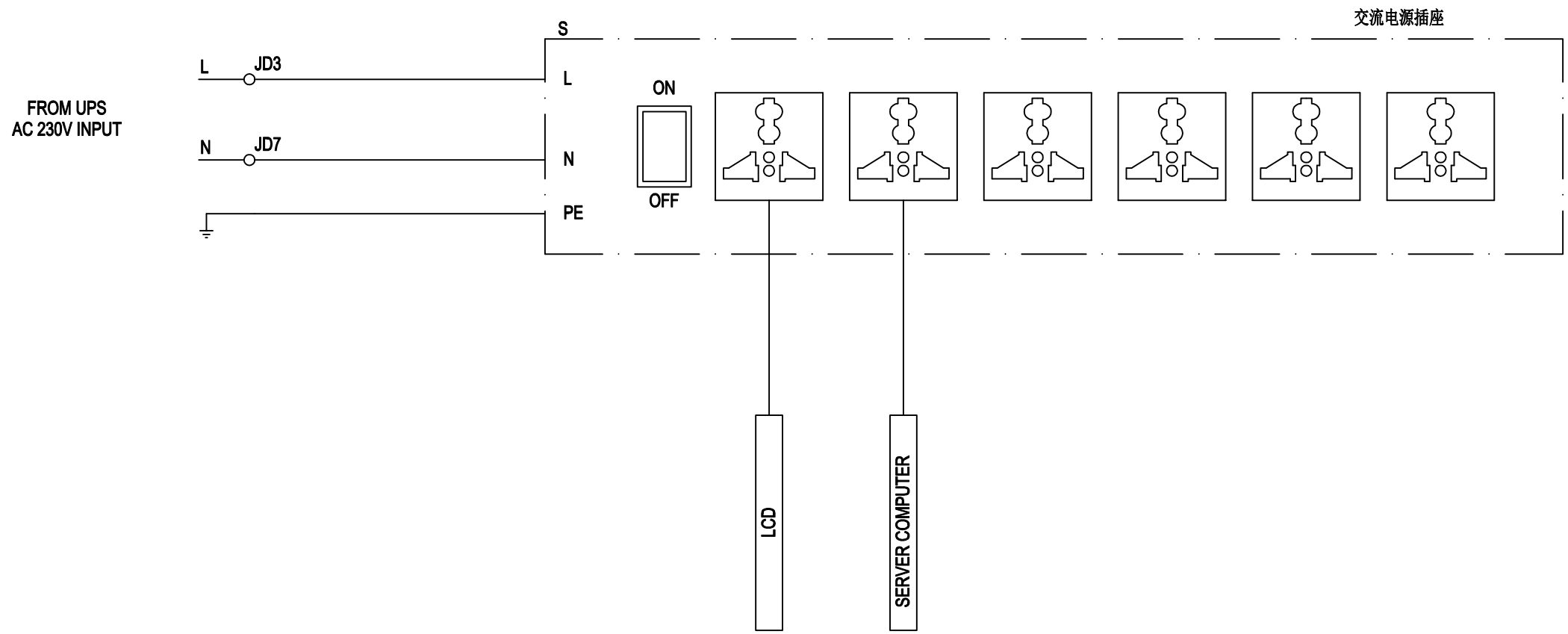
DRAWING TITLE / (图纸名称):
AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING

PROTECTION PANEL DETAILS

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0218/H194-I0110-18	6 OF 9

ORIGINAL A3





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EPC / (EPC单位):
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DRAWING TITLE / (图纸名称):
AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING

AC POWER SUPPLY

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
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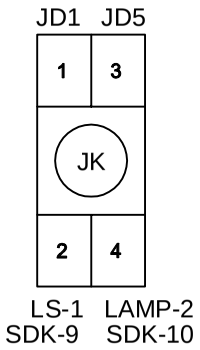
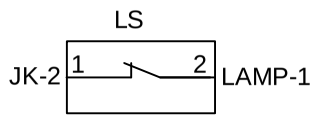
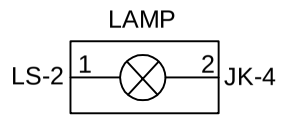
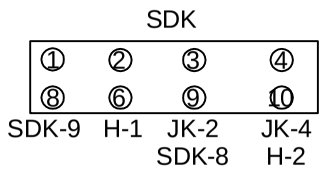
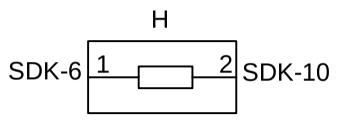
ORIGINAL A3

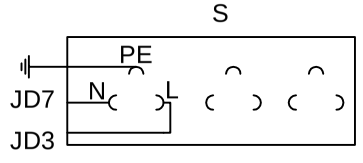












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100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

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POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):

AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING

MCB REAR WIRING DIAGRAM

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
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JD		
JK-1	1	PH
	2	
S-L	3	L
	4	
JK-3	5	N
	6	
S-N	7	N
	8	

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DRAWING TITLE / (图纸名称):

AGC AND AVC CONTROL SERVER PANEL MANUFACTURE DRAWING

WIRING DIAGRAM OF TERMINAL

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
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ORIGINAL A3

THE WEATHER FORECAST AND DATA PROCESSING

SERVER PANEL MANUFACTURE DRAWING

NOTE:

PANEL MECHANICAL CHARACTERISTICS:

ITEM	DESCRIPTION	PARAMETER
1	TYPE	NR-G03
2	DIMENSION	2260(H)×800(W)×600(D) mm
3	COLOR	EXTERIOR:RAL7035; INTERIOR:RAL7035
4	PROTECTION DEGREE	IP54
5	MATERIAL	SHEET STEEL
6	TECHNICAL RATING	DC:110V CT:5A PT:110V AC:230V F:50Hz
7	QUANTITY	1

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EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL MANUFACTURE DRAWING
天气预报数据处理服务器屏厂家资料

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
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THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL
MANUFACTURER DRAWING CATALOG

NO. 序号	DRAWING NO. 图　　号	TITLE 0F DRAWING 图　　名	QTY. 数 量
1	H194-I-D-0222/H194-I0114-13(1 OF 11)	INDEX	1
2	H194-I-D-0222/H194-I0114-13(2 OF 11)	LEGEND	1
3	H194-I-D-0222/H194-I0114-13(3 OF 11)	LAYOUT	1
4	H194-I-D-0222/H194-I0114-13(4 OF 11)	BILL OF MATERIALSBILL OF MATERIALS	1
5	H194-I-D-0222/H194-I0114-13(5 OF 11)	PROTECTION PANEL STRUCTURE	1
6	H194-I-D-0222/H194-I0114-13(6 OF 11)	PROTECTION PANEL DETAILS	1
7	H194-I-D-0222/H194-I0114-13(7 OF 11)	AC POWER SUPPLY	1
8	H194-I-D-0222/H194-I0114-13(8 OF 11)	DC POWER SUPPLY	1
9	H194-I-D-0222/H194-I0114-13(9 OF 11)	PCS-9882AD-S REAR WIRING DIAGRAM	1
10	H194-I-D-0222/H194-I0114-13(10 OF 11)	MCB REAR WIRING DIAGRAM	1
11	H194-I-D-0222/H194-I0114-13(11 OF 11)	WIRING DIAGRAM OF TERMINAL	1

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DRAWING TITLE /(图纸名称):
THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL MANUFACTURE DRAWING

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ORIGINAL A3

SYMBOL	DESCRIPTION
+	POSITIVE POLARITY
-	NEGATIVE POLARITY
N	NEUTRAL
	GROUND
	CONDUCTOR, LINE TRANSMISSION PATH
	CABLE
	NON-DISCONNECTOR TERMINAL
	DISCONNECT WITH TEST PLUGS TERMINAL
	KNIFE DISCONNECT TERMINAL
	MAKE CONTACT
	BREAK CONTACT
	CHANGEOVER CONTACT
	FAN
	MINIATURE CIRCUIT BREAKER
	HEATER

SYMBOL	DESCRIPTION
	LAMP
	SOCKET
	RELAY COIL (1 COIL)
	RELAY COIL(1 ACTIVE COIL AND 1 RESET COIL)
	LATCHING RELAY
	DIRECT CURRENT CONVERTER
	ALTERNATING CURRENT / DIRECT CURRENT CONVERTER
	TRANSDUCER
	RJ45 ETHERNET PORT
	COAXIAL CABLE PORT
	FIBER OPTICAL PORT
	OPERATED BY PUSHING
	OPERATED BY TURNING WITH SPRING RETURN
	OPERATED BY TURNING
	FUSE

SYMBOL	DESCRIPTION
	WINDING
	THREE PHASE WINDING STAR
	THREE PHASE WINDING DELTA
	DIODE
	OPTOCOUPLER
M	OPERATED BY MOTOR
	RESISTER
	LIGHTNING ARRESTER
	SHUNT REACTOR
	CAPACITOR
	CIRCUIT BREAKER
	TEST BLOCK

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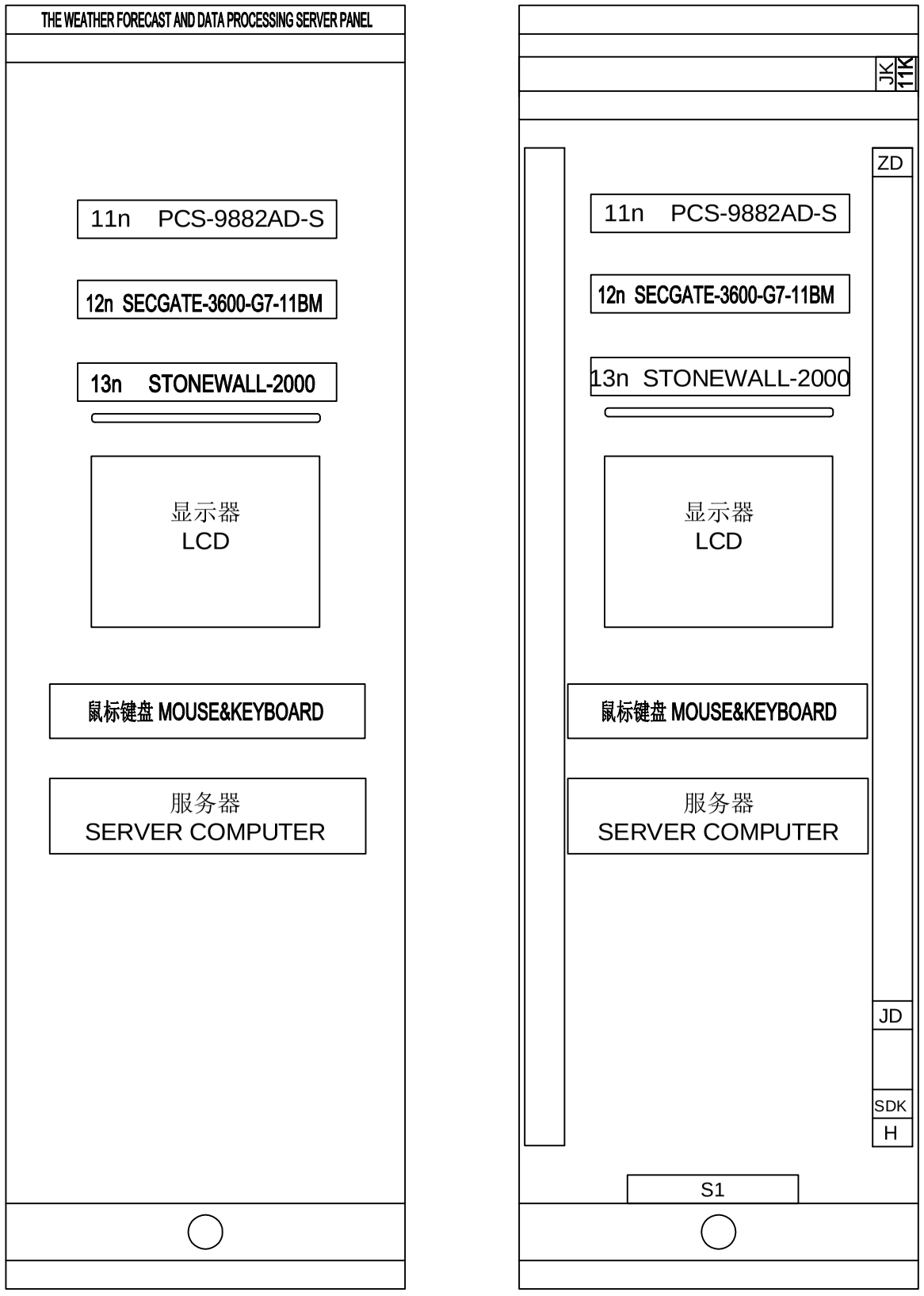
LEGEND

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0222/H194-I0114-13	2 OF 11

ORIGINAL A3



正视
FRONT VIEW

背视
REAR VIEW

MATERIAL TAKE OFF (MTO) / (材料清册)

ITEM / (编号)	DESIGNATION / (名称)	DESCRIPTION / (规格参数)	Q-ty	WEIGHT kg	NOTE / (备注)
1	SERVER COMPUTER	NEC GT110e	1		
2	LCD		1		
3	MOUSE&KEYBOARD		1		
4	ETHERNET SWITCH	PCS-9882AD-S	1		11n
5	FIREWALL	SECGATE-3600-G7-11BM	1		12n
6	REVERSE SECURITY ISOLATION	STONEWALL-2000	1		13n
7	AC OUTLET	TZ-Y/TJ-08-43E-32	1		S1
8	HUMIDIFIER	YD-HTC	1		SDK
9	AC MCB	S201-C4	1		JK
10	HEATER	DJR-100W	1		H
11	DC SUPPLY MCB	S202M-C4DC	1		11K
12	TERMINAL FOR DC POWER SUPPLY CIRCUIT				ZD
13	TERMINAL FOR AC POWER SUPPLY CIRCUIT				JD

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A	18.08.2014	ISSUE FOR APPROVAL	TANG LI	HU KE	LIU XIAOHONG

PROJECT / (项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT / (业主):
QUAID-E-AZAM SOLAR
POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL MANUFACTURE DRAWING

LAYOUT

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0222/H194-I0114-13	3 OF 11

ORIGINAL A3

No.	SYMBOL	DESCRIPTION	TYPE	QTY.	MAKER	REMARK
1		SERVER COMPUTER	NEC GT110e	1		
2		LCD		1		
3		MOUSE&KEYBOARD		1		
4	JK	AC MCB	2P-C-16A	1		
5	H	HEATER	150W	1		
6	SDK	HUMIDIFIER	TH-D-11	1		
7	S1	AC OUTLET	TZ-Y/TJ-08-43E-32	1		
8	11n	ETHERNET SWITCH	PCS-9882AD-S	1		
9	12n	FIREWALL	SECGATE-3600-G7-11BM	1		
10	13n	REVERSE SECURITY ISOLATION	STONEWALL-2000	1		
11	11K	DC SUPPLY MCB	2P-C-4A-DC	1		
12	LS	LIMIT SWITCH		1		
13	LAMP	LIGHTING LAMP		1		

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EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

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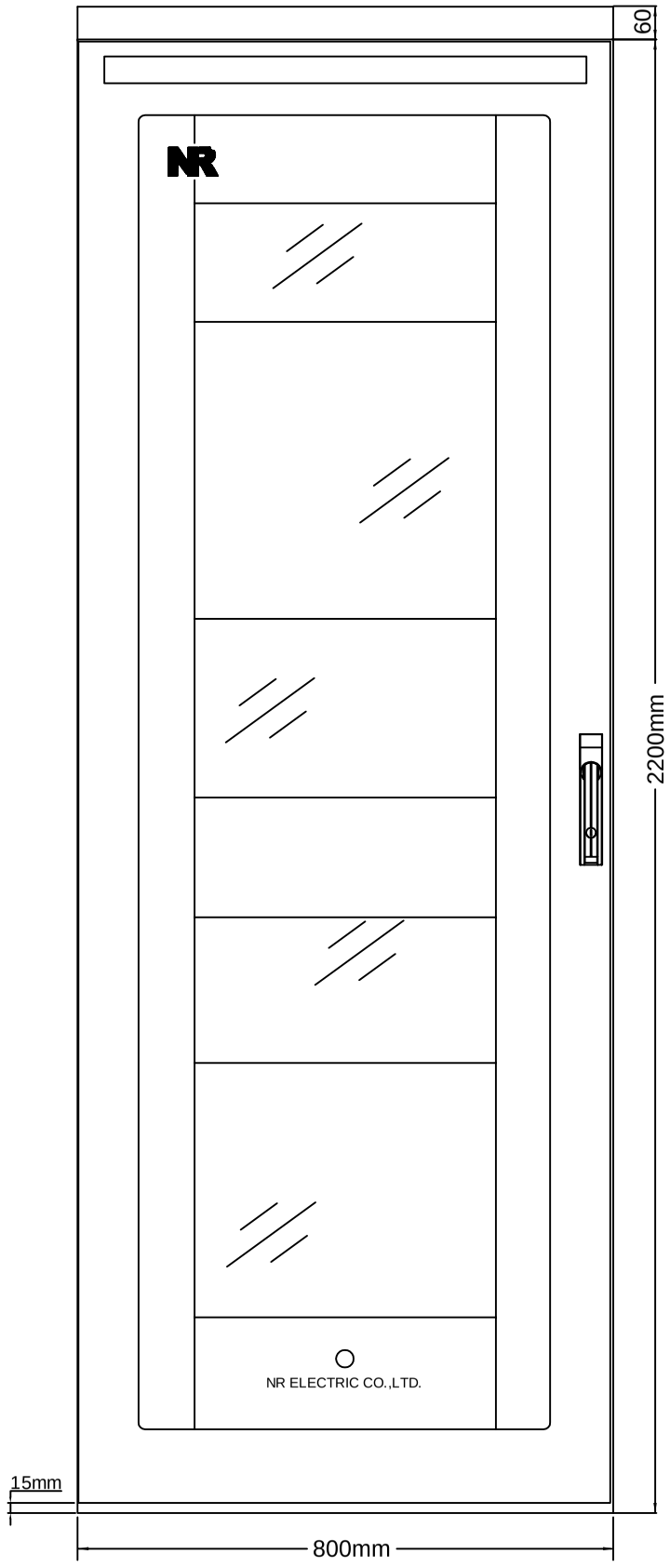
THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL MANUFACTURE DRAWING

BILL OF MATERIALS

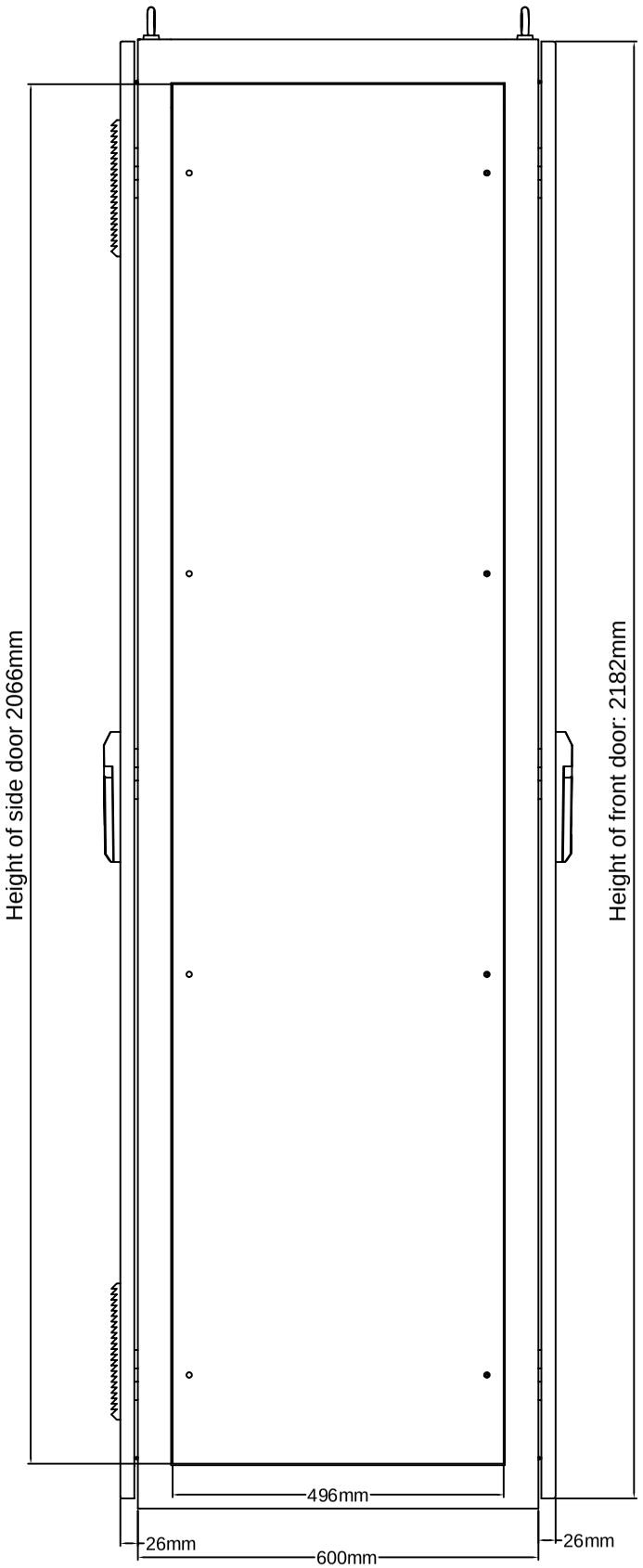
SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0222/H194-I0114-13	4 OF 11

ORIGINAL A3

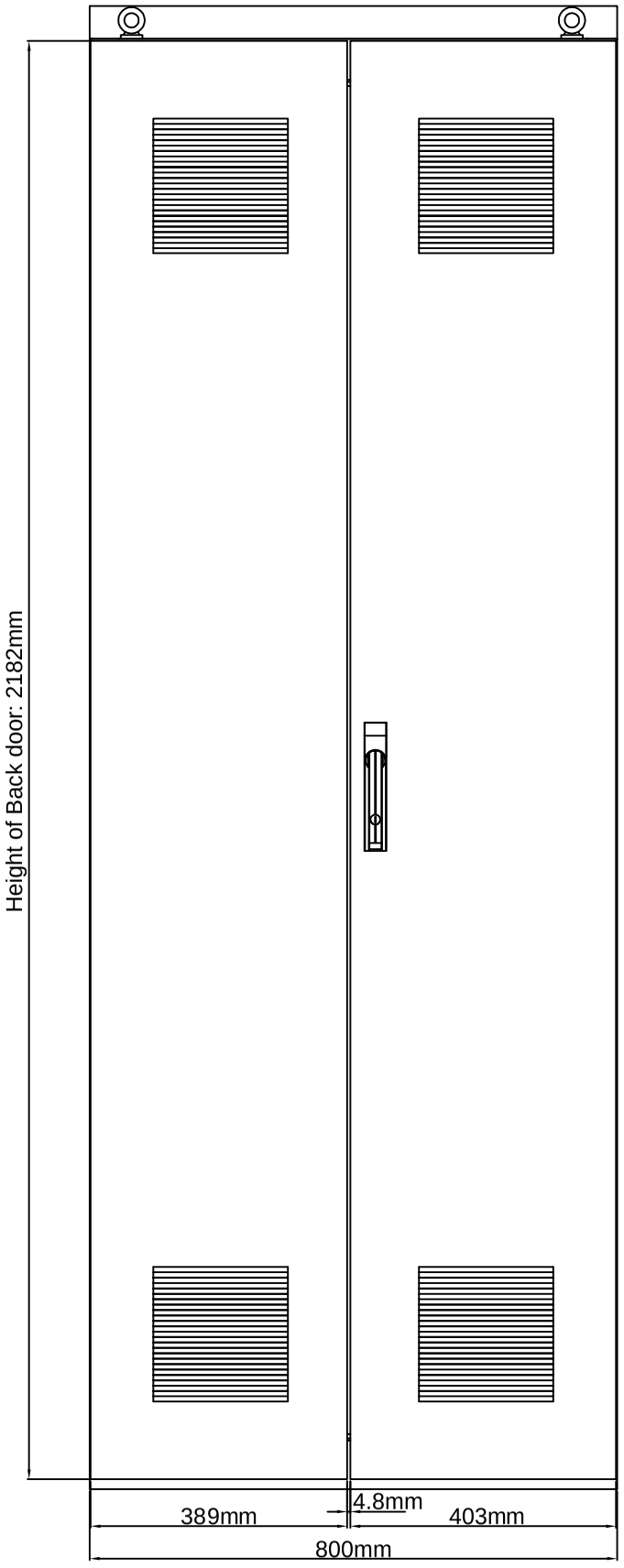
Front View



Side View



Rear View



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QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT /(业主): QUAID-E-AZAM SOLAR POWER Pvt. (Ltd)

EPC / (EPC单位): TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问): ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):

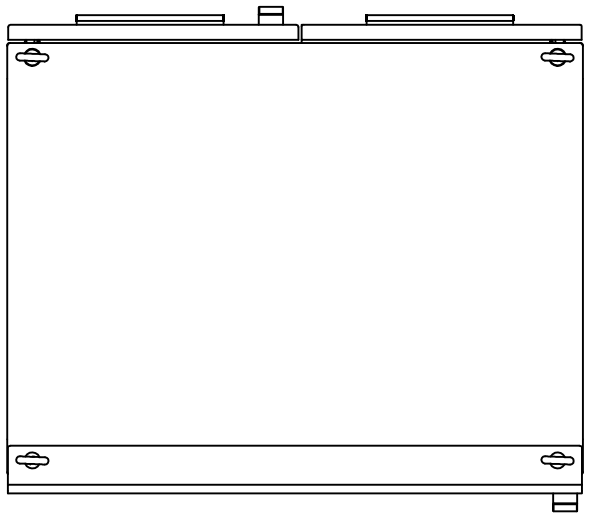
THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL MANUFACTURE DRAWING

PROTECTION PANEL STRUCTURE

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0222/H194-I0114-13	5 OF 11

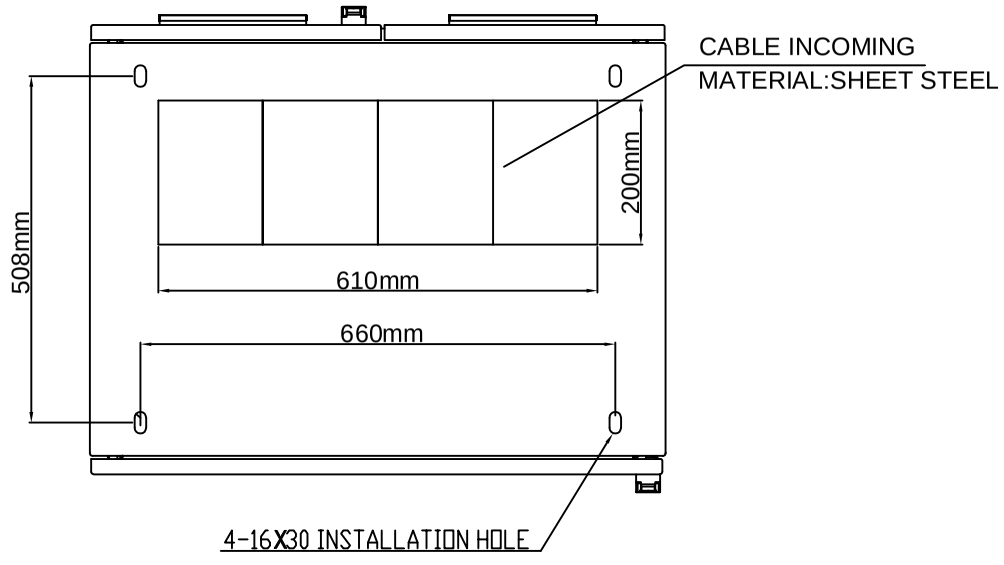
ORIGINAL A3

PANEL ROOF



FRONT

FOUNDATION DETAILS



Front

PANEL MECHANICAL CHARACTERISTICS:

ITEM	DESCRIPTION	PARAMETER
1	TYPE	NR-G03
2	DIMENSION	2260(H)×800(W)×600(D) mm
3	COLOR	EXTERIOR:RAL7035; INTERIOR:RAL7035
4	**PROTECTION DEGREE**	IP54
5	MATERIAL	SHEET STEEL
6	PLATE THICKNESS	COLUMN: 2.5mm REST: 2mm
7	MOUNTING	**FLOOR MOUNTING,BOTTOM ENTRY OF POWER AND MULTI-CORE CABLES**
8	**WEIGHT(APPROXIMATE)**	200Kg
9	EARTH BAR	COPPER STRIP: 485(L)×25(W)×4(D)mm
10	ILLUMINATION	DOOR-CONTROLLED LAMP,40W
11	NAME PLATE	**THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL**

NOTE

1.CABLE ENTRY IS FROM BOTTOM OF THE CABINET.

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CLIENT /(业主):
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POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

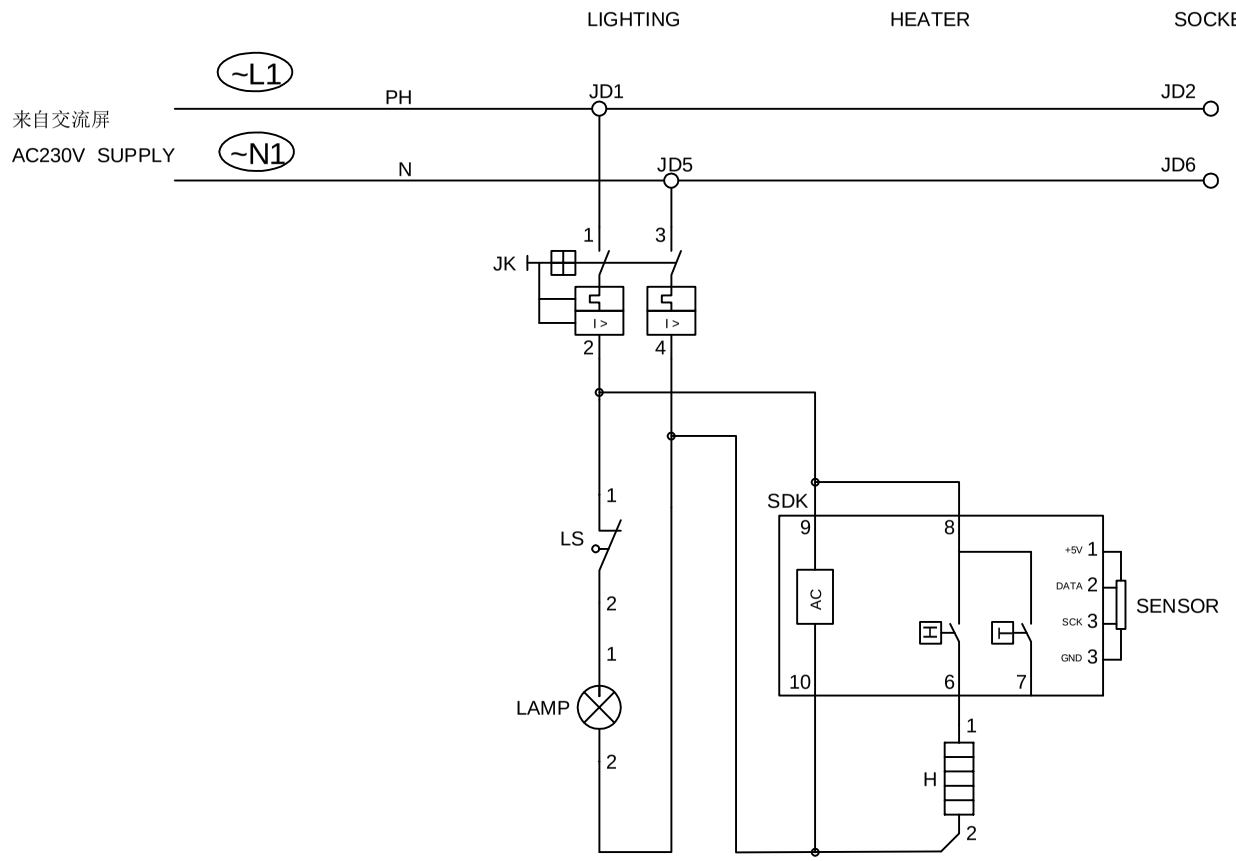
CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

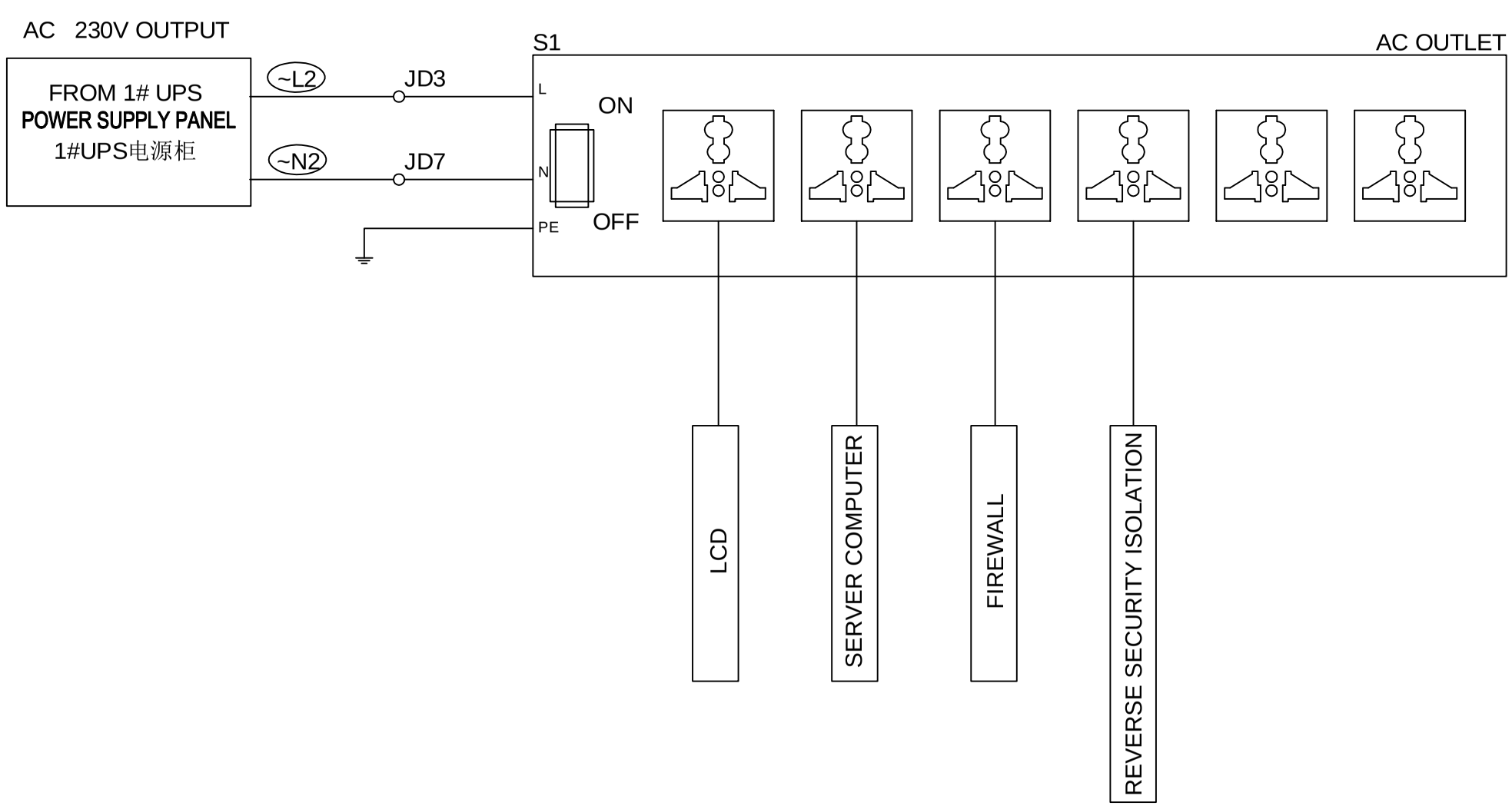
DRAWING TITLE / (图纸名称):
THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL MANUFACTURE DRAWING

PROTECTION PANEL DETAILS

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0222/H194-I0114-13	6 OF 11

ORIGINAL A3





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DRAWING TITLE / (图纸名称):
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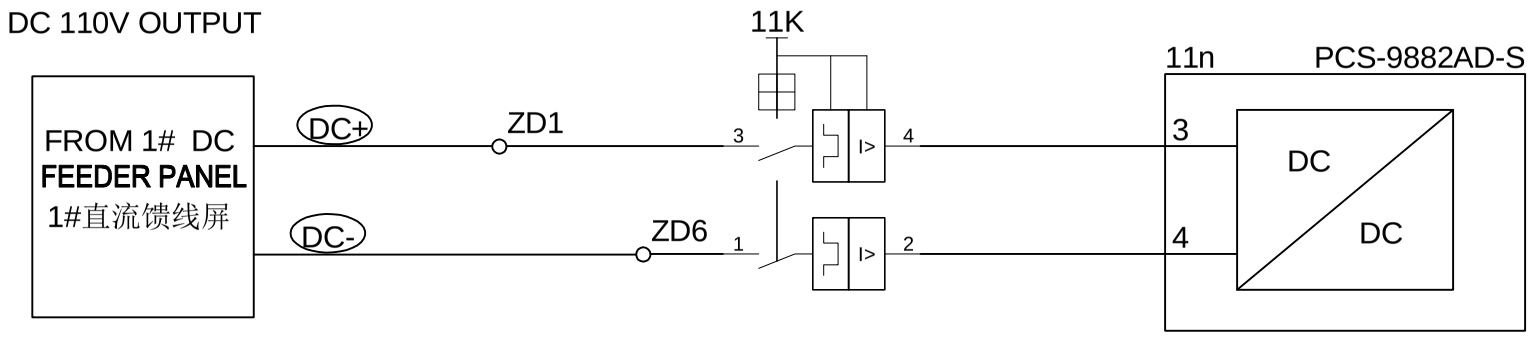
AC POWER SUPPLY

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
NTS	H194	H194-I-D-0222/H194-I0114-13	7 OF 11

ORIGINAL A3



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DC POWER SUPPLY

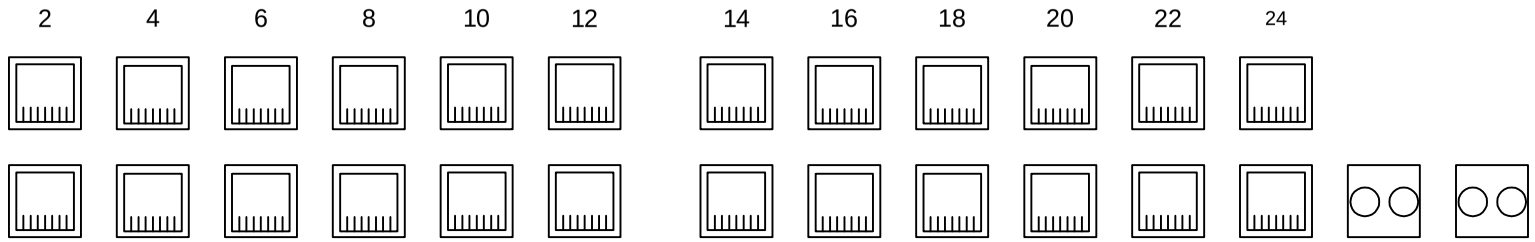
SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0222/H194-I0114-13	8 OF 11

ORIGINAL A3

11n PCS-9882AD-S

POWER SUPPLY				
		+	-	
1	2	3	4	5
		11K-4	11K-2	
6	7	8	9	10

接地
GND



LEGEND

LEGEND	NAME
	RJ45 ETHERNET PORT
	FIBER OPTICAL PORT
	EARTHING

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EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
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THE WEATHER FORECAST AND DATA PROCESSING SERVER PANEL MANUFACTURE DRAWING

PCS-9882AD-S REAR WIRING DIAGRAM

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
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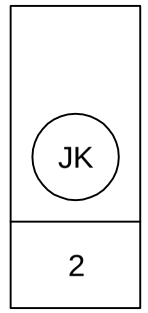
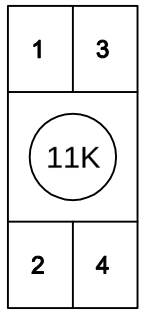
ORIGINAL A3



JD3

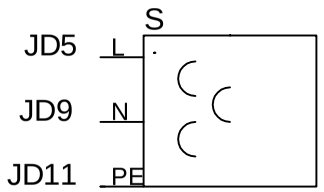


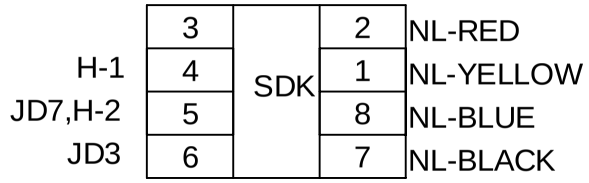
11n4 11n3

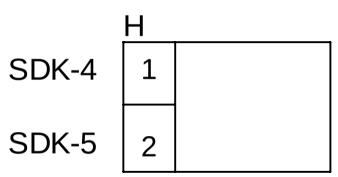
NL

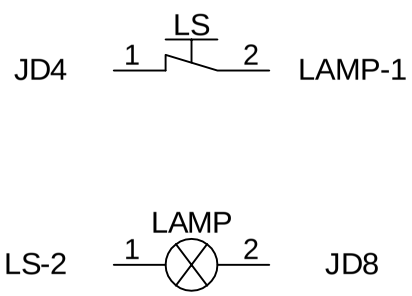
RED	YELLOW	BLUE	BLACK

SDK-2 SDK-1 SDK-8 SDK-7









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EPC / (EPC单位):
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CONSULTANT / (顾问):
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MCB REAR WIRING DIAGRAM

SCALE / (比例)	PROJECT NO.	DRAWING NO. / (图号):	SHEET
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ORIGINAL A3

ZD		
11K-3	1	DC+
	2	
	3	
	4	
	5	
11K-1	6	DC-
	7	
	8	
	9	
	10	
JD		
JK-1	1	PH
	2	
S-L	3	L
	4	
JK-3	5	N
	6	
S-N	7	N
	8	

NOTES:

SYMBOL	DESCRIPTION
JD	TERMINAL FOR AC POWER SUPPLY CIRCUIT
ZD	TERMINAL FOR DC POWER SUPPLY CIRCUIT
11K	DC SUPPLY MCB
JK	AC SUPPLY MCB

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WIRING DIAGRAM OF TERMINAL

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0222/H194-I0114-13	11 OF 11

ORIGINAL A3

Quaid-e-Azam Solar Power (Pvt.) Ltd.

Quaid-e-Azam Solar Power (Pvt.) Limited

Organization： JI BIN

Check： LIU XIAO HONG

Auditor： LIN YU JUN

Ratify： QIAO WEI

100 MWp Solar Photovoltaic (PV) Project

THE TECHNICAL PROTOCOL OF COMPREHENSIVE AUTOMATION SYSTEM

1-11-2015

TBEA 特变电工 Always Reliable 全球信赖

ILF CONSULTING ENGINEERS

PROJECT STAKEHOLDERS

Client	Quaid-e-Azam Solar Power (Pvt.) Limited	**QUAID-E-AZAM SOLAR POWER (PVT.) LTD.**
Contractor (EPC)	TBEA 特变电工 Always Reliable 全球信赖	**TBEA SUN OASIS CO. LTD** No. 399 SOUTH CHANGCHUN ROAD HI-TECH ZONE, 830011URUMQI P.R. CHINA
Consultant	ILF CONSULTING ENGINEERS	**ILF PAKISTAN** 11-B, OLD FCC, OFF FEROZPUR ROAD, 54000, LAHORE PAKISTAN.

REVISION REGISTER

Rev.	Date	Description	Author	Check	App.
2	**01.11.2015**	**Issued for As built**	**JIN BIN**	**LIU XIAO HONG**	**LIN YU JUN**
1	**29.09.2015**	**Issued for As built**	**JIN BIN**	**LIU XIAO HONG**	**LIN YU JUN**
0	**03.12.2014**	**Issued for Information**	**JIN BIN**	**LIU XIAO HONG**	**LIN YU JUN**
E	**03.12.2014**	**Issued for Approval**	**JIN BIN**	**LIU XIAO HONG**	**LIN YU JUN**
D	**31.10.2014**	**Issued for Approval**	**JIN BIN**	**LIU XIAO HONG**	**LIN YU JUN**
C	**08.10.2014**	**Issued for Approval**	**JIN BIN**	**LIU XIAO HONG**	**LIN YU JUN**
B	**27.08.2014**	**Issued for Approval**	**JIN BIN**	**LIU XIAO HONG**	**LIN YU JUN**
A	**06.07.2014**	**Issued for Approval**	**JIN BIN**	**LIU XIAO HONG**	**LIN YU JUN**

PROJECT OFFICE:

TBEA SUN OASIS CO. LTD.
201, Sector H, Street 8, Phase V, DHA,
Lahore, Pakistan.
Tel : +92-42-37177612

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0. General Description

The 100MW Bahawalpur Solar Project is constituted by 100 sets of 1MW PV units with 100 sets of inverter cabinet, and a 132KV Grid station is included for the grid-connection. For local operations and collection, evaluation and forwarding of data, we propose the scheme of integrated system automation for PV generation and 132KV grid station.

The PV power station solution is based on KEMA certified PCS-9700 Automation System and takes into account the characteristics of PV power stations. The system can perform real-time monitoring and control on the PV solar array, DC current convergent cubicle, DC distribution cabinet, grid-tie inverter, step-up substation, and environmental monitoring system. It is designed with rich user interfaces, strong analysis and processing functions as well as complete monitoring alarm mechanism.

System Structure

The system consists of three-layer control equipment and two-layer networks. The former includes the equipment on the local layer, the control layer and the substation control layer and the latter includes the network of the power station/substation layer and the control layer. The equipment on the substation control layer and the control layer are mounted in the computer room and the main control room in the CSCS main control building and the equipment on the local layer are distributed mounted in the inverter room of the power station.

The network on the control layer is designed with optical 100Mbps industrial Ethernet (single). The network on the generator unit control layer is composed of optical Ethernet. The network on the substation control layer is composed of optical 100Mbps industrial Ethernet, in double host, double network, double channel redundant design.

The schematic diagram is as below. The complete SAS Topology Diagram is attached as appendix 2.

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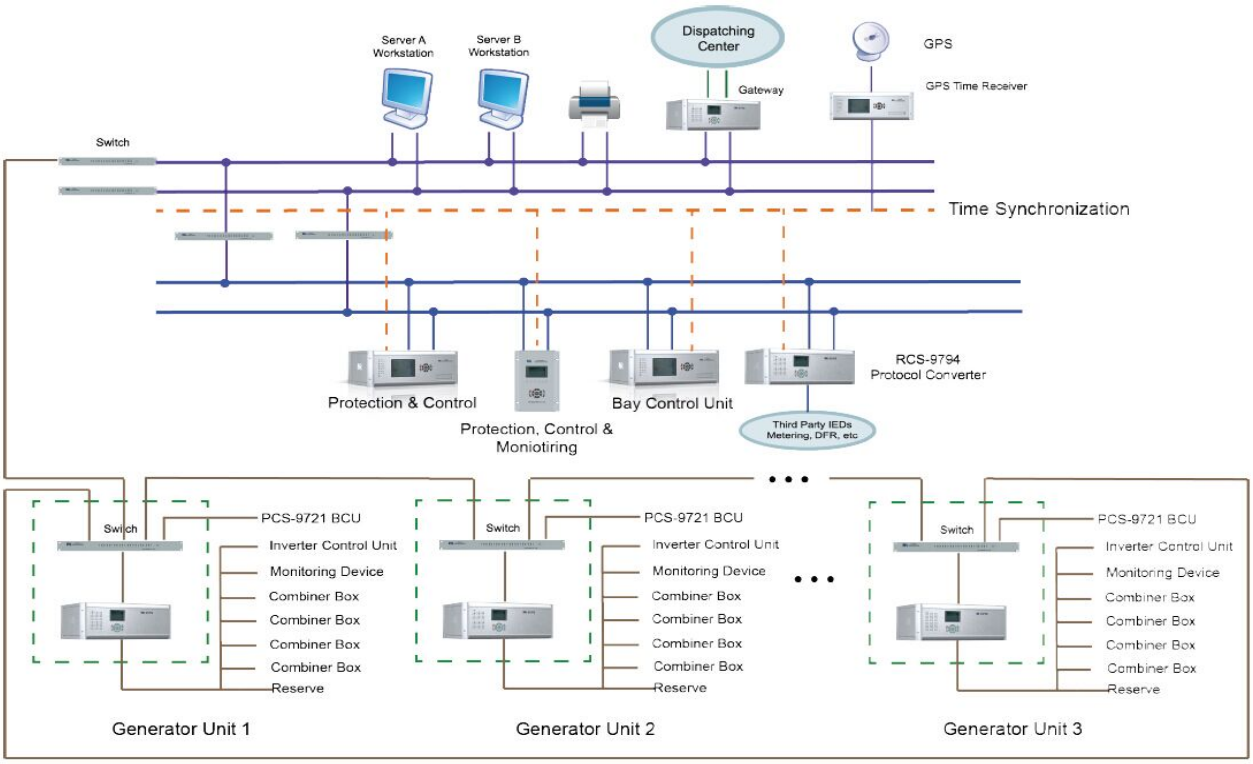

System Functions

- **Data Acquisition and Processing**

- **Data acquisition**

The local equipment in a PV power station consists of convergent cubicle, DC cabinet, inverter, box-type step up transformer with measurement and control unit. The CSCS will acquire the real-time data of the local equipment via the intelligent serial communication devices in data acquisition cabinet of the inverter room. The intelligent interfacing devices will transmit the real-time data marked with quality description to the host on the control layer via the control layer Ethernet.

- **Data processing**

Over limit check: Check the measured analogue signals and send out alarm when any of them is over limit, record the number of override position, occurrence time and the over limit value into the database;

In case of position change of DI/DO: record the operation sequence, event occurrence time, name of the event, nature of the event and issue alarm and report as specified.

- **Control & Operation**

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- Perform Watt/Var control of generator unit;
- In/Out generator unit;
- On/Off CB/DS (disconnector);
- Control the local equipment via communication;
- Automatic generation control; and
- Automatic voltage control.

- **Operation Monitoring and Event Alarm**

• Status change monitoring: Monitor the real-time parameters and status of the substation systems and display on the monitor; it will automatically switch to fault display in case incident/fault is detected; and it will also automatically recall the incident/fault display even the monitor is in dark screen;

• Fault display/record: make records in chronological sequence for all detected incidents and send out incident sound and audio alarm;

• The manual operation command is in both the scope of SOE and operation records;

• Alarm handling and make SOE records;

• PDR and relevant quantity records: The system will record 20 samples pre-fault and post fault within the sampling period of 1s.

- **Tele-Control Function**

Power station and step-up substation will communicate with dispatching center via the same communication device to transmit real time data. The communication device can also perform data processing and protocol conversion to meet the requirement of automatic dispatching. In addition, it is provided with serial output and network output capacity to meet the communication requirement with the master station of each dispatching center via dedicated channel and dispatching data network channel.

Features

• Unified data platform, seamless connection of supervisory control systems of the step-up substation and the power station;
• Complete series of protection, measurement and control with stable, reliable and advanced products;

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• PV power station AGC application can realize optimal power distribution, improving the economical and running efficiency.

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Complete BOQ of Automation and Protection System

PART I Station Level SCADA and Automation System

No.	Item	Description	Make	Unit	Qty.
1	Automation System				
1.1	Server	DELL790 I5-2400/4G/320G/DVD-RW OS: WIN 7 Pro /Mouse + keyboards/	DELL	unit	4
	LCD	DELL 24”	DELL	unit	4
	Automation system and HMI Application Software Package	PCS-9700	NR	set	4
	Printer	HP		unit	4
	Desk	Each for 7 workers		Set	2
	Loudspeaker			unit	4
	Communication Cable	Multi-mode Optic Fiber (8 terminals)		m	500
	UPS	5KVA (8 no.s of 12Vdc, 100Ah, battery)		set	1
	Optical/Electrical Converter	Optical/Electrical Converter module		unit	4
	RS485-Optical Converter	RS485-Optical Converter		unit	4
1.2	Mico-computer Prevention System (Anti-maloperation system)		NR	set	1
	Prevention System Server	DELL790 I5-2400/4G/320G/DVD-RW 24'LCD		unit	1
	Computer Key			unit	2
	Lock			unit	
	Software package		NR	set	1
1.3	Remote Control Panel		NR	Set	1
	Remote Control Unit	RCS-9799B	NR	unit	2
	GPS Synchronization	RCS-9785D	NR	unit	1

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	Clock				
	A/D channel arrester		NR	unit	6
	Protocol converter	RCS-9794A	NR	unit	1
	Ethernet Switch	PCS-9882AD-S	NR	unit	4
	Panel and accessories	PRC		unit	1
1.4.0	Ethernet Switch Panel		NR		1
	Ethernet Switch	PCS-9882AD-S	NR	unit	6
	Panel and accessories	PRC		unit	1
1.4	Distributed Control System		NR	set	2
	Distributed Station Manager	PCS-9799B	NR	unit	2
	LCD (local HMI)	17”		unit	2
	LCD (AGC/AVC)	17”		unit	2
	AGC/AVC server	NEC GT110E		unit	2
	Local HMI			unit	2
	Ethernet Switch	PCS-9882ED-S	NR	unit	4
	Panel and accessories	PRC		unit	2
1.5	Common Control Panel (Station Level)		NR	set	1
	Common Control Unit	PCS-9705	NR	unit	2
	Panel and accessories	PRC		unit	1
1.6	Common Control Panel(33KV Level)		NR	set	1
	Common Control Unit	PCS-9705	NR	unit	2
	Panel and accessories	PRC	NR	unit	1
1.7	Online Monitor of Power Quality			set	1
	Online Monitor of Power Quality	WPQ1000A		unit	1
	Panel and accessories	PRC		set	1
1.8	AGC/AVC Server Panel		NR	set	1
	AGC/AVC server	NEC GT110e		unit	1
	LCD	17”		unit	1
	AGC Software	PCS-9700 AGC application		set	1
	AVC Software	PCS-9700 AVC application		set	1
	Panel and accessories	PRC		set	1

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1.9	Power Forecast System			set	1
	Power Forecast Server Panel		NR	set	1
	Power Forecast Server	NEC GT110e		unit	2
	LCD			unit	1
	kVM Switch			unit	1
	Power Forecast System Software	PCS-9700F Software		set	1
	Panel and accessories			set	1
1.10	Weather Forecast Data Server Panel			set	1
	Weather Forecast Data Server	NEC GT110e		unit	1
	LCD	17”		unit	1
	Firewall			unit	1
	Ethernet	PCS-9882AD-S		unit	1
	Reverse Security Segretion			unit	1
	NWP Weather Data Service			year	1
	Power Forecast System Software	PCS-9700		set	1
	Panel and accessories			set	1
	Environment Monitoring System	Weather Monitoring Equipments		set	4
1.11	Digital Fault Recorder Panel		NR	set	1
	Digital Fault Recorder	PCS-996R		unit	2
	LCD	17”		unit	1
	Server			unit	1
	Printer			unit	1
	Panel and accessories	PRC		set	1
1.12	Metering Panel			set	1
	Energy Meter	DTSD-3419DSF (Active poer 0.2S, Reactive Power 2.0)	Wasion	unit	6
	Auxiliary Relay			unit	1
	Panel and accessories	PRC		set	1
1.13	Tarrif Metering Panel			set	0

1.14	Energy Meter	(Active poer 0.2S, Reactive Power 2.0)	Wasion	unit	25
1.15	Interface Panel to Energy Control Center			set	1
	Firewall			unit	1
	Panel and accessories	PRC		set	1

PART II 132KV Grid Station Control and Relay System

No.	Item	Type	Make	Unit	Qty.
1.1	132kV Line Relay Panel (RP-3)		NSI (Pakistan)	set	2
	Line Distance Relay	REL650	ABB Sweden	unit	2
	OC/EF Relay	REF610	ABB Finland	unit	2
	Auxiliary Relay			unit	2
	Tripping Relay			unit	2
	Test Block	MMLG-01	ALSTOM	unit	4
	Panel and accessories	PRC		unit	2
1.2	Transformer Relay Panel (RP-4)		NR	set	2
	Transformer Differential Relay	PCS-9671	NR	unit	2
	Auxiliary Relay	MD1501	NR	unit	2
	OC & EF Relay	PCS-9611	NR o	unit	4
	Lockout Relay	BJ-8RP or equivalent	Arteche or equivalent	unit	7
	Test Block	MMLG-01 or equivalent	ALSTOM or equivalent	unit	3
	TCS	VDF-10 or equivalent	Arteche or equivalent	unit	4
	Panel and accessories	PRC		set	2
1.3	132kV Bus Coupler Relay Panel (RP-1)		NR	Set	1
	Bus-coupler Protection Relay	PCS-9611	NR	Unit	1
	Tripping Relay	BJ-8RP or equivalent	Arteche or equivalent		1
	Test Block	MMLG-01 or equivalent	ALSTOM or		1

			equivalent		
	TCS	VDF-10 or equivalent	Arteche or equivalent		2
	Panel and accessories	PRC		set	1
1.4	132kV Busbar Relay Panel (RP-7)		NR	set	1
	Busbar Protection Relay	PCS-915	NR	unit	1
	Lockout Relay	BJ-8RP or equivalent	Arteche or equivalent	unit	6
	Test Block	MMLG-01 or equivalent	ALSTOM or equivalent	unit	5
	Panel and accessories	PRC		set	1
1.5	132kV Line Control Panel (CP-31)		NR	Set	2
	Bay Control Unit	PCS-9705 or equivalent	NR	unit	2
	Panel and accessories	PRC		Set	2
1.6	132Kv Bus-coupler Control Panel (CP-40)		NR	set	1
	Bay control unit	PCS-9705	NR	unit	1
	Panel and accessories	PRC		unit	1
1.7	Transformer Control Panel (CP-51)		NR	set	2
	Bay control Unit (HV)	PCS-9705		unit	2
	Bay control Unit (LV)	PCS-9705		unit	2
	Bay control Unit (Mechnism)	PCS-9705		unit	2
	Temperature transducer	Pt100		unit	6
	Panel and accessories	PRC		set	2
1.8	PT Voltage Paralleling and Switching Panel		NR	set	1
	RCS-9663D-II	Auxiliary Relay		set	1
	Panel and accessories	PRC		set	1

PART III PV Generation Level Protection System

No.	Description	Type	Make	Unit	Qty.
2.1	33kV Control/Protection Integrated Device		NR	set	1
	33KV Feeder Protection & Control Device	PCS-9611	NR	unit	20

	33KV Earthing Transformer Protection & Control Device	PCS-9671	NR	unit	2
	33KV Station Transformer Protection & Control Device	PCS-9611	NR	unit	1
	33KV SVC Bay Protection & Control Device	PCS-9611	NR	unit	2
2.2	33KV Bus-section Panel		NR	set	1
	Auxiliary Relay	MD1501	NR	unit	1
	33kV Bus-section Protection	PCS-9611	NR	unit	1
	Panel and accessories	PRC		unit	1
2.3	Data Acquisition Panel for Inverters			set	100
	Bay Control Unit	PCS-9721D		unit	100
	Panel and accessories	PRC		set	100
2.4	Frequency & Voltage Controller			set	1
	Frequency & Voltage Controller	PCS-994		unit	2
	Panel and accessories	PRC		set	1

Recommended Spare Parts

No.	Description	Type	Make	Unit	Qty.
1	Bay control Unit	PCS-9705	NR	unit	1
2	Bay control Unit	PCS-9721D	NR	unit	1
3	PCS-9600 Power supply module		NR	unit	1
4	PCS-9600 CPU Module		NR	unit	1
5	PCS-9600 AI Module		NR	unit	1
7	PCS-9600 BI Module		NR	unit	1
8	PCS-9600 BO Module		NR	unit	1

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1. System Structure

System Components

Station Level

The station level consists of station computers, printers, operator stations, GPS receiver, gateway and station bus. It provides supervisory, control and management functions for operators in the substation. Station level can communicate with dispatching centers or other concentrated control stations via gateway using different standard protocols such as IEC-60870-5-101 and IEC-60870-5-104.

Bay Level

The bay level consists of bay control units, protection relays, disturbance recorders and other IEDs which are connected to stations level via Ethernet. All IEDs produced by NR support IEC 61850 station bus and redundant Ethernet connection.

1.2 Network Structure

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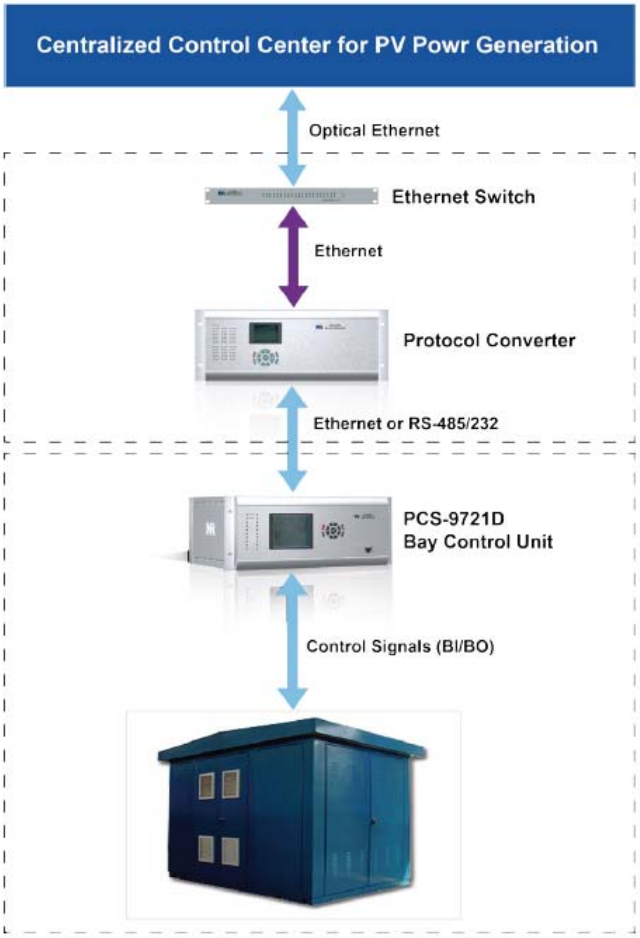
The network on the control layer is designed with optical 100Mbps industrial Ethernet (single). The network on the generator unit control layer is composed of optical Ethernet. The network on the substation control layer is composed of optical 100Mbps industrial Ethernet, in double host, double network, double channel redundant design. All redundant devices can work parallely for data exchange and communication. The high speed bus such like RS-485 will also work in some practice and will connect to the Ethernet network through RCS-9794 protocol converter. The schematic diagram of step-up equipment is as above



This type of network architecture will ensure the reliability of system operation and prevent the system crash caused by overload of network in both normal operation condition and partial fault condition.

The network is designed with capability of electromagnetic immunity, high transmission speed to satisfy the requirement of automation system.

To ensure the safety and reliability of the system, the following design philosophy are applied:

- Assign system administrative rights, divide the security of shared resources into different levels and provide appropriate safeguards. Management authority have at least three levels, the advanced level can configure the authority of lower level.
- Identification and signature measures, to prevent counterfeiting and denying of

operation activity.

- Established an access control system to prevent the illegal users' visiting and damaging of network resources and services.
- Equip hardware firewall to strengthen the entire network safety, record the user's network activities in detail, and enhance internal network security.
- Make data encryption to ensure that data will not be shifted, analyzed, changed or damaged during transmission and storage process.

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2. Design of Automation System

2.1 System Hardware

The station level system includes server/operator workstation, RTU, Protection management unit, IED and network communication equipments, etc.

Sever/Operator Workstation

It's HMI of SAS system which play the role of both processer and server. It's the data acquisition, analysis, data saving and transmission center of station level, display and manage operation information, by which the operators can supervise and control the substation and PV station.

The two servers will work on hot-standby mode. They can independently carry out all the functions. When one server fails, the other one is able to carry out all the functions smoothly without system disturbance. The operation of shifting or switch on/off of any module can also ensure the data security without affection to system.

The Operator workstation includes: 1 set of industrial PC, 1 or 2 monitors, one keyboard, one mouse, two network interfaces , one CD-RW drive (40x or more) , two serial ports, a parallel and so on .

Both the main and standby server are always available for data acquisition and saving, the difference is only the authority. So the data security is guaranteed even if one of them shut down. It takes less than 1 min to shift the main/standby status authority.

To ensure the security of power supply, a 5KVA (8 no.s of 12Vdc, 100Ah, battery) back-up UPS power is provided to meet the minimum 12 hours use in case of power failure.

Remote workstation

The PCS-9799B redundant gateway (remote workstation) is used to establish a communication links between a substation and the Load Dispatching Centers, or Grid Control Centers, in order to achieve data exchange. It is capable of communicating with several dispatching centers simultaneously via different telecommunication channels according to the applied protocol. Industrial hardware with embedded components is adopted instead of PC technology with weak rotary machinery (Hard disk, Cooling Fan, etc.). PCS-9799B supports both conventional communication channels and modern powerful Ethernet, and is fully compliance with the IEC-61850 international standard communication protocol.

PCS-9799B adopts duplicated scheme to realize HOT-STANDBY or Dual-HOT running mode.

Basic Communication Protocol

- Upward communications: IEC 60870-5-101, IEC 60870-5-104, MODBUS, CDT, DNP3.0, SCI1801, RP570 and further protocols upon request
- Downward communications: IEC 60870-5-103 or IEC61850
- It can cooperate with RCS-9794A/B protocol converter to realize various protocols.

The PCS-9799B remote workstation is able to work at dual host running or hot standby mode according to requirements of operation. Power supply of dual modem are from different DC bus to ensure the reliability. The Communication module used to communicate in different levels can be configured independently, and support hot-swappable. When fault happens in data acquisition, the data sent to dispatching center will be marked with quality bits.

Function:

- **Collect Information from IEDs**

Depending on the applied protocol and database configuration, and also owing to its powerful communication interface, PCS-9799B can communicate with various IEDs in a substation, and automatically collect any wanted information from them, e.g. sequence of events (SOE), binary signals, transformer tap position, pulse counting of electricity quantity, communication states and so on. In addition, all the collected information can be sent to the dispatching center.

- **Small-capacity memory storage**

With the incorporation of small-capacity industrial-grade NANDFLASH memory (128MBytes for single machine or 256MBytes for a dual machine system), a user can improve the collection of event information, such as: protection relays' selfchecking information, trip event records, fault information, settings modification records and so on. This technology also improves remote command from dispatching center, including selecting and executing of the binary outputs and setting modifications, remote regulation of transformer tap position, remote signaling reset events and so on. These events are stored, then automatically collected from various BCUs, protection relays and some other auxiliary IEDs.

- **Settings management**

PCS-9799B can upload/download and modify settings of various protection relays and auxiliary IEDs. Setting management can be done by the Debugging Tool or accomplished by the dispatching center up.

- **Communicate with dispatching center via various protocols and interfaces**

Due its powerful communication function, RCS- 9698H can send all collected information to the dispatching center via multiple standard communication interfaces (e.g. electrical/ optical Ethernet port, electrical/optical serial port and so on). and RTU protocols (new protocols are provided upon client's request). Moreover, information sent to the dispatching center can be selected according to the necessities.

- **Information marshalling and synthesizing**

An important aspect in multiple protocol application for RCS- 9698G/H (e.g. communicate with several dispatching centers) is the proper marshalling of the data that is to be transferred according to appropriate RTU protocols. With the help of the Configuration Tool, signal synchronization is implemented, such as General Alarm or General Failure.

- **Signal transmitting**

Depending on the utilized RTU protocol, all the collected signals can be selectively sent to the dispatching center. Signal selection can be done during PCS-9799B database configuration by the Configuration Tool.

- **Multiple Switchover Scheme for Dual-machine Configuration**

Whenever an error happens in the HOST MACHINE (e.g. CPU or power supply failure), the HOT STAND-BY MACHINE is forced to serve as a primary host. With a dedicated seamless switchover technique, the equipment will guarantee that records are not lost during the switchover. There are up to four kinds of dual-machine switching schemes.

- **T ime Management**

The equipment's Real Time Clock has small drift per day, therefore, in order to set a correct time for the time tagging of events the operator should set the time periodically or it should be synchronized by a master clock. The equipment can be configured to synchronize itself with the IED's clock.

- **Diagnostic**

The equipment can continuously self-supervise on its firmware. Once a hardware/software fault happens; its watchdog will make the CPU card restart.

Micro-computer Prevention System

The Micro-computer Prevention System consists mainly of servers, software, Computer-keys, charged communication controller, coded locks, etc, and achieves integrated operation blocking function for the whole station equipments. The Micro-computer Prevention System

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is integrated with substation automation system, its' one part of PCS-9700 SAS.

The Micro-computer Prevention System includes at least: a workstation , a monitor , a keyboard, a mouse, two network interfaces, two serial ports, one parallel port and unlock keys (includes two unlock tools, one is alternative objects oriented and the other is entire substation oriented).

Ethernet Switch

PCS-9882 series switches provide 1000Mbps Ethernet ports with higher data transmission rates to meet the increasing requirements of the device communication. PCS-9882 series switches support up to twenty-four 10/100Mbps electrical Ethernet ports and four 1000Mbps Ethernet ports. The fiber ports adopt SFP sockets, which support hot plugging.

Functions:

• Provide 10/100Mbps self-adaptive electrical Ethernet ports. The electrical Ethernet ports comply with 10BASET/ 100BASE-TX standards. They are self-adaptive for cross over and straight-through network cable. MDI/MDIX automatic identification is supported.

• The 100Mbps fiber ports of this device adopt SFP socket. The SFP transceiver complies with IEEE802.3 100BASEFX fiber Ethernet standards and can be plugged into the 100Mbps SFP socket of this device.

• The 1000Mbps fiber ports of this device adopt SFP socket. The SFP transceiver complies with IEEE802.3 1000BASESX 1000Mbps fiber Ethernet (1.25GBd) standards can be plugged into the 1000Mbps SFP socket of this device.

• Both the 100Mbps SFP socket and the 100Mbps SFP device socket support hot plugging.

• The switching mode adopts non-blocking store and forward.

• Support IEEE802.3x Flow Control.

Intelligent Interface Device (Protocol converter)

The RCS-9794A/B protocol converter is an integral part of PCS-9700 automation system. It is used to establish reliable and flexible communication links between IEDs and the workstation.

As a powerful and multifunctional communication and data storage piece of equipment, the RCS-9794A/B builds a bridge between workstation and IEDs using a variety of communication protocols from diverse venders. With its modular configuration, it is flexible, allowing for the addition of new protocols. The device is fully compliant with IEC61850

communication protocol. RCS- 9794A can be used independently. In contrast, RCS-9794B adopts duplicated scheme with two RCS-9794A units to realize HOT-STANDBY or Dual-HOT running mode.

2.2 System Software

The PCS-9700 is a state-of-the-art automation solution for substations, power generators and a variety of industries. The PCS-9700 is equipped with diverse advanced technologies and patents. It can be incorporated into a variety of substations, from distribution level to the extra high voltage level. It integrates the applications of protection, control, Ethernet, IT and communication technologies based on international standards. Furthermore, PCS-9700 is fully compatible with the IEC-61850 standard. The system adopts the layered distributed architecture with a bay-oriented and object-oriented structure, which is more reliable, extensible and easy to maintain.

Functions

- **Real-time data acquisition and processing**

The system makes acquisition and processing of real-time data of the supervisory and control units, installed at the bay level.

Any operation on system such like the changing of CB/ Isolators status, the settings, will be saved in database and logged in Alarm Bar with the detail information including time, operator and status.

- **Control operation, synchronism checking and interlocking**

The system can make sequential operations on circuit breakers, motor-driven isolators, transformer tap changer, reactive power device group, etc. The PCS-9705 bay control units carry out control operations, synchronous checking and electrical interlocking functions. Interlocking software is used mainly for implementation of edition, compilation and download of interlocking logic.

- **Communication with control center**

Communication with control center is independent of local HMI. The control command is transmitted directly from the control center. It supports IEC standard protocols and other standard protocols such as DNP3.0 and 1801.

- **T ime synchronization**

The system receives GPS standard time signals for clock synchronism. The absolute time is

broadcasted through the network. The second or minute pulse signal is inputted to the equipment by RS-485 ports or potential free contact. IRIG-B signal (AC or DC) is also supported.

- **Interfaces with third-party IEDs**

Protocol converters complied with IEC-61850 standards are provided for the integration of third-party IEDs. These can convert non-IEC-61850 protocols to IEC-61850 and realize the full automation of all IEDs in the substation.

- **Protection and fault information management.**

The system can acquire protection information, fault information, power system stability control and other automation equipment. Then it can display, analyze and process information locally. The information subsystem provides a powerful fault analysis tool. When faults occur, the information subsystem can transmit protection operation information and fault reports to the dispatching center quickly, helping dispatchers to get correct fault information, make rapid and correct fault analysis as well as decisions on fault clearance.

- **SAS software package (HMI)**

The system provides a powerful and friendly human machine interface software package, which includes:

-- Setup and maintenance of data base

-- Reactive power and voltage automatic regulation

-- Configurable Alarm processing

-- Sequence of events record and post-fault review

-- Configuration and displaying of graph and chart

-- On-line calculation and reports preparing

-- Operation management

-- Electricity processing

-- Self-diagnosis and self-restoration

-- The offered system must be able to print monthly, quarterly and yearly reports of Data transfer. For example, deviations from the guaranteed Performance Ratio (PR).

-- The history data will be saved to database, and the Report function provide the exporting service. The format support the Microsoft Excel.

Features

- **Optimized design scheme**

The PCS-9700 system considers various functions of protection, local supervision, control, reactive power and voltage regulation, interlocking, selective ground fault protection (of an ineffectively grounded system), management of equipments, operation and information protection, fault recorder information, etc.,

- **Powerful and flexible communication facilities**

The station bus uses 100M Ethernet while the bay level uses dual 100M Ethernet for redundancy. A powerful communication platform is thus formed by merging these facilities together with network communication equipment, such as 100Mbps Ethernet Switches and gateways. The process bus uses redundant Gigabit or 100M Ethernet based on optical fibers. It will guarantee the real-time transmission of important information, such as tripping/closing commands.

The system uses IEC 60870-5-103 standard protocol for communication with protection relays and other IEDs. The RCS-9794A/B communication unit in the multiple CPU structure serves as protocol converter. It provides various standard ports so that the system can be connected with equipment made by other manufactures. Therefore, the user has the flexibility to select from various lines of products.

- **Open HMI software in substation level**

The software of the system is developed based on Windows and UNIX operational systems. Either, SQL server (compatible with Windows) or ORACLE (compatible with UNIX) is selected as the database management software.

Based on softbus and network technology, the appropriate software package is installed greatly enhancing the availability of the system.

- **Direct data transmission to control center**

Functions of external communication and internal communication are independent to each other. Information can be acquired directly from the bay level and transmitted to dispatching centers. Communication bottlenecks are a problem in traditional RTU schemes. These can be solved so that reliability of information transmission can be greatly enhanced in the PCS-9700 system.

- **Object-oriented information structure**

The information structure is object-oriented. Each logic device in the database is associated with a physical device.

Influence of single item change is limited to a related part on the corresponding logic device.

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Thus, it is easy to be extended. Attribution of information is self-described. It supports on-line configuration and real-time check functions for the equipment.

- **Secure and reliable bay control unit**

The bay control unit is based on a 32 bits CPU and a DSP hardware platform. It adopts real-time multitasks operational system with powerful processing ability and is well suited for the requirements of data acquisition and processing at bay level.

Power forecast system

The power forecast system is used to predict the output power of renewable energy power station in an upcoming period. The system computes reliable forecast based on high accurate numerical weather prediction (NWP), with acquired site monitoring data, environment data and historical statistical data through the process of physical model and artificial neural network (ANN) model.
NR Electric's PCS-9700F power forecast system consists of two power forecast servers (main/standby), one weather data processor server, one WEB-based engineer workstation, one reverse isolation equipment, and one fire wall.
Enviromental data such as ground radiation intensity, temperature, wind speed, etc; are required for solar power forecast. Therefore, the environmental monitor is provided, and is generally integrated into the solar power forecast supplier.

Fault Recorder System

The PCS-996R disturbance & fault recorder (DFR) is a multifunctional data acquisition system designed to address the data recording requirements of substations. It captures the curves of monitored quantities and aligns the values of different supervised objects to build disturbance records. It was already approved/installed in for Pakistan NTDC 500KV Shikapur Grid station, 220KV Chishtian & Vehari Substation, and IESCO 132KV Gangal grid station, 132KV Bahter More Wah Grid Station, etc.

2.3 Bay level

Hardware Components

Bay level equipments includes BCUs, protection devices, automatic transfer relays, small current grounding line selection devices, bay level network devices and station level network interfaces, etc.

- **Bay Control Unit**

PCS-9705 series bay control units (abbreviated as BCUs) are used for the control and monitoring of different types of bays in power networks. PCS-9705 series BCUs are especially suitable for applications in control systems with distributed control IEDs in all bays with high demands on reliability. The IED can be used up to the highest voltage levels.

PCS-9705 series BCUs are designed for the control, monitoring of circuit breakers, disconnectors, and earthing switches in any type of switchgear and different switchgear configurations.

Additionally, PCS-9705 series BCUs enable the manual control of a tap changer.

PCS-9705 series BCUs adopt new UAPC hardware platform, 16 bits A/D converter, 320*240 graphic dot matrix LCD, and real time multi-task operating system for industrial purposes so as to realize high-capacity, high-precision, fast, real-time information processing. With high-precision A/D converters, synchronization sampling can be conducted for all the AC signals to ensure the accuracy of analog quantity measurements, which is up to the 15th harmonic component.

Software and hardware clock synchronization are both adopted with 1ms timing accuracy to ensure the resolution of the Sequence Of Events (abbreviated as SOE).

Large scale LCD provides graph and text HMI, which make the operation convenient.

Duplex Ethernet ports with 100M optical fiber or RJ45 are provided.

Back plug-in module structure is adopted. Electrical and electronic circuits are strictly separated, which enhances EMC immunity performance.

Low power consumption and wide ambient temperature range.

PCS-9705 series BCUs support IEC61850 and IEC60870-5- 103 protocols.

- **Bay level network equipment**

It includes PCS-9882 100M Ethernet switches and RCS-9794A/B protocol converters.

Function Description

- **Data acquisition and processing**

The system is able to collect and process real-time data and classify data as per data attribute as below:

Analog Input: Electric signals use AC sampling method, while non-electric signals adopt DC sampling method; BCU can also connect 4 ~ 20mA DC acquisition interfaces to access

neutral DC components of transformer by transducer.

Binary input: It adopts passive contact input method. And double contact input method is used to control device.

Pulse, electrical specification is same as binary input.

Communications data: The data from other devices access into the station level through communication, and be uniformly processed and stored in database .

Electrical analog acquisition will meet the following basic requirements:

- AC input current converter circuit cannot be broken while voltage converter cannot be shorted. The mentioned device should be able to withstand the impact of the high frequency interference waves, pressure test and meet the system measurement accuracy requirements;
- Full scale should has 2 times margin of rated input, and when outrange occurs, the data can not be set zero but send flag bit.
- It should be able to ensure system accuracy and linearity requirements under circumstance of AC voltage fluctuation, current mutation, frequency changes, vibration, unbalanced load, temperature, high-frequency interference, shock, over- limit and voltage fluctuation within allowed system range.
- The algorithm error, phase error, A / D conversion error and sampling frequency error due to harmonic should meet measurement accuracy requirement.
- The Collected real-time data should be necessarily preprocessed and stored in regularly (or randomly) updated real-time database in a certain format .

Data processing will meet the following requirements:

- Analog input signal processing should include data validity, discriminant validity, over-limit alarm, digital filtering, error compensation (including accuracy, linearity, zero drift correction, etc.), engineering unit conversion , prevention and detection of control circuit break, signal anti-interference and so on.
- BI signals processing should include optical isolation, contacts bounce processing, hardware and software filtering , reference time compensation, data validity and accuracy discrimination ,and so on.
- SOE should record the sequence, time (year, month, day, hour , minute, seconds, milliseconds) , name and property of events.
- Pulse input signal processing should include contacts debounce processing, data validity, discriminant validity and scale conversion functions, etc.

- **Control and operation**

Control Scope: all circuit breakers, electrical disconnecters, electrical eatch switches, main transformer tap regulator , reactive power compensation devices, equipments related to operation and control, and other important equipments .

Control mode: iManual control and automatic control modes.

The Manual control should include the following levels, the priority level arrange from low to high lists:

1) Remote control of all levels of dispatching center;

2) Remote control of centralized control center;

3) Control of SAS;

4) Control of manual switch on Control panel;

5) Control of local manual switch.

Automatic control should include sequential control and regulation control, and be enabled / disabled in site. It mainly includes voltage and reactive power automatic control, transformer regulation control, and sequential control.

Sequence control and regulation control functions should be relatively independent. It can be enabled / disabled by operator without affecting the normal operation

Sequential control should convert various operation tickets to task tickets, reduce artificial operation, reduce mal-operation and improve efficiency.

The system should consider the safety of sequential control and ensure all the sequential control can be verified by micro-computer prevention system.

During the automatic control process, the system shall display prompts. And when software or hardware failure occurs, it should output alarms, stop control, and maintain the status of the device.

The operator workstation shall provide bay operation graph, displaying the relevant information, including related action events, alarm windows, etc. It’s better to do control operations in bay operation graph.

Operation: To ensure the safe and reliable operation of entire automation system, the system must have appropriate security and protection measures.

Operation authority: It defines the operation area of operators as per operator’s authority. Operators should login with password, and be supervised during operation.

Uniqueness of operation: only one mode of operation is allowed at the same time. And once an operation mode is been determined, the other must be blocked.

The computer will do validity check and interlock check for any operation of operators.

Operation should follow the steps of selection, verification, and execution.. Selection will be canceled during verification when faced with one of the following circumstances:

When one control point is controlling a device, other control points are disabled to control it.

When a task is to operate multiple devices, computer monitoring system can do sequence control operations according to specified procedure on the premise of ensuring safety and reliability.

Operation only can be done in authorized workstation.

Remote or local set a tag to forbid controlling.

Provide a detailed log file to record the operator name, supervisor name, operation object , operation content , operation time and operating results, etc. And it is available for viewing and printing

It should achieve that operation can be done in one workstation while supervision in another.

- **Synchronization**

SAS is equipped with Synchronization function to meet the requirement of synchronous closing and blocking circuit breaker.

Synchronization function is proposed to be done in bay level, while the monitoring and control shall be done in station level.

Synchronization commands of each circuit breaker is proposed to block each other, to only close one breaker at the same time.

Synchronization function is able to self-test and set, it should output information whether synchronize successfully or not.

Interactive information like orders, parameter calculation and command confirmation will be displayed during synchronization operation. The process and results should be recorded.

Synchronization is able to achieve remote control dead check/synchronism check function.

- **Time synchronization**

Protection devices, BCUs and automatic transfer devices should accepts IRIG-B (DC) code to meet the timing requirements.

Bay level devices ensure the time accuracy of IRIG-B signal less than 1ms.

2.4 List of Automation System Equipments

Please refer to PART-I of Complete BOQ of Automation and Protection System

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3. Protection Scheme

NR Electric is dedicated to providing diverse protection and control products with well-proven technologies that have been widely implemented in thousands of projects worldwide. The protection and control solution plans cover all primary assets including: generator, transformer, transmission line, busbar, circuit breaker, reactor, capacitor, motor and beyond.

As for hardware architecture, NR Electric's innovative two-out of-two logic is implemented to eliminate mal-operations due to the component failure. The combination of the two-out-of-two logic and the implementation of a redundant scheme ensure the dependability and security of our protection and control solution systems. NR Electric invented the Deviation of Power Frequency Component (DPFC), a protection principle, which can help identify and confirm the fault in milliseconds and aid in the issuing of control commands accordingly. NR Electric's continuous focus on research and development has led to the creation of many innovative technologies and patents that have greatly improved the performance of NR Electric’s protection products.

The protection scheme is divided into two parts separately, which are 132KV Grid station part and 33KV/PV generation part. Separate protection / control system satisfied the specification of NTDC P-151 SEPC for control and protection equipments are proposed for 132KV level and integrated measurement, control and protection unit is proposed for 33KV level.

Since the inverter units of PV generation are distributed in the yard, the PCS-9721D smart step-up measurement & control equipment is used for status measurement, breaker control, nonelectric quantity protection and remote data transmission of the box-type step up transformers in PV power station. The step-up units will be integrated to the distributed Control System, and have data exchange in network level with station level servers and equipments.

3.1 132KV Grid Station Control and Relay System

No.	Item	Type	Make	Unit	Qty.
1.1	132kV Line Relay Panel (RP-3)		NSI (Pakistan)	set	2
	Line Distance Relay	REL650	ABB Sweden	unit	2
	OC/EF Relay	REF610	ABB Finland	unit	2
	Auxiliary Relay			unit	2
	Tripping Relay			unit	2
	Test Block	MMLG-01	ALSTOM	unit	4
	Panel and accessories	PRC		unit	2
1.2	Transformer Relay Panel (RP-4)		NR	set	2
	Transformer Differential Relay	PCS-9671	NR	unit	2
	Auxiliary Relay	MD1501	NR	unit	2
	OC & EF Relay	PCS-9611	NR o	unit	4
	Lockout Relay	BJ-8RP or equivalent	Arteche or equivalent	unit	7
	Test Block	MMLG-01 or equivalent	ALSTOM or equivalent	unit	3
	TCS	VDF-10 or equivalent	Arteche or equivalent	unit	4
	Panel and accessories	PRC		set	2
1.3	132kV Bus Coupler Relay Panel (RP-1)		NR	Set	1
	Bus-coupler Protection Relay	PCS-9611	NR	Unit	1
	Tripping Relay	BJ-8RP or equivalent	Arteche or equivalent		1
	Test Block	MMLG-01 or equivalent	ALSTOM or equivalent		1
	TCS	VDF-10 or equivalent	Arteche or equivalent		2
	Panel and accessories	PRC		set	1
1.4	132kV Busbar Relay Panel (RP-7)		NR	set	1
	Busbar Protection Relay	PCS-915	NR	unit	1
	Lockout Relay	BJ-8RP or equivalent	Arteche or equivalent	unit	6
	Test Block	MMLG-01 or equivalent	ALSTOM or equivalent	unit	5
	Panel and accessories	PRC		set	1

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1.5	132kV Line Control Panel (CP-31)		NR	Set	2
	Bay Control Unit	PCS-9705 or equivalent	NR	unit	2
	Panel and accessories	PRC		Set	2
1.6	132Kv Bus-coupler Control Panel (CP-40)		NR	set	1
	Bay control unit	PCS-9705	NR	unit	1
	Panel and accessories	PRC		unit	1
1.7	Transformer Control Panel (CP-51)		NR	set	2
	Bay control Unit (HV)	PCS-9705		unit	2
	Bay control Unit (LV)	PCS-9705		unit	2
	Bay control Unit (Mechnism)	PCS-9705		unit	2
	Temperature transducer	Pt100		unit	6
	Panel and accessories	PRC		set	2
1.8	PT Voltage Paralleling and Switching Panel		NR	set	1
	RCS-9663D-II	Auxiliary Relay		set	1
	Panel and accessories	PRC		set	1

3.2 PV Generation Level Protection System

No.	Description	Type	Make	Unit	Qty.
2.1	33kV Control/Protection Integrated Device		NR	set	1
	33KV Feeder Protection & Control Device	PCS-9611	NR	unit	20
	33KV Earthing Transformer Protection & Control Device	PCS-9671	NR	unit	2
	33KV Station Transformer Protection & Control Device	PCS-9611	NR	unit	1

	33KV SVC Bay Protection & Control Device	PCS-9611	NR	unit	2
2.2	33KV Bus-section Panel		NR	set	1
	Auxiliary Relay	MD1501	NR	unit	1
	33kV Bus-section Protection	PCS-9611	NR	unit	1
	Panel and accessories	PRC		unit	1
2.3	Data Acquisition Panel for Inverters			set	100
	Bay Control Unit	PCS-9721D		unit	100
	Panel and accessories	PRC		set	100
2.4	Frequency & Voltage Controller			set	1
	Frequency & Voltage Controller	PCS-994		unit	2
	Auxiliary Relay	MD1501		unit	1
	Panel and accessories	PRC		set	1

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4. System Performance

1. Automation System Performance

Item Perfor		**mance**
Max. time lag for a bay level measured value to show on substation level display		≤2s
Max. time lag for a bay level status change to show on substation level display		≤2s
Total response time between a command issued and corresponding status change received at the operating workstation (excluding the operating time of the circuitry and device)		≤4s
Switchover time between two machines		≤30s
Dynamic graph response time		≤2s
Display real-time data refresh cycle		≤3s
Success rate of tele-control		100%
Qualified rate of measurement		≥98%
System availability		≥99.9%
Mean time between failures (MTBF)		≥30000h
Average loading of the CPU of workstations	Normal working (within any 30min)	≤30%
	During power system failure (within 10s)	≤50%
Average loading of SAS network	Normal working (within any 30min)	≤20%
	During power system failure (within 10s)	≤40%
The max recovery time of the system		≤1min

2. Electromagnetic Compatibility

Item Standard	
Electrostatic discharge	IEC 61000-4-2, class 4
Radiated, radio-frequency electromagnetic field	IEC 61000-4-3, class 3
Electrical fast transient/burst	IEC 61000-4-4, class 4
Surge	IEC 61000-4-5, class 3
Conducted disturbances, induced by radio-frequency fields	IEC 61000-4-6, class 3
Power frequency magnetic field	IEC 61000-4-8, class 4
Pulse magnetic field	IEC 61000-4-9, class 5
Damped oscillatory magnetic field	IEC 61000-4-10, class 5
Oscillatory waves	IEC 61000-4-12, class 2

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3. Automation System Capacity

Item Perfor	**mance**
Substation	64 IED 1000
IED	1000
Bay	600
Circuit breaker and disconnector	2000
Measurement	40000
Binary input	80000
Control	20000
Metering	15000
Tap position	1000

3. Protection System Technical Data Sheet

As attached in appendix

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5. Abbreviation List

The Abbreviations used in this document are listed below:
SAS- Substation Automation System
IED- Intelligent Electronic Device
HMI- Human Machine Interface
PC- Personal Computer
LAN-Local Area Network
DR-Disturbance Recorder
DMP-Dot Matrix Computer
RCC-Remote Control Centre
RLDC- Regional Load Dispatch Centre
LN-Logical Node
BCU-Bay Control Unit
GOOSE- Generic Object Oriented Substation Event
SNMP: Simple Network Management Protocol
SNTP: Simple Network Time Protocol
SLD: Single Line Diagram
NMS: Network Monitoring System
CSCS: Computer Supervisory Control System

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6. Version History

Proposal version and modification history records

Version	Date	Description of Change
1.00	01-07-2014	Form the original proposal.
1.01	21-07-2014	Modify according to ILF Document No. H194-CS-0184-RevA-ID0225C
1.02	30-09-2014	Modify according to ILF Document No. H194-CS-0184-RevA-ID0225

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Appendix 1 SLD

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Appendix 2 SAS Topology Diagram

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Appendix 3 Automation System T echnical Catalog

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Appendix 4 T ech Data Sheet of 132 KV Grid Station Protection and Control System

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Appendix 5 Manuals

1. PCS-9700 Automation System Manual
2. PCS-9799B Remote Terminal Unit Manual
3. PCS-9705 Bay control unit Manual

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Appendix 6 Type Test Reports

1. KEMA Certificate and Reports of PCS-9700Automation System
2. KEMA Certificate and Reports of PCS-9705 Bay control unit

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Appendix 7 NR FAT Procedure

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Automation System

PCS-9700 Automation System

The PCS-9700 is a state-of-the-art automation solution for substations, power generators and a variety of industries. The PCS-9700 is equipped with diverce advanced technologies and patents. It can be incorporated into a variety of substations, from distribution level to the extra high voltage level.

PCS-9700 HMI Software

The PCS-9700 HMI (PCS-9700) is designed based on advanced distributed network technology, object-oriented database technology and cross-platform visualization technology. It is fully compatible with multiple International standards such as IEC60870-5-103 and IEC61850.

PCS-9700F Power Forecast System

The power forecast system is used to predict the output power of renewable energy power station in an upcoming period.

PCS-9705 Bay Control Unit

PCS-9705 series bay control units (abbreviated as BCUs) are used for the control and monitoring of different types of bays inpower networks.

RCS-9698G/H Gateway

The RCS-9698G/H gateway is used to establish a communication links between a substation and the Load Dispatching Centers, or Grid Control Centers,

RCS-9698M/N Remote Terminal Unit

RCS-9698M/N is a remote terminal unit (abbreviated RTU) designed for the highest standards of performance, safety and reliability to meet the requirements of a complex substation automation system (abbreviated SAS).

Automation System

PCS-9799 Station Manager

The PCS-9799 is a station manager designed for the highest standards of performance, safety and reliability in effort to meet the requirements of a complex substation automation system (SAS).

RCS-9794A/B Protocol Converter

The RCS-9794A/B protocol converter is an integral part of PCS-9700 substation automation system. It is used to establish reliable and flexible communication links between IEDs and the workstation.

PCS-9882 Ethernet Switch

The PCS-9882 series switches can be used in substation automation system (SAS), networked control system (NCS) and distributed control systems (DCS). They can also be used in power plants, industrial control systems, etc.

RCS-9785C/D GPS Synchronization Clock

The RCS-9785C/D is a GPS Synchronized Unit with abuiltin GPS receiver module. It receives timing messages through a built-in GPS receiver module. Alternatively, it receives IRIG-B standardized timing code through one of the two input channels, decodes and converts the timing code, and then outputs such timing signals to the whole station.

RCS-9785E Clock Extension Unit

The RCS-9785E is a timing signal expansion unit without an internal GPS module. It receives IRIG-B standardized timing code from external GPS timing sources, decodes and converts timing codes, and then outputs expanded timing signals to the whole station.

MUX-2M/64 Communication Interface

The MUX-2M/64 communication interface is a communication interface between tele-protection devices and digital communication multiplexers. The tele-protection devices include PCS-902 line distance protection, PCS-931 line differential protection and power stability control devices.

PCS-9700

Automation System

The PCS-9700 is a state-of-the-art automation solution for substations, power generators and a variety of industries. The PCS-9700 is equipped with diverce advanced technologies and patents. It can be incorporated into a variety of substations, from distribution level to the extra high voltage level. It integrates the applications of protection, control, Ethernet, IT and communication technologies based on international standards. Furthemore, PCS-9700 is fully compatible with the IEC-61850 standard. The system adopts the layered distributed architecture with a bay-oriented and object-oriented structure, which is more reliable, extensible and easy to maintain.

The PCS-9700 helps customers realize the automation of local operations and collection, evaluation and forwarding of data. It provides remote control and monitoring of the power system operation status. It is suitable for the following applications:

- Transmission and distribution substations, power generation and a variety of industrial electrical systems
- Utilities, power plants and industries
- Newly constructed substations and retrofit substations
- Gas and air isolated switchgears
- Subway systems, light-rail systems, and electrified railway systems

IEC-61850 Compatibility

NR Electric's substation automation system is fully compatible with the IEC-61850 standard and has passed the IEC-61850 conformance test, obtaining the level A certification issued by KEMA. NR Electric has set up its own IEC-61850 level B test laboratory to confirm the standard compliance for all products.

The IEC-61850 standard provides an internationally recognized method targeted at increasing the interoperability between IEDs from different venders. The IEC-61850 standard has built-in capabilities for high-speed control and data sharing over the network, eliminating most dedicated control wiring. Interoperation between multi-vendor IEDs using the IEC-61850 standard is the future of communication technology. In the long run, such inteconectivity should save capital in long-term upgrade investment for customers.

NR Electric protection relays, bay control units and substation automation systems are completely compatible with IEC-61850. We also provide solutions that allow the migration from the conventional substation automation system to the new standard. The PCS series protection and bay control units support the IEC-61850-9-2 standard and GOOSE message for the process bus. The sampled value, interlocking, real-time tripping/closing, interlocking and state information are transported via process bus. Compared to traditional substations, the process bus based optical fiber is used to replace cable connections between IEDs. This will significantly reduce the construction time and cost.

Process Bus Solution

The process bus is one of the cornerstones in the development of the new digital substation. The process bus, with GOOSE and IEC 61850-9- 2 standard, is adopted in NR Electric's digital substation solution. It realizes the transmission of sampled values, state information, tripping/closing commands and interlocking commands.

NR Electric's innovative digital substation solution aims at improving the modern substation operation modes by using a fiber optic network instead of conventional cable wiring, thereby reducing the workload and extending the substations operational period. NR Electric's digital substation solutions include process level equipment such as electronic fiber CT/VTs, merging units, circuit breaker controller and local control panels. It also includes PCS series protection and control devices like protective relays, disturbance recorders, automation systems, remote control systems and protection information systems.

The merging unit is suitable for traditional CT/VTs and electronic CT/VTs. It distributes the digitalized data of current/voltage to various IEDs at the bay level via the process bus or point-to-point optical fibers.

• Electronic CT/VTs digitalize the current/voltage signals and transmit them to various IEDs (protection units, control units, metering and disturbance recorders) via optical fibers.

• Merging Units gather digitalized data of current/voltage and distribute it to various IEDs via the process bus.

• Circuit Breaker Controllers collect state information from the breaker, and transmits it to various IEDs via the process bus, which receive the tripping/closing commands and implements them.

• Local control panels realize the local installation of the protection and control devices

• Gigabit switches guarantee the real-time transmission of information in the process bus.

Functions

- Real-time data acquisition and processing
  The system makes acquisition and processing of real-time data of the supervisory and control units, installed at the bay level.

- Control operation, synchronism checking and interlocking
  The system can make sequential operations on circuit breakers, motor-driven isolators, transformer tap changer, reactive power device group, etc. The PCS-9705 bay control units carry out control operations, synchronous checking and electrical interlocking functions. Interlocking software is used mainly for implementation of edition, compilation and download of interlocking logic.

- Communication with control center
  Communication with control center is independent of local HMI. The control command is transmitted directly from the control center. It supports IEC standard protocols and other standard protocols such as DNP3.0 and 1801.

- Time synchronization
  The system receives GPS standard time signals for clock synchronism. The absolute time is broadcasted through the network. The second or minute pulse signal is inputted to the equipment by RS-485 ports or potential free contact. IRIG-B signal (AC or DC) is also supported.

- Interfaces with third-party IEDs
  Protocol converters complied with IEC-61850 standards are provided for the integration of third-party IEDs. These can convert non-IEC-61850 protocols to IEC-61850 and realize the full automation of all IEDs in the substation.

- Protection and fault information management.
  The system can acquire protection information, fault information, power system stability control and other automation equipment. Then it can display, analyze and process information locally. The information subsystem provides a powerful fault analysis tool. When faults occur, the information subsystem can transmit protection operation information and fault reports to the dispatching center quickly, helping dispatchers to get correct fault information, make rapid and correct fault analysis as well as decisions on fault clearance.

- SAS software package (HMI)
  The system provides a powerful and friendly human machine interface software package, which includes:
  - Setup and maintenance of data base
  - Reactive power and voltage automatic regulation
  - Configurable Alarm processing
  - Sequence of events record and post-fault review
  - Configuration and displaying of graph and chart
  - On-line calculation and reports preparing
  - Operation management
  - Electricity processing
  - Self-diagnosis and self-restoration

Features

- Optimized design scheme
  The PCS-9700 system consideres various functions of protection, local supervision, control, reactive power and voltage regulation, interlocking, selective ground fault protection (of an ineffectively grounded system), management of equipements, operation and information protection, fault recorder information, etc.,

- Powerful and flexible communication facilities
  The station bus uses 100M Ethernet while the bay level uses dual 100M Ethernet for redundancy. A powerful communication platform is thus formed by merging these facilities together with network communication equipment, such as 100Mbps Ethernet Switches and gateways. The process bus uses redundant Gigabit or 100M Ethernet based on optical fibers. It will guarantee the real-time transmission of important information, such as tripping/closing commands.

  The system uses IEC 60870-5-103 standard protocol for communication with protection relays and other IEDs. The RCS-9794A/B communication unit in the multiple CPU structure serves as protocol converter. It provides various standard ports so that the system can be connected with equipment made by other manufactures. Therefore, the user has the flexibility to select from various lines of products.

- Open HMI software in substation level
  The software of the system is developed based on Windows and UNIX operational systems. Either, SQL server (compatible with Windows) or ORACLE (compatible with UNIX) is selected as the database management software. Based on softbus and network technology, the appropriate software package is intalled greatly enhancing the availability of the system.

- Direct data transmission to control center
  Functions of external communication and internal communication are independent to each other. Information can be acquired directly from the bay level and transmitted to dispatching centers. Communication bottlenecks are a problem in traditional RTU schemes. These can be solved so that reliability of information transmission can be greatly enhanced in the PCS-9700 system.

- Object-oriented information structure
  The information structure is object-oriented. Each logic device in the database is associated with a physical device. Influence of single item change is limited to a related part on the corresponding logic device. Thus, it is easy to be extended. Attribution of information is self-described. It supports on-line configuration and real-time check functions for the equipment.

- Secure and reliable bay control unit
  The bay control unit is based on a 32 bits CPU and a DSP hardware platform. It adopts real-time multitasks operational system with powerful processing ability and is well suited for the requirements of data acquisition and processing at bay level.

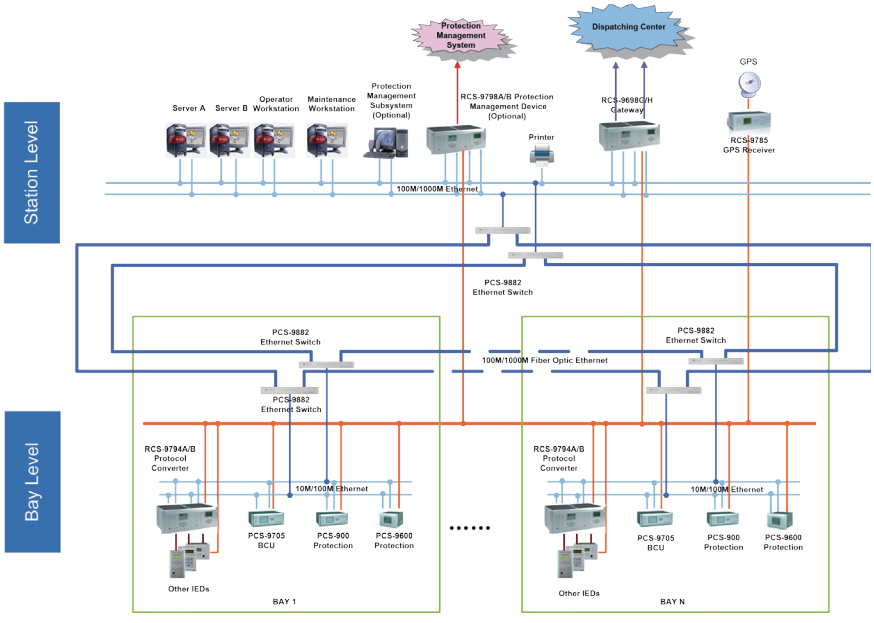


Figure 1-1. Automation system structures for substation applications

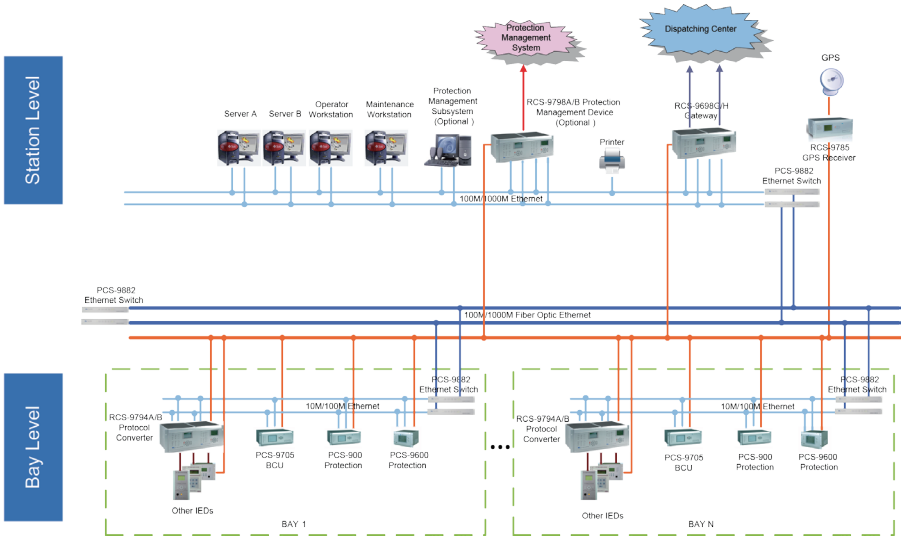


Figure 1-2. Automation system structures for substation applications

System Architecture

The system is comprised of three or four levels in hierarchical structure: Station Level, Network Level, Bay Level and optional Process Level.

For Substations

PCS-9700 HMI can be widely applied to substations.

For power plants

- Safety monitoring of electrical devices
- Complete telecontrol functions for power system dispatching, incorporating remote metering, remote dispatching, remote control and remote signal transmition.
- Real-time monitoring of electrical parameters and other electrical devices if necessary
- AGC and AVC functions
- Power plant operation management and economic power distribution between each generator set.

For Solar Energy

PCS-9700 HMI also can be widely applied to PV substations.

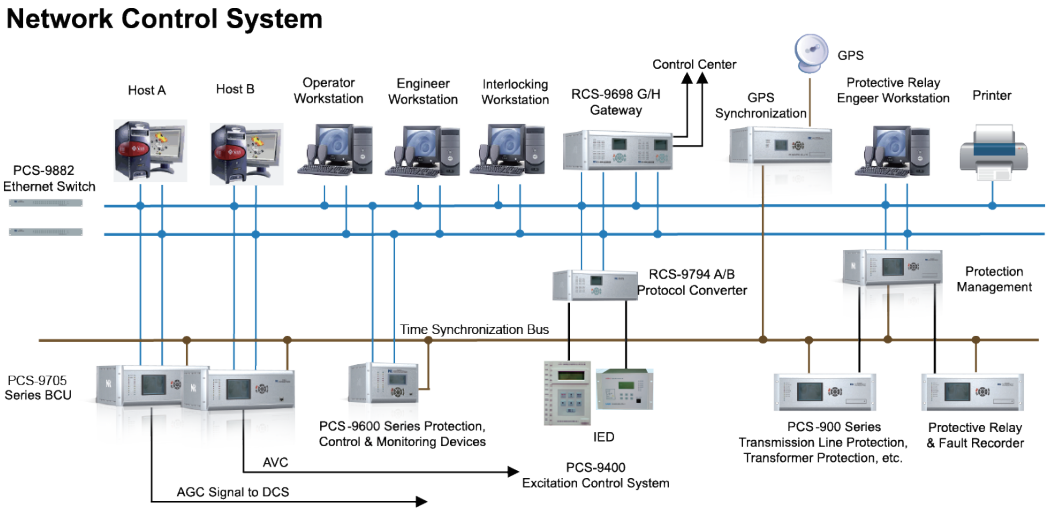


Figure 2-1. NCS structures for power plants applications

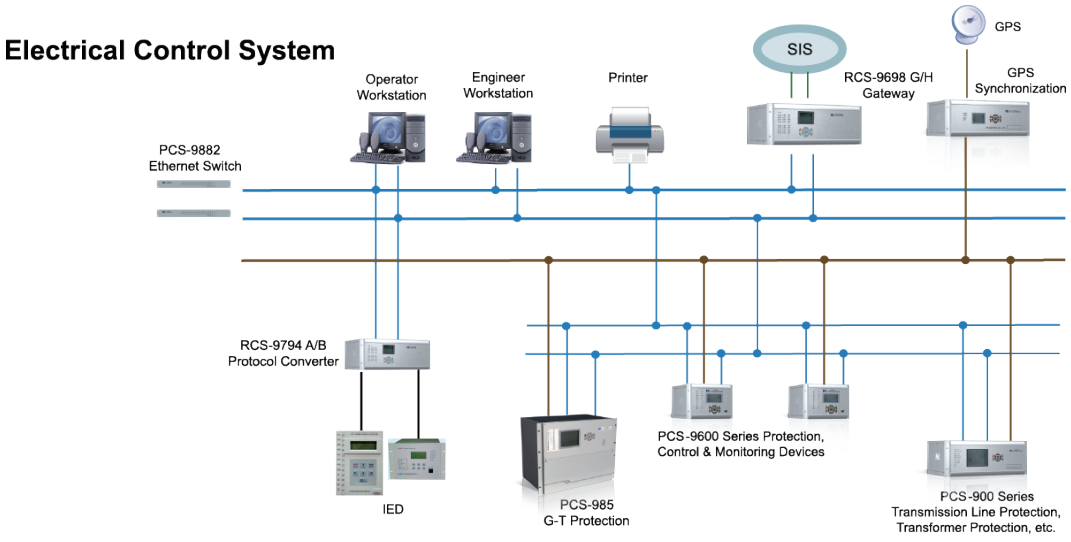


Figure 2-2. ECS structures for power plants applications

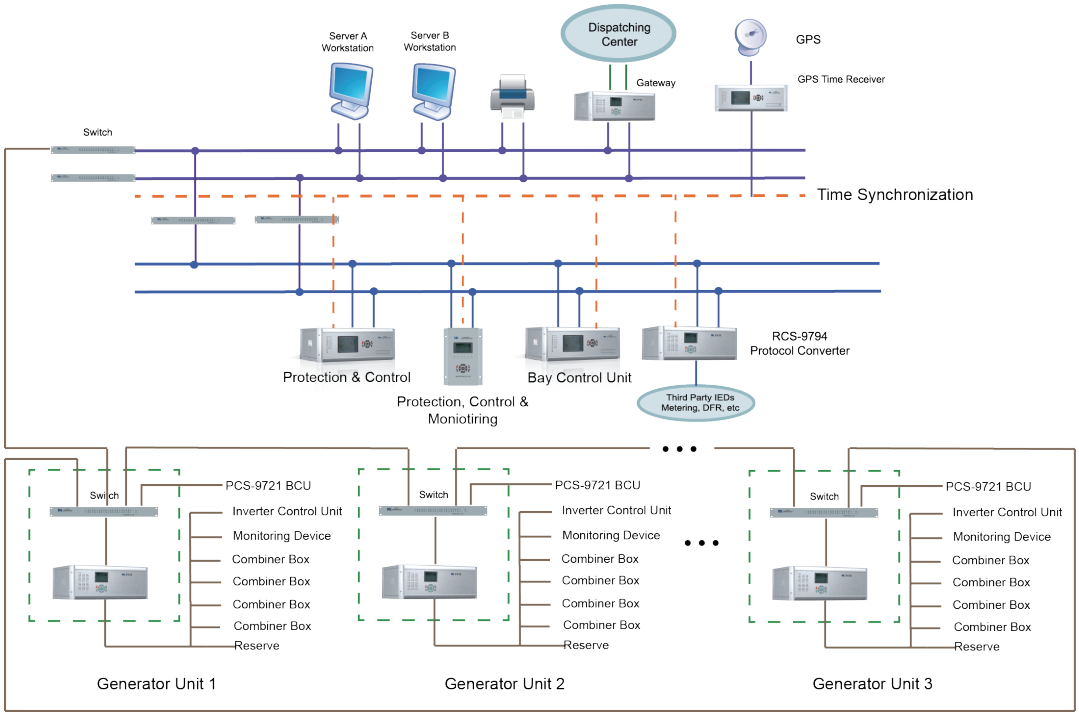


Figure 3. Automation system structures for solar energy applications

• Station Level

The station level is a distributed system comprised of a single computer host or several hosts. It provides supervisory, control and management functions for operators in the substation. The man-machine interface is friendly and easy to handle. The structure is flexible and capable of extention. Furthermore, the operation mode is reliable. By applying the component technology, “plug-and-play” can be realized for software functions. It can communicate with dispatching centers or other concentrated control stations using different standard protocols such as IEC-60870-5-101 and IEC- 60870-5-104.

• Network level

The network level supports single or dual networks, based on distributed or ring structures. Balance flow control is used for duplicated network, so the reliability and the real-time performance can be ensured. This network level can communicate smoothly with equipment produced by other manufacturers using IEC standard communication protocols or private communication protocols. Optical links are used as a transmission medium with sever EMC immunity. Time synchronization is conveniently and correctly realized by a GPS system.

• Bay level

The bay level consists of bay control units, various protection devices, disturbance recorders and other IEDs. All of NR Electric’s IEDs support IEC 61850-8-1 standards for station bus and redundant Ethernet ports. These equipment can operate with long-term stability in severe environments; for example, high temperatures, high humidity or high electro-magnetic disturbance.

• Process Level (Optional)

The process level consists of process bus and intelligent devices including electronic CT/VTs, merging units, a circuit breaker controller and a local control panel. Merging units can be incorporated to traditional CT/VTs. Merging units receive the current/voltage via cables, then converts them into digital information and distributes them to various IEDs at the bay level. A gigabit switch is supplied so that the process bus can realize the real-time information transmission. The process bus can be configured in a redundant structure utilizing either Ethernet or optical fiber.

• Typical structure description

- The station level consists of a host, operator station and engineer station. Several computers or single computer configuration may be adopted.
- Windows or UNIX can be used as the operational system.
- The gateway can adopt RCS-9698G/H device, channel switching equipment and channel interface.
- RCS-9785 can be used as the GPS receiver.
- PCS and RCS series protection equipment can be connected with the station level directly via two 100M Ethernet ports or via two RS-485 ports through a protocol converter.

Technical Data

Ratings

AC power supply	380 V/220 V, 50 Hz, 60 Hz
DC power supply	250V/220 V/125V/110 V
Secondary current of TA	5 A/1 A
Secondary voltage of TV	100 V/31/2, 110V/31/2
Pulse input:	potential free contact, 40 ms min.
Digital input:	potential free contact, DC 250V/220 V/125V/110 V
Digital output:	potential free contact, 8 A

Electromagnetic Compatibility

Electrostatic discharge	IEC 61000-4-2, class 4
Radiated, radio-frequency electromagnetic field	IEC 61000-4-3, class 3
Electrical fast transient/burst	IEC 61000-4-4, class 4
Surge	IEC 61000-4-5, class 3
Conducted disturbances, induced by radio-frequency fields	IEC 61000-4-6, class 3
Power frequency magnetic field	IEC 61000-4-8, class 4

Pulse magnetic field	IEC 61000-4-9, class 5
Damped oscillatory magnetic field	IEC 61000-4-10, class 5
Oscillatory waves	IEC 61000-4-12, class 2
Maximum capacity	
Telesignal	80000
Telemetering	40000
Telecontrol	20000
Total number of stations can be comprised in system of a controlling station	64

Accuracy

Resolution of A/D conversion	14 bits
GPS clock synchronism	≤ 1 ms
Total error of analog quantity measurement	
Voltage and current	≤ 0.2%
Active and reactive power	≤ 0.5%
Power frequency	≤ ±0.005 Hz

Refreshing cycle

Telemetering, from acquisition input to communication interface output	≤ 3 sec
Telesignal, from change of state input to communication interface output	≤ 3 sec
Telecontrol, from command creation to communication interface output	≤ 1 sec
Updating period of analog quantities on chart	≤ 3 sec
Updating period of change of state on chart	≤ 2 sec
Switch over time of standby hosts	≤30s

Print Port

Characteristic	Glass optical fiber
Optical fiber type	Multi-mode
Connector type	ST
Wave length	820nm
Minimum transmission power	-25dBm
Margin	Min. +3.0dB

Clock Synchronization Port

Type	RS-485
Transmission distance	<500m
Maximal capacity	32
Timing standard	PPS, IRIG-B
Safety level	Isolation to ELV level

Type Test

Environmental Tests

Dry cold test	Per IEC60068-2-1:2007
Dry heat test	Per IEC60068-2-2:2007
Damp heat test, cyclic	Per IEC60068-2-30:2005

Mechanical Tests

Vibration	Per IEC 60255-21-1:1988 Class I
Shock and bump	Per IEC 60255-21-2:1988 Class I

Electrical Tests

Standard	IEC 60255-27:2005
Dielectric tests	Test voltage 2kV, 50Hz, 1min
Standard	IEC 60255-5:2000
Impulse voltage tests	Test voltage 5kV
Overvoltage category	III
Insulation resistance measurements	Isolation resistance >100MΩ@500VDC

Electrical Tests

1MHz burst disturbance test	Per IEC 60255-22-1:2007
	Common mode: class III 2.5kV
	Differential mode: class III 1.0kV
Electrostatic discharge test	Per IEC60255-22-2:2008 class IV
	For contact discharge: 8kV
	For air discharge: 15kV
Radio frequency interference tests	Per IEC 60255-22-3:2007 class III
Frequency sweep - Radiated amplitude-modulated - Spot frequency - Radiated amplitude-modulated - Radiated pulse-modulated	 10V/m(rms), f=80…1000MHz 10Vm(rms), f=80MHz/160MHz/450MHz/900MHz 10Vm(rms), f=900MHz
Fast transient disturbance tests	Per IEC 60255-22-4:2008
	Power supply, I/O, Earth: class IV, 4kV, 2.5kHz, 5/50ns
	Communication terminals: class IV, 2kV, 5kHz, 5/50ns
Surge immunity test	Per IEC 60255-22-5:2008 Power supply, AC input, I/O port: class IV, 1.2/50us Common mode: 4kV Differential mode: 2kV
Conducted RF Electromagnetic Disturbance	Per IEC 60255-22-6:2001
	Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Power Frequency Magnetic Field Immunity	Per IEC 61000-4-8:2001
	class V, 100A/m for 1min, 1000A/m for 3s
Pulse Magnetic Field Immunity	Per IEC 61000-4-9:2001
	class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10:2001
	class V, 100kHz & 1MHz–100A/m
Auxiliary power supply performance	IEC60255-11: 2008 Voltage dips: Up to 300ms for dips to 40% of rated voltage without reset Voltage short interruptions: 100ms for interruption without rebooting

PCS-9700

HMI Software

The PCS-9700 HMI (PCS-9700) is designed based on advanced distributed network technology, object-oriented database technology and cross-platform visualization technology. It is fully compatible with multiple International standards such as IEC60870-5-103 and IEC61850. The PCS-9700 is suitable for conventional substations, digital substations, and NCS systems in power plants.

The system adopts distributed and expandable system framework to accommodate different structures. Applications and databases can be flexibly configured on each computer node without modification. The whole system is comprises by computers on which different operating systems are installed. The systems functions can be easily expanded according to user's demands in order ensure system flexibility and scalability.

Functions

- Real-time data acquisition and processing
- Control operation, synchronism checking and interlocking
- Setup and maintenance of data bases
- Reactive power and voltage automatic regulation
- Configurable alarm processing
- Sequence of events record and post-fault review
- Configuration and displaying of graph and chart

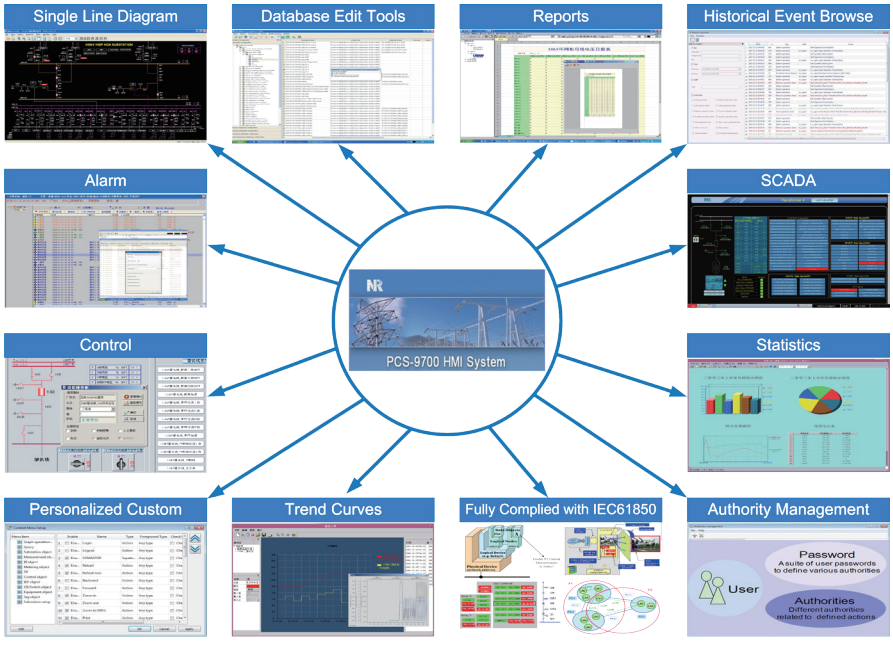


Figure 1. Basic functions for PCS-9700 HMI Software

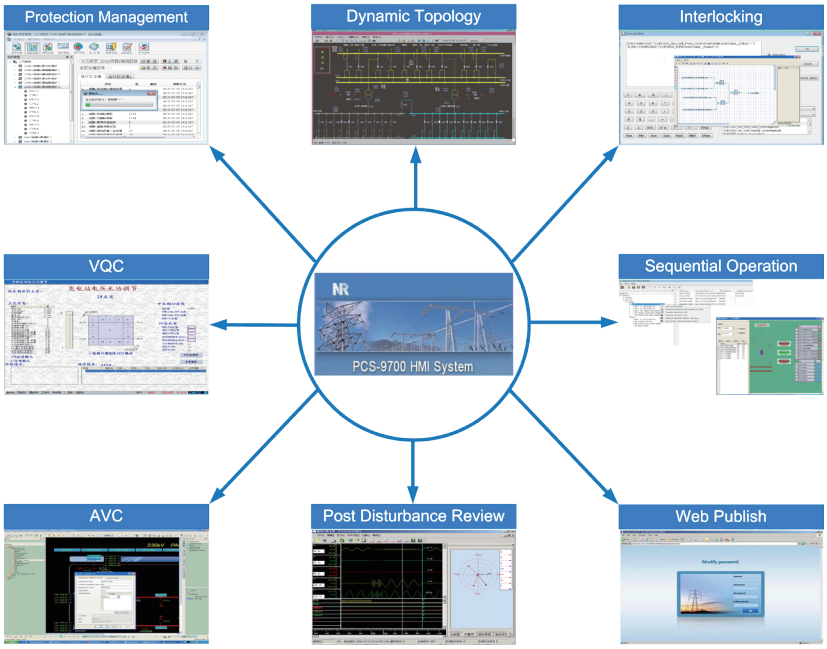


Figure 2. Advanced functions for PCS-9700 HMI

The system adopts distributed and expandable system framework to accommodate different structures. Applications and databases can be flexibly configured on each computer node without modification. The whole system is comprises by computers on which different operating systems are installed. The systems functions can be easily expanded according to user's demands in order ensure system flexibility and scalability.

- List of events
  The system can provide various information, such as protection information, list of protection events, real-time and historical curves and real-time and historical reports. Besides, users can perform the following functions via the main interface, such as the reset of protection signals and configuration of protection setting, post-fault review and display of the results in picture form,,supervision of communication bit stream, etc.

- On-line calculation and reports preparation
  Based on the real-time data acquired, the system can make calculations on current, voltage, active and reactive power, power factor, statistics of maximum and minimum value per day, month and year of assigned quantities and duration of these values' occurrence.

- Operation management
  The system can give suggestions on typical failure, fault, accident or normal operation, and making of operational statistics.

- Self-diagnosis and self-restoration
  Software and hardware can self-diagnose on-line. The range of self-diagnosis components include supervisory and control units, various kinds of stations, communication interface and other equipment, networks, channels, clock synchronism system and peripheral equipment.

Features

The PCS-9700 HMI fully satisfies the customers' requirements through using up-to-date technology. It has the advantages of high reliability, extensibility, easy maintenance, friend ly user interface and high system performance.Its features are listed below:

- Module and object oriented technologies are used to build up the system.
- The design adopts international standards such as C++, TCP/ IP, OLEDB, SQL,ActiveX, etc.
- Supports various interfaces, such as: DDE and shared memory, supporting flexible network structure, connecting easily with other systems
- Supporting cross platform function.
- he system can operate in UNIX, LINUX and Windows platforms and can be installed in computers with different OS.
- Friendly HMI with online help function, which are easy to learn and use.
- Adopting unified commercial and realtime database. The equipment oriented database management system supports online equipment configuration and realtime verification functions.
- Realizing network information by mutually exchanging, processing and verifying technologies based on softbus technology.
- Switching over of redundant equipment without disturbance through network and node redundant configuration.
- Well-designed online self-diagnosing function to identify the failures of equipmentand network on time.
- Self-restoration function helps the system restore the normal operation mode when the program losses control.
- Having a well-designed online self-diagnosing function, finding the failure of equipment and network system on time, then providing alarm information
- Having self-restoration function, the system can restore itself to the normal operation mode when the program losses control.

PCS-9700F

Power Forecast System

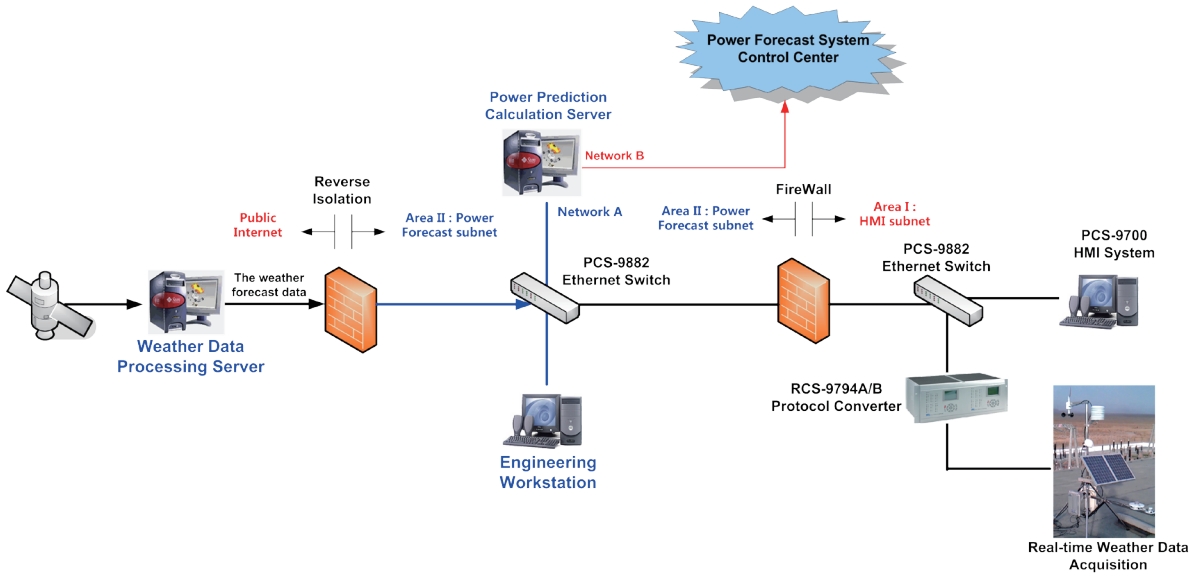
The power forecast system is used to predict the output power of renewable energy power station in an upcoming period. The system computes reliable forecast based on high accurate numerical weather prediction (NWP), with acquired site monitoring data, environment data and historical statistical data through the process of physical model and artificial neural network (ANN) model.

NR Electric's PCS-9700F power forecast system consists of two power forecast servers (main/standby), one weather data processor server, one WEB-based engineer workstation, one reverse isolation equipment, and one fire wall.

Enviromental data such as ground radiation intensity, temperature, wind speed, etc;are required for solar power forecast. Therefore, the environmental monitor is provided,and is generally integrated into the solar power forecast supplier.

Features

- Advanced and mature software platform: The power forecast system is based on NR Electric's SOPHIC platform. The platform features such virtues as advanced architecture, mature and stable performance and has been applied to a series of national key projects.
- Advanced forecast algorithm: The physical model and ANN are used for power forecast to ensure forecast accuracy.
- The power forecast system is isolated from the public internet via reverse isolation device.
- The power forecast system is isolated from substation monitoring system via firewall.



PCS-9705

Bay Control Unit (BCU)

PCS-9705 series bay control units (abbreviated as BCUs) are used for the control and monitoring of different types of bays inpower networks. PCS-9705 series BCUs are especiallysuitable for applications in control systemswith distributed control IEDs in all bays withhigh demands on reliability. The IED can beused up to the highest voltage levels.

PCS-9705 series BCUs are designed for the control, monitoring of circuit breakers, disconnectors, and earthing switches in any type of switchgear and different switchgear configurations. Additionally, PCS-9705 series BCUs enable the manual control of a tapchanger.

Functions

Main functions of PCS-9705 are listed in the following table:

Main functions of PCS-9705

No.	Function	ANSI
1	Synchronism-check	25
2	Tap changer control and supervision	84
3	Monitoring (Binary inputs, AC/DC analog inputs)	/
4	Regulation(DC analog outputs)	/
5	Control(Binary outputs)	/
6	Interlocking	/

Maximum configuration of PCS-9705 is listed in the following table:

Model	PCS-9705A	PCS-9705B	PCS-9705C	PCS-9705D	PCS-9705E
AC inputs	5VT/4CT	13VT	8VT/7CT	24VT	12VT/12CT
Binary Inputs	Up to 120	Up to 120	Up to 120	Up to 140	Up to 140
Binary Outputs	Up to 32pairs	Up to 32pairs	Up to 32pairs	Up to 25 pairs	Up to 25 pairs
Configurable Outputs	Up to 30	Up to 30	Up to 30	Up to 20	Up to 20
DC Inputs (4-20mA,0-5V, 0-250V)	Up to 16	Up to 16	Up to 16	Up to 16	Up to 16
DC Outputs (4-20mA)	Up to 4	Up to 4	Up to 4	0	0
Synchro-check	1 breaker	0	2 breaker	0	4breaker
Interlocking Logic	Yes	Yes	Yes	Yes	Yes
Support to ECVT (optional)	Yes	Yes	Yes	NO	NO
IEC61850 Process Bus (optional)	Yes	Yes	Yes	NO	NO

Features

- PCS-9705 series BCUs adopt a fully-closed chassis with a complete panel, and completely separated spaces for electronic and electrical systems provided.
- PCS-9705 series BCUs adopt new UAPC hardware platform, 16 bits A/D converter, 320*240 graphic dot matrix LCD, and real time multi-task operating system for industrial purposes so as to realize high-capacity, high-precision, fast, real-time information processing. With high-precision A/D converters, synchronization sampling can be conducted for all the AC signals to ensure the accuracy of analog quantity measurements, which is up to the 15th harmonic component.
- Software and hardware clock synchronization are both adopted with 1ms timing accuracy to ensure the resolution of the Sequence Of Events (abbreviated as SOE).
- Large scale LCD provides graph and text HMI, which make the operation convenient.
- Duplex Ethernet ports with 100M optical fiber or RJ45?are provided.
- Back plug-in module structure is adopted. Electrical and electronic circuits are strictly separated, which enhances EMC immunity performance.
- Low power consumption and wide ambient temperature range.
- PCS-9705 series BCUs support IEC61850 and IEC60870-5-103 protocols.

Technical Data

Power Supply

Standard	IEC 60255-11:2008
Rated voltage	110Vdc/125Vdc, 220Vdc/250Vdc
Operating range	88~300Vdc
Permissible AC ripple voltage	≤15% of the nominal auxiliary voltage

Analog Current

Standard		IEC 60255-27:2005	
Phase rotation		ABC	
Nominal frequency (fn)		50Hz, 60Hz	
Nominal range		45~65Hz	
Accuracy		0.2 class	
Rated Current (In)		1A	5A
Linear to		0.05In ~ 2In	
Thermal withstand capability	continuously	2In	
	for 10s	12In	
	for 1s	30In	
	for half a cycle	75In	
Burden		<0.2VA/phase @Ln	< 0.25VA/phase @Ln

Analog Voltage

Standard		IEC 60255-6, IEC60288
Phase rotation		ABC
Nominal frequency (fn)		50Hz, 60Hz
Nominal range		45~65Hz
Rated phase-to-phase voltage (Un)		100~130V
linear to		1~130V
Thermalwithstand capability	continuously	130V
	10s	200V
	1s	250V
Burden		< 0.20VA/phase @Ln

Transducer Inputs

Standard	IEC 60255-1:2009			
Input range	0-20mA	0-5V	0-48V	0-250V
Input resistance	235Ω	4.4kΩ	54.2kΩ	248kΩ
Accuracy	class 0.5	class 0.5	class 0.5	class 0.5

DC Analog Output

Standard	IEC 60255-1:2009	
Output range	0-20mA /4-20mA	0-10V
Max load	<500Ω	<5mA
Dielectric tests	2000VAC	2000VAC
Accuracy	class 0.5	class 0.5

Binary Inputs

Rated voltage	24Vdc	48Vdc	110Vdc	125Vdc	220Vdc	250Vdc
Rated current drain	1.2mA	2.4mA	1.1mA	1.25mA	2.2mA	2.5mA
Pickup voltage	13~17Vdc	26~34Vdc	60.5~77Vdc	70~87.5Vdc	121~154Vdc	
Dropoff voltage	50% of pickup voltage					
Maximum permissible voltage	100Vdc		300Vdc			
Withstand voltage	2000Vac, 2800Vdc (continuously)					
Response time for logic input	≤1ms					

Binary Outputs

Contact type	Tripping/signaling contact
Output mode	Potential free contact
Continuous carry	5A@380Vac 5A@250Vdc
Pickup time	<8ms (typical 3~5ms)
Dropoff time	<5ms
Breaking capacity (L/R=40ms)	0.65A@48Vdc 0.30A@110Vdc 0.15A@220Vdc
Burden	300mW
Maximal system voltage	380Vac 250Vdc
Test voltage across open contact	1000V RMS for 1min
Short duration current	6A@3s 15A@0.5s 30A@0.2s
Durability	10,000 operations minimum

Mechanical Specifications

Enclosure dimensions (W×H×D)	482.6mm×177.0mm×227.7mm (4U)
Mounting Way	Flush mounted
Trepanning dimensions (W×H)	450.0mm×179.0mm, M6 screw
Chassis color	Silver grey
Weight per device	Approx. 8kg
Chassis material	Aluminum alloy
Location of terminal	Rear panel of the device
Device structure	Plug-in modular type @ rear side, integrated frontplate
Protection class	
Standard	IEC 60225-1:2009
Front side	IP40, up to IP51(With cover)
Other sides	IP30
Rear side, connection terminals	IP20

Ambient Temperature and Humidity Range

Standard	IEC 60255-1:2009
Operating temperature	-25~55 (Readability of display may be impaired below -20°C)
Transport and storage temperature range	-40°C to +70°C
Permissible humidity	5%-95%, without condensation
Pollution degree	2
Altitude	<3000m

Communication Port

- Ethernet Port

Connector type	RJ-45	ST (Multi mode)
Transmission rate	100Mbits/s	
Transmission standard	10Base-T/100Base-TX	100Base-FX
Transmission distance	<100m	<2km (1310nm)
Protocol	IEC 60870-5-103:1997, DNP 3.0 or IEC 61850	
Safety level	Isolation to ELV level	

- Optical Fiber Port

- For Station Level

Characteristic	Glass optical fiber
Connector type	ST
Fiber type	Multi mode
Transmission distance	<2km
Wave length	1310nm
Transmission power	Min. -20.0dBm
Minimum receiving power	Min. -30.0dBm
Margin	Min. +3.0dB

- For Process Level

Characteristic	Glass optical fiber
Connector type	LC
Fiber type	Multi mode
Transmission distance	<2km
Wave length	1310nm
Transmission power	Min. -20.0dBm
Minimum receiving power	Min. -30.0dBm
Margin	Min. +3.0dB

- For Synchronization Port

Characteristic	Glass optical fiber
Connector type	ST
Fiber type	Multi mode
Wave length	820nm
Minimum receiving power	Min. -25.0dBm
Margin	Min. +3.0dB

- Clock Synchronization Port

Type	RS-485
Transmission distance	<500m
Maximal capacity	32
Timing standard	PPS, PPM, IRIG-B
Safety level	Isolation to ELV level

PCS-9799

Station Manager

The PCS-9799 is a station manager designed for the highest standards of performance, safety and reliability in effort to meet the requirements of a complex substation automation system (SAS). It is an integral part of the SAS, and it is a communication gateway that maps signals between protection and control IEDs in industrial or utility substations and higher-level systems (such as Control Centers (CC) or Distributed Control Systems (DCS)).

Generally the PCS-9799 is applied in a variety of voltage level substation. Its high performance provides multiple functions, which are critical in a substation. It is used to acquire complete information from substation. Then it builds the general data platform and works as the terminal for data transmission. In addition, it also provides many advanced functions, such as: substation supervision, general gateway, protection information acquisition and transmission, on-line monitoring, electricity metering, PMU, etc.

The PCS-9799 supports various protocols: IIEC60870-5-101, IEC60870-5-104, CDT, DNP, etc. The data can be transmitted across an analog channel, digital channel or net to the CC, DCS or other control centers. The PCS-9799 can also receive signals or commands from the remote centers.

The information transmitted from the PCS-9799 applies the “Directly get and send” mode. This device can run independently with the HMI system although no interaction exists between these two.

Features

- High performance hardware architecture
  - CPU: >1Ghz, RAM: > 1GB
  - Capable for data management and communication of the SAS of mega substation or power plant
  - Capacity of device access: > 512 sets
  - Multiple MON module: at most 4 with 6 net port on each module
  - COM module: each module has 5 serial ports, RS-485/ RS-232 configurable
  - MODEM module: 3/6 analog channels, parameters configurable
  - IO Module: 9 adaptable binary inputs and 6 outputs

- Advanced real-time database
  - Object-oriented design attitude
  - Compatible for data model IEC61850 and IEC 103
  - Multiple models included: Primary/ secondary equipment model, association model between primary and secondary equipment, primary schematic diagram model
  - Provides full view model and data information for advanced applications
  - Unified data gathering and sending for advanced applications

- Unified historical database
  - Embedded historical database, completely solves the problem of large data storage
  - Database capacity: >8GB
  - Multiple data information: Historical event, operation report, wave file, etc.

- Real-time data transmission platform
  - Furthest ensure the real-time data transmission to the RCC, which provide the real-time data for the advanced application in RCC
  - Internal SOE transmission delay: <100ms

- Basic substation SCADA operation supported
  - Basic SCADA functions integrated(require computer for HMI)
  - Real-time and historical alarm query
  - Measurement and operation supported
  - Powerful report recording function: device running report, operation report, SOE report
  - Optimal report structure, high efficient query function

- Powerful synchronization
  - Independent synchronization system for each MON board
  - Multiple synchronization source supported: Net message, GPS, NTP net synchronization
  - Hardware synchronization: PPS, PPM, IRIG-B

- Unified substation data sending platform
  - Realized the data model transformation between substation and RCC by using the SCD file
  - Support most of mainstream protocols: IEC60870-5-101/104, IEC60870-5-102, IEC60870-5-103, IEC61850

- Redundant working mode
  - Automatically running-standby state switch
  - Support channel-only switch mode which ensures the seamless switch between different channels with different protocols

- Powerful configuration tool
  - Fully use of the SCD file
  - Highly integrated functions
  - Total life cycle adoptable: project implementation, running and maintenance, analyze and diagnose

Technical Data

Mechanical Specifications

Rated Voltage (Un)	110Vdc/125Vdc, 220Vdc/250Vdc;
Variation	(80% ~ 120%)Un
Ripple in the DC auxiliary voltage	Max 15% of the DC value. Per IEC 60255-11:1979
Voltage dips and voltage short interruptions	Per IEC 60255-11:1979 20ms for interruption without de-energizing, dips 60% of Un without reset up to 100ms
Burden	Single device: <45W

Mechanical Specifications

Chassis color	Silver grey
Weight per device	Approx. 15kg
Chassis material	Aluminum alloy
Location of terminal	Rear panel of the device
Device structure	Plug-in modular type @ rear side, integrated frontplate
Protection class	
Standard	IEC 60225-1:2009
Front side	IP40
Other sides	IP30
Rear side, connection terminals	IP20

Ambient Temperature and Humidity Range

Standard	IEC60255-1:2009
Operating temperature	-25°C ~ +55°C
Transport and storage temperature range	-40°C ~ +70°C
Permissible humidity	5% ~ 95%, condensation not permissible

Communication Port

Communication medium	Parameters	
Digital channel interfaces		
RS-232/422/485 (EIA)	Port number	Up to 12/24 (single machine/dual machine)
	Baud rate	300, 600, 1200, 2400, 9600, 19200 or 38400 bps
	Transmission distance	< 1000m@4800bps
	Maximal capacity	32
	Safety level	Isolation to ELV level
Ethernet channel interfaces		
EIA-485 Port	Port number	Single machine: 4 ~ 16 Dual machine: 8 ~ 32
	Connector type	RJ45
	Transmission Rate	10M/100Mbps auto-negotiation
	Transmission standard	10Base-T/100Base-TX
	Transmission distance	< 100m
	Safety level	Isolation to ELV level
Interfaces for clock synchronization		
MODEM	Port number	Up to 6/12(single machine/dual machine)
	Baud rate	300bps, 600bps,1200bps asynchronous
	Center Frequency	1080 ~ 3000Hz
	Offset Frequency	±150 ~±500Hz
EIA-422 Port		
RS-485 (EIA)	Port number	1
	Transmission distance	< 500m
	Maximal capacity	32
	Timing standard	PPS, IRIG-B
	Safety level	Isolation to ELV level

Communication Protocols

Upward Communication (To control centers)	IEC 60870-5-101
	IEC 60870-5-104
	DNP 3.0 (serial and TCP/IP)
	MODBUS
	RP570
	CDT
	SC1801
	New programs can be developed for new protocols to meet the demands of the users.
Downward Communication (To local SCADA system manufactured by NR Electric)	IEC 60870-5-103

Type Test

Environmental Tests

Dry cold test	Per IEC60068-2-1:2007
Dry heat test	Per IEC60068-2-2:2007
Damp heat test, cyclic	Per IEC60068-2-30:2005

Mechanical Tests

Vibration	Per IEC 60255-21-1:1988 Class I
Shock and bump	Per IEC 60255-21-2:1988 Class I

Electrical Tests

Standard	IEC 60255-27:2005
Dielectric tests	Test voltage 2kV, 50Hz, 1min
Standard	IEC 60255-5:2000
Impulse voltage tests	Test voltage 5kV
Overvoltage category	III
Insulation resistance measurements	Isolation resistance >100MΩ@500VDC

Electromagnetic Compatibility

1MHz burst disturbance test	Per IEC 60255-22-1:2007
	Common mode: class III 2.5kV
	Differential mode: class III 1.0kV
Electrostatic discharge test	Per IEC60255-22-2:2008 class IV
	For contact discharge: 8kV
	For air discharge: 15kV
Radio frequency interference tests	IEC 60255-22-3:2007 class III
	Frequency sweep Radiated amplitude-modulated 10V/m(rms), f=80…1000MHz
	Spot frequency Radiated amplitude-modulated 10Vm(rms), f=80MHz/160MHz/450MHz/900MHz 10Vm(rms), f=900MHz
Fast transient disturbance tests	Per IEC 60255-22-4:2008
	Power supply, I/O, Earth: class IV, 4kV, 2.5kHz, 5/50ns
	Communication terminals: class IV, 2kV, 5kHz, 5/50ns
Surge immunity test	Per IEC 60255-22-5:2008
	Power supply, AC input, I/O port: class IV, 1.2/50us Common mode: 4kV Differential mode: 2kV
Conducted RF Electromagnetic Disturbance	IEC 60255-22-6:2001
	Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Power Frequency Magnetic Field Immunity	IEC 61000-4-8:2001
	class V, 100A/m for 1min, 1000A/m for 3s
Pulse Magnetic Field Immunity	IEC 61000-4-9:2001
	class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10:2001
	class V, 100kHz & 1MHz–100A/m
Auxiliary power supply performance - Voltage dips - Voltage short interruptions	IEC60255-11: 2008 Up to 500ms for dips to 40% of rated voltage without reset 100ms for interruption without rebooting

RCS-9794A/B

Protocol Converter

The RCS-9794A/B protocol converter is an integral part of PCS-9700 substation automation system. It is used to establish reliable and flexible communication links between IEDs and the workstation.

As a powerful and multifunctional communication and data storage piece of equipment, the RCS-9794A/B builds a bridge between workstation and IEDs using a variety of communication protocols from diverse venders. With its modular configuration, it is flexible, allowing for the addition of new protocols. The device is fully compliant with IEC61850 communication protocol. RCS-9794A can be used independently. In contrast, RCS-9794B adopts duplicated scheme with two RCS-9794A units to realize HOT-STANDBY or Dual- HOT running mode.

Basic Communication Protocol

- Upward: IEC 61850, IEC 60870-5-103
- Downward: IEC 60870-5-101, IEC 60870-5-103, IEC 61850-5-104, MODBUS, CDT, DNP 3.0 (serial port).
- NR Electric can customize new protocols for specific applications.

Functions

- Universal protocol converter
  The RCS-9794A/B is a highly reliable, fully non-blocking intelligent protocol converter, which supports interworking between a wide range of protocols.

- Linking protection equipment and other IEDs to substation automation system
  The RCS-9794 can send data from protective relays and other IEDs to SAS. It also can send the control commands from SAS to local bay units.

- Linking protection equipment and other IEDs to remote terminal units
  The RCS-9794 can send data from protective relays and other IEDs to RTUs. It can also send the remote commands from the remote control center to local bay units.

- Inspection and communication status monitoring.
  The RCS-9794 can inspect and monitor the communication status of various types of equipment. If a connection or a disconnection occurs, the RCS-9794 will send a change-of-state message to a station-level device, such as a local HMI or RTU.

- Clock synchronization and system time unification
  The RCS-9794 can receive Pulses Per Second (PPS) and timing signals from a GPS device. It also synchronizes its clock with the GPS device and sends timing messages to all linked equipment.

- Information synthesis and transmission
  According to engineering requirements, the RCS-9794 can consolidateseveral signals into one signal, and send this synthetic signal to the user appointed control center.

- Self-diagnosis
  When in operating mode, the RCS-9794 continuously checks for any hardware or software faults.

Features

- Various communication protocols can be selected flexibly for individualcommunication ports,
- Suitable for installation in cubicles.
- Supporting a dual machine system configuration with the merit of absolute electrical independence.
- Dual Ethernet communication is used for upward communication with local HMI or RTUs at the station level to ensure the reliability of all upward communication.
- Embedded multiple processor architecture.All processors are mutually independent and run parallel to each other. Moreover, the equipment can equalizeworkloads among theprocessors. This way, it exploits the full benefitsof the distributed multiprocessor system's parallel processing ability.
- Configurable communication interfaces.
- Hardware time synchronization (pulse per second (PPS))
- Various communication interfaces can be flexible selected according to engineering requirements. Serial ports, copper Ethernet ports, fiber serial ports and fiber Ethernet ports can be selected.
- Data marshalling and distribution
- Continuous self-monitoring
- Continuous supervision of connected devices
- Powerful and friendly configuration tools and debugging tools
- Standard device functions (e.g. general alarm, general fault signal, communication monitoring, etc.)

Technical Data

Power Supply

Rated Voltage (Un)	110V, 125Vdc, 220V, 250Vdc
Variation	(80% ~ 120%)Un
Ripple in the DC auxiliary voltage	Max 15% of the DC value. Per IEC 60255-11
Voltage dips and voltage short interruptions	Per IEC 61000-4-11:2004, IEC 60255-11:2008 20ms for interruption without de-energizing, dips 60% of Un without reset up to 100ms
Burden	<40W

Mechanical Specifications

Enclosure dimensions (W×H×D)	482.6×177.0×291(unit: mm)
Trepanning dimensions	450.0×179.0, M6 screw
Mounting Way	Flush mounted
Protection class	Front side: IP51 Rear side, connection terminals: IP20 Other Sides: IP30

Atmospheric Environment

Standard	IEC60255-6:1988
Service temperature range	-25°C ~ +55°C
Transport and storage temperature range	-40°C ~ +70°C
Permissible humidity	5% ~ 95%, condensation not permissible

Communication Interfaces

Communication medium		Parameters	
Serial Interfaces			
RS-232/422/485	Copper	Baud rate	300bits/s ~ 38400bits/s
		Transmission distance	< 1000m@4800bps
		Safety level	Isolation to ELV level
	Fiber	Baud rate	300bits/s ~ 38400bits/s
		Optical Fiber Type	Multi-mode
		Connector type	ST
		Wavelength	850nm
		Transmission distance	≤ 2000m
		Safety level	Isolation to ELV level
LonWorks	Copper	Baud rate	9600bits/s
		Safety level	Isolation to ELV level
	Fiber	Connector type	9600bits/s
		Optical Fiber Type	Multi-mode
		Connector type	ST
		Wavelength	850nm
		Transmission distance	≤ 2000m
		Safety level	Isolation to ELV level
Ethernet Interfaces			
Copper Ethernet Ports)		Connector type	RJ-45
		Transmission Rate	100Mbits/s
		Transmission standard	100BASE-TX
		Transmission distance	< 100m
		Safety level	Isolation to ELV level
Fiber Ethernet Ports		Connector type	SC
		Transmission Rate	100Mbits/s
		Transmission standard	100Base-FX
		Optical Fiber Type	Multi-mode
		Wavelength	1300nm
		Transmission distance	< 2000m
		Safety level	Isolation to ELV level
Interfaces for clock synchronization			
RS-485 (EIA)		Port number	1
		Transmission distance	< 500m
		Timing standard	PPS
		Safety level	Isolation to ELV level

Type Test

Environmental Tests

Dry cold test	Per IEC60068-2-1:2007
Dry heat test	Per IEC60068-2-2:2007
Damp heat test, cyclic	Per IEC60068-2-30:2005

Mechanical Tests

Vibration	Per IEC 60255-21-1:1988 Class I
Shock and bump	Per IEC 60255-21-2:1988 Class I

Electrical Tests

Standard	IEC 60255-27:2005
Dielectric tests	Test voltage 2kV, 50Hz, 1min
Standard	IEC 60255-5:2000
Impulse voltage tests	Test voltage 5kV
Overvoltage category	III
Insulation resistance measurements	Isolation resistance >100MΩ@500VDC

Electromagnetic Compatibility

1MHz burst disturbance test	Per IEC 60255-22-1:2007
	Common mode: class III 2.5kV
	Differential mode: class III 1.0kV
Electrostatic discharge test	Per IEC60255-22-2:2008 class IV
	For contact discharge: 8kV
	For air discharge: 15kV
Radio frequency interference tests Frequency sweep - Radiated amplitude-modulatedSpot frequency - Radiated amplitude-modulated - Radiated pulse-modulated	Per IEC 60255-22-3:2007 class III 10V/m(rms), f=80…1000MHz 10Vm(rms), f=80MHz/160MHz/450MHz/900MHz 10Vm(rms), f=900MHz
Fast transient disturbance tests	Per IEC 60255-22-4:2008
	Power supply, I/O, Earth: class IV, 4kV, 2.5kHz, 5/50ns
	Communication terminals: class IV, 2kV, 5kHz, 5/50ns
Surge immunity test	Per IEC 60255-22-5:2008
	Power supply, AC input, I/O port: class IV, 1.2/50us Common mode: 4kV Differential mode: 2kV
Conducted RF Electromagnetic Disturbance	Per IEC 60255-22-6:2001
	Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Power Frequency Magnetic Field Immunity	Per IEC 61000-4-8:2001
	Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Pulse Magnetic Field Immunity	Per IEC 61000-4-9:2001
	class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10:2001
	class V, 100kHz & 1MHz–100A/m
Auxiliary power supply performance	IEC60255-11: 2008 Voltage dips: Up to 300ms for dips to 40% of rated voltage without reset Voltage short interruptions: 100ms for interruption without rebooting

PCS-9882

Ethernet Switch

The PCS-9882 series switches can be used in substation automation system (SAS), networked control system (NCS) and distributed control systems (DCS). They can also be used in power plants, industrial control systems, etc.

PCS-9882 series switches provide 1000Mbps Ethernet ports with higher data transmission rates to meetthe increasing requirements of the device communication.PCS-9882 series switches support up to twenty-four 10/100Mbps electrical Ethernetports and four 1000Mbps Ethernet ports.The fiber ports adopt SFP sockets, which support hot plugging.

The following table shows the sub types of PCS-9882.The number and type of the fiber ports are different in each sub type in order to meet various requirements.

Type	Communication Ports			Maximum Power Supply
	1000Mbpsfiber ports	100Mbpsfiber ports	10/100Mbps electrical ports	
PCS-9882AD	0~4	0~2	22~24	2
PCS-9882BD	0~2	0~16	0	2
PCS-9882ED	0	0~12	12	2
PCS-9882PD	0~4	0~4	24	2
PCS-9882QD	0~4	0~18	0	2

Functions

Ethernet Switch

- Provide 10/100Mbps self-adaptiveelectrical Ethernet ports. The electrical Ethernet ports comply with 10BASE-T/100BASE-TX standardsThey are self-adaptive for crossover and straight-through network cable. MDI/MDIX automatic identification is supported.
- The 100Mbps fiber ports of this device adopt SFP socket. The SFP transceiver complies with IEEE802.3 100BASE-FX fiber Ethernet standards andcan be plugged into the 100Mbps SFP socket of this device.
- The 1000Mbps fiber ports of this device adopt SFP socket. The SFP transceiver complies with IEEE802.3 1000BASE-SX 1000Mbps fiber Ethernet (1.25GBd) standardscan be plugged into the 1000Mbps SFP socket of this device.
- Both the 100Mbps SFP socket and the 100Mbps SFP device socket support hot plugging.
- The switching mode adopts non-blocking store and forward.
- Support IEEE802.3x Flow Control.

Flow Control

- Network storm protection:
  The upper rate limit to forward broadcasting/multicasting/addressing-failure messages is configurable.
- Port rate Limiting:
  The message forwarding rate and burst rate of each port is configurable.
- Port mirror function:
  The user can designate a specific port to monitor the inflow/outflow data from the other ports.
- Link aggregation:
  Supports link aggregation based on port, MAC address, etc.
- QoS control:
  Supports message priority control based on IEEE 802.1pstandards; it also supports strict priority strategy and weighted priority strategy.

VLAN

- Support VLAN based on port
- Support VLAN based on MAC address
- SupportVLAN based on protocol
- Support VLAN based on IEEE 802.1Q
- Support overlapped VLAN configuration
- Support VLAN tag insertion, modification or deletion
- Support GARP VLAN registration protocol.

Note!

GARP is the abbreviation of “Generic Attribute Registration Protocol”.

Ring Network

- Support STP (802.1D) and RSTP (802.1w), fast switch to backup linksin case of communication link failure.
- Supports“NR Electric-Ring” private ring network protocol with a fast ring network recovery speed.
- Supports the dedicated ring network protocol, able to minimize network storms when cooperating with a common Ethernet switch (i.e.: the Ethernet switch unable to deal with network storm).
- Supports MRP ring protocol.

Multicast Management

- Supports VLAN multicast based on IEEE802.1Q
- Supports static multicast management based on MAC address
- Supports GMRP dynamic multicast management
- Note!GMRP is the abbreviation of “GARP Multicast Registration Protocol”.
- Supports IGMP snooping dynamic multicast management.

Port Security

- Provides 3 port security states:
  - None;
  - Static MAC address;
  - 802.1X.
- Supports network security protocols based on SSL/SSH.
- Supportsquantitative limitation on MAC address learning.
- Supports Telnet functionsenable and disable.
- Free of DoS(Denial-of-Service) attacks.
- Supports security log and operation log.

File Management

- Supports offline modification functions of the switch configuration file.
- Supports switch configuration file upload and download.
- SupportsPC download functions of switch log and event file.

Management Method

- Supports WEB Server, Telnet and CLI.
- Supports simple network management protocol SNMPV1/V2C/V3.
- SupportsRMON Management
- Provides an alarm signal output contact to indicate any abnormity of the device.
- Provides a block signal output contact to indicate device blocking.
- Supports IP conflict detection.

Features

All PCS-9882 series switches adopt a high-performance switch chip and excellent industrial design to keep line speed forwarding under full-duplex and full-rate operation of all the ports. The design and manufacturing of the device has fully considersvarious adverse conditions and interference factors in industrial applications to ensure reliable data transmission under tough environments.

- This device is suitable for application according to IEC61850 and indigital substation.
- Patent protected advanced heat emission technology incorporated to the device in order to ensure excellent heat emission performance. This device can perform in a range of temperatures, from-40°C~ +85°C. Furthermore, it does so stably and reliably.
- The device adopts the following advanced technologies: totally enclosed chassis, partitioned grounding connection, anti-interference power supply, printed circuit board (abbreviated PCB) division by voltage level, cable shielding. Therefore, no package loss occur under strong electromagnetic interferences (abbreviated EMI).
- Compact field parallel processing technology is incorporated into this device to ensure excellent performance.
- Save and transfer processes occur in less that 2μs due to the 100 Mbps ports.
- Process time of save and transfer at 1000Mbps ports is less than 1μs.
- Supports IEC61850 protocol modeling, the user can monitor the device with the IEC61850 protocol.
- Optimized RSTP protocol is adopted. The restoration time of the device is less than 1.2 ms per hop. A leading international landmark.
- The processing capacity guarantees report handling at an average speed between 64-1518bytes without losing any packages.
- VLAN, traffic prioritization, RSTP, port security, GMRP/GVRP, IGMP applications are supported to meets the process level requirements in intelligent substations.
- Provides port security methods (based on static MAC address or based on 802.1X) to guarantee securityin linking of IEDs in substations.
- Network security protocol based on SSL/SSH is supported, so as to ensure safe access control.
- Static multicast management is supported. In this way, transparent and reliable flow control oflinkied IEDs to the device is ensured.
- This device is designed as an industrial management Ethernet switch with abundant functions (e.g.: port flow control, network storm limitation, port mirroring, SNMP, RMON, WEB, port trunking, SNTP clock synchronization).
- In case of short power supply interruptions, the device can still work up to 500ms.
- Several 1000Mbps cascading fiber ports are provided to improve the cascading performance.
- Dual power supply technology based on load balance is supported. Both AC and DC power supplies can be applied to this device.

Technical Data

AC Power Supply

Standard	IEC 61000-4-11:2004
Rated voltage	110Vac/220Vac
Operating range	88~264Vac
Burden (No load)	PCS-9882AD: <14W PCS-9882BD: <13W PCS-9882ED: <14W
Burden (Full load)	PCS-9882AD: <20W PCS-9882BD: <34W PCS-9882ED: <28W

DC Power Supply

Standard	GB/T 17626.29-2006(idt IEC 61000-4-29:2000).
Rated voltage	3 options available: 110Vdc/125Vdc/220Vdc/250Vdc; 48Vdc; 24Vdc.
Operating range	88~300Vdc (Rated voltage is 110Vdc/125Vdc/220Vdc/250Vdc) ; 36~72Vdc (Rated voltage is 48Vdc). 16~36Vdc (Rated voltage is 24Vdc)
Permissible AC ripple voltage	≤15% of the nominal auxiliary voltage
Burden (No load)	PCS-9882AD: <10W PCS-9882BD: <9W PCS-9882ED: <10W
Burden (Full load)	PCS-9882AD: <16W PCS-9882BD: <30W PCS-9882ED: <24W

Mechanical Specifications

Enclosure dimensions (W×H×D)	482.6mm×44.4mm×266.0mm(1U)
Mounting Way	Flush mounted
Trepanning dimensions (W×H)	450.0mm×44.45mm, M6 screw
Chassis color	Silver grey
Weight per device	Approx. 3.5kg
Chassismaterial	Aluminumalloy
Location of terminal	Rear panel of the device
Device structure	Plug-in modular type @ rear side, integrated frontplate
Protection class	
Standard	IEC 60225-1:2009
Front side	IP40, up to IP51(With cover)
Other sides	IP50
Rear side, connection terminals	IP30

Ambient Temperature and Humidity

Standard	IEC 60255-1:2009; IEEE1613:2007
Operating temperature	-40°C to +85°C
Transport and storage temperature range	-40°C to +85°C
Permissible humidity	5%-95%, without condensation
Pollution degree	2
Altitude	<3000m

Communication Interfaces

Communication Standards	IEEE 802.3, IEEE 802.3u, IEEE 802.3ab, IEEE802.3z, IEEE802.3x
100Mbits/s Ethernet Port	
Connector type	RJ-45
Transmission rate	100Mbits/s
Transmission standard	10Base-T/100Base-TX
Transmission distance	<100m
Safety level	Isolation to ELV level
100Mbits/s Optical Fiber Port	
Characteristic	Glass optical fiber
Connector type	LC
Transmission standard	100Base-FX
Fiber type	50/125μm multimode fiber 62.5/125μm multimode fiber 9/125μm single mode fiber
Transmission distance	Multi mode: <2km Single mode: <40km
1000Mbits/s Optical Fiber Port	
Characteristic	Glass optical fiber
Connector type	LC
Transmission standard	1000Base-SX
Fiber type	50/125μm multimode fiber 62.5/125μm multimode fiber 9/125μm single mode fiber
Transmission distance	Multi mode: <500m Single mode: <10km If procured by users themselves, the transmission distance is subject to the SFP transceiver module.

Type Test

Environmental Tests

Dry cold test	Per IEC60068-2-1:2007
Dry heat test	Per IEC60068-2-2:2007
Damp heat test, cyclic	Per IEC60068-2-30:2005

Mechanical Tests

Vibration	IEC60870-2-2:1996 Class Cm, IEEE1613:2007
Shock	IEC60870-2-2:1996 Class Cm

Electrical Tests

Dielectric tests	IEEE1613:2007, Ur <50V then 500 Vrms 51<Ur <250V then 2000 Vrms
Impulse voltage tests	IEC60255-5:2000, test voltage: 5kV IEEE1613:2007, 5kV
Overvoltage category	III
Insulation resistance measurements	IEC60255-5:2000, Isolation resistance >100MΩ@500VDC

Electromagnetic Compatibility

Damped oscillatory wave immunity test	IEC 61000-4-18
	Common mode: class III ±2.5kV
	Differential mode: class III ±1.0kV
Electrostatic discharge test	IEC61000-4-2
	For contact discharge: class IV, ±8kV
	For air discharge: class IV, ±15kV
Radio frequency interference tests	IEC61000-4-3
	Radiated amplitude-modulated f=80~1000MHz, class III, AM 80%, 1kHz,10V/m (un-modulated) f=800~960MHz and 1400~2000MHz, class III, AM 80%, 1kHz,10V/m (un-modulated)
Fast transient disturbance tests	IEC61000-4-4
	Power supply, I/O, Earth: class IV, 4kV, 5kHz or 100kHz, 5/50ns
	Communication terminals: class IV, 2kV, 5kHzor 100kHz, 5/50ns
Surge immunity test	IEC61000-4-5
	Power supply, AC input, I/O port: class IV,1.2/50μs Common mode: ±4kV Differential mode: ±2kV
Conducted RF Electromagnetic Disturbance	IEC61000-4-6
	Power supply, AC, I/O, Comm. Terminal:Class III, 0.15~80MHz AM 80% 1kHz 10V (un-modulated)
Power Frequency Magnetic Field Immunity	IEC61000-4-8
	class V, 100A/m for 1min, 1000A/m for 3s
Pulse Magnetic Field Immunity	IEC61000-4-9
	class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC61000-4-10
	class V, 100kHz & 1MHz–100A/m
Auxiliary AC power supply performance - Voltage dips	Per IEC 61000-4-11:2004, dips to 40% of rated voltage without reset up to 12 cycles, dips to 70% of rated voltage without reset up to 30 cycles, dips to 80% of rated voltage without reset up to 300 cycles.
- Voltage short interruptions	500ms for interruption without rebooting(only for 220Vac), 60ms for interruption without rebooting(only for 110Vac).
Auxiliary DC power supply performance - Voltage dips	Per IEC 61000-4-29:2000, Up to 100ms for dips to 40% of rated voltage without reset
- Voltage short interruptions	100ms for interruption without rebooting.

RCS-9785C/D

GPS Synchronization Clock

The RCS-9785C/D is a GPS Synchronized Unit with abuiltin GPS receiver module. It receives timing messages through a built-in GPS receiver module. Alternatively, it receives IRIG-B standardized timing code through one of the two input channels, decodes and converts the timing code, and then outputs such timing signals to the whole station. Output timing signals can be IRIG-B signals, pulse per second (PPS) signals, pulse per minute (PPM), pulse per hour (PPH) signals and timing messages. It also can provide Ethernet clock synchronization services (CSS) for bay units. The Ethernet CSS can work in the dual Ethernet mode (RJ45 over 100BASE-TX).Multi-business acquisition simultaneous, access BCU, protection, PMU, meter, online monitoring device and among other advanced functions.

Features

- Highly accurate time signal output
  - The device is precise with a lag time of ±1μs for IRIG-B/ PPS/PPM/PPH time signals (excluding the propagation delay time on the cable). The pulse front edges of these time signals are less than 50ns.
  - The inaccuracies of IRIG-B/PPS/PPM/PPH output signals for RS- 485 and TTL are ≤100ns.
  - The inaccuracies of IRIG-B/PPS/PPM/PPH output signals foroptic-coupled dry (potential-free) contacts are ≤3μs.
- Various output interfaces forthe time signals
  The RCS-9785C/D can provide electrical (including RS-232/RS- 485, TTL, and AC modulation) or optical output timing signals. The timing signals supports IRIG-B, PPS, PPM, PPH, etc.
- Application for large system
  The device is equipped with enough ports for output. The RCS- 9785C/D can be used to multiply time synchronizing pulses to meet demand if required.
- High reliability
  The use of high-integration circuits and modular design technology in the RCS-9785C/D enhances the reliability of the device.

Technical Data

Power Supply

Rated Voltage (Un)	110V/125Vdc, 220V/250Vdc
Variation	(80% ~ 120%)Un
Ripple in the DC auxiliary voltage	Max 15% of the DC value. Per IEC 60255-11:1979
Burden	<40W

Binary Outputs

Item	Signal contact
Output mode	Potential free contact
Max system voltage	380Vac, 250Vdc
Test voltage across open contact	1200V RMS for 1min
Continuous carry	8A@380V AC 8A@250V DC
Breaking capacity at 250Vdc	0.7A@48VDC 0.3A@110VDC 0.2A@220VDC
Short duration current	10A@3s 20A@0.5s
Pickup time	<10ms
Drop-off time	<8ms
Bounce time	1ms

Mechanical Specifications

Enclosure dimension (W×H×D)	482.6×177.0×291.0(unit: mm)
Trepanning dimension (W×H)	450.0×179.0, (unit: mm), M6 screw
Mounting	Flush mounted
Protection class(per IEC60529:2001)	Front side: IP51 Rear side, connection terminals: IP20 Other Sides: IP30

Atmospheric Environment

Standard	IEC60255-6:1988
Service temperature range	-25°C ~ +55°C
Transport and storage temperature range	-40°C ~ +70°C
Permissible humidity	5% ~ 95%, condensation not permissible

Communication Interfaces

Communication medium	Parameters	
Ports to Transmit Clock Synchronization Signals		
Ethernet	Connector type	RJ45
	Transmission Rate	100Mbps
	Transmission standard	10Base-T/100Base-TX
	Transmission distance	< 100m
	Protocol	SNTP
	Safety level	Isolation to ELV level
RS-232	Synchronization Standard	Serial Port Timing Messages(9.6kbit/s) or IRIG-B
	Transmission distance	<30m
	Safety level	Isolation to ELV level
	Twisted pair	Screened twisted pair cable
RS-485 (EIA)	Synchronization Standard	Serial Port Timing Messages(9.6kbit/s) or IRIG-B
	Transmission distance	<500m
	Safety level	Isolation to ELV level
	Twisted pair	Screened twisted pair cable

Optical Fiber Port	Characteristic	Glass optical fiber
	Connector type	ST or SC
	Fiber type	62.6/125 μm for multi-mode
	Transmission standard(for IEEE1588)	100Base-FX
	Protocol	IRIG Standard 200-04 or IEEE1588
	Transmission distance	<2km
	Wave length	820nm
	Synchronization Standard	IRIG-B
TTL Port	Output voltage	0 - 5V
	Output impedance	50Ω
	Transmission distance	<100m
	Safety level	Isolation to ELV level
Ports to Receive Clock Synchronization Signals		
RS-485 (EIA)	Synchronization Standard	IRIG-B
	Safety level	Isolation to ELV level
	Twisted pair	Screened twisted pair cable
TTL Port	Synchronization Standard	IRIG-B
	Safety level	Isolation to ELV level
	Twisted pair	Screened twisted pair cable
Optical Fiber Port	Characteristic	Glass optical fiber
	Connector type	ST
	Fiber type	62.6/125 μm for multi-mode
	Wave length	820nm
	Synchronization Standard	IRIG-B

Type Test

Environmental Tests

Dry cold test	Per IEC60068-2-1:2007
Dry heat test	Per IEC60068-2-2:2007
Damp heat test, cyclic	Per IEC60068-2-30:2005

Mechanical Tests

Vibration	Per IEC 60255-21-1:1988 Class I
Shock and bump	Per IEC 60255-21-2:1988 Class I

Electrical Tests

Standard	IEC 60255-27:2005
Dielectric tests	Test voltage 2kV, 50Hz, 1min
Standard	IEC 60255-5:2000
Impulse voltage tests	Test voltage 5kV
Overvoltage category	III
Insulation resistance measurements	Isolation resistance >100MΩ@500VDC

Electromagnetic Compatibility

1MHz burst disturbance test	Per IEC 60255-22-1:2007
	Common mode: class III 2.5kV
	Differential mode: class III 1.0kV
Electrostatic discharge test	Per IEC60255-22-2:2008 class IV
	For contact discharge: 8kV
	For air discharge: 15kV

Radio frequency interference tests Frequency sweep - Radiated amplitude-modulated Spot frequency - Radiated amplitude-modulated - Radiated pulse-modulated	Per IEC 60255-22-3:2007 class III 10V/m(rms), f=80…1000MHz 10Vm(rms), f=80MHz/160MHz/450MHz/900MHz 10Vm(rms), f=900MHz
Fast transient disturbance tests	Per IEC 60255-22-4:2008 Power supply, I/O, Earth: class IV, 4kV, 2.5kHz, 5/50ns Communication terminals: class IV, 2kV, 5kHz, 5/50ns
Surge immunity test	Per IEC 60255-22-5:2008 Power supply, AC input, I/O port: class IV, 1.2/50us Common mode: 4kV Differential mode: 2kV
Conducted RF Electromagnetic Disturbance	Per IEC 60255-22-6:2001 Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Power Frequency Magnetic Field Immunity	Per IEC 61000-4-8:2001 Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Pulse Magnetic Field Immunity	Per IEC 61000-4-9:2001 class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10:2001 class V, 100kHz & 1MHz–100A/m
Auxiliary power supply performance	IEC60255-11: 2008 Voltage dips: Up to 300ms for dips to 40% of rated voltage without reset Voltage short interruptions: 100ms for interruption without rebooting

RCS-9785E

Clock Extension Unit

The RCS-9785E is a timing signal expansion unit without an internal GPS module. It receives IRIG-B standardized timing code from external GPS timing sources, decodes and converts timing codes, and then outputs expanded timing signals to the whole station. The expanded timing signals are IRIG-B signals, pulse per second (PPS) signals, pulse per minute (PPM), pulse per hour (PPH) signals and timing messages.

Features

- Highly accurate time signaling output
  - The device is precise with a deviation of ±1μs for IRIG-B, PPS, PPM and PPH time signals (excluding the propagation delay time on the cable). The pulse front edges of these time signals are less than 50ns.
  - The inaccuracies of IRIG-B/PPS/PPM/PPH output signals forRS- 485 and TTL are ≤100ns.
  - The inaccuracies of IRIG-B/PPS/PPM/PPH output signals foroptic-coupled dry (potential-free) contacts are ≤3μs.
- Various output interfaces forthe time signals
  The RCS-9785E provides electrical (including RS-232/RS-485, TTL, and AC modulation) or optical clock output timing signals. The timing signals support IRIG-B, PPS, PPM, PPH, etc.
- Application in large systems
  The RCS-9785E is equipped with enough ports for output. The time distribution can be separated for multiple devices wih a maximumdistance of 1km (when the optical ports areapplied).
- High reliability
  The use of high-integration circuits and modular design technology in the RCS-9785E enhances the reliability of device.

Technical Data

Power Supply

Rated Voltage (Un)	110V/125Vdc, 220V/250Vdc
Variation	(80% ~ 120%)Un
Ripple in the DC auxiliary voltage	Max 15% of the DC value. Per IEC 60255-11:1979
Burden	<40W

Binary Outputs

Item	Signal contact
Output mode	Potential free contact
Max system voltage	380Vac, 250Vdc
Test voltage across open contact	1000V RMS for 1min
Continuous carry	8.0A
Breaking capacity at 250Vdc	0.4A resistance 0.2A inductive(L/R=40ms)
Short duration current	50A for 200ms
Pickup time	5ms/10ms
Drop-off time	<8ms
Bounce time	1ms

Mechanical Specifications

Enclosure dimension (W×H×D)	482.6×177.0×291.0(unit: mm)
Trepanning dimension (W×H)	450.0×179.0, (unit: mm), M6 screw
Mounting	Flush mounted
Protection class(per IEC60529:2001)	Front side: IP51 Rear side, connection terminals: IP20 Other Sides: IP30

Atmospheric Environment

Standard	IEC60255-6:1988
Service temperature range	-25°C ~ +55°C
Transport and storage temperature range	-40°C ~ +70°C
Permissible humidity	5% ~ 95%, condensation not permissible

Communication Interfaces

Communication medium	Parameters	
Ports to Transmit Clock Synchronization Signals		
Ethernet	Port number	7 per module
	Connector type	RJ45
	Transmission Rate	100Mbps
	Transmission standard	10Base-T/100Base-TX
	Transmission distance	< 100m
	Protocol	SNTP
	Safety level	Isolation to ELV level
RS-232	Port number	7 per module
	Transmission distance	<30m
	Safety level	Isolation to ELV level
RS-485 (EIA)	Port number	7 per module
	Maximal capacity	32
	Transmission distance	<500m
	Safety level	Isolation to ELV level
Optic-Coupled Dry Contact	Port number	8 per module
	Operating voltage	≤ 300Vdc
	Operating current	≤ 60mA
	Transmission distance	< 200m
	Safety level	Isolation to ELV level

	Port number	8 per module
	Connector type	ST
	Fiber type	62.6/125 μm for multi-mode
	Wave length	820nm
	Transmission mode	The optical fiber has light in it when the channel is idle. Or: The optical fiber has no light in it when the channel is idle
	Transmission distance	< 2000m
	Safety level	Isolation to ELV level
TTL Port	Port number	8 per module
	Output voltage	0 - 5V
	Output impedance	50Ω
	Transmission distance	<100m
	Safety level	Isolation to ELV level
Ports to Receive Clock Synchronization Signals		
RS-485 (EIA)	Port number	2
	Synchronization Standard	IRIG-B
	Safety level	Isolation to ELV level
TTL Port	Port number	2
	Synchronization Standard	IRIG-B
	Safety level	Isolation to ELV level
Optical Fiber Port	Port number	2
	Connector type	ST
	Fiber type	62.6/125 μm for multi-mode
	Wave length	820nm
	Transmission mode	The optical fiber has light in it when the channel is idle. Or: The optical fiber has no light in it when the channel is idle.
	Synchronization Standard	IRIG-B
	Safety level	Isolation to ELV level

Type Test

Environmental Tests

Dry cold test	Per IEC60068-2-1:2007
Dry heat test	Per IEC60068-2-2:2007
Damp heat test, cyclic	Per IEC60068-2-30:2005

Mechanical Tests

Vibration	Per IEC 60255-21-1:1988 Class I
Shock and bump	Per IEC 60255-21-2:1988 Class I

Electrical Tests

Standard	IEC 60255-27:2005
Dielectric tests	Test voltage 2kV, 50Hz, 1min
Standard	IEC 60255-5:2000
Impulse voltage tests	Test voltage 5kV
Overvoltage category	III
Insulation resistance measurements	Isolation resistance >100MΩ@500VDC

Electromagnetic Compatibility

1MHz burst disturbance test	Per IEC 60255-22-1:2007
	Common mode: class III 2.5kV
	Differential mode: class III 1.0kV
Electrostatic discharge test	Per IEC60255-22-2:2008 class IV
	For contact discharge: 8kV
	For air discharge: 15kV
Radio frequency interference tests	Per IEC 60255-22-3:2007 class III
Frequency sweep	
- Radiated amplitude-modulated	10V/m(rms), f=80…1000MHz
Spot frequency	
- Radiated amplitude-modulated	10Vm(rms), f=80MHz/160MHz/450MHz/900MHz
- Radiated pulse-modulated	10Vm(rms), f=900MHz
Fast transient disturbance tests	Per IEC 60255-22-4:2008
	Power supply, I/O, Earth: class IV, 4kV, 2.5kHz, 5/50ns
	Communication terminals: class IV, 2kV, 5kHz, 5/50ns
Surge immunity test	Per IEC 60255-22-5:2008
	Power supply, AC input, I/O port: class IV, 1.2/50us Common mode: 4kV Differential mode: 2kV
Conducted RF Electromagnetic Disturbance	Per IEC 60255-22-6:2001
	Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Power Frequency Magnetic Field Immunity	Per IEC 61000-4-8:2001
	Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Pulse Magnetic Field Immunity	Per IEC 61000-4-9:2001
	class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10:2001
	class V, 100kHz & 1MHz–100A/m
Auxiliary power supply performance	IEC60255-11: 2008 Voltage dips: Up to 300ms for dips to 40% of rated voltage without reset Voltage short interruptions: 100ms for interruption without rebooting

RELAY PANELS

1.20 TECHNICAL SCHEDULE

Item No.	Description	Unit	Requirements
(I)	**DISTANCE PROTECTION SET-I FOR OVERHEAD LINES**		
1.	a) Manufacturer		ABB
	b) Country of Manufacture		Sweden
2.	Type		REL650 / REL670
3.	Manufacturer's ordering code		
4.	Detailed technical catalogue provided - Yes / No		Yes
5.	Rated Current		1 or 5A
6.	Maximum zone relay operating time		30ms
7.	Polarizing system		Volatge Memory
8.	Zone switched		No, full scheme
9.	Number of zones		5
10	C.T supervision		Yes
11.	Shape of impedance characteristic		
	a) Zone 1 Phase - Ground		Quadrilateral
	b) Zone 2 Phase - Phase		Quadrilateral
12.	Reverse locking element (Blocking signal initiation)		All zones fully reversible
13.	Sensitivity		
	a) Minimum Operating Current		
	- Earth Faults		1% of Ir
	- Phase Faults		1% of Ir
14.	Minimum necessary voltage at zone-I reach point (if applicable)		
	- Earth Faults		0.1-1.1 x Ur
	- Phase Faults		0.1-1.1 x Ur

Note:-

Teschnical schedule should be filled properly with all relevant information.

Item No.	Description	Unit	Requirements
15.	Minimum zone 1 ohmic impedance to which relay can be set		
16.	Minimum zone 1 ohmic impedance to which relay can be set and maintain accuracy		
17.	Minimum zone 2 ohmic impedance to which relay can be set		
18.	Minimum zone 2 ohmic impedance to which relay can be set.		3000
19.	Maximum zone 3 ohmic: a) Forward reach. b) Reverse reach.		 3000 3000
20.	Are forward and reverse reach settings, independent of each other?		Yes
21.	Can resistance and reactance reaches be set independent of each other?		Yes
22.	Directional sensitivity		5%Static & 2%Angular
23.	Current transformer requirements		See section 18 application manual
24.	Voltage transformer requirements		See section 18 application manual
25.	VT supervision		Yes
26.	Back up zone time ranges: a) Zone 1 b) Zone 3		 0,000 - 60,000s 0,000 - 60,000s
27.	Power swing blocking a) Forward reach b) Reverse reach		 inner/outer Reactive reach 30000 ohm inner/outer Reactive reach 10000 ohm
28.	Auto reclose with Sync. Check - Internal / External		 Internal
29.	**Modes of operating provided:** a) Basic mode b) Zone accelerator mode c) Permissive Overreach / Under reach transfer trip mode		 Yes Yes Yes

Positive sequence reactance, zone 1	(0-10-3000.00) / phase
Positive sequence reactance, zone 2-5	(0-50-3000.00) / phase
Positive sequence reactance	(0-10-1000.00) / phase
Zero sequence reactance, zone 1	(0-10-9000.00) / phase
Zero sequence reactance, zone 2-5	(0-50-9000.00) / phase
Zero sequence reactance	(0-50-9000.00) / phase

Item No.	Description	Unit	Requirements
	d) Blocking / Unblocking mode		Yes
	e) Method of conversion of site from one mode to other, Describe		By software settings
	f) Details of extra components for above, Describe.		No extra component required
30.	**Methods used to clear close-in faults**		
	a) Which occur when line is already energized in service.		see section 6.7.2 of application manual
	b) Which exist upon the energization		autoswitch on fault logic non-directional
31.	Distance to fault locator, event recorder, fault recorder and disturbance recorder included in the distance relay.		Included
32.	**Has distance protection been previously used in the type of scheme specified for this contract.**		
	a) If yes, year of going into service.		2009
	b) Year of first going into service.		2009
33.	Year of first going into service		2009
	Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		732
34.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		
35.	Relay catalogue provided with the tender.		Yes
36.	List of relay optional functions included for this application to be listed clearly.		-

Item No.	Description	Unit	Requirements
37.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS)		ethernet LC & ST optical fibre
	a) **Front Port**		
	● RS232 Port (9 Pin, D-SUB female connector) (Yes / No)		No
	● USB Port (Yes / No)		No
	● Ethernet Port (Yes / No)		Yes
	b) **Rear Port** (with IEC-60870-5-103)		
	● RS485 Port (3-wire connection) (Yes / No)		No
	● Ethernet Port (Yes / No)		No
	● Any suitable standard port		
	c) **Rear Port** (with IEC-61850)		
	● Ethernet Port (RJ-45) & Fibre Optic ST-connector (Yes / No)		Yes
	● Any suitable standard port		
	d) IRIG - B Time Synchronization (Yes / No)		Yes
38.	**Burden**		
	a) Max. DC burden		35W TYPICALLY
	b) Max. AC burden		Current<0,20mVA at Ir=1A Voltage < 0.05VA at 110V
39.	**Environmental**		
	a) Temperature		-10°C to +55°C
	b) Enclosure Protection		IP40 (front)
	c) Insulation IEC-60255-5		Yes
	d) HV impulse IEC-60255-5		Yes
	e) HF disturbance IEC-60255-22-1		Yes
40.	**Mechanical**		
	a) Overall Size H x W x D		265.9mm X 220mm X 249.5mm
	b) Mounting		Flush or Rack
	c) Weight		≤ 10kg (1/2 X 19”)

Item No.	Description	Unit	Requirements
41.	**Zone 1 Operating times**		

a) Earth Faults

Source of line ratio	Fault position % of relay setting	Operating time in m. sec	
		Min.	Max.
1	0 (Relay Point)		
	50		
	90		
10	0		
	50		
	90		
30	0		
	50		
	90		

b) Phase to Phase Faults

Source of line ratio	Fault position % of relay setting	Operating time in m. sec	
		Min.	Max.
1	0 (Relay Point)		
	50		
	90		
10	0		
	50		
	90		
30	0		
	50		
	90		

Item No.	Description	Unit	Requirements
	c) Three Phase Faults		

Source of line ratio	Fault position % of relay setting	Operating time in m. sec	
		Min.	Max.
1	0 (Relay Point)		
	50		
	90		
10	0		
	50		
	90		
30	0		
	50		
	90		

Item No.	Description	Unit	Requirements
(II)	**CURRENT DIFFERENTIAL PROTECTION FOR 132kV TRANSMISSION LINE.**		NOT APPLICABLE
1.	Current Differential Protection for Overhead Line Feeders. a) Name of Manufacturer b) Country of Manufacture c) Type d) Rating		
2.	Manufacturer's ordering code		
3.	Relay technical manuals/catalogue provided with the tender.		
4.	Service experience list attached		
5.	Phase segtregated type.		
6.	In-built full scheme distance protection as specified in clause 1:11:11 including tele-protection sugnaling interface facility provided		
7.	Class of Insulation.		
9.	Maximum relay operating time.		
10.	Maximum burden of relay.		
11.	Mimimum sensitivity. a) Earth fault.s b) Phase faults.		
12.	Maximum throught fault stability operating time-fault initiation to trip initial at: a) Three times minimum setting: b) Ten times minimum setting.		
13.	a) Guard relay provided for over current / Earh fault. b) Tyoe of guard relay. c) Rating. d) Setting ranges.		
14.	End-End Communication media.		

Item No.	Description	Unit	Requirements
15.	Autoreclose with Sync. Check.		
16.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		
17.	Year of first going into service Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		
18.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		
19.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS) a) **Front Port** ● RS232 Port (9 Pin, D-SUB female connector) (Yes / No) ● USB Port (Yes / No) ● Ethernet Port (Yes / No) b) **Rear Port** (with IEC-60870-5-103) ● RS485 Port (3-wire connection) (Yes / No) ● Ethernet Port (Yes / No) ● Any suitable standard port c) **Rear Port** (with IEC-61850) ● Ethernet Port (RJ-45) & Fibre Optic ST-connector (Yes / No) ● Any suitable standard port d) IRIG - B Time Synchronization (Yes / No)		
20.	List of relay Optional functions included as per relay ordering code for this application to be listed clearly.		
21.	Distance to fault locator, event recorder, fault recorder and disturbance recorder included in the relay		

Item No.	Description	Unit	Requirements
22.	**Burden** a) Max. DC burden b) Max. AC burden		
23.	**Environmental** a) Temperature b) Enclosure Protection c) Insulation IEC-60255-5 d) HV impulse IEC-60255-5 e) HF disturbance IEC-60255-22-1		
24.	**Mechanical** a) Overall Size H x W x D b) Mounting c) Weight		
(III)	**PERCENTAGE BIASED DIFFERENTIAL RELAY FOR TRANSFORMER.**		
1.	a) Manufacturer. b) Country of manufacture.		ABB FINLAND
2.	Type.		RET615
3.	Manufacturer's ordering code.		HBTABABAAND1ABN1XD
4.	Detailed technical catalogur provided.		Yes
5.	Design - For 2 winding / 3 winding / Auto		for 2 winding
6.	In-built interposing CT ratio matching logic.		Yes
7.	In-built disturbance recording, events recording and fault recording.		Yes
8.	On demand system V, I, W display.		Yes
9.	**Protection Functions:** a) Differential.		Yes
	b) Back-up O/C on HV . LV sides (optional).		-

Item No.	Description	Unit	Requirements
	c) Thermal overload (thermal replica)		Yes but not specified
	d) Farth fault protection.		Yes but not specified
	e) Over fluxing function.		Yes but not specified
	f) Magnetizing in rush restraint.		Given in attached product guide
	g) Additional relay optional functions included in this application.		-
10.	**Ratings.**		
	a) AC current.		1 or 5 A
	b) Frequency.		50/60 Hz
	c) Aux .supply - (DC)		(24-60) or (90-250) V DC ±20%
11.	**AC Thermal Rating.**		
	a) Continuous.		4 x Ir
	b) Short time - (1 sec)		500 x Ir
12.	**Basic Settings:**		
	a) Differential:		
	● Sensitivity (pick-up)		5-50%
	● Bisa X-tics slope.		10-5%
	● Operating time.		34mS
	● Accuracy of per unit value.		-
	b) Unrestrained High Set Unit (if provided)		
	● Current setting.		500-3000%
	● Operating time.		21mS
	c) bay unit Over-current (3-Phase)		
	● Setting range.		0.05 – 5.00 In
	● Operating X-tics (DMT) BS142.		Definite / Inverse
	d) Overload:		
	● Setting range (I thermal)		-
	● Time constraint (TC).		-
	● Accuracy (both I thermal & TC)		-

Item No.	Description	Unit	Requirements
13.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS)		Yes
	a) **Front Port**		
	● RS232 Port (9 Pin, D-SUB female connector) (Yes / No)		No
	● USB Port (Yes / No)		No
	● Ethernet Port (Yes / No)		Yes
	b) **Rear Port** (with IEC-60870-5-103)		
	● RS485 Port (3-wire connection) (Yes / No)		No
	● Ethernet Port (Yes / No)		Yes
	● Any suitable standard port		
	c) **Rear Port** (with IEC-61850)		
	● Ethernet Port (RJ-45) & Fibre Optic ST-connector (Yes / No)		Yes
	● Any suitable standard port		
	d) IRIG - B Time Synchronization (Yes / No)		Yes
14.	Has relay been previously used in the type of scheme specified for the contract.		
	a) If yes, year of going into service.		2009
	b) Year of first going into service.		2009
15.	Year of first going into service		2009
	Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		801
16.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		Attached
17.	a) Operating time including trip relay at two times relay minimum setting.		25ms typically(restrained function)
	b) Operation time including trip relays at five times relay minimum setting.		12ms typically(unrestrained function)
18.	Year of first going into service		2005
	Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		3000pcs

Item No.	Description	Unit	Requirements
19.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		-
20.	Relay catalogue provided with the tender.		Yes
21.	List of Relay Optional functions included for this application to be listed clearly.		Given in attached product guide
22.	**Burden**		
	a) Max. DC burden		10W/15W
	b) Max. AC burden		Current < 2,20mVA at Ir=5A
23.	**Environmental**		
	a) Temperature		-10°C to +55°
	b) Enclosure Protection		IP54
	c) Insulation IEC-60255-5		Yes
	d) HV impulse IEC-60255-5		Yes
	e) HF disturbance IEC-60255-22-1		Yes
24.	**Mechanical**		
	a) Overall Size H x W x D		177mm X 177mm X 201mm
	b) Mounting		Flush or Rack
	c) Weight		4.1 kg
(IV)	**HIGH IMPEDANCE BUSBAR PROTECTION.**		NOT APPLICABLE
1.	a) Manufacturer. b) Country of manufacture.		
2.	Type.		
3.	Manufacturer's ordering code.		
4.	Detailed technical catalogue provided.		
5.	Rated current (In).		

Item No.	Description	Unit	Requirements
6.	Auxiliary DC supply voltage.		
7.	Rated power.		
8.	a) Operation principle. b) Multiple operation criterion included in the relay.		
9.	Minimum Operating Current/Voltage.		
10.	Setting Range: a) Earth faults. b) Phase faults.		
11.	Maximum through fault current at which protection is stable: a) Earth faults. b) Phase faults.		
12.	a) Operating time including trip relay at two times relay minimum setting. b) Operation time including trip relays at five times relay minimum setting.		
13.	Sensitivity of scheme (allowing for current transformer magnetizing current, etc).		
14.	Bus Wire Supervision Relay.		
15.	C.T supervision setting range: a) Current b) Time delay.		
16.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		

Item No.	Description	Unit	Requirements
17.	Year of first going into service Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		
18.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		
19.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS) a) **Front Port** ● RS232 Port (9 Pin, D-SUB female connector) (Yes / No) ● USB Port (Yes / No) ● Ethernet Port (Yes / No) b) **Rear Port** (with IEC-60870-5-103) ● RS485 Port (3-wire connection) (Yes / No) ● Ethernet Port (Yes / No) ● Any suitable standard port c) **Rear Port** (with IEC-61850) ● Ethernet Port (RJ-45) & Fibre Optic ST-connector (Yes / No) ● Any suitable standard port d) IRIG - B Time Synchronization (Yes / No)		
20.	Relay cataogue provided with the tender.		
21.	List of relay optional functions included for this allication to be listed clearly.		
22.	**Burden** a) Max. DC burden b) Max. AC burden		
23.	**Environmental** a) Temperature (operation).		

Item No.	Description	Unit	Requirements
	b) Enclosure Protection c) Insulation IEC-60255-5 d) HV impulse IEC-60255-5 e) HF disturbance IEC-60255-22-1		
24.	**Mechanical** a) Overall Size H x W x D b) Mounting c) Weight		
(V)	**<u>LOW IMPEDANCE BUSBAR PROTECTION.</u>**		NOT APPLICABLE
1.	a) Manufacturer. b) Country of manufacture.		
2.	Type.		
3.	Manufacturer's ordering code.		
4.	Phase segrated type.		
5.	Rated current (In).		
6.	Auxiliary D.C supply.		
7.	No. of Zones.		
8.	No. of peripheral units.		
9.	Typical operating time.		
10.	Dual characteristics provided (Yes / No)		
11.	Check zone element provided (Yes / No)		
12.	Dead end zone or blind zone. Protection provided (Yes / No)		
13.	Current transformer supervision provided (Yes / No)		
14.	Isolator discrepancy alarm provided (Yes / No)		
15.	Events recorder and disturbance provided (Yes / No)		
16.	Back up two stage over current and earth fault protection included (Yes / No)		

Item No.	Description	Unit	Requirements
17.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS) a) **Front Port** ● RS232 Port (9 Pin, D-SUB female connector) (Yes / No) ● USB Port (Yes / No) ● Ethernet Port (Yes / No) b) **Rear Port** (with IEC-60870-5-103) ● RS485 Port (3-wire connection) (Yes / No) ● Ethernet Port (Yes / No) ● Any suitable standard port c) **Rear Port** (with IEC-61850) ● Ethernet Port (RJ-45) & Fibre Optic ST-connector (Yes / No) ● Any suitable standard port d) IRIG - B Time Synchronization (Yes / No)		
18.	Current and frequency measurement provided (Yes / No)		
19.	Bus wise supervision relay.		
20.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		
21.	Year of first going into service Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		
22.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		
23.	Relay catalogue provided with the tender.		
24.	List of relay optional functions included for this allication to be listed clearly.		

Item No.	Description	Unit	Requirements
25.	**Burden** a) Max. DC burden b) Max. AC burden		
26.	**Environmental** a) Temperature b) Enclosure Protection c) Insulation IEC-60255-5 d) HV impulse IEC-60255-5 e) HF disturbance IEC-60255-22-1		
27.	**Mechanical** a) Overall Size H x W x D b) Mounting c) Weight		
(VI)	**HIGH IMPEDANCE RESTRICTED EARTH FAULT PROTECTION.**		NOT APPLICABLE
1.	a) Manufacturer. b) Country of manufature.		
2.	Type.		
3.	Manufacturer's ordering code (Separate relay to be provided. Built-in function of main Differential Relay is not acceptable)		
4.	Detailed technical catalogue provided.		
5.	Rating.		
6.	Operating principle e.g. high impedance.		
7.	Minimum relay setting.		
8.	Sensitivity of scheme (Allowing of current transformer magnetizing current, etc.).		

Item No.	Description	Unit	Requirements
9.	Maximum through fault current at which protection is stable.		
10.	Current transformers requirements.		
11.	Operating time at three times relay minimum setting.		
12.	Operating time at ten times relay minimum setting.		
13.	a) Stabilizing resistors provided. b) Stabilizing resistor value.		
14.	a) Non linear resistors provided. b) Non linear resistor value.		
15.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS) a) **Front Port** ● RS232 Port (9 Pin, D-SUB female connector) (Yes / No) ● USB Port (Yes / No) ● Ethernet Port (Yes / No) b) **Rear Port** (with IEC-60870-5-103) ● RS485 Port (3-wire connection) (Yes / No) ● Ethernet Port (Yes / No) ● Any suitable standard port c) **Rear Port** (with IEC-61850) ● Ethernet Port (RJ-45) & Fibre Optic ST-connector (Yes / No) ● Any suitable standard port d) IRIG - B Time Synchronization (Yes / No)		
16.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		

Item No.	Description	Unit	Requirements
17.	Year of first going into service Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		
18.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		
19.	Relay catalogue provided with the tender.		
20.	List of relay optional functions included for this allication to be listed clearly.		
21.	**Burden** a) Max. DC burden b) Max. AC burden		
22.	**Environmental** a) Temperature b) Enclosure Protection c) Insulation IEC-60255-5 d) HV impulse IEC-60255-5 e) HF disturbance IEC-60255-22-1		
23.	**Mechanical** a) Overall Size H x W x D b) Mounting c) Weight		
(VII)	**<u>TRIPPING RELAYS.</u>**		
1.	a) Manufacturer. b) Country of manufacture.		ABB Sweden
2.	Manufacturer's ordering code.		RXMB2/RXMD2

Item No.	Description	Unit	Requirements
3.	Nominal operating voltage.		110V
4.	Minimum operating voltage.		65% to 75% of Ur
5.	Contact Mechanism Reset (Hand / Electrical)		Electrical / Hand
6.	Operation indicator.		No
7.	Operating time at nominal voltage.		4ms
8.	Contact rating: a) Make and carry continuosly. b) Make and carry for 3 secs. c) Break resistive watts. d) Inductive VA.		 1mA – 5mA 14A 1500VA 3.0W
9.	Thermal withstand capacity.		Yes
10.	Reset mechanism.		Yes
11.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		 2003 2003 >700
12.	Year of first going into service Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		
13.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		-
14.	Relay catalogue provided with the tender.		Yes
15.	List of relay optional functions included for this allication to be listed clearly.		Given in attached technical data
16.	**Burden** a) Max. DC burden b) Max. AC burden		 2.5W 1VA

Item No.	Description	Unit	Requirements
17.	**Environmental**		
	a) Temperature		-10°C to +55°C
	b) Enclosure Protection		IP54
	c) Insulation IEC-60255-5		Yes
	d) HV impulse IEC-60255-5		Yes
	e) HF disturbance IEC-60255-22-1		Yes
18.	**Mechanical**		
	a) Overall Size H x W x D		83mmx85mmx145mm
	b) Mounting		Rack mounting
	c) Weight		450 grams
(VIII)	**<u>TRIP CIRCUIT SUPERVISION.</u>** (Supervision relays to be provided. Built-in functionality of a Main Relay is not considered sufficient to meet the requirements)		
1.	a) Manufacturer.		E-LABS
	b) Country of Manufacture.		Pakistan
2.	Manufacturer's ordering code.		TS-101-110
3.	Monitors full trip curcuit with CB open and close.		
4.	a) Operating time.		25ms
	b) Resetting time.		400ms
	c) Time delayed drop off period.		Yes
5.	Has relay been previously used in the type of scheme specified for the contract.		
	a) If yes, year of going into service.		2003
	b) Year of first going into service.		2003
6.	Year of first going into service		2003
	Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		>500

Item No.	Description	Unit	Requirements
7.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		Yes
8.	Relay catalogue provided with the tender.		Yes
9.	List of relay optional functions included for this allication to be listed clearly.		Given in attached product guide
10.	**Burden**		
	a) Max. DC burden		2.5W
	b) Max. AC burden		1VA
11.	**Environmental**		
	a) Temperature		-
	b) Enclosure Protection		IP44
	c) Insulation IEC-60255-5		Yes
	d) HV impulse IEC-60255-5		Yes
	e) HF disturbance IEC-60255-22-1		Yes
12.	**Mechanical**		
	a) Overall Size H x W x D		115mm x 155mm x 184mm
	b) Mounting		Flush
	c) Weight		-
(IX)	**LINE OVER CURRENT AND EARTH FAULT RELAY.**		
1.	a) Manufacturer.		ABB
	b) Country of Manufacture.		Finland
2.	Type.		REF615 / REF610
3.	Manufacturer's ordering code.		
4.	Detailed technical catalogue provided.		Yes
5.	**Tripping time X-tics provide.**		
	a) Definite time.		0.5…..5.0 x In
	b) Normally inverse.		0.5…..2.5 x In

Item No.	Description	Unit	Requirements
	c) Very inverse. d) Extremely inverse. e) Long time inverse.		0.05…..300s 0.05…..300s 0.05…..300s
6.	**Phase Current Element.** a) Range of current settings: - Over current - Earth fault b) Range of operating times at ten times current setting. d) Time Multiplier setting range / step.		 0.5…..5.0 x In 0.1…..1.0 x In 1.00E 2.22E
7.	**Instantaneous element** **(for applicable case only)** a) Range of setting: - Earth fault / Phase current element. b) Time Multiplier setting range / step. c) Transient over-reach. d) Operating times: - At three times setting current. - At ten times setting current. e) Burden of relay on minimum inverse time element current setting at a current ten times setting: - Earth fault / Over current element.		 NOT APPLICABLE
8.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		 2007 2007
9.	Year of first going into service Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		2007 10306

Item No.	Description	Unit	Requirements
10.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		
11.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS)		
	a) **Front Port**		
	● RS232 Port (9 Pin, D-SUB female connector) (Yes / No)		No
	● USB Port (Yes / No)		No
	● Ethernet Port (Yes / No)		Yes
	b) **Rear Port** (with IEC-60870-5-103)		
	● RS485 Port (3-wire connection) (Yes / No)		No
	● Ethernet Port (Yes / No)		Yes
	● Any suitable standard port		
	c) **Rear Port** (with IEC-61850)		
	● Ethernet Port (RJ-45) & Fibre Optic ST-connector (Yes / No)		Yes
	● Any suitable standard port		
	d) IRIG - B Time Synchronization (Yes / No)		Yes
12.	Relay catalogue provided with the tender.		Yes
13.	List of relay optional functions included for this application to be listed clearly.		
14.	**Burden**		
	a) Max. DC burden		~4W / ~6W
	b) Max. AC burden		0.4 VA
15.	**Environmental**		
	a) Temperature		-10°C to +55°C
	b) Enclosure Protection		IP40 (front)
	c) Insulation IEC-60255-5		Yes
	d) HV impulse IEC-60255-5		Yes
	e) HF disturbance IEC-60255-22-1		Yes

Item No.	Description	Unit	Requirements
16.	**Mechanical**		
	a) Overall Size H x W x D		177mm x 177mm x 201mm
	b) Mounting		Flush
	c) Weight		4.1kg
(X)	**H.V SIDE T/F OVER CURRENT AND EARTH FAULT RELAY.**		
1.	a) Manufacturer.		ABB
	b) Country of Manufacture.		Finland
2.	Type.		REF615 / REF610
3.	Manufacturer's ordering code.		
4.	Detailed technical catalogue provided.		Yes
5.	**Tripping time X-tics provide.**		
	a) Definite time.		0.5…..5.0 x In
	b) Normally inverse.		0.5…..2.5 x In
	c) Very inverse.		0.05…..300s
	d) Extremely inverse.		0.05…..300s
	e) Long time inverse.		0.05…..300s
6.	**Phase Current Element.**		
	a) Range of current settings:		
	- Over current / Earth fault element.		0.1…..0.8 x In
	b) Range of operating times at ten times current setting.		1.00E
	c) Range of operating times at two times current setting.		2.22E
	d) Time Multiplier setting range / step.		0.5…..5.0 x In
7.	**Instantaneous element (for applicable case only)**		NOT APPLICABLE
	a) Range of setting:		
	- Earth fault / Phase current element.		
	b) Time Multiplier setting range / step.		
	c) Transient over-reach.		

Item No.	Description	Unit	Requirements
	d) Operating times: - At three times setting current. - At ten times setting current.		
	e) Burden of relay on minimum inverse time element current setting at a current ten times setting: - Earth fault / Over current element.		
8.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		 2007 2007
9.	Year of first going into service Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		2007 10306
10.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		
11.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS) a) **Front Port** ● RS232 Port (9 Pin, D-SUB female connector) (Yes / No) ● USB Port (Yes / No) ● Ethernet Port (Yes / No) b) **Rear Port** (with IEC-60870-5-103) ● RS485 Port (3-wire connection) (Yes / No) ● Ethernet Port (Yes / No) ● Any suitable standard port d) IRIG - B Time Synchronization (Yes / No)		Yes No No Yes No Yes Yes
12.	Relay catalogue provided with the tender.		Yes
13.	List of relay optional functions included for this application to be listed clearly.		

Item No.	Description	Unit	Requirements
14.	**Burden**		
	a) Max. DC burden		~4W / ~6W
	b) Max. AC burden		0.4 VA
15.	**Environmental**		
	a) Temperature		-10°C to +55°C
	b) Enclosure Protection		IP40 (front)
	c) Insulation IEC-60255-5		Yes
	d) HV impulse IEC-60255-5		Yes
	e) HF disturbance IEC-60255-22-1		Yes
16.	**Mechanical**		
	a) Overall Size H x W x D		177mm x 177mm x 201mm
	b) Mounting		Flush
	c) Weight		4.1kg
(XI)	**<u>UNDER FREQUENCY RELAYS.</u>**		NOT APPLICABLE
1.	a) Manufacturer. b) Country of manufacture.		
2.	Type.		
3.	Manufacturer's ordering code.		
4.	Detailed technical catalogue provided.		
5.	Frequency settings.		
6.	Range of charge (df / dt)		
7.	Time Setting Range.		
8.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		
9.	Year of first going into service Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		

Item No.	Description	Unit	Requirements
10.	Relay manufacturer's confirmation of suitability of the relay for system application as specified in the main specification.		
11.	Communication interface to Substation Control & Management System (SCMS) & Protection Work Station (WS) a) **Front Port** ● RS232 Port (9 Pin, D-SUB female connector) (Yes / No) ● USB Port (Yes / No) ● Ethernet Port (Yes / No) b) **Rear Port** (with IEC-60870-5-103) ● RS485 Port (3-wire connection) (Yes / No) ● Ethernet Port (Yes / No) ● Any suitable standard port d) IRIG - B Time Synchronization (Yes / No)		
12.	Relay catalogue provided with the tender.		
13.	List of relay optional functions included for this application to be listed clearly.		
14.	**Burden** a) Max. DC burden b) Max. AC burden		
15.	**Environmental** a) Temperature b) Enclosure Protection c) Insulation IEC-60255-5 d) HV impulse IEC-60255-5 e) HF disturbance IEC-60255-22-1		
16.	**Mechanical** a) Overall Size H x W x D b) Mounting c) Weight		

RELAY PANELS
TECHNICAL SCHEDULE

Item No	Description	Unit	Requirements
(I)	**DISTANCE PROTECTION SET-I FOR OVERHEAD LINES**		
1.	a) Manufacturer.		NR Electric
	b) Country of Manufacture.		China
2.	Type.		PCS-902
3.	Manufacturer's ordering code.		
4.	Detailed technical catalogue provided. (Yes/No).		Yes
5.	Rated Current.		1A/5A
6.	Maximum zone relay operating time.		-
7.	Polarizing system.		Yes
8.	Zone Switched.		N/A
9.	Number of zones.		5
10.	C.T supervision.		Yes
11.	Shape of impedance characteristic.		
	(a) Zone 1 Phase -Ground.		Mhn/ Quad
	(b) Zone 2 Phase- Ground.		Mhn/ Quad
12.	Reverse locking element. (Blocking signal initiation).		Yes
13.	Sensitivity. (a) Minimum operating current.		
	– Earth Faults.		0.01A
	– Phase Faults.		0.01A
14.	Minimum necessary voltage at Zone-I reach point (if applicable).		
	– Earth Faults.		0.3V
	– Phase Faults.		0.3V

Note:-

Technical schedule should be filled properly with all relevant information.

Item No	Description	Unit	Requirements
15.	Minimum zone 1 ohmic impedance to which relay can be set.		0.001 ohm
16.	Maximum zone 1 ohmic impedance to which relay can be set and maintain accuracy.		4*Unn/In ohm
17.	Minimum zone 2 ohmic impedance to which relay can be set.		0.001 ohm
18.	Maximum zone 2 ohmic impedance to which relay can be set.		4*Unn/In ohm
19.	Maximum zone 3 ohmic:		
	a) Forward reach.		4*Unn/In ohm
	b) Reverse reach.		4*Unn/In ohm
20.	Are forwarded and reverse reach settings, independent of each other?		Yes
21.	Can resistance and reactance reaches be set independent of each other?		Yes
22.	Directional sensitivity.		Yes
23.	Current transformer requirements.		No special requirement
24.	Voltage transformer requirements.		No special requirement
25.	V.T supervision.		Yes
26.	Back up zone time ranges:		
	a) Zone 1.		0.000~10.000s
	b) Zone 2.		0.000~10.000s
27.	Power swing blocking.		
	a) Forward reach.		Yes
	b) Reverse reach.		Yes
28.	Auto reclose with Sync. Check.		Yes
	– Internal / External.		
29.	**Modes of operating provided:**		
	a) Basic mode.		Yes
	b) Zone accelerator mode.		Yes
	c) Permissive Overreach / Under reach transfer trip mode.		Yes

Item No	Description	Unit	Requirements
	d) Blocking / Unblocking mode.		Yes
	e) Method of conversion of site from one mode to other, Describe.		Yes
	f) Details of extra components for above, Describe.		Please refer to the manual
30.	**Methods used to clear close-in faults:**		
	a) Which occur when line is already energized in service.		DPFC element & Distance
	b) Which exist upon the energisation.		DPFC element
31.	Distance to Fault Locator, event recorder, fault recorder and disturbance recorder included in distance relay.		Yes
32.	**Has distance protection been previously used in the type of scheme specified for this contract.**		
	a) If yes, year of going into service.		Yes, 2007
	b) Year of first going into service.		2007
33.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		2007 >2300
34.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification.		Yes, We confirm.
35.	Communication interface to SCMS & Protection WS.		Yes
36.	Relay catalogue provided with the tender.		Yes

Item No	Description	Unit	Requirements
37.	List of Relay Optional functions included for this application to be listed clearly.		Yes. Please refer to the catalogue.
38.	**Communications:-**		
	a) Front Port RS232 (Yes / No).		Yes
	b) Rear Port RS485 (Yes / No).		Yes
	c) Port RS422 (Yes / No).		Yes
	d) Ethernet Port (Yes / No).		Yes
	e) Fiber Optic Port (Yes / No).		Yes
	f) IEC 60870-5 Protocol (Yes / No).		Yes
	g) IEC 61850 Protocol (Yes / No).		Yes
	h) RTU Protocol (Yes / No).		Yes
	i) IRIG – B Time Synchronization (Yes / No).		Yes
39.	**Burden.**		
	a) Max. DC Burden.		<30W
	b) Max. AC Burden.		<0.2VA/Phase
40.	**Environmental.**		
	a) Temperature (operation).		-40°C to +70°C
	b) Enclosure protection.		IP40, up to IP51 (Flush mounted)
	c) Insulation IEC 60255-5.		Yes. Comply
	d) HV Impulse IEC 60255-5.		Yes. Comply
	e) HF disturbance IEC 60255-22-1.		Yes. Comply
41.	**Mechanical.**		
	a) Overall Size H x W x D.		482.6mm×177.0mm×291.0mm
	b) Mounting.		Flush mounted
	c) Weight.		15kg

Item No	Description	Unit	Requirements
42.	**Zone 1 operating times.** a) Earth Faults.		

Source of line ratio	Fault position % of relay setting	Operating time in m. sec.	
		Min.	Max.
1	0%	5ms	
10	50%	15ms	
30	90%	20ms	

b) Phase to Phase Faults.

Source of line ratio	Fault position % of relay setting	Operating time in m. sec.	
		Min.	Max.
1	0%	5ms	
10	50%	15ms	
30	90%	20ms	

Item	Description	Unit	Requirements

No			

c) Three Phase Faults.

Source of line ratio	Fault position % of relay setting	Operating time in m. sec.	
		Min.	Max.
1	0%	5ms	
10	50%	15ms	
30	90%	20ms	

Item No	Description	Unit	Requirements
(II)	**LINE DIFFERENIAL PROTECTION**		**Not Applicable**
1.	Differential Current Protection for Overhead Line Feeders.		
	a) Manufacturer.		
	b) Country of Manufacture.		
2.	Type.		
3.	Manufacturer's ordering code.		
4.	Detailed technical catalogue provided.		
5.	Service experience list attached.		
6.	Phase segregated type.		
7.	Rating.		
8.	Insulation.		
9.	Maximum relay operating time.		
10.	Maximum burden of relay.		
11.	Minimum Sensitivity.		
	a) Earth faults.		
	b) Phase faults.		
12.	Maximum through fault stability Operating time – fault initiation to trip initial at:		
13.	a) Three times minimum setting.		
	b) Ten times minimum setting.		
14.	Relay manufacturer's confirmation for the suitability of the relay for the 220 KV line feeder system specified.		
15.	a) Guard relay provided for over current / Earth fault.		
	b) Type of guard relay.		
	c) Rating.		
	d) Setting ranges.		
16.	End – End communication media.		

Item No	Description	Unit	Requirements
17.	Autoreclose with Sync. Check.		
18.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service. b) Year of first going into service.		
19.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service).		
20.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification.		
21.	Communication interface to SCMS & Protection WS. Relay catalogue provided with the tender		
22.	Relay catalogue provided with the tender		
23.	List of Relay Optional functions included for this application to be listed clearly.		
24.	Distance to fault locator, event recorder and disturbance recorder included in the relay		
25.	**BURDEN:** a) Max. DC Burden b) Max. AC Burden		

Item No	Description	Unit	Requirements

26.	ENVIRONMENTAL		
	a) Temperature (operation)		
	b) Enclosure protection		
	c) Insulation IEC 60255-5		
	d) HV Impulse IEC 60255-5		
	e) HF disturbance IEC 60255-22-1		
27.	Mechanical		
	a) Overall Size H x W x D		
	b) Mounting		
	c) Weight		
(III)	**PERCENTAGE BIASED DIFFERENTIAL RELAY FOR TRANSFORMER**		
1.	a) Manufacturer		NR Electric
	b) Country of Manufacture		China
2.	Type		PCS-9671
3.	Manufacturer's ordering code		
4.	Detailed technical catalogue provided		
5.	Design		
	– For 2 winding / 3 winding / Auto		Yes
6.	In–built interposing CT ratio matching logic		Yes
7.	In–built disturbance recording, events recording and fault recording		Yes
8.	On demand system V, I. W display		Yes
9.	**Protection Functions:**		
	a) Differential		Yes
	b) Back–up O/C on HV / LV sides (Optional)		Yes

Item No	Description	Unit	Requirements

	c) Thermal overload (thermal replica)		Yes
	d) Earth fault protection		Yes
	e) Over fluxing function		Yes
	f) Magnetizing in rush restraint		Yes
	g) Additional relay optional functions included in this application.		Yes
10.	**RATINGS.**		
	a) AC Current		1A/5A
	b) Frequency		50HZ/60HZ
	c) Aux. Supply – (D.C)		88 to 300 Vdc or 88 to 264 Vac
11.	**AC THERMAL RATING:**		
	a) Continuous		
	b) Short time – (1 sec)		
12.	**BASIC SETTINGS:**		
	a) Differential • Sensitivity (pick–up)		0.1pu
	• Bias X-tics Slope		0.3~0.75
	• Operating time		≤ 35ms
	• Accuracy of per unit valve		0.001 pu
	b) Unrestrained High Set Unit (if provided) • Current setting		
	• Operating time		
	c) Bay unit Over–current (3–Phase) • Setting range		0.05In~30In
	• Operating X–tics (DMT) BS142		
	d) Overload: • Setting range (I thermal)		
	• Time constraint (TC)		
	• Accuracy (both I thermal & TC)		

Item No	Description	Unit	Requirements

13.	Communication interface to SCMS & Protection WS		Yes
14.	Has relay been previously used in the type of scheme specified for the contract.		
	a) If yes, year of going into service		Yes, 2007
	b) Year of first going into service		2007
15.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		2007 >2000
16.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		Yes, We confirm
17.	a) Operation time including trip relay at two relay minimum setting.		<25 ms
	b) Operation time including trip relays at five times relay minimum setting.		<25 ms
18.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		2007 >2000
19.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		Yes, We confirm.
20.	Relay catalogue provided with the tender		Yes
21.	List of Relay Optional functions included for this application to be listed clearly.		Yes

Item No	Description	Unit	Requirements

22.	**BURDEN:**		
	a) Max. DC Burden		<15W
	b) Max. AC Burden		<0.1A/Phase
23.	**ENVIRONMENTAL.**		
	a) Temperature (operation)		-40°C to +70°C
	b) Enclosure protection		Yes
	c) Insulation IEC 60255-5		Yes
	d) HV Impulse IEC 60255-5		Yes
	e) HF disturbance IEC 60255-22-1		Yes
24.	**MECHANICAL**		
	a) Overall Size H x W x D		177.00×225.00×224.80
	b) Mounting		Flush mounted
	c) Weight		15kg
(IV)	**HIGH IMPEDANCE BUSBAR PROTECTION**		Not Applicable
1.	a) Manufacturer		
	b) Country of Manufacture		
2.	Type		
3.	Manufacturer's ordering code		
4.	Detailed technical catalogue provided		
5.	Rated Current (In)		
6.	Auxiliary DC supply voltage.		
7.	Rated Power		

Item No	Description	Unit	Requirements

8.	a) Operation principle b) Multiple operation criterion included in the relay		
9.	Minimum Operating Current/Voltage		
10.	Setting Range: a) Earth faults. b) Phase faults		
11.	Maximum through fault current at which protection is stable: a) Earth faults. b) Phase faults		
12.	a) Operating time including trip relay at two relay minimum setting b) Operating time including trip relays at five times relay minimum setting		
13.	Sensitivity of scheme (allowing for current transformer magnetizing current, etc)		
14.	Bus Wire Supervision Relay		
15.	C.T supervision setting range: a) Current b) Time delay		
16.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service b) Year of first going into service		

Item No	Description	Unit	Requirements

17.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		
18.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		
19.	Communication interface to SCMS and protection WS.		
20.	Relay catalogue provided with the tender		
21.	List of Relay Optional functions included for this application to be listed clearly.		
22.	**BURDEN:** a) Max. DC Burden b) Max. AC Burden		
23.	**ENVIRONMENTAL.** a) Temperature (operation) b) Enclosure protection c) Insulation IEC 60255-5 d) HV Impulse IEC 60255-5 e) HF disturbance IEC 60255-22-1		
24.	**MECHANICAL** a) Overall Size H x W x D b) Mounting c) Weight		

Item No	Description	Unit	Requirements

(V)	**LOW IMPEDANCE BUS BAR PROTECTION**		**Not Applicable**
1.	a) Manufacturer		
	b) Country of Manufacture		
2.	Type		
3.	Manufacturer's ordering code		
4.	Phase segregated type		
5.	Rated current (In)		
6.	Auxiliary DC supply		
7.	No. of Zones.		
8.	No. of peripheral units		
9.	Typical operating time		
10.	Dual characteristic provided (Yes/No)		
11.	Check zone element provided (Yes/No)		
12.	Dread end zone or blind zone. Protection provided (Yes/No)		
13.	Current transformer supervision provided (yes/No)		
14.	Isolator discrepancy alarm provided (Yes/No)		
15.	Events recorder and disturbance provided (Yes/No)		
16.	Back up two stage over current and earth fault protection included (Yes/No)		
17.	Local and remote communication parts provided (Yes/No)		
18.	Current and frequency measurement provided (Yes/No)		
19.	Bus wise supervision relay		
20.	Has relay been previously used in the type of scheme specified for the contract.		
	a) If yes, year of going into service		
	b) Year of first going into service		

Item No	Description	Unit	Requirements

21.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		
22.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		
23.	Relay catalogue provided with the tender		
24.	List of Relay Optional functions included for this application to be listed clearly.		
25.	**BURDEN:** a) Max. DC Burden b) Max. AC Burden		
26.	**ENVIRONMENTAL.** a) Temperature (operation) b) Enclosure protection c) Insulation IEC 60255-5 d) HV Impulse IEC 60255-5 e) HF disturbance IEC 60255-22-1		
27.	**MECHANICAL** a) Overall Size H x W x D b) Mounting c) Weight		

Item No	Description	Unit	Requirements

(VI)	**HIGH IMPEDANCE RESCTRICTED EARTH FAULT PROTECTION**		**Not Applicable**
1.	a) Manufacturer		
	b) Country of Manufacture		
2.	Type		
3.	Manufacturer's ordering code (Separate relay to be provided. Built-in function of main Differential Relay is not acceptable)		
4.	Detailed technical catalogue provided.		
5.	Rating		
6.	Operating principle e.g. high impedance		
7.	Minimum relay setting		
8.	Sensitivity of scheme (Allowing for current transformer magnetizing current, etc)		
9.	Maximum through fault current at which protection is stable		
10.	Current transformer requirements		
11.	Operating time at three times relay minimum setting.		
12.	Operating time at ten times relay minimum setting		
13.	a) Stabilizing resistors provided		
	b) Stabilizing resistor value		
14.	a) Non linear resistors provided.		
	b) Non linear resistors value		
15.	Communication interface to SCMS & Protection WS		

Item No	Description	Unit	Requirements

16.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service b) Year of first going into service		
17.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		
18.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		
19.	Relay catalogue provided with the tender		
20.	List of Relay Optional functions included for this application to be listed clearly.		
21.	**BURDEN:** a) Max. DC Burden b) Max. AC Burden		
22.	**ENVIRONMENTAL.** a) Temperature (operation) b) Enclosure protection c) Insulation IEC 60255-5 d) HV Impulse IEC 60255-5 e) HF disturbance IEC 60255-22-1		

Item No	Description	Unit	Requirements

23.	**MECHANICAL**		
	a) Overall Size H x W x D		
	b) Mounting		
	c) Weight		
(VII)	**<u>TRIPPING RELAYS</u>**		
1.	a) Manufacturer		NR ELECTRIC
	b) Country of Manufacture		China
2.	Manufacturer's ordering code		MD1501
3.	Nominal operating voltage		88Vdc~300Vdc
4.	Minimum Operating voltage		88V
5.	Contact Mechanism Reset (Hand/Electrical)		Selectable
6.	Operating indicator		Yes
7.	Operating time at nominal voltage		<10ms
8.	Contact rating:		
	a) Make and carry continuously		8A
	b) Make and carry for 3 sec		10A
	c) Break resistive watts		
	d) Inductive VA		
9.	Thermal withstand capacity		
10.	Reset mechanism		
11.	Has relay been previously used in the type of scheme specified for the contract.		
	a) If yes, year of going into service		
	b) Year of first going into service		
12.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		

Item No	Description	Unit	Requirements

13.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		
14.	Relay catalogue provided with the tender		
15.	List of Relay Optional functions included for this application to be listed clearly.		
16.	**BURDEN:**		
	a) Max. DC Burden		
	b) Max. AC Burden		
17.	**ENVIRONMENTAL.**		
	a) Temperature (operation)		-25°C~+55°C
	b) Enclosure protection		Front side IP40
	c) Insulation IEC 60255-5		Comply
	d) HV Impulse IEC 60255-5		Comply
	e) HF disturbance IEC 60255-22-1		Comply
18.	**MECHANICAL**		
	a) Overall Size H x W x D		35.5×173.8×198 (unit: mm)
	b) Mounting		Flush mounted
	c) Weight		Approx. 1kg
(VIII)	**<u>TRIP CIRCUIT SUPERVISION</u>**		
	(Supervision relays to be provided. Built-in functionality of a Main Relay is not considered sufficient to meet the requirements)		
1.	a) Manufacturer		NR Electric
	b) Country of Manufacture		China
2.	Manufacturer's ordering code		MD1501

Item No	Description	Unit	Requirements

3.	Monitors full trip circuit with CB open and close.		Yes
4.	a) Operating time		<10 ms
	b) Resetting time		
	c) Time delayed drop off period.		
5.	Has relay been previously used in the type of scheme specified for the contract.		
	a) If yes, year of going into service		
	b) Year of first going into service		
6.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		
7.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		
8.	Relay catalogue provided with the tender		
9.	List of Relay Optional functions included for this application to be listed clearly.		
10.	**BURDEN:**		
	a) Max. DC Burden		
	b) Max. AC Burden		
11.	**ENVIRONMENTAL.**		
	a) Temperature (operation)		-25°C~+55°C
	b) Enclosure protection		Front side IP40
	c) Insulation IEC 60255-5		Comply
	d) HV Impulse IEC 60255-5		Comply
	e) HF disturbance IEC 60255-22-1		Comply

Item No	Description	Unit	Requirements
12.	**MECHANICAL**		
	a) Overall Size H x W x D		35.5×173.8×198 (unit: mm)
	b) Mounting		Flush mounted
	c) Weight		Approx. 1kg
(IX)	**LINE OVERCURRENT AND EARTH FAULT RELAY**		
1.	a) Manufacturer		NR Electric
	b) Country of Manufacture		China
2.	Type		PCS-9611
3.	Manufacturer's ordering code		
4.	Detailed technical catalogue provided		Yes
5.	**Tripping time X-stics provided**		
	a) Definite time		0.00~100.00s
	b) Normally inverse		0.00~100.00s
	c) Very inverse		0.00~100.00s
	d) Extremely inverse		0.00~100.00s
	e) Long time inverse		0.00~100.00s
6.	**Phase Current Element**		
	a) Range of current settings:		
	– Over current		0.05 ~ 30.0×In
	– Earth fault		0.05 ~ 4.0×In
	b) Range of operating times at highest time settings at ten times current setting		<20ms
	c) Range of operating times at highest time settings at two times current setting		<20ms
	d) Time Multiplier setting range/step		0.01s

Item No	Description	Unit	Requirements
7.	**Instantaneous element (for applicable cases only)** a) Range of setting: – Earth fault/Phase current element b) Time Multiplier setting range/steps c) Transient over-reach d) Operation times: – At three times setting current flowing – At ten times setting current flowing e) Burden of relay on minimum inverse time element current setting at a current ten times setting: – Earth fault/over current element		**Not Applicable**
8.	Has relay been previously used in the type of scheme specified for the contract. a) If yes, year of going into service b) Year of first going into service		Yes, 2007 2007
9.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		2007, >11000 units
10.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		Yes
11.	Communication interface to SCMS & Protection WS.		Yes
12.	Relay catalogue provided with the tender		Yes

Item No	Description	Unit	Requirements
13.	List of Relay Optional functions included for this application to be listed clearly.		Yes
14.	**BURDEN:**		
	a) Max. DC Burden		<10W
	b) Max. AC Burden		0.4VA
15.	**ENVIRONMENTAL.**		
	a) Temperature (operation)		-40°C ~ +70°C
	b) Enclosure protection		IP40, up to IP51 (Flush mounted)
	c) Insulation IEC 60255-5		Yes
	d) HV Impulse IEC 60255-5		Yes
	e) HF disturbance IEC 60255-22-1		Yes
16.	**MECHANICAL**		
	a) Overall Size H x W x D		177mm ×225mm × 224.80mm
	b) Mounting		Flush mounted
	c) Weight		10kg
(X)	**H.V SIDE T/F OVERCURRENT AND EARTH FAULT RELAY**		
1.	a) Manufacturer		NR Electric
	b) Country of Manufacture		China
2.	Type		PCS-9611
3.	Manufacturer's ordering code		
4.	Detailed technical catalogue provided		Yes
5.	**Tripping time X-stics provided**		
	a) Definite time		0.00~100.00s
	b) Normally inverse		0.00~100.00s
	c) Very inverse		0.00~100.00s

Item No	Description	Unit	Requirements
	d) Extremely inverse		0.00~100.00s
	e) Long time inverse		0.00~100.00s
6.	**Phase Current Element.**		
	a) Range of current settings:		0.05 ~ 30.0×In
	– Over current /Earth fault element		0.05 ~ 4.0×In
	b) Range of operating times at highest time setting at ten times current setting		<20ms
	c) Range of operating times at highest time setting at two times current setting		<20ms
	d) Time Multiplier setting range/step.		0.01s
7.	**Instantaneous element (for applicable cases only)**		**Not Applicable**
	a) Range of setting:		
	– Earth fault/Phase current element		
	b) Time Multiplier setting range/steps		
	c) Transient over-reach		
	d) Operation times:		
	– At three times setting current flowing		
	– At ten times setting current flowing		
	e) Burden of relay on minimum inverse time element current setting at a current ten times setting:		
	– Earth fault/over current element		
8.	Has relay been previously used in the type of scheme specified for the contract.		
	a) If yes, year of going into service		Yes, 2007
	b) Year of first going into service		2007

Item No	Description	Unit	Requirements
9.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		2007, >11000 units
10.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		Yes
11.	Communication interface to SCMS & Protection WS.		Yes
12.	Relay catalogue provided with the tender		Yes
13.	List of Relay Optional functions included for this application to be listed clearly.		Yes
14.	**BURDEN:**		
	a) Max. DC Burden		<10W
	b) Max. AC Burden		0.4VA
15.	**ENVIRONMENTAL.**		
	a) Temperature (operation)		-40°C ~ +70°C
	b) Enclosure protection		IP40, up to IP51 (Flush mounted)
	c) Insulation IEC 60255-5		Yes
	d) HV Impulse IEC 60255-5		Yes
	e) HF disturbance IEC 60255-22-1		Yes
16.	**MECHANICAL**		
	a) Overall Size H x W x D		177mm ×225mm × 224.80mm
	b) Mounting		Flush mounted
	c) Weight		10kg

Item No	Description	Unit	Requirements
(XI)	**UNDER FREQUENCY RELAYS**		
1.	a) Manufacturer		NR Electric
	b) Country of Manufacture		China
2.	Type		PCS-9611
3.	Manufacturer's ordering code		
4.	Detailed technical catalogue provided		Yes
5.	Frequency Settings		45.000~60.000 (Hz)
6.	Rate of charge (df/at)		-10~10Hz/s
7.	Time setting range		0.000~100.000s
8.	Has relay been previously used in the type of scheme specified for the contract.		
	a) If yes, year of going into service		Yes, 2007
	b) Year of first going into service		2007
9.	Year of first going into service. Approximate number if service (A complete reference list should be submitted stating client, system voltage and year of going into service)		2007, >11000 units
10.	Relay manufacturer's confirmation of suitability of the relay for the system application as specified in the main specification		Yes
11.	Communication interface to SCMS & Protection WS.		Yes
12.	Relay catalogue provided with the tender		Yes
13.	List of Relay Optional functions included for this application to be listed clearly.		Yes

Item No	Description	Unit	Requirements
14.	**BURDEN:**		
	a) Max. DC Burden		<10W
	b) Max. AC Burden		0.4VA
15.	**ENVIRONMENTAL.**		
	a) Temperature (operation)		-40°C ~ +70°C
	b) Enclosure protection		IP40, up to IP51 (Flush mounted)
	c) Insulation IEC 60255-5		Yes
	d) HV Impulse IEC 60255-5		Yes
	e) HF disturbance IEC 60255-22-1		Yes
16.	**MECHANICAL**		
	a) Overall Size H x W x D		177mm ×225mm × 224.80mm
	b) Mounting		Flush mounted
	c) Weight		10kg

PCS-9700

HMI System

Instruction Manual

NR Electric Co., Ltd.

Preface

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Version: 1.00

P/N: EN_HTJK0500.0086.0001

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1 Introduction

1.1 Application

PCS-9700 HMI system (abbreviated **PCS-9700**) is a new generation HMI system developed by **NR** based on years of **SAS** research achievements and site operation experiences. This system adopts advanced distributed network technology, object-oriented database technology, cross-platform visualization technology, and latest standards in the industry. It is the achievement of elaborate design and devoted in-depth development. International standards such as IEC60870-5-103 and IEC61850 are fully supported. **PCS-9700** can satisfy the demands on HMI system in conventional substations, digital substations, as well as the NCS system in power plants.

PCS-9700 HMI system consists of a generic applications support platform and station monitoring applications that adopt integral design and development based on this platform. This system adopts distributed and expandable system framework that can accommodate different structures. Applications and databases can be flexibly configured on each computer node, without modification of applications. The whole system can comprise computers on which different operating systems are installed. System functions can be easily expanded to user demands, thus satisfying user requirements on system flexibility and scalability to the maximum extent.

This product is applicable to:

- **Power systems**

  Conventional substations and digital substations of various voltage levels;

- **Other systems**

  Subway system, light-rail system, and electrified railway system;

  Other industrial automation applications: mines, petrochemical industry and metallurgy, etc.

1.2 Functional Configuration

Table 1.2-1 Functional Configuration

Functional modules
Basic functions (Integrated in standard version)
Data acquisition and processing
Sequence of events (SOE)
Alarm, record events
Historical data record
Display/Print graph

Functional modules
Curve management
Report Management
Control CB, DS, ES, tap position
SLD dynamic topological coloring
System parameters configuration
Database configuration
Edit graph/primitive
Clock synchronization
User and authority management
System self-diagnosis and self-restore
System backup/restore
Advanced functions(Optional)
Anti-maloperation
Post disturbance review (PDR)
Protection information management
Sequential control

NOTE: Please refer to the *Section* "***12.5.1.3 Configure IED***" and read relative contents of "Set Host/Standby_Mode" for the function of "Host/Standby_Mode" of 2 IEDs. will not be adopted.

2 IEDs of the same model (e.g.: Two PCS-9705 BCUs) can be assigned to a virtual parent IED. These 2 sub-IEDs can be configured to work in "Host/Standby_Mode". The virtual parent IED will only adopt the data acquired from the "Host sub_IED" to transmit to the HMI system. The data acquired by the "Standby sub-IED" will not be adopted.

NOTE: In "Host/Standby_Mode", the device model of the "Host sub_IED" and "Standby sub-IED" must be the same. I.e.: If "Host sub_IED" is a PCS-9705 BCU, then the "Standby sub-IED" must be selected from another PCS-9705 BCU.

1.3 System Performance

Table 1.3-1 System Performance

Item	Performance
Max. time lag for a bay level measured value to show on substation level display	≤ 2s
Max. time lag for a bay level status change to show on substation level display	≤ 2s
Total response time between a command issued and corresponding status change received	≤ 4s

at the operating workstation (excluding the operating time of the circuitry and device)		
Switchover time between two machines		≤ 30s
Dynamic graph response time		≤ 2s
Display real-time data refresh cycle		≤ 3s
Success rate of telecontrol		100%
Qualified rate of measurement		≥ 98%
System availability		≥ 99.9%
Mean time between failures (MTBF)		≥ 30000h
Average loading of the CPU of workstations	Normal working (within any 30min)	≤ 30%
	During power system failure (within 10s)	≤ 50%
Average loading of SAS network	Normal working (within any 30min)	≤ 20%
	During power system failure (within 10s)	≤ 40%

1.4 System Capacity

Table 1.4-1 System Capacity

Item	Capacity
Substation	64
IED	1000
Bay	600
Circuit breaker and disconnector	2000
Measurement	40000
Binary input	80000
Control	20000
Metering	15000
Tap position	1000

NOTE: The system capacity listed in the above table refers to the standard configuration. It can be extended according to the actual requirements.

2 Console

2.1 General

This console provides visual interface used to call other programs. All applications in PCS-9700 HMI system can be accessed from this console. In this console, users can adopt configuration according to their habits. Besides, this console can display basic status information of the PCS-9700 HMI system.

2.2 Console

The console locates at the bottom of the screen, similar to the task bar in WINDOWS operating system.

It consists of the start menu, shortcut program buttons, and status display etc., as shown below.

Figure 2.2-1 Console

2.2.1 Structure of Console

2.2.1.1 Start Menu

Click the “Start” button on the console to pop up the system menu. Contents of the start menu can be configured by user. For details, please refer to *Section **2.2.4***.

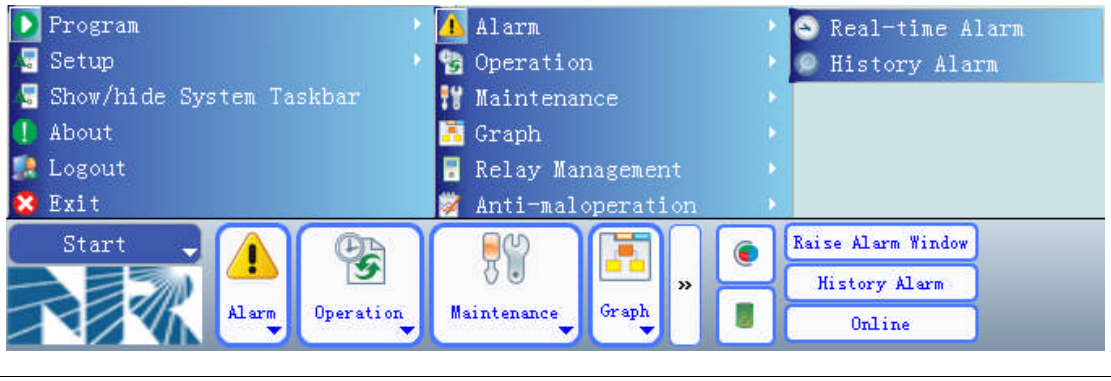


Figure 2.2-2 Start menu

Table 2.2-1 List of PCS-9700 system functions

Program	
Real-time Alarm	Start real-time alarm interface; in default, this will start along with the console

History Alarm	Start historical alarm interface
Relay Management	Start protection management interface
Authority Management	Start authority management program
Report Tool	Start report program
Database Editor	Start database maintenance tools
Graph Editor	Start graphic edit tools
Primitive Editor	Start primitive edit tools
Report Editor	Start report edit tools
Online	Start online graphic interface; in default, this will start along with the console
Setup	
Console setup	Used for self definition of console appearance and menu structure, addition or deletion of program, and setup of self-triggered program
System configuration	Used to set system parameters
Other	
Show/hide System Taskbar	Used to show and hide system task bar (only effective for WINDOWS)
About	
Logout	Log off current user
Exit	Exit console. You will exit applications started by the console at the same time.

2.2.1.2 Shortcut Program Buttons

Shortcut buttons allow common operations. There are 4 types:

1) All program groups under “Program” in “Start” menu are displayed in button mode;

2) Shortcut program buttons are provided in “Icon button” mode, which can be configured by user;

3) Shortcut buttons are provided in “Text button” mode, which can be configured by user;

4) In case there are too many “Program” buttons, surplus buttons will be hidden.

Program buttons in shortcut program button bar are set in “Console setup”. For details, please refer to *Section **2.2.2***.

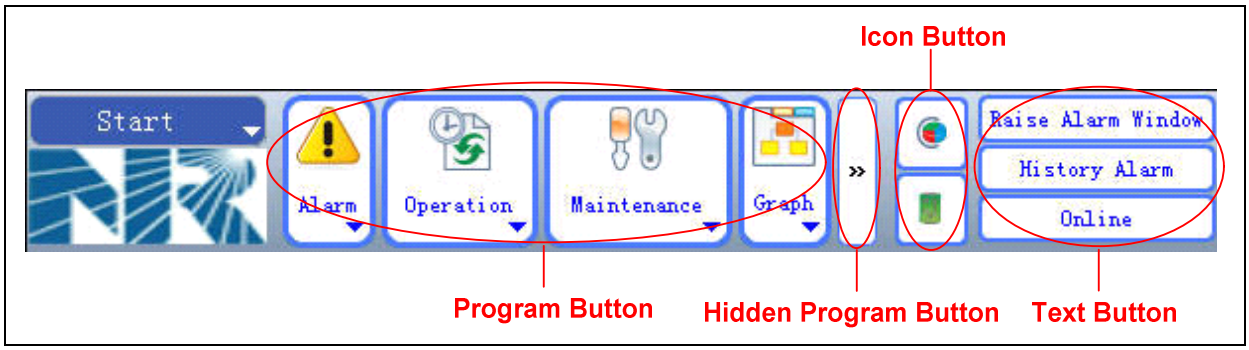


Figure 2.2-3 Shortcut program buttons

2.2.1.3 Status Display

The status display bar has 3 parts:

1) Safe operation days:

   This number counts from the day when the station was put into operation (this day can be configured in database configuration tool);

2) User Name and Effective Duration: click this button to pop up console log-off dialog box; you can log off current user. When effective duration expires, click here can log on the system again;

3) Current time: display current time of the system.

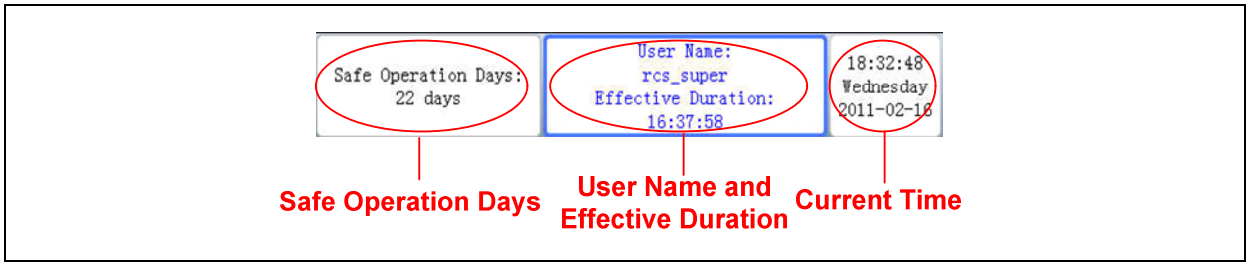


Figure 2.2-4 Status display bar

2.2.2 Console Setup

Console setup is used to set console parameters, icon buttons, and text buttons.

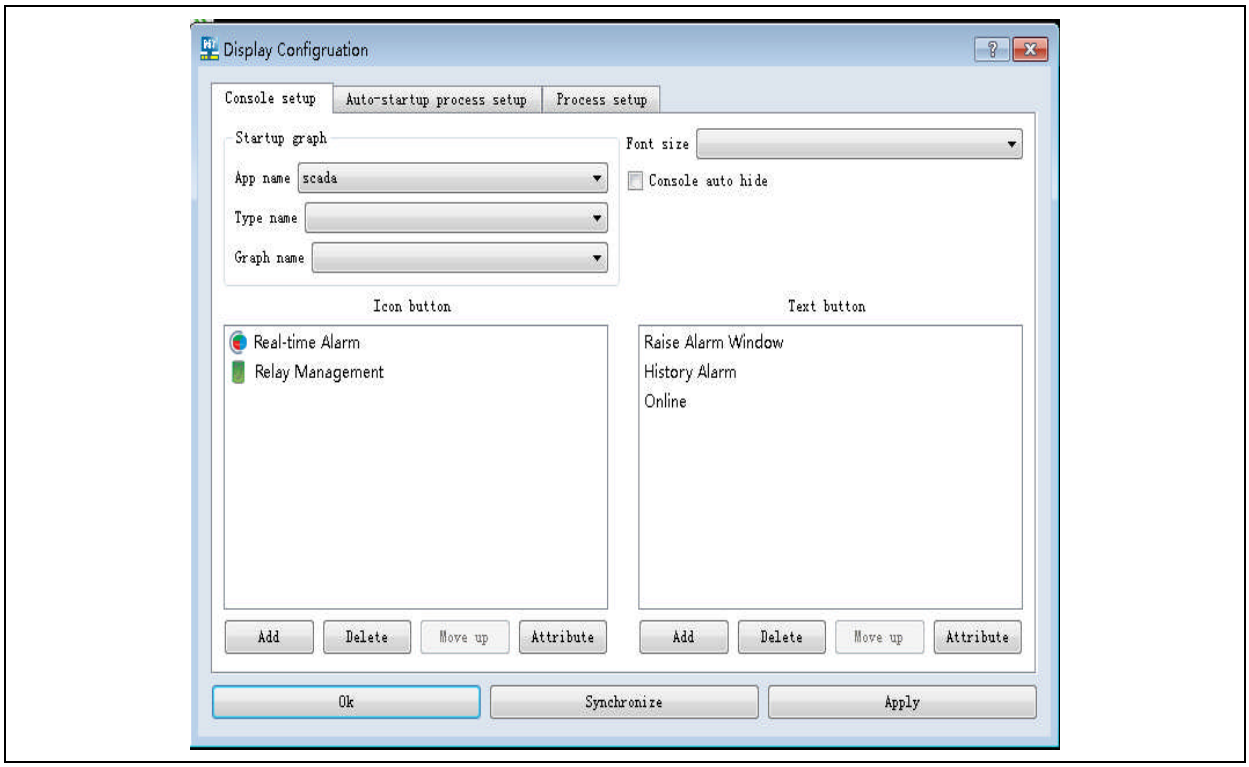


Figure 2.2-5 Console setup

2.2.2.1 Online Startup Graphic

By selection of “App name”, “Type name”, and “Graph name”, set the online operation graph to be displayed in default when the console starts.

2.2.2.2 Font Size

Set font size for text on the console; this setting can only be valid after restart of the console.

2.2.2.3 Automatic Hiding of the Console

Select “Console auto hide” to allow automatic hiding of console when idle. After the console is hidden, it will be displayed again when the mouse is moved to bottom of the screen.

2.2.2.4 Icon Button

By means of buttons of “Add”, “Delete”, “Move up”, and “Attribute”, icon buttons on the console can be configured.

- “Add”: click this button to pop up the program setup dialog box shown below:

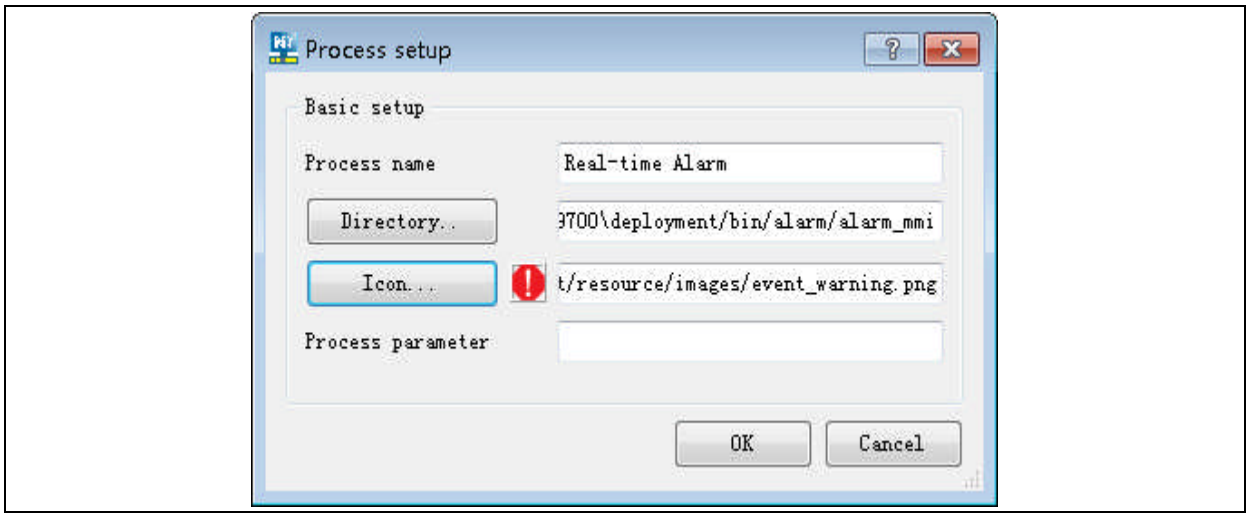


Figure 2.2-6 Process setup dialog box

Table 2.2-1 Description of configuration options in process setup dialog box

Configuration item	Description
Process name	Name of the application
Directory	Click button “Program path” to pop up “Choose a process” dialog box, to select corresponding application program.
Icon	Click button “Icon…” to pop up “Select image” dialog box, to select corresponding program icon.
Process parameter	Configure starting parameters during program startup

- “Delete”: In “Icon button” list, select the icon to be deleted and click “Delete” button to delete it.
- “Move up”: In “Icon button” list, select the icon to be moved. Click “Up” button to move it up by one position.

- “Attribute”: In “Icon button” list, select the icon for which attribute needs to be modified. Click “Attribute” button to pop up the program setup dialog box as shown in the above figure. Double clicking an icon can also pop up the “Process setup” dialog box.

2.2.2.5 Text Button

This is used to set text buttons on the console. The operation method is similar to that of “Icon button”.

2.2.3 Auto-startup Process Setup

Configure programs to be started along with the console, as shown in the figure below.

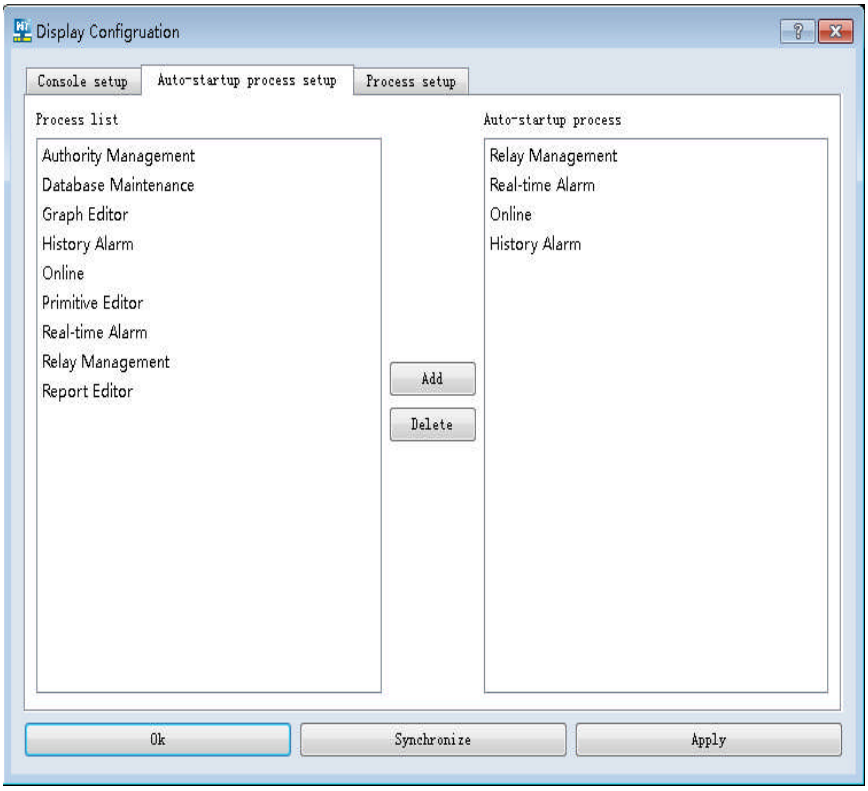


Figure 2.2-7 Set self-triggered programs

In the “Process list” at left side, all programs existing in the console are listed.

In “Auto-startup process” at right side, all programs that will start along with the console are listed. In default, “Real-time alarm” and “Online” will be listed.

To add an auto-startup process, select this process in “Process list” and click “Add” button.

To delete an auto-startup process, select this process in “Auto-startup process” list and click “Delete” button.

2.2.4 Process Setup

All programs used in “Start” menu can be configured here.

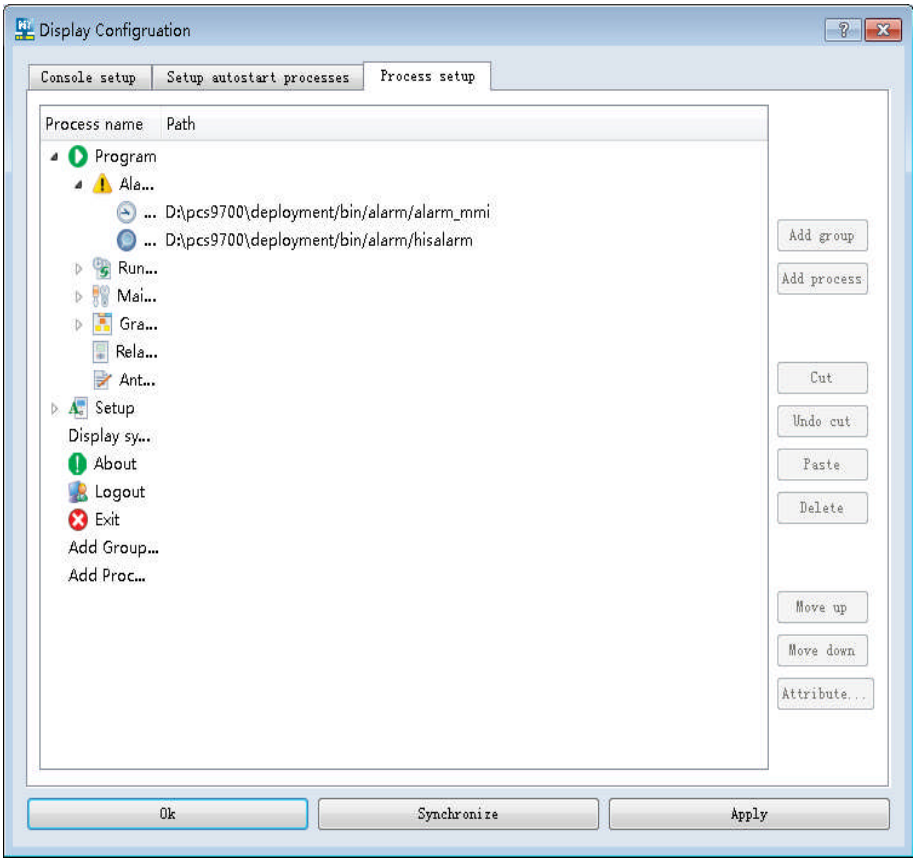


Figure 2.2-8 Program setup

In the directory tree, all programs that can be currently started by the console are displayed. Among them, “Programs” and “Setup” etc. are program groups, while “Real-time alarm” etc. are programs. In “Process name” column, the name of the program or program group is displayed. In “Path” column, program path is displayed.

- “Add group”: When program group item is selected, “Add group” button will be available. Click this button to pop up Add Group dialog box. In “groupName” box, enter name of the new group. Click “icon” button to pop up icon selection dialog box to select icon.

Figure 2.2-9 Set group

In case sub-group is created in “Program”, corresponding sub-group button will be created on the console at the same time. Refer to the figure below.

Figure 2.2-10 Program group displayed under "Program"

In case many program groups are added under "Program", the surplus buttons will be hidden in the console,. Click  can pop up additional menu bar and display surplus program groups in this menu bar. Refer to the figure below.

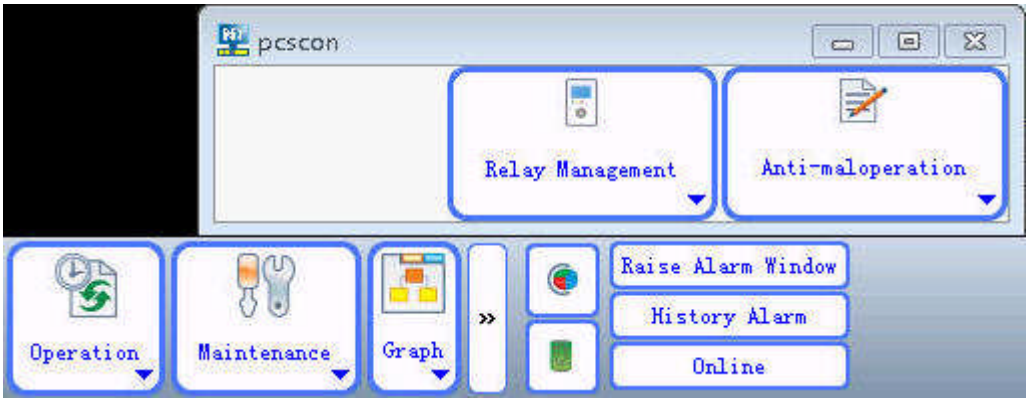


Figure 2.2-11 Hide buttons and hide menu

- "Add process": only usable for program group. Select target program group and click "Add process" button to pop up the program setup dialog box shown in *Figure 2.2-6.* Operation is the same as described earlier.
- "Cut": usable for both program group and program. Used to move position of program or program group. Select the program or program group to be moved and click "Cut" button.
- "Undo cut": usable after "Cut" is used. This is used to restore a program or program group.
- "Paste": usable after "Cut" is used. Usable when a program group is selected. This is used to move a program or program group to required directory.
- "Delete": delete selected program or program group.
- "Move up", "Move down": move selected program or program group up or down by one position. In the "Start" menu, position of corresponding program or program group will change at the same time.
- "Attribute": view and modify attribute of selected program or program group. Double clicking an item can also pop up corresponding configuration dialog box for configuration of attribute.

Besides, the directory tree includes 2 options:

- "Add Group…": used to create process group under root directory. Method of use is the same as for "Add group".

- "Add Proc…": used to create a process under root directory. Method of use is the same as for "Add process".

2.2.5 Other Functions

2.2.5.1 System Hot Key

When the console is hidden, press F10 to show it again.

NOTE: This function is only effective in WINDOWS OS!

2.2.5.2 Right Key Shortcut Menu

Right-click mouse at a blank place of the console to pop up the following shortcut menu:

- Hide console:

  To hide the console;

- Console setup:

  To pop up the console setup dialog box;

- Logout:

  To log off current user. It is only available when current user is logged on;

- Exit from PCS9700:

  To exit the PCS-9700.

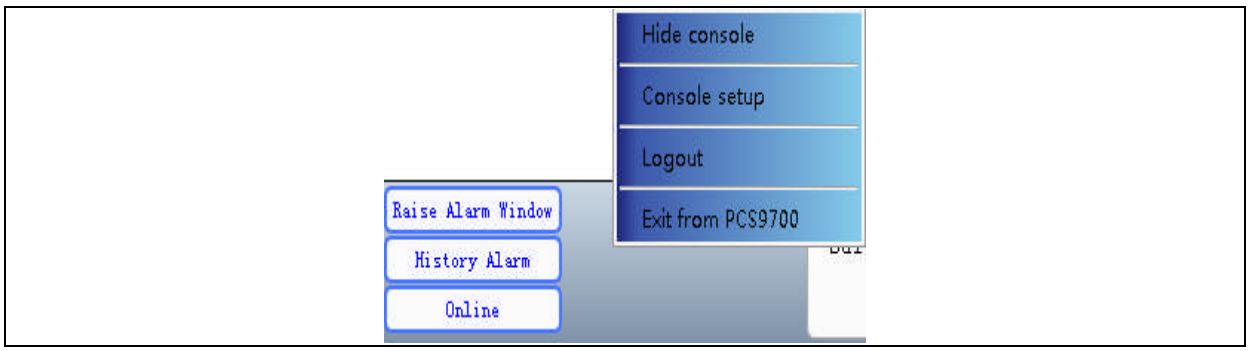


Figure 2.2-12 Right key shortcut menu

3 Online Operation

3.1 General

Through online graphs, user can monitor grid operation, inquire relevant statistic data, issue control/regulation commands, and execute relevant operations of each application.

3.1.1 Interface

After online startup of graph, screen display is shown as figure below:

- Title bar: displays information of current open graph (name of application, name of graph, and version No.).
- Menu bar: menu integrating various types of operations.
- Toolbar: common operation buttons, including ordinary toolbar and self-defined information toolbar.
- Main window: displays current open graph.
- Status bar: displays data refreshing frequency, number of data modifications, and current file format etc. of current open graph.

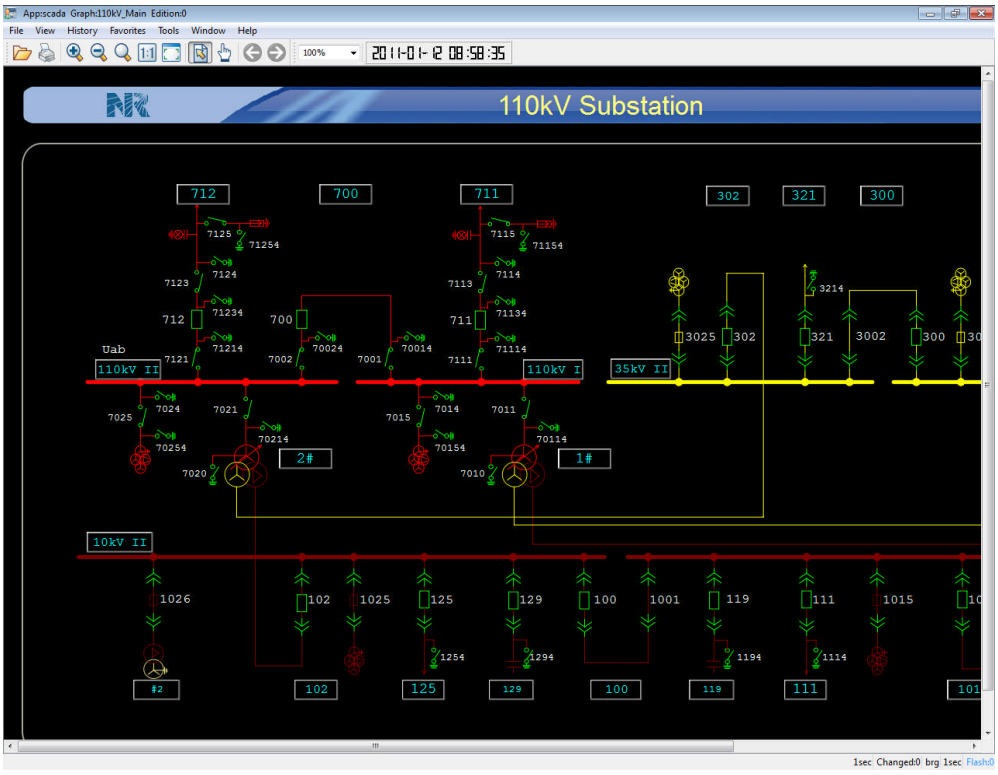


Figure 3.1-1 Main interface

Right click mouse on the Toolbar or Menu bar to pop up menu items shown in the figure below.

The Toolbar will be displayed if selected, and hidden if not selected.

- Resources: graph index (similar to “Open” operation in the Toolbar described below)
- Overview map: displays the thumbnail of current graph.
- Equipment browser: list all equipment in current graph according to voltage levels; fast search and locating are supported.
- toolbar: collection of common operation buttons.
- Misc: graph zooming multiple and digital clock.
- User Define Info: displays self-defined system information that user find them important.

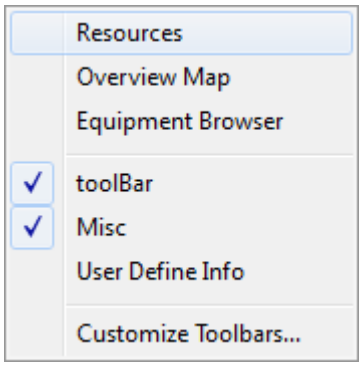


Figure 3.1-2 Toolbar menu

3.2 Toolbar

When mouse cursor is moved onto an icon on the Toolbar, corresponding name of operation will automatically pop up near the cursor. The following describes common operations according to Toolbar shown in *Figure 3.1-1*:

Open: display/hide graph index. User can use the graph index to open graphs. The graph index classifies and arranges graphs according to hierarchy of “Graphic application→ Type of graph→ Graph”. The pull-down box in upper part of the graph index provides a fast inquiry method using entry of first letter of phonetic, to allow fast locating of target graph. Take opening of graph “110kV100 sectioned diagram” as an example, enter “110” in the box below and then press Enter. The pull-down list shown below will pop up. Select “110kV100 sectioned diagram” to open this graph.

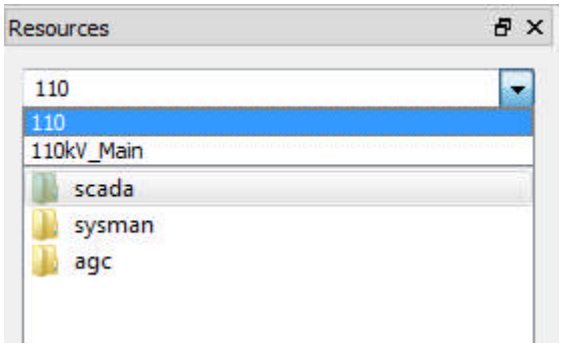


Figure 3.2-1 Fast inquiry of graph file

Right click graph type of the graph index to select if all editions of the graph are to be displayed, as shown in the figure below:

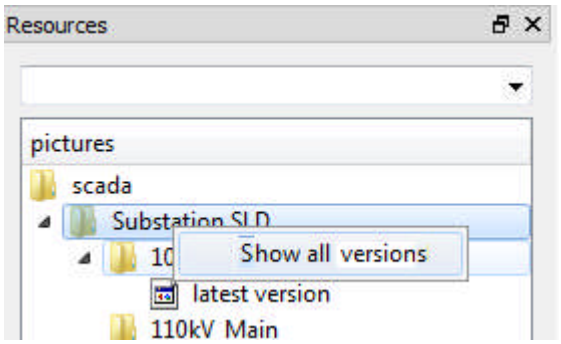


Figure 3.2-2 Show all editions

After selection of “Show all versions”, for graphs with history version, a branch of “History version” will appear under its item, as shown in the figure below. User can view them as requested.

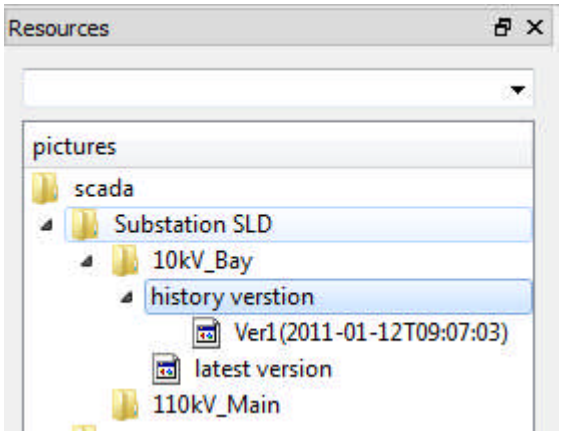


Figure 3.2-3 History version

 Print: user can print this graph. For printing, user can specify background color, foreground color, and set water mark etc. For particular method of setting, please refer to *Section* ***3.3.2***.

 Zoom in: Amplify current graph according to default ratio. This ratio is 1.2 times original graph.

 Zoom out: reduce current graph according to default ratio. This ratio is 0.8 time original graph.

 Zoom free: step-less zooming of current graph. Particular method: on the graph, press and drag left mouse key and then release it. Dragging toward lower right corner will zoom in the graph; dragging toward upper left corner will zoom out the graph. Ratio of zooming depends on distance of dragging.

 Zoom to 100%: restore current graph to its original size.

 Fit to image: zoom the graph according to size of current display zone, so that this graph occupies the whole zone.

 Select: after clicking this tool, user will be switched to selection mode (default mode when online operation tools start). User can use Left button or Right button to select foreground to perform relevant operations.

 Pan: after clicking this tool, user will be switched to Pan mode (click “Select” or right mouse button to switch to “Selection mode”). User can hold down left mouse button to drag current graph.

 Previous page: return to previous graph.

 Next page: move to next graph.

Ratio: zoom current graph according to corresponding ratio. User can choose from pre-set ratio in the pull-down box, or manually enter the ratio (positive integer) in the input box.

Clock: displays current time.

User-defined info: user can set some values or statuses to be shown on the Toolbar for monitoring. For particular method of definition, please refer to the *Section* ***3.3.13.4***.

3.3 Menu Bar

3.3.1 Export Image

Select “Export Image” under “File” menu to export current open graph as image file (JPG, BMP or PNG) to facilitate viewing and transmission.

3.3.2 Print Setup

Select “Print Setup” under “File” menu; the following dialog will pop up.

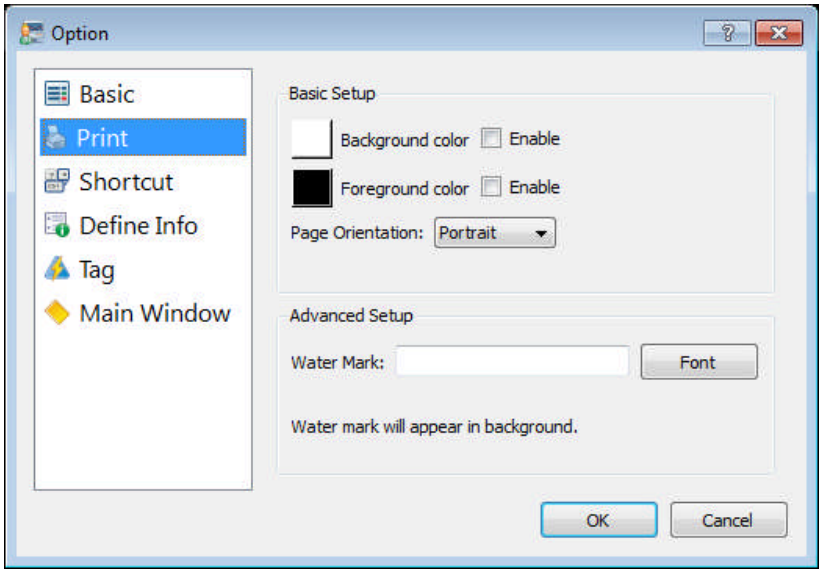


Figure 3.3-1 Print setup

Background color and Foreground color: if enabled, user can specify background color and foreground color of printing. In case background of current graph is in deep color, this setting can be used to save ink and improve definition of printing.

Page Orientation: set default printing direction (portrait or landscape)

Water mark: set water mark on background.

3.3.3 Print Preview

Select “Print Preview” under menu “File”; the following dialog will pop up:

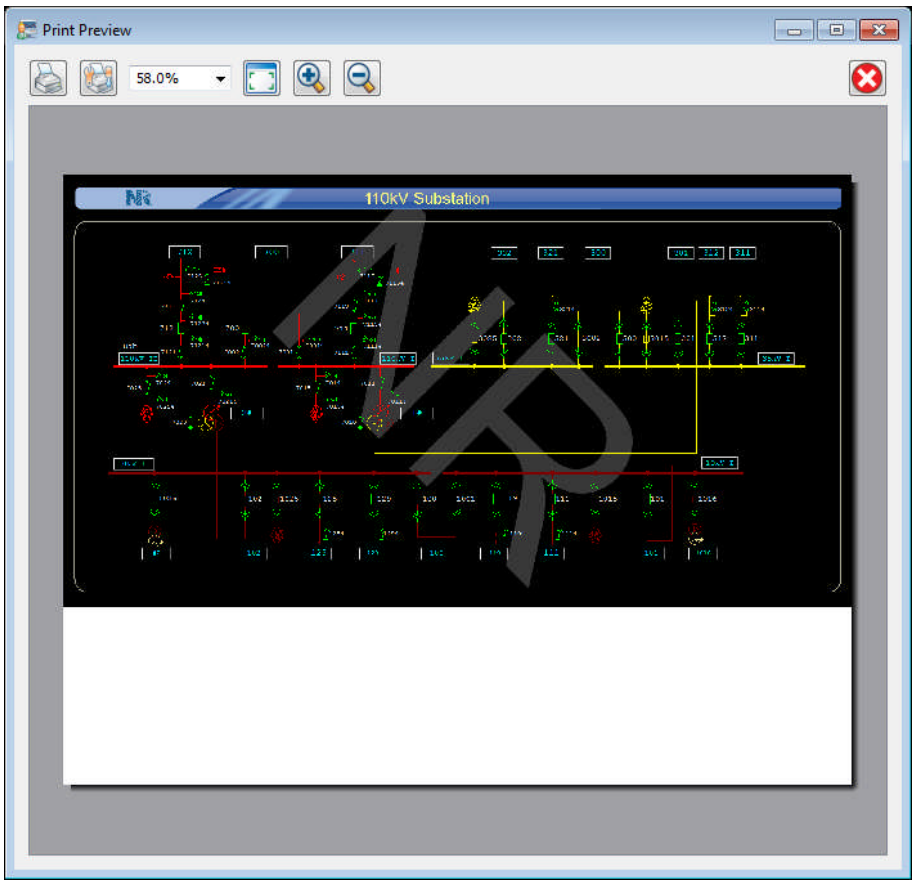


Figure 3.3-2 Print preview

User can preview result of “Print Setup”. Use of shortcuts can realize functions of printing, print setup, full screen, zoom in and zoom out.

3.3.4 Planes

Select “Planes” under menu “View”; user can switch display/hide between different graphic layers. Refer to the figure below:

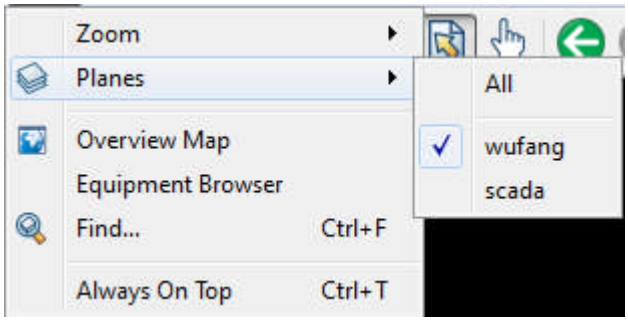


Figure 3.3-3 Select plane

3.3.5 Overview map

Select “Overview map” under menu “View”; at left side of the graph, a thumbnail of current graph

will be displayed. User can use mouse for fast browsing or zooming.

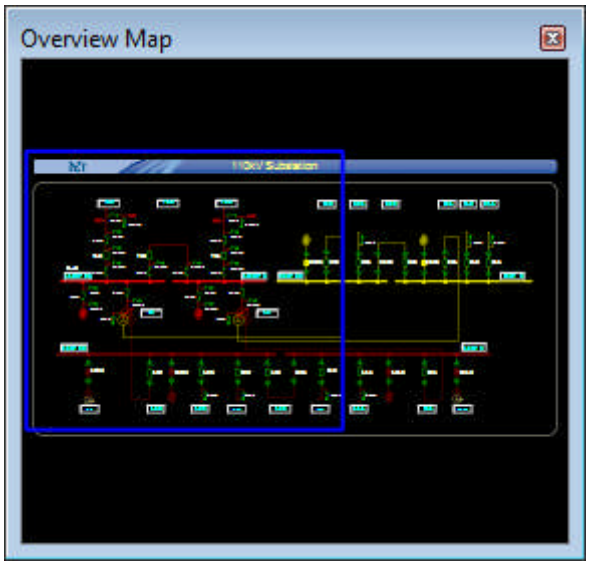


Figure 3.3-4 Overview map

3.3.6 Equipment Browser

Select “Equipment Browser” under menu “View”; equipment browser will be displayed at left side of the graph. All equipment in current graph will be listed according to voltage level. Fast search and locating are supported. Refer to the figure below:

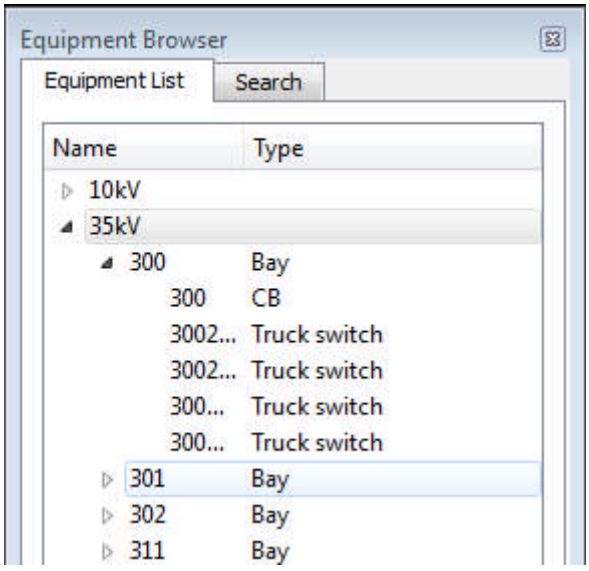


Figure 3.3-5 Equipment browser

After double clicking selected equipment, this equipment can be located in the graph and marked by red dashed line. Refer to the figure below:

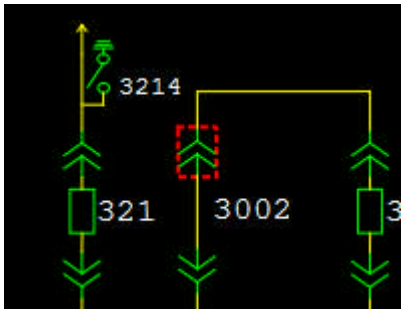


Figure 3.3-6 Locating of equipment

Click “Search” tab to quickly search equipment in current graph. Refer to the figure below:

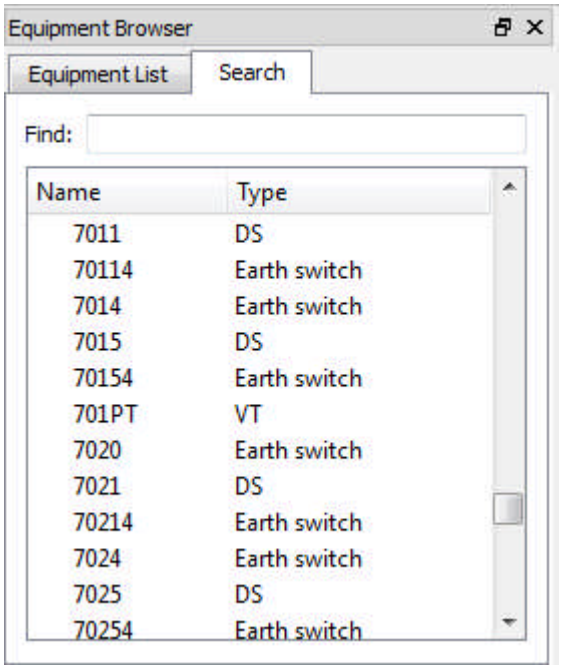


Figure 3.3-7

3.3.7 Find

Select “Find” under menu “View”; the “Find” dialog will pop up.

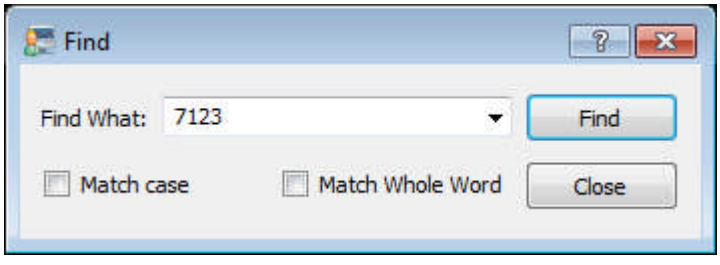


Figure 3.3-8 Find

In “Find What” editing box, input information to be found. Click “Find” button; the object found will be identified by red dashed line box in the graph, as shown below.

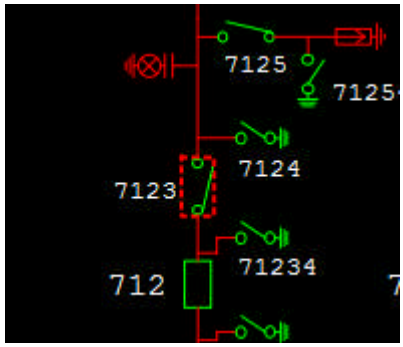


Figure 3.3-9 Locating equipment

3.3.8 Favorites

Select “Add to favorites” under menu “Favorites”; current graph will be added to “Favorites”. Right click a favorite graph to manage it, as shown below:

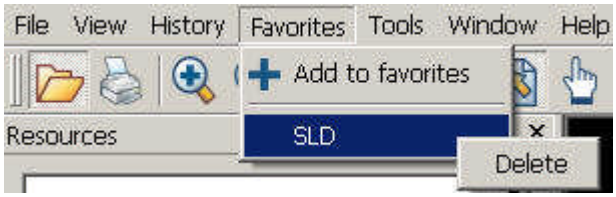


Figure 3.3-10 Management of favorites

3.3.9 Customize Toolbars

This function allows user to self-define displayed items of toolbar. Select “Customize Toolbars…” under menu “Tools”; the “Customize Toolbars” dialog shown in the figure below will pop up.

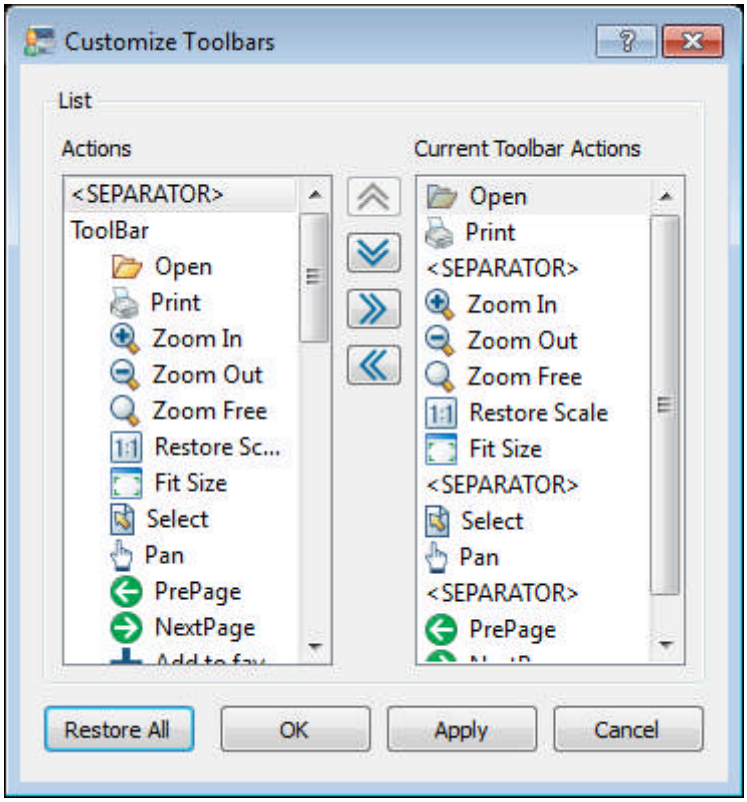


Figure 3.3-11 Customize toolbars

Add: add selected item to the “Current toolbar actions” list.

Delete: delete selected item from “Current toolbar actions” list.

Up: move this item up from its position on the Toolbar.

Down: move this item down from its position on the Toolbar.

Restore All: restore default Toolbar setup of the system.

3.3.10 Refresh Picture

Select “Refresh Picture” under menu “Tools” to reload current graph.

3.3.11 Refresh Tree

Select “Refresh Tree” under menu “Tools” to reload graph tree type list.

3.3.12 Context Menu Setup

This function allows user to self-define displayed items in case of right clicking of mouse. Select “Context Menu Setup” under menu “Tools”; the “Context Menu Setup” interface as shown in the figure below will pop up.

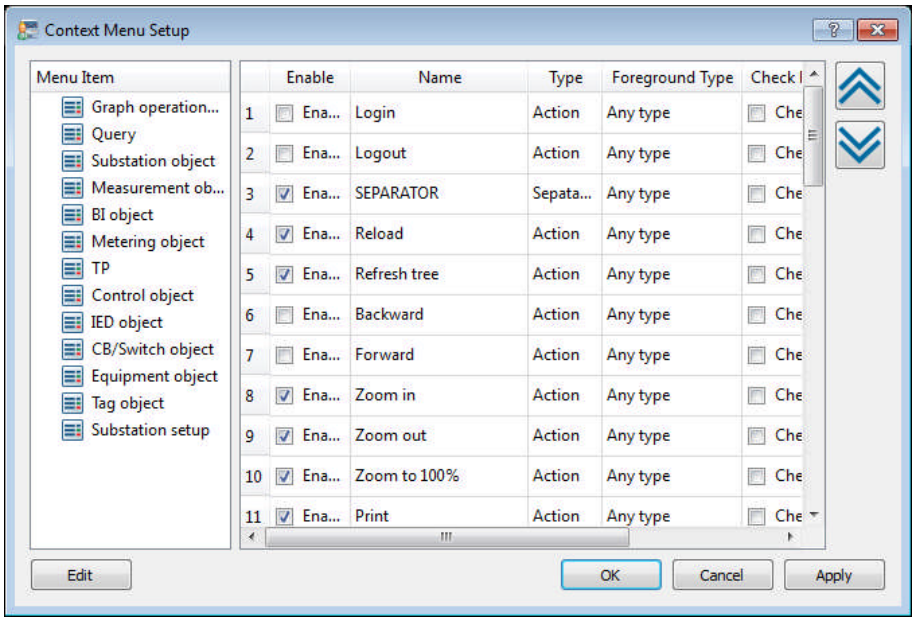


Figure 3.3-12 Context menu setup

- Edit: after clicking this button and authority check, user is allowed to edit context menu.
- Menu Item: menu items displayed after right clicking corresponding object.
- Enable: after checking Enable, this function will be displayed in the context menu.
- Name: user can modify displayed name of this function in the context menu.
- Check password: if selected, this function will require password check.
- Authority: if password check is selected, this item is usable. Here, user can set type of authority.
- Picture: configure icon of this menu item.
- Up: move this item up in the displayed position on the context menu.
- Down: move this item down in the displayed position on the context menu.

3.3.13 Options

Select “Options” under menu “Tools”; user can configure basic functions of the graph online.

3.3.13.1 Basic Setup

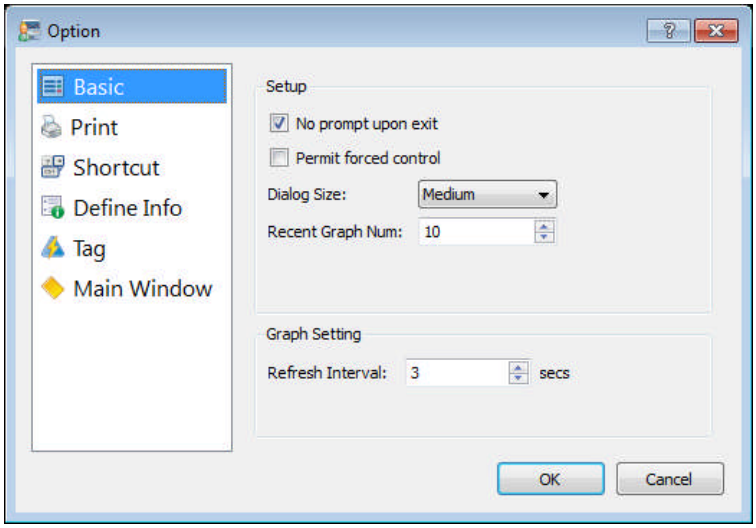


Figure 3.3-13 Basic setup

- No prompt upon exit: if enabled, no confirmation dialog box will pop up when closing graphic ONLINE.
- Permit forced control: if enabled, user can select forced tripping or closing during control operation; when disabled, the system will automatically judge forced tripping or closing according to current position of switch/circuit breaker during control.
- Dialog Size: sizes of dialog box popped up, context menu interface, and font size can be configured. User can select “Medium”, “Bigger”, “Biggest”, and “Auto-adjust”. “Auto-adjust” automatically selects sizes according to user screen resolution.
- Recent Graph Num: number of graphs recently opened will be displayed in the “History” menu.
- Refresh Interval: modify data refreshing frequency of current graph.

3.3.13.2 Print Setup

Please refer to *Section **3.3.2***.

3.3.13.3 Shortcut Setup

This function allows user to open specified graph via shortcut.

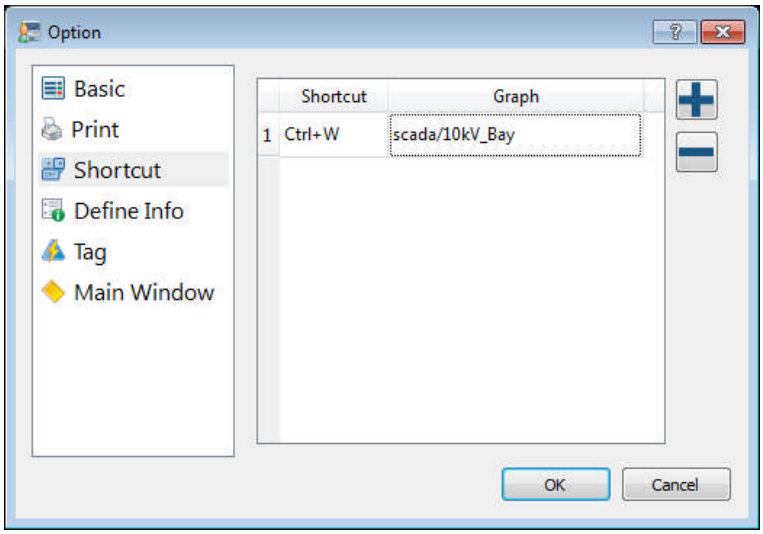


Figure 3.3-14Shortcut setup

- Add: add a shortcut definition entry.
- Delete: delete selected shortcut definition entry.
- Shortcut: click the cell and enter shortcut from keyboard.
- Graph: click the cell and select graphic file from the pull-down list.

3.3.13.4 Define Info Setup

User can define some numerical quantities or status quantities of concern on the Toolbar to facilitate monitoring.

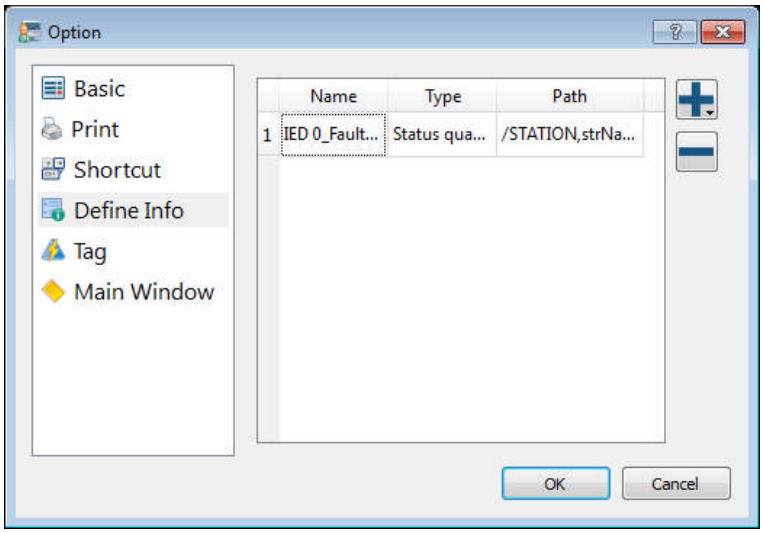


Figure 3.3-15 Defined info setup

- Add: add an item of self-defined information.
- Delete: delete selected self-defined information.

- Name: click the cell and modify displayed name.
- Type: status quantity or numerical quantity.
- Path: path of foreground.

The following describes an example of the process of adding self-defined information with numerical quantity. First, click "+" button, and select numerical quantity; the following dialog box will pop up:

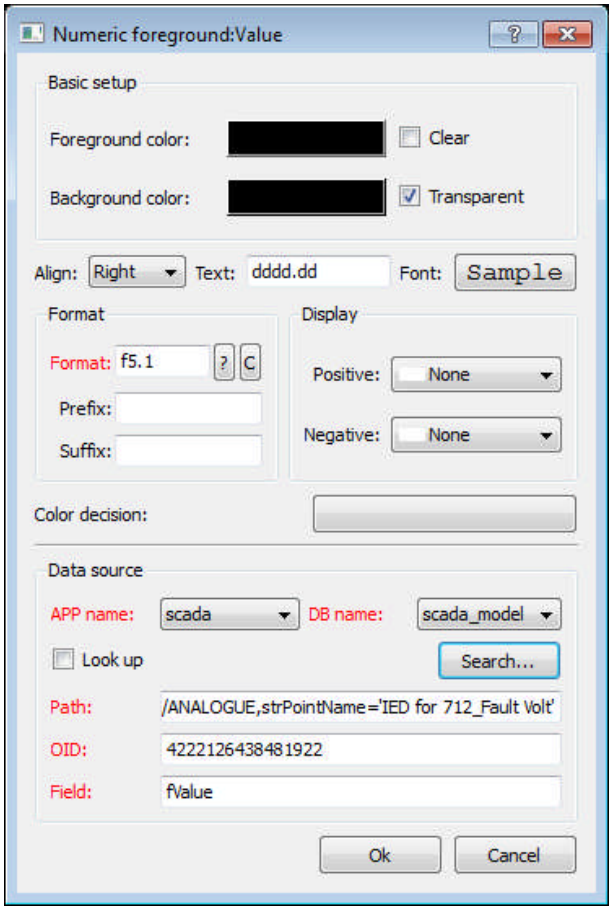


Figure 3.3-16 Foreground attribute box

Click "Search…" button to associate numerical quantity. After completion, click "OK" to exit. The effect is shown in the figure below.

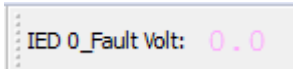


Figure 3.3-17 User-defined information

3.3.13.5 Tag Setup

Prompt message displayed when mouse over a tag can be changed here.

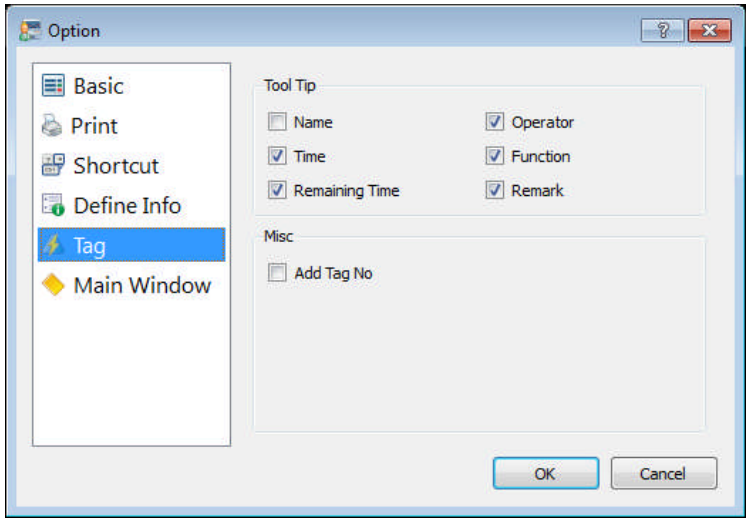


Figure 3.3-18 Tag setup

- **Name:** displays name of tag.
- **Operator:** displays operator.
- **Time:** displays time of tagging.
- **Function:** displays function of the tag.
- **Remaining time:** displays remaining time of the tag. When this time expires, the tag will be automatically canceled. If tag duration is not set, this item will be “N/A”.
- **Remark:** displays remark added by user.
- **Add Tag No.:** automatically adds tag No. for the same type of tag.

Effect of display after setup:

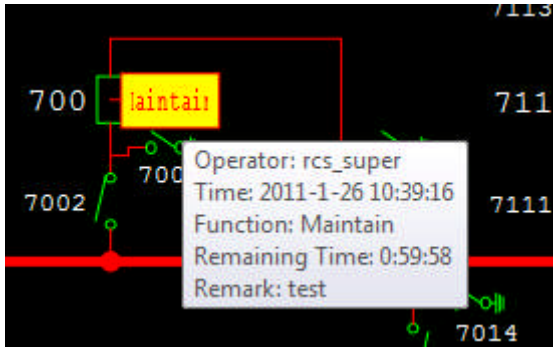


Figure 3.3-19 Tag prompt

3.3.13.6 Main Window Setup

This item can be used to change main window display.

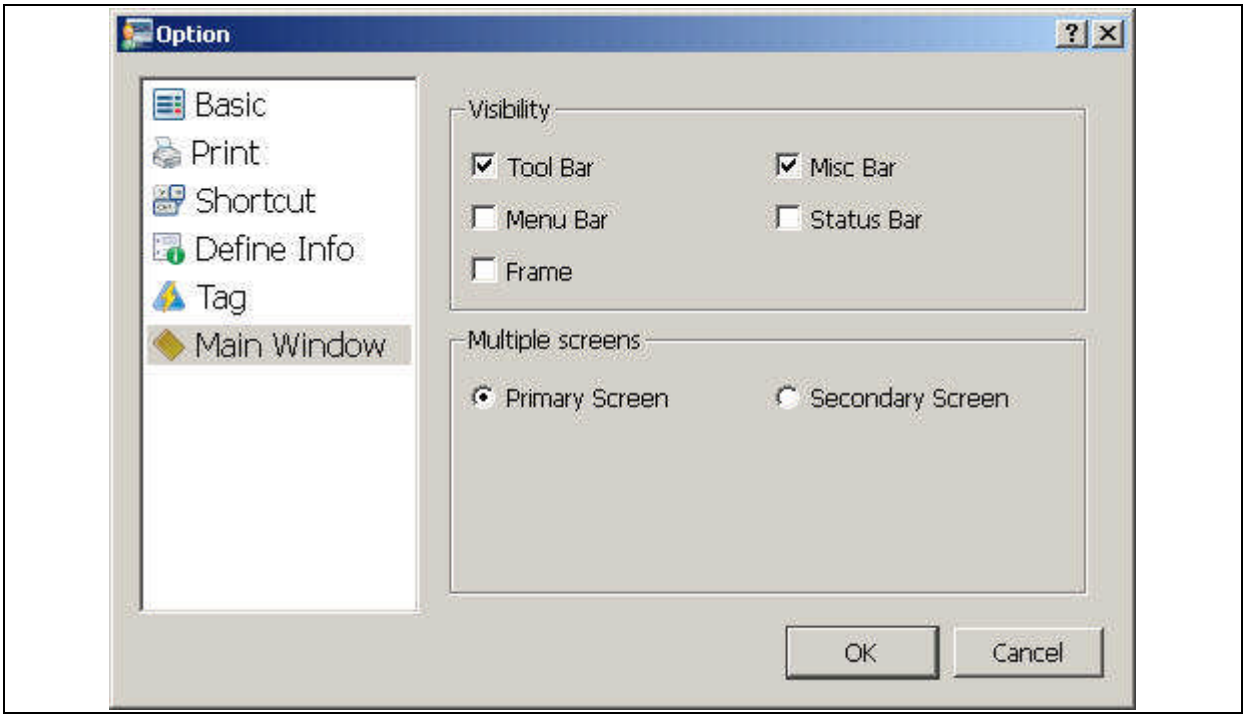


Figure 3.3-20 Main window setup

- **Visibility:** settings here determine certain components of main window are displayed or not.
- **Multiple screens:** select the screen of online graph when 2 screens are used.

After “Visibility”, display effect is as follows:

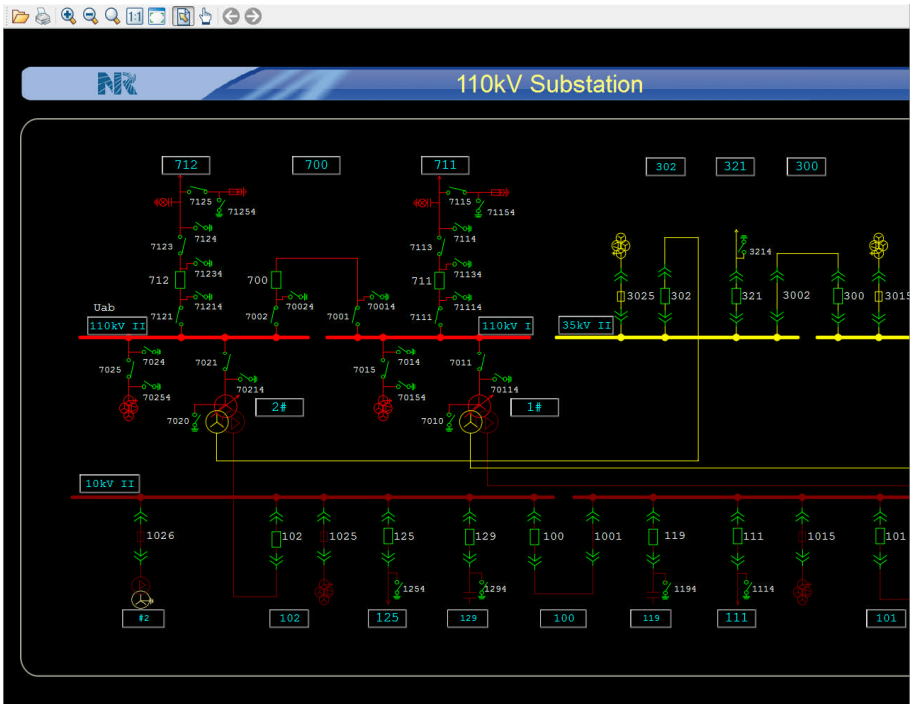


Figure 3.3-21 Main window

3.3.14 Import/Export Style

This function uses wizard mode to assist user to import or export online style of graph, including Toolbar, window borders, and dialog size. Select “Import/Export Online Style” under the menu “Tools”; the following dialog will pop up.

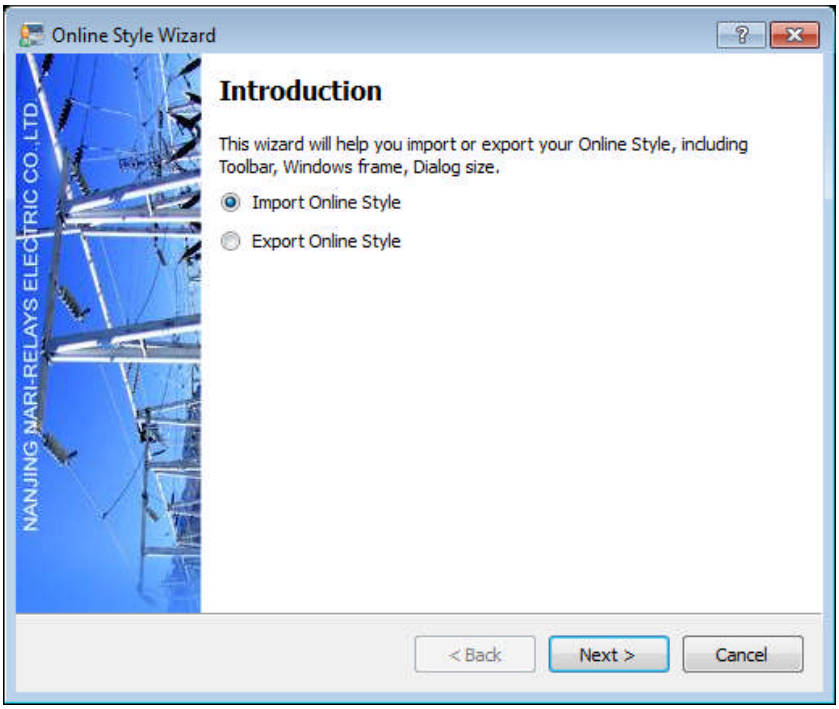


Figure 3.3-22 Select import or export

Select import or export of style as required.

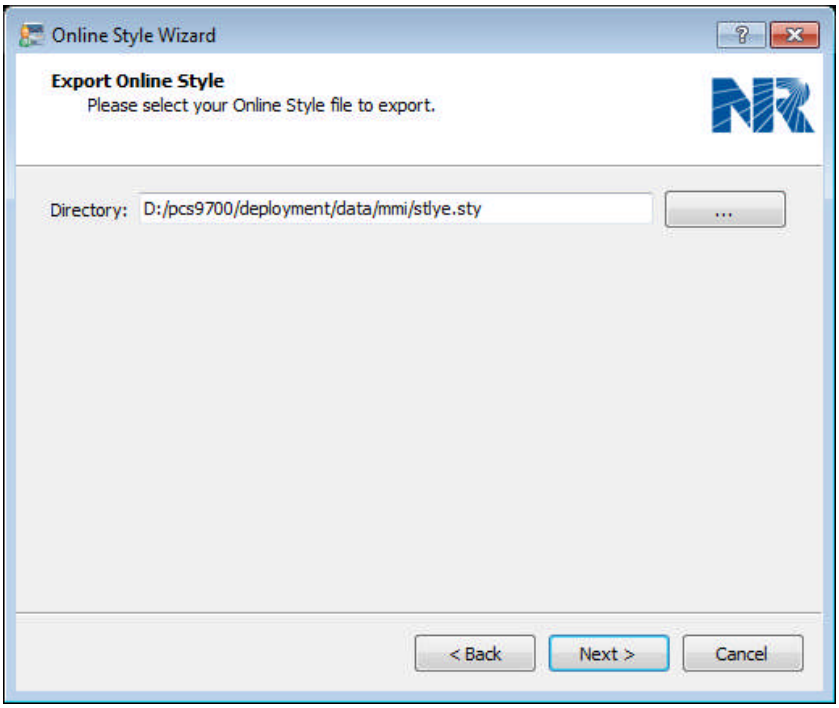


Figure 3.3-23 Select path

Select the style file to be imported or exported.

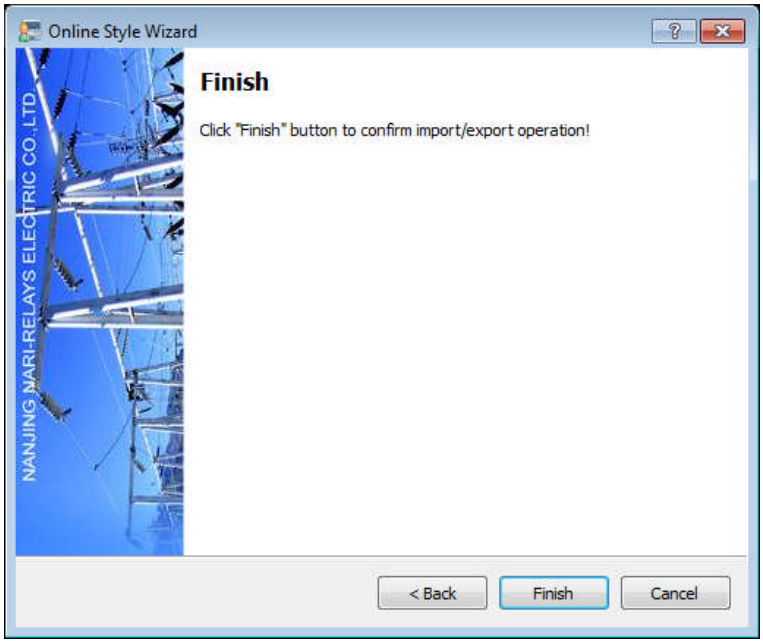


Figure 3.3-24 Complete import/export

After clicking Finish button, import/export will be validated.

3.4 Online Inquiry

3.4.1 Foreground Point Attribute

When the mouse is moved onto a foreground point, it will be changed to the shape of a hand, as shown below.

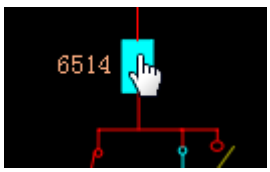


Figure 3.4-1 Foreground point

If this foreground point is associated to an object in database, left click mouse to pop up foreground point attribute dialog box.

3.4.2 Circuit Breaker/Switch Attributes

Click circuit breaker/switch equipment to pop up “Equipment attribute” dialog box as shown below.

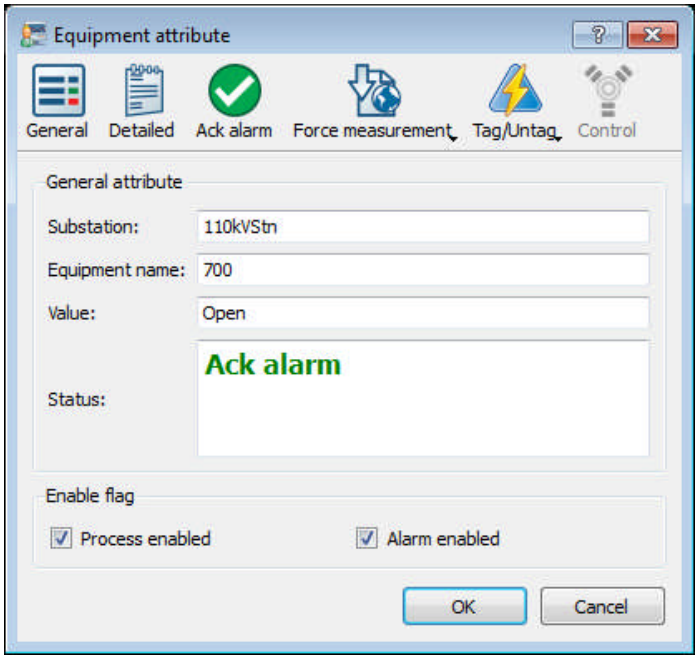


Figure 3.4-2 Equipment attribute

The general attributes display general view of status of this measuring point or equipment.

- Substation: name of substation to which current object belongs.
- Equipment name: name of current object.
- Value: trip/close status of current object.
- Status: status of current object.
- Enable flag: after clicking each item in Enable flag, and passing authority check, user can change Enable flag of current object.

3.4.3 General Equipment Attribute

Click General equipment to pop up “Attribute” dialog box.

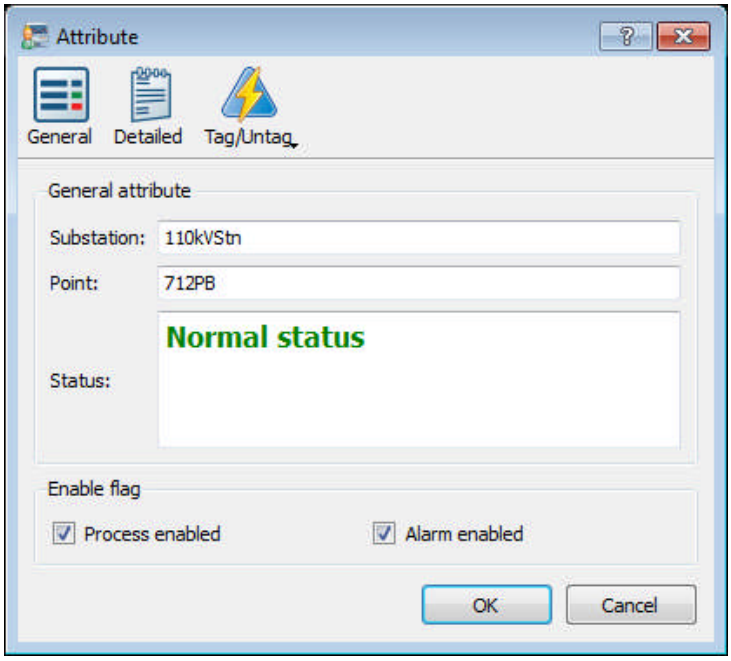


Figure 3.4-3 Equipment attribute

Please refer to *Section* ***3.4.2*** for general information.

3.4.4 Measurement Attribute

Click measurement foreground point to pop up “Measurement attribute” dialog box.

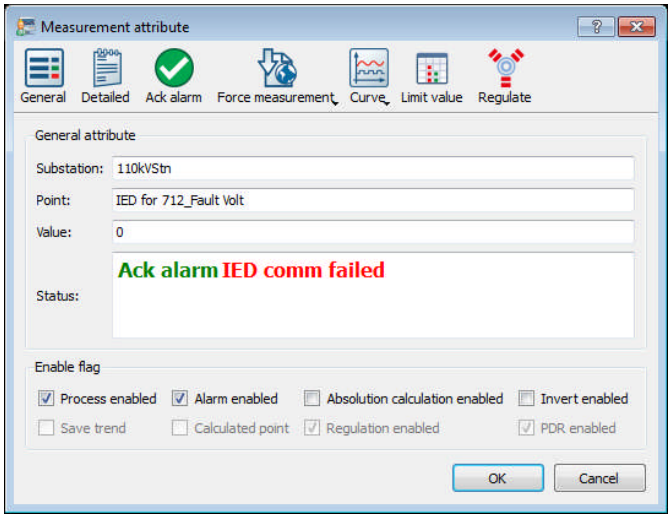


Figure 3.4-4 Measurement attribute

Please refer to *Section* ***3.4.2*** for general information.

3.4.5 BI Attribute

Click BI foreground point to pop up “BI attribute” dialog box.

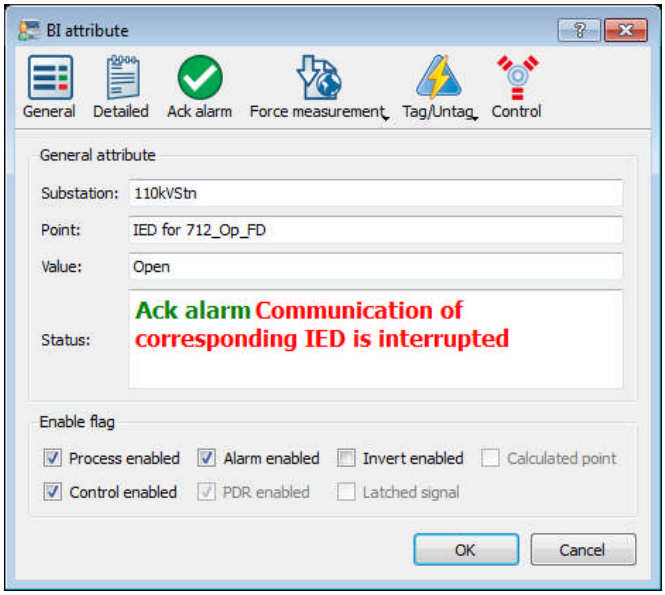


Figure 3.4-5 BI attribute

Please refer to *Section* ***3.4.2*** for general information.

3.4.6 Metering Attribute

Click metering foreground point to pop up “Metering attribute” dialog box.

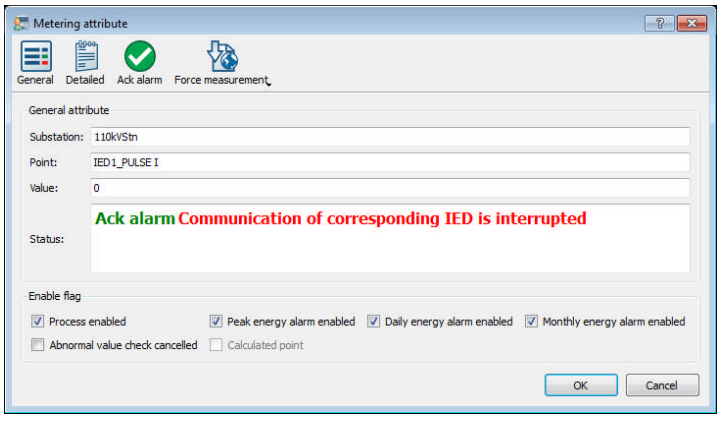


Figure 3.4-6 Metering attribute

Please refer to *Section* ***3.4.2*** for general information.

3.4.7 TP Attributes

Click TP foreground point to pop up “TP attribute” dialog box.

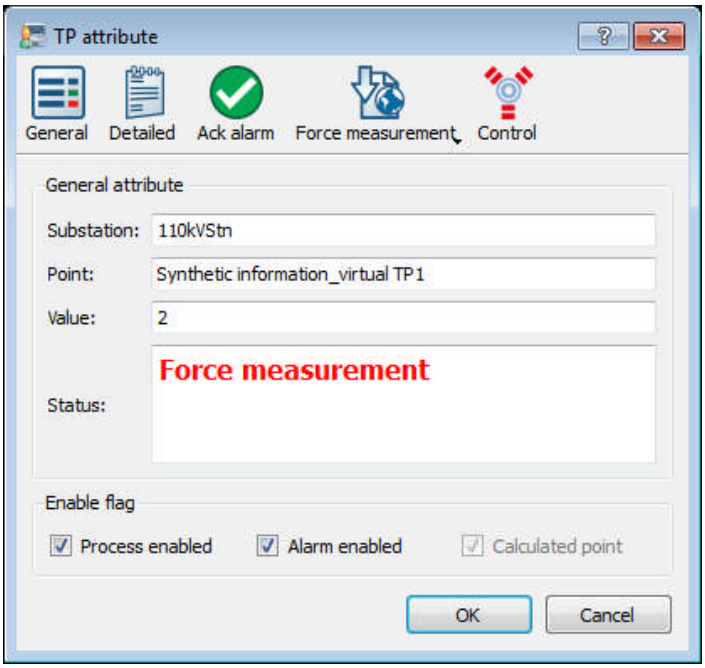


Figure 3.4-7 TP attribute

Please refer to *Section* ***3.4.2*** for general information.

3.4.8 Device Attribute

Click a point with device foreground to pop up a dialog box shown below.

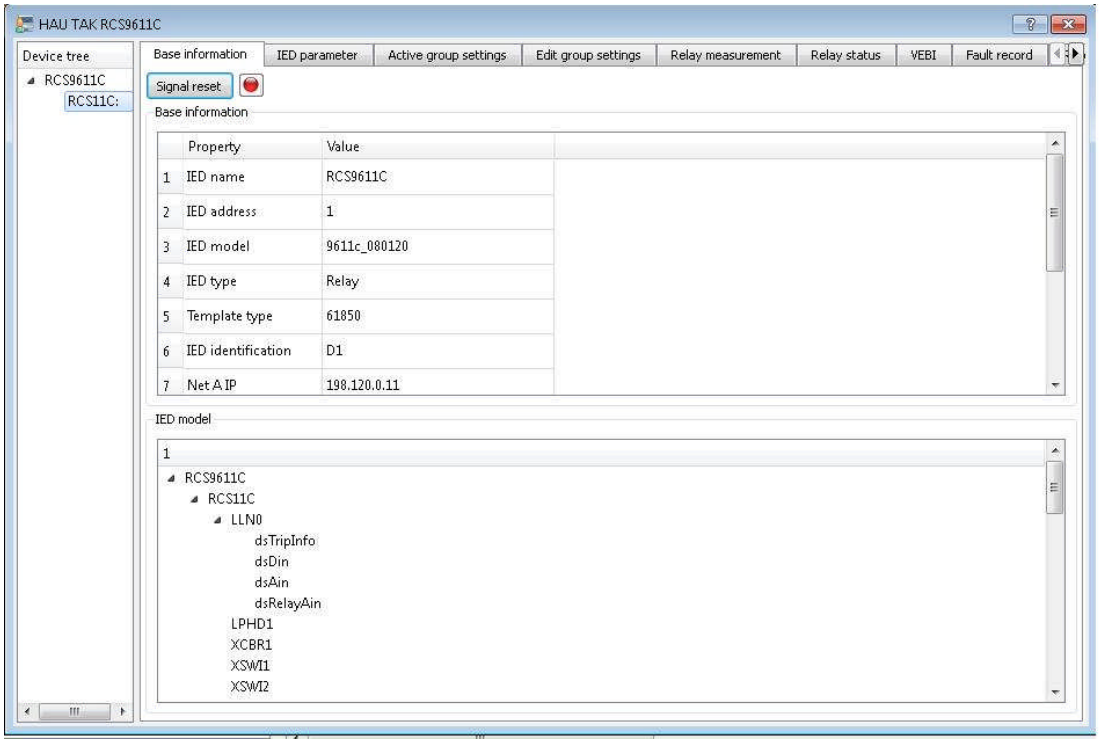


Figure 3.4-8 Basic information

3.4.8.1 Basic Information

The indicator is used to display device communication status.

Signal reset: click signal reset button to reset signal of the device.

3.4.8.2 Other Attributes

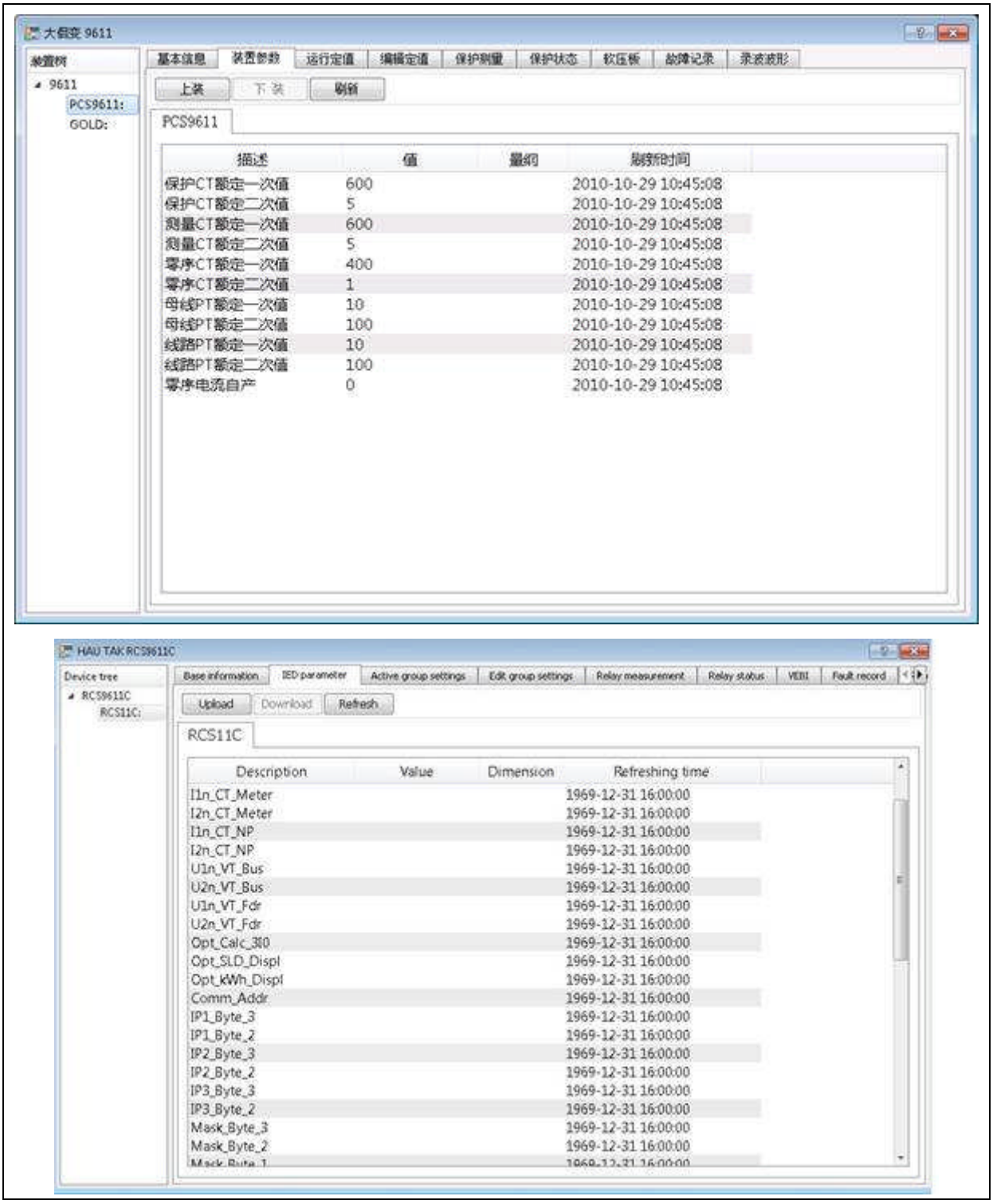


Figure 3.4-9 IED parameter

- IED parameter: display the device parameters.
- Active group settings: display the active group settings.
- Edit group settings: . display the edit group settings.
- Relay measurement: displays measured quantities acquired by the device.
- Relay status: displays current status of the device; Downloading function is not provided for relay status.
- VEBI: display and modify VEBI (virtual enabling binary input, i.e.: virtual link).
- Fault record: Please refer to the following sections for more details.
- History events: only refreshing command is available. Please input time range, CPU No., and event type and click Refresh button to display history event information related to selected device. This attribute can be configured to be displayed or hidden by configuring the "relaymmi.ini" file in the folder "pcs9700/deploymen/tetc/relay".
- Recorded waveform: Please refer to the following sections for more details.
- Upload: upload content of the information viewing window. All functional options can be uploaded.
- Download: download contents of user modification in the information viewing window. Contents that can be downloaded include protection settings, setting group No., and VEBI.
- Refresh: refresh all information in all functional windows. Different from Upload operation, this operation refreshes both numerical quantities and description quantities, not just value quantities in the window.

3.4.8.3 Fault Record

Searching can be carried out according to start time and end time. Fault distance, Fault phase, Relevant operation element, Relevant relay measurement, and Relevant event can be displayed as shown in the following figure.

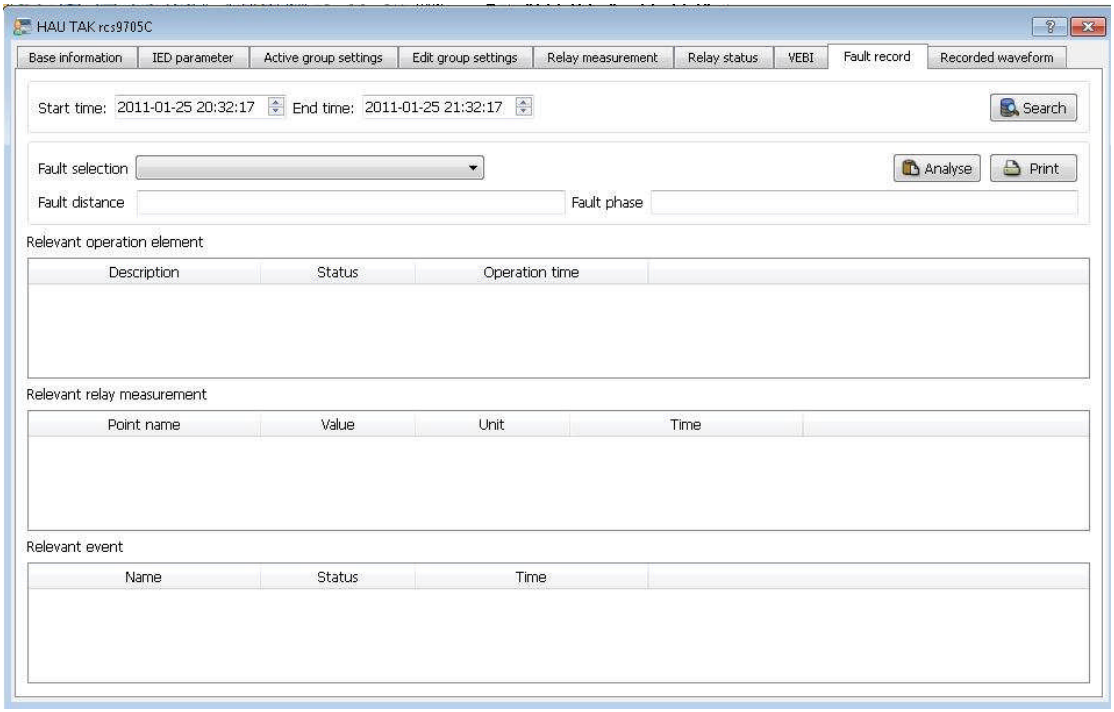


Figure 3.4-10 Fault record

Click **Analyse** button to analyse particular waveform file.

3.4.8.4 Recorded Waveform

At upper part of the information view, there are 4 operation buttons: Search, Wave List, Wave File, and Manage.

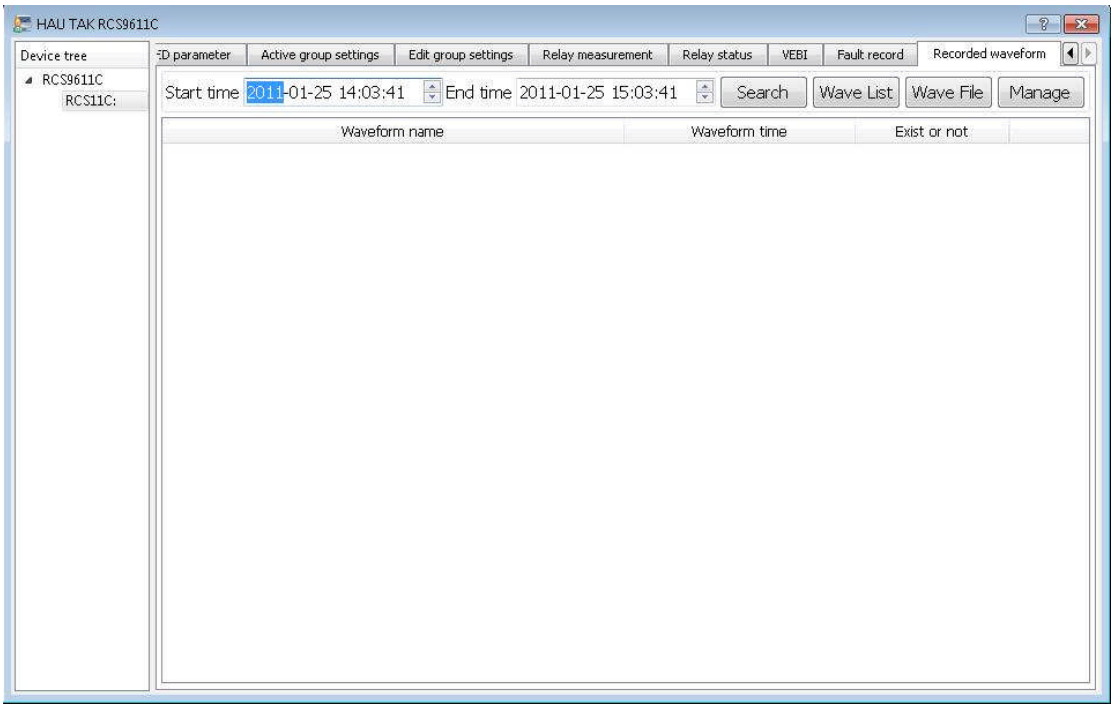


Figure 3.4-11 Recorded waveform

- Search: search waveform file of specified device from database and obtain display of waveform file list.
- Wave List: call and obtain waveform file list from specified device.
- Wave File: from waveform file list, select a waveform file not existing in database and click “Wave File”, to call this waveform into database.
- Manage: select a waveform and double click to analyze this waveform.

3.5 Online Operations

3.5.1 Alarm Acknowledgement

Click “Ack alarm” button in the Attribute dialog box, to acknowledge alarm information of current object.

3.5.2 Force measurement

Click “Force measurement” button in the Attribute dialog box to force measurement for current object.

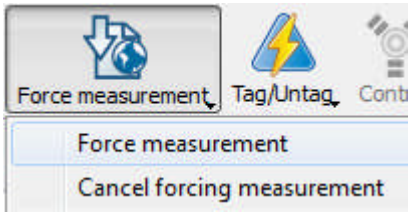


Figure 3.5-1 Force measurement

3.5.2.1 Force measurement

Click “Force measurement” in above menu. After passing authority check, Force measurement dialog box will pop up.

In case the object is circuit breaker/switch or BI type foreground, the Force measurement dialog box is shown as below.

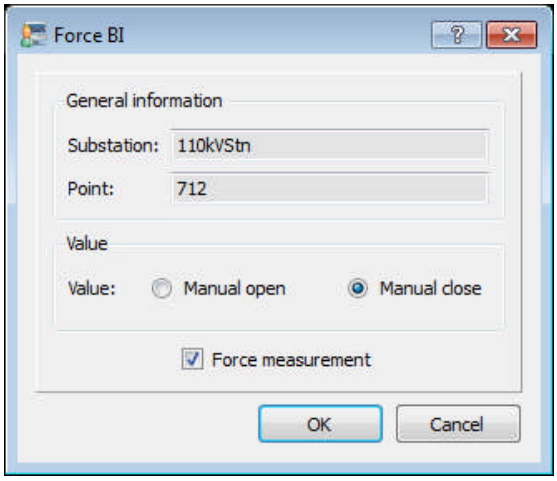


Figure 3.5-2 Force measurement for circuit breaker/switch and BI object

Select “Manual open” or “Manual close”, and click “OK” button to complete Force measurement.

In case the object is under the foreground type of measurement, metering, or TP, the Force measurement dialog box is shown as below.

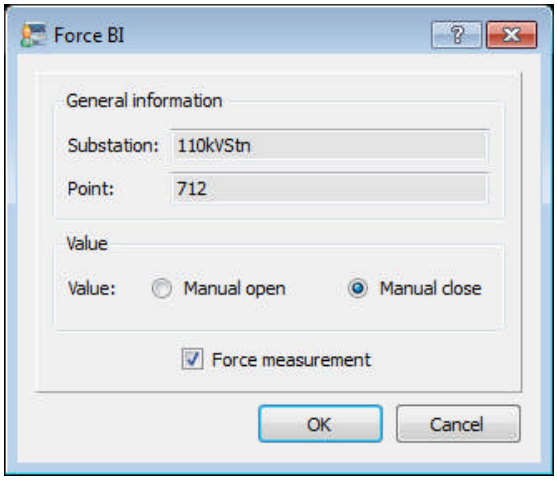


Figure 3.5-3 Force measurement for measurement, metering, and TP objects

In case input value does not match the type of current object, the following dialog box will pop up:

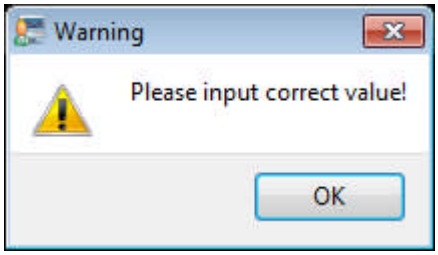


Figure 3.5-4 Warning dialog box

3.5.2.2 Cancel Forcing Measurement

Click “Cancel forcing measurement” in the menu; after check of authority, Force measurement for current object will be canceled.

3.5.3 Tagging

In case current object is equipment foreground, click the button in the Attribute dialog box to tag current object.

Figure 3.5-5 Tagging

3.5.3.1 Tagging

Click “Tag” in above menu. After check of authority, Tag dialog box will pop up.

In case the object is equipment type foreground, tagging is shown as below.

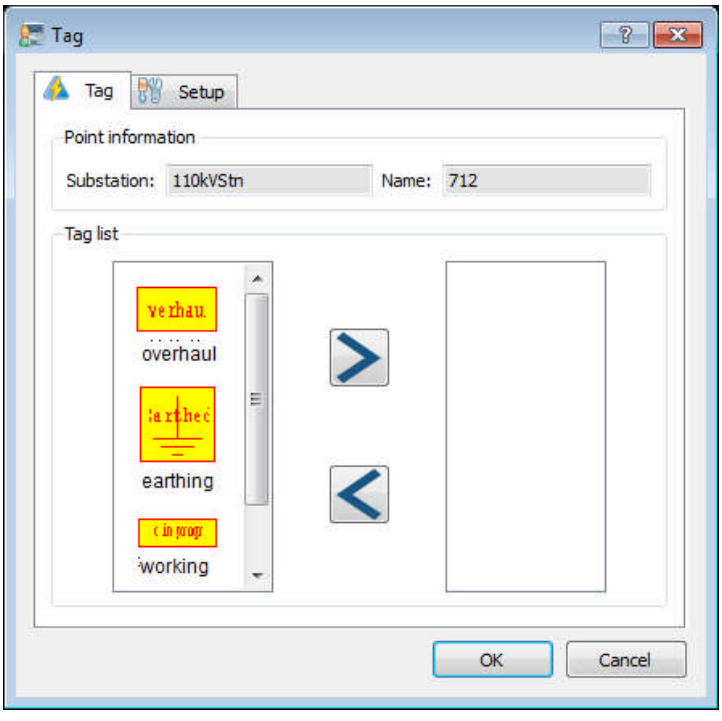


Figure 3.5-6 Tagging

Add: add a tag.

Delete: delete a tag.

For each object, more than one tag can be attached. After clicking OK, the tags will be automatically arranged near the object.

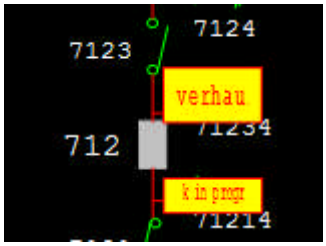


Figure 3.5-7Tagging

3.5.3.2 Tag Setup

Click “Setup” page to enter the following interface, where tag setup can be carried out.

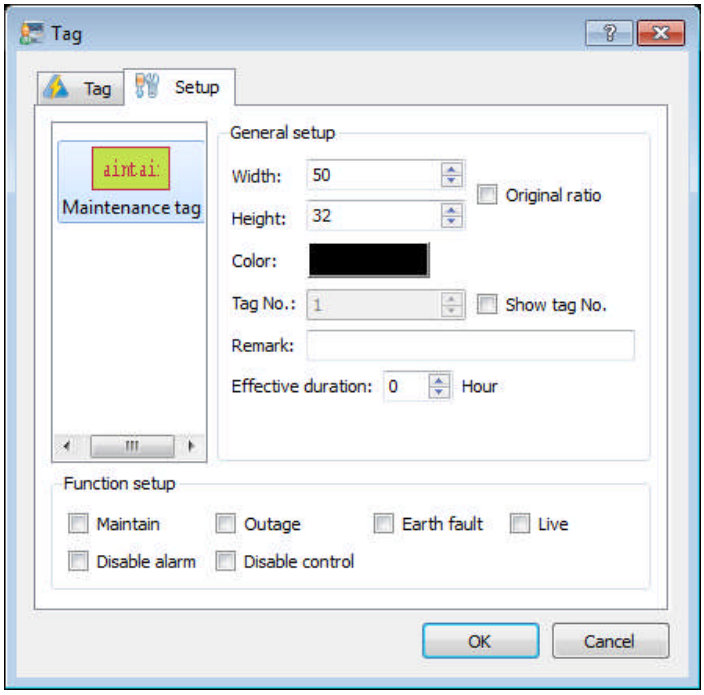


Figure 3.5-8 Tag setup

- Width: set width of tag
- Height: set height of tag
- Original ratio: if checked, original ratio can be maintained after resizing
- Color: color of tag
- Tag No.: after checking “Show tag No.”, No. can be attached to tags of the same type

- Remark: operator can add a remark to the tag. This remark will be displayed when mouse over the tag.
- Effective duration: timing will start after tagging or modification of tag; when this duration expires, this tag will be automatically untagged.
- Function setup: actual functions corresponding to this tag.

3.5.3.3 Untag

- Untag all tags: click “Untag” in the menu. After check of authority, all the tags attached to current object will be deleted.

3.5.4 View Curve

In case current object is a numerical type foreground, user can click “View curve” button  in the Attribute dialog box to view history and real-time curves of current object.

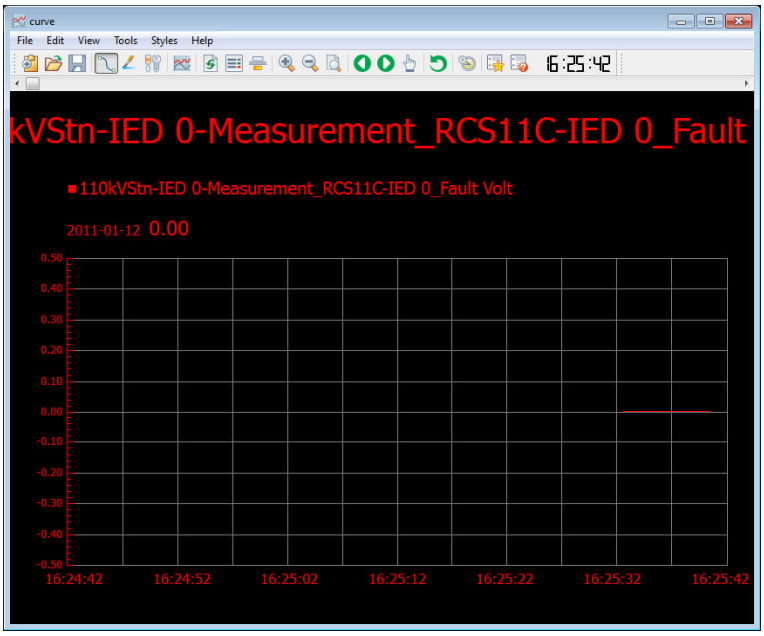


Figure 3.5-9 Curve

3.5.5 Viewing and Modification of Limit

In case current object is a numerical type foreground, if this object is associated to a limit, user can click “View limit” button  in the Attribute dialog box to view and modify limit values corresponding to current object online. After clicking “Edit” button, user can modify limit values online.

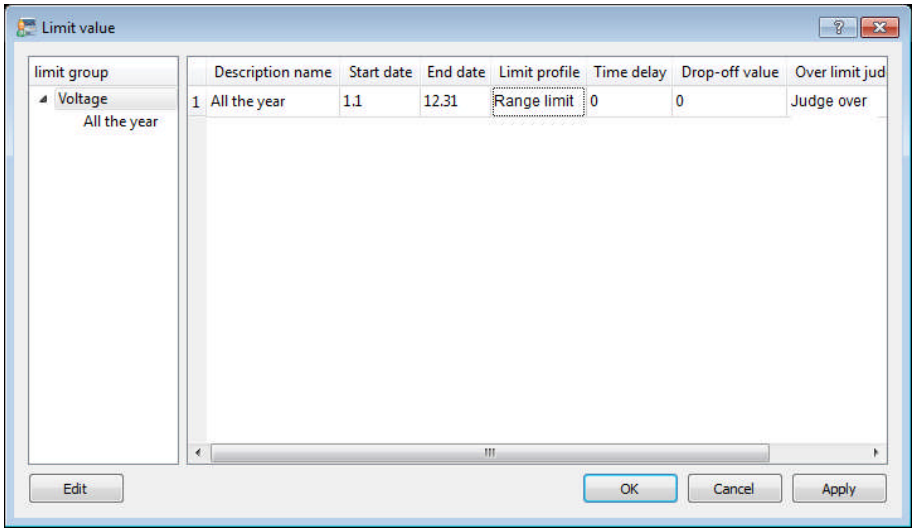


Figure 3.5-10 Viewing and modification of limit values

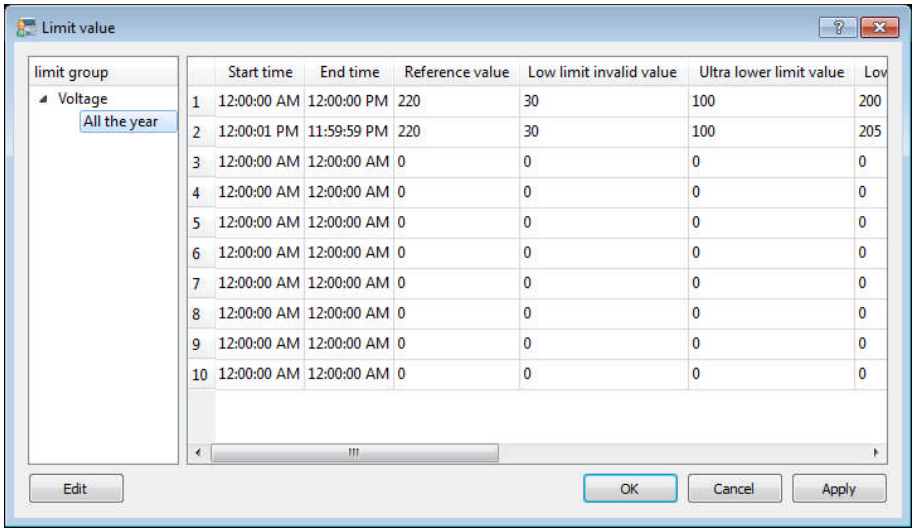


Figure 3.5-11 Viewing and modification of limit values

3.5.6 Batch Enable/Disable VEBI

This function allows user to enable/disable all VEBI of current graph in batch. To begin, right click mouse at a blank place on the graph and select “Batch Enable/Disable VEBI”, as shown below.

NOTE: If this function is not provided in the context menu, please refer to *Section* ***3.3.12*** to enable this function.

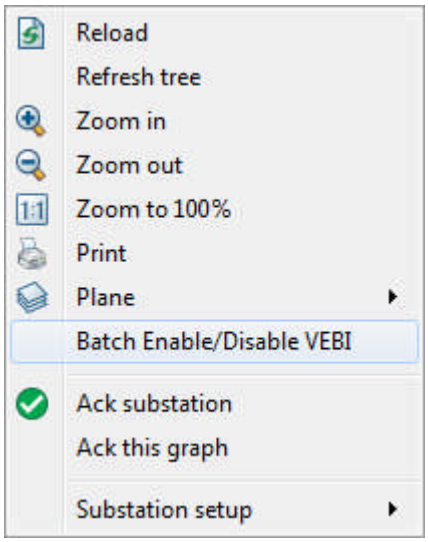


Figure 3.5-12 Batch enable/disable VEBI

Select “Batch Enable/Disable VEBI” to pop up the interface below.

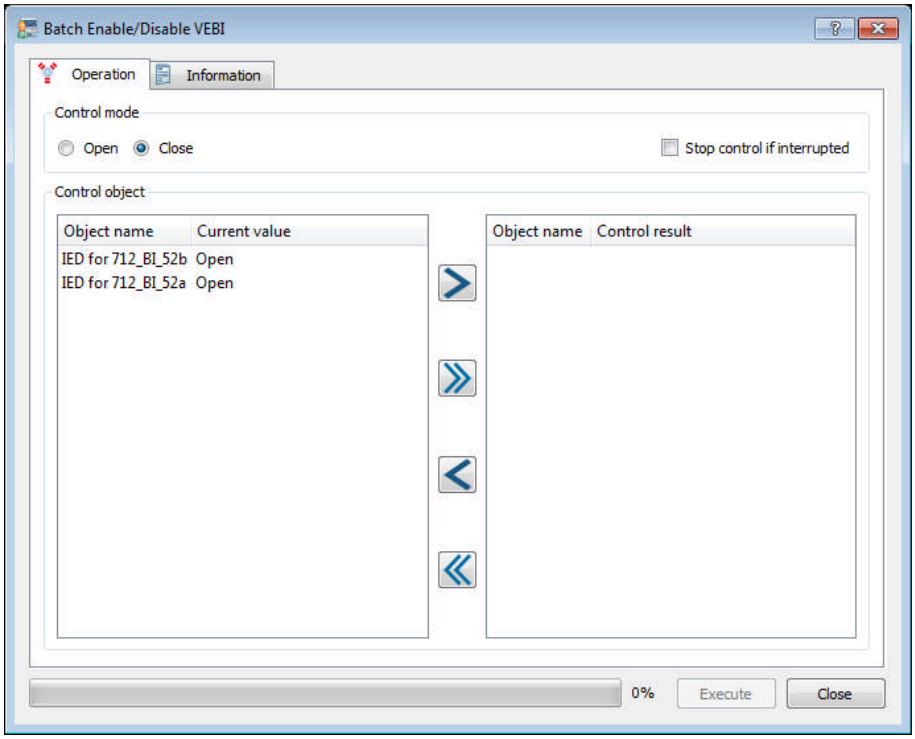


Figure 3.5-13 Operation interface to batch enable/disable VEBI

- Control mode (Open/Close): modes of batch enable/disable VEBI
- Stop control if interrupted: after this item is checked, if execution of an intermediate item fails, enabling/disabling of remaining VEBI will stop; otherwise this operation will continue.
- > Add: add currently selected items.

- Add all: add all items.
- Delete: delete currently selected items.
- Delete all: delete all items.

Click “Information” page to view particular information of each step of execution, as shown below.

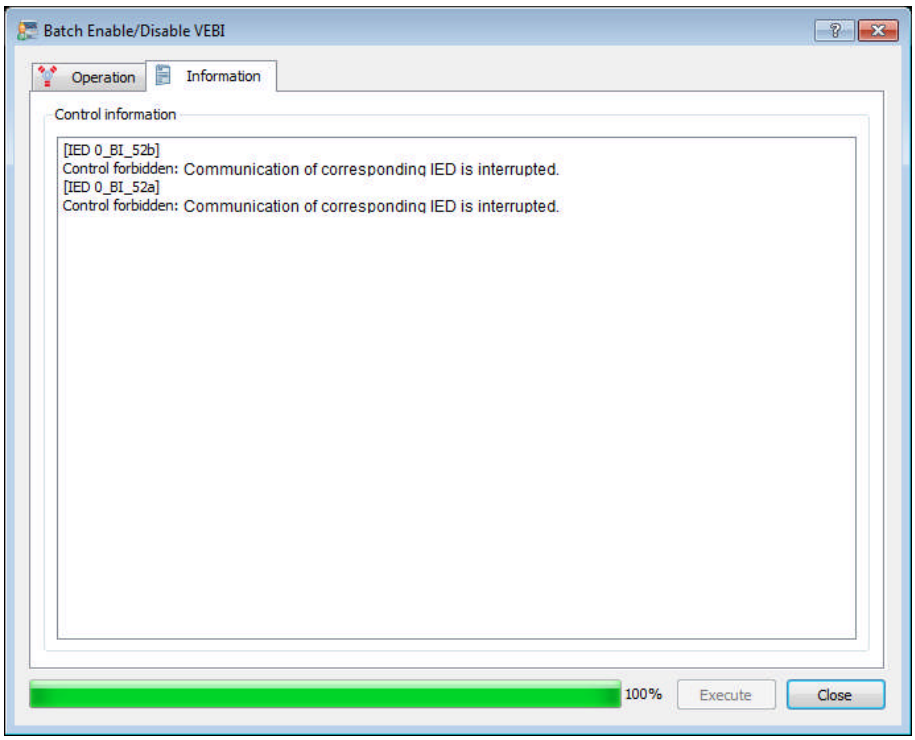


Figure 3.5-14 Operation information

When all operations are completed, the following prompt will pop up.

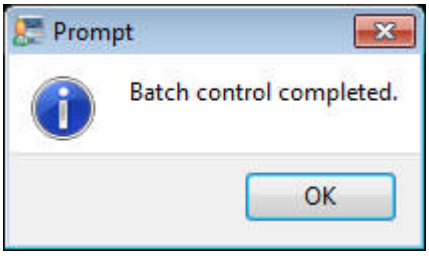


Figure 3.5-15 Completion of operations

After all operations are executed, summarized results of each step of operation are available for review, as shown below.

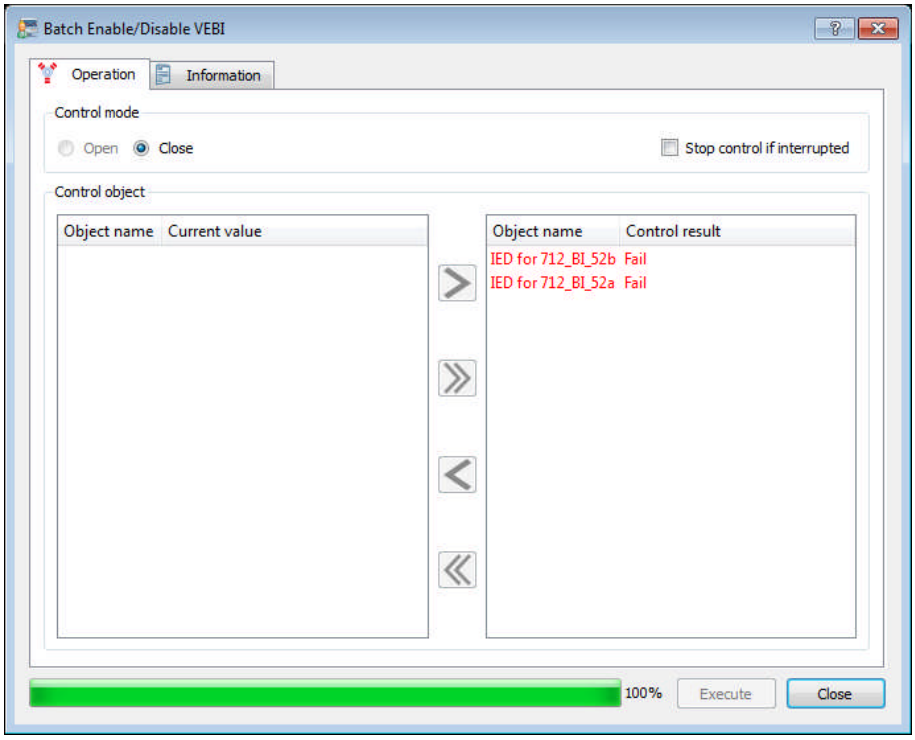


Figure 3.5-16 Operation results

3.5.7 Control Operations

3.5.7.1 Telecontrol Operations

Telecontrol can be carried out for 3 types of foregrounds: CB, BI points, and telecontrol foreground points. In the Attribute dialog box, click “Control” button (if this object cannot be remotely controlled, this button will be greyed).

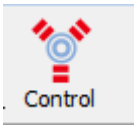


Figure 3.5-17 Control button

The Control dialog box as shown below will pop up.

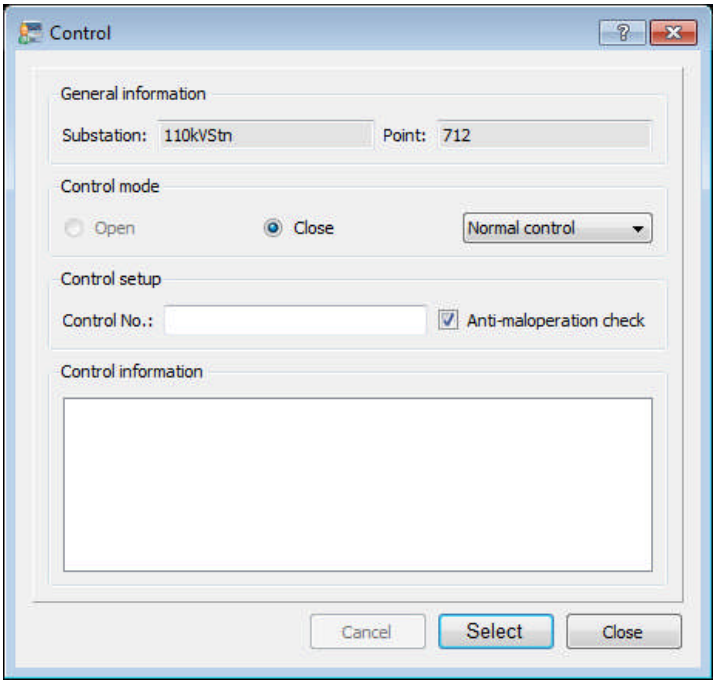


Figure 3.5-18 Telecontrol operations

- Open, close: modes of telecontrol operation
- Control mode: user can select “Normal control”, “Synchronism-check”, “Dead check”, or “No check”.
- Control No.: If “Dispatch No. check TC” is enabled in system configuration tool “configmain” and “Dispatch No.” has been set for the telecontrol object, user can only perform telecontrol after entering correct dispatch No.
- Anti-maloperation check: telecontrol shall be subject to anti-maloperation rule check.
- Control information: displays failure or success prompt message of current control operation

Click “Select” button in above figure to pop up authority check dialog box as shown below.

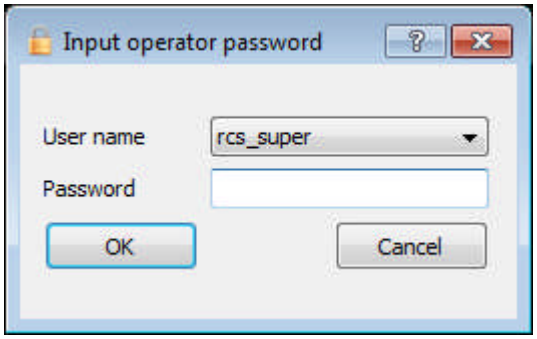


Figure 3.5-19 Check of operator

After successful check, if guard function is enabled in system configuration tools, user will need to

input guardian password before proceeding. If non-local guard is configured in system configuration and guard node is not local, Check guardian dialog box will pop up at specified guard node. If the guard node has not passed guardianship within a set time, this will be automatically switched to local guard. The operator and the guardian must not be the same person.

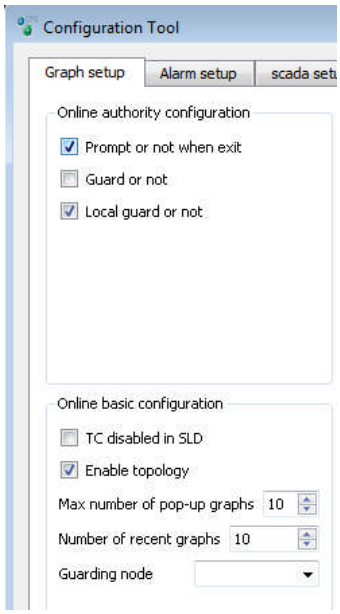


Figure 3.5-20 Setup of telecontrol monitoring options

After passing authority check, telecontrol selection operation will start, as shown below. After successful selection, the "Select" button will change to "Execute". Click this button to execute telecontrol operation.

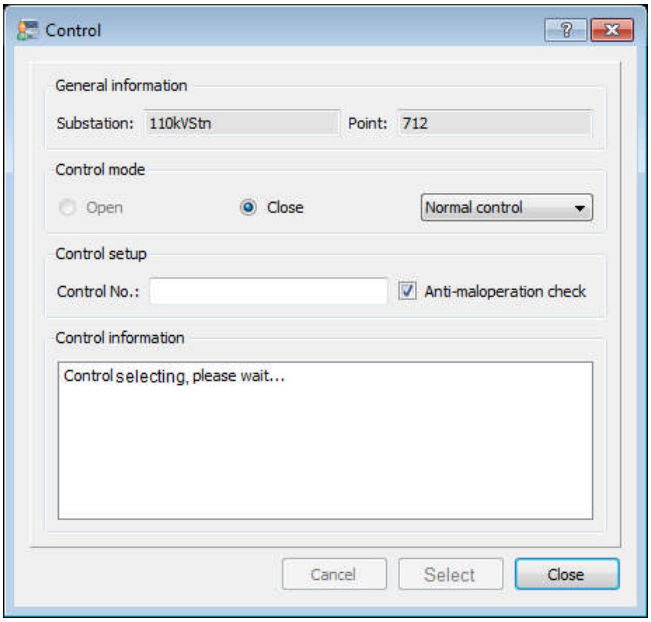


Figure 3.5-21 Telecontrol operation

NOTE: When type of telecontrol is set to “Sudden stop” or “Direct control”, there is no telecontrol selection step for telecontrol operations.

3.5.7.2 Step up/down Operations

Step up/down operations can be used for two types of foregrounds: TP and telecontrol foreground points. Click “Control” button on the Attribute box (unusable if this object cannot be remotely controlled) to pop up Step up/down dialog box.

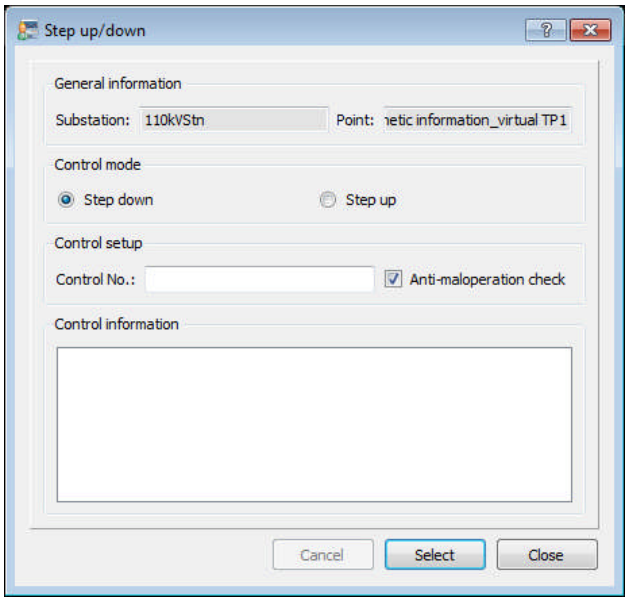


Figure 3.5-22 Step up/down operations

The operation method is the same as described in *Section **3.5.7.1***.

3.5.7.3 Regulation Operation

Regulation can be carried out for measurement and remote control foreground points. Click “Regulate” button on the Attribute box (unusable if this object cannot be remotely controlled).

Figure 3.5-23 Regulate button

After clicking “Regulate” button, Regulate dialog box will pop up.

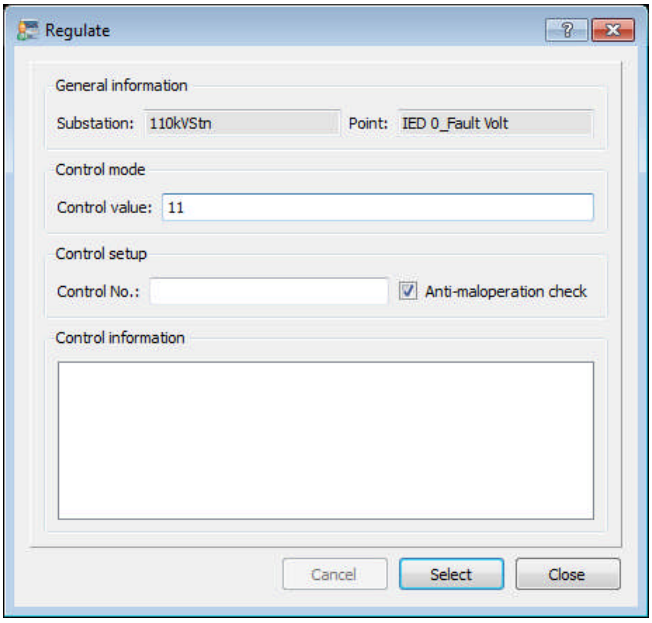


Figure 3.5-24 Regulate operation

Input value of regulation in “Control value”.

The operation method is the same as described in *Section* ***3.5.7.1***.

4 Alarm and Event Record

4.1 General

The alarm and event record system is a sub-system of PCS-9700 background monitoring system. It performs real-time alarm processing for displacement of various binary quantities, overreach of analog quantities, monitoring system self-diagnosis events, and various operation events acquired by the HMI system, provides real-time alarm service for substation operating personnel, and prompts operating personnel for timely handling. Alarm and event records include real-time alarm window and history events retrieval.

4.2 Real-time Alarm Window

4.2.1 Start of Real-time Alarm Window

Start of the console will automatically start the real-time alarm window. Or, user can enter “alarm_mmi” at the command terminal to start real-time alarm window. Click “Raise alarm” on the console to display real-time alarm window in the foremost of all windows.

On one node, only one real-time alarm window can be started.

4.2.2 Real-time Alarm Window

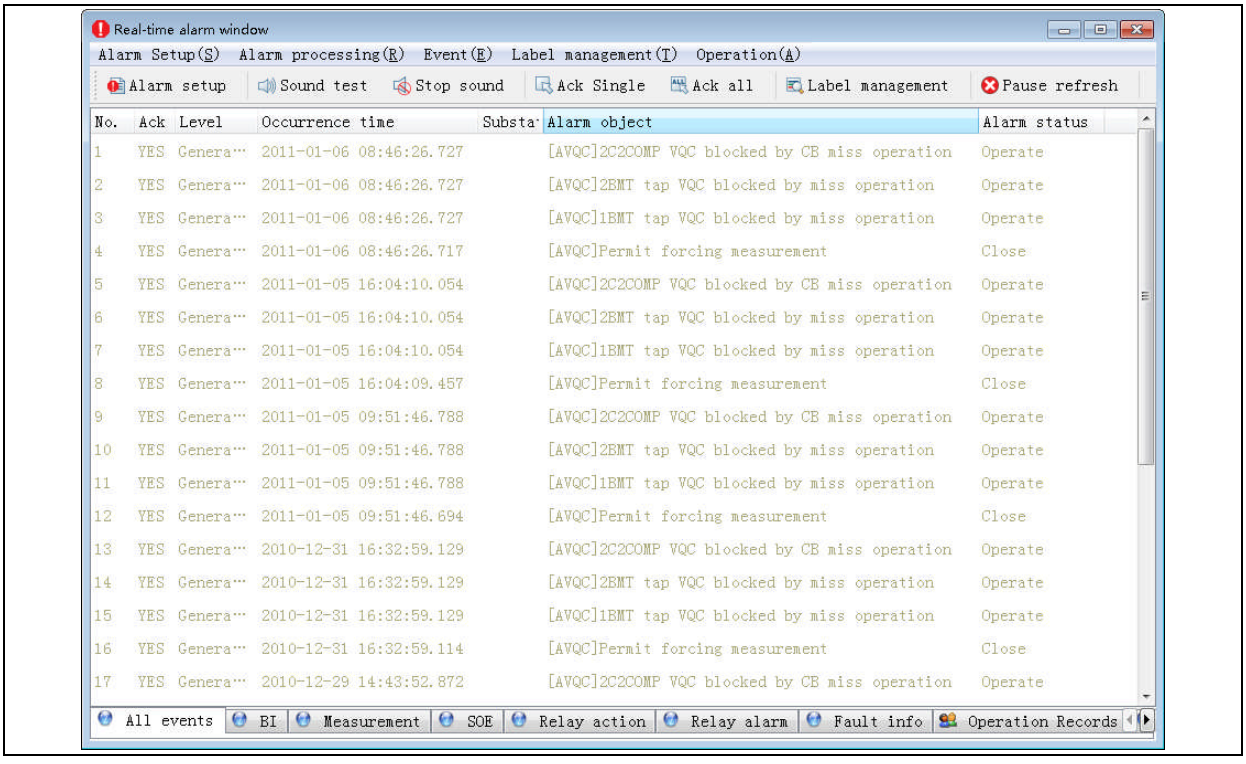
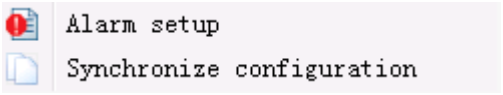
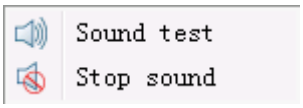
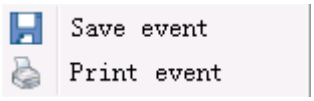
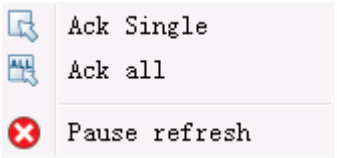


Figure 4.2-1 Real-time alarm window

The real-time alarm window is as shown above. It includes a menu bar, a tools bar, alarm tabs, and event list box.

4.2.3 Real-time Alarm Menu Bar

Table 4.2-1 Real-time alarm menu bar

Menu	Menu item	Function
Alarm setup 	Alarm setup	Pop up Alarm Setup dialog box to set alarms
	Synchronize configuration	Synchronize alarm configuration file on this node to other nodes. Alarm configuration of such other nodes will be replaced.
Alarm processing 	Sound test	Play a segment of alarm audio to test if audio is normal
	Stop sound	Stop audio currently being played
Event 	Save event	Save selected alarm events in event list box as text file. If no event is selected, all events in this list will be saved.
	Print event	Print selected alarm events in event list box on current tab page. If no event is selected, all alarm events in current list box will be printed.
Label management 	Modify label	Pop up “Label management” dialog box to modify current label definition
	Add label	Pop up “Label management” dialog box to add a new alarm label
	Delete label	Delete currently selected alarm label
	Label management	Pop up “Label setup” dialog box, in which user can adjust label sequence and modify, add, or delete label etc.
Operation 	Ack Single	Acknowledge a selected alarm event in current event list; authentication is required before proceeding
	Ack all	Acknowledge all events in current event list box; authentication is required before proceeding
	Pause refresh	When pause refreshing is selected, events in the event list box will not be refreshed.

4.2.4 Real-time Alarm Tools Bar

Some common operations of the menu bar are placed on the tools bar, as shown below.

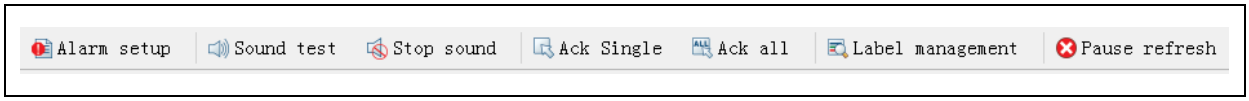


Figure 4.2-2 Tools bar

4.2.5 Alarm Labels

By defining different labels, alarm events can be graded, classified and displayed in layers, and this facilitates the analysis of alarm events by operating personnel. Each label corresponds to an event filtering condition. Through switching among different labels, the event list box can display only the events that satisfy current alarm label condition. Whenever an unidentified alarm event is spotted in a certain label, a red alarm LED will be displayed on this label; otherwise, a green alarm LED will be displayed if everything is under normal condition. Typical label definitions are given in the table below.

Table 4.2-2 Alarm labels

Label	Description
All types	Display all events except operation record events
BI	Display all BI displacement alarm events
Measurement	Display all alarm events related to measurement
SOE	Display all SOE events, including circuit breaker, switch shift, protection actions and protection alarms, etc.
Protection operation	Display related events of protection operation
Protection alarm	Display related events of protection alarms
Fault info	Display protection fault info, including fault measurement, fault current and fault wave-record, etc.
Operation record	Display all operation recording events, e.g. remote control operation record and setting modification record
System event	Display all system events, e.g. switching of application duties and abnormal process etc.
Signal not reset	Display all BI signals not reset in the system

4.2.6 Alarm Event List Box

An alarm event includes fields of “No.”, “Acknowledgement”, “Class”, “Time of occurrence”, “Station”, “Alarm object”, and “Alarm action”. Display of columns in alarm list box can be manually set. Latest alarm event is displayed in the foremost position. Different types and classes of events can be discriminated by different colors.

Select an alarm event and right click mouse to pop up the menu below:

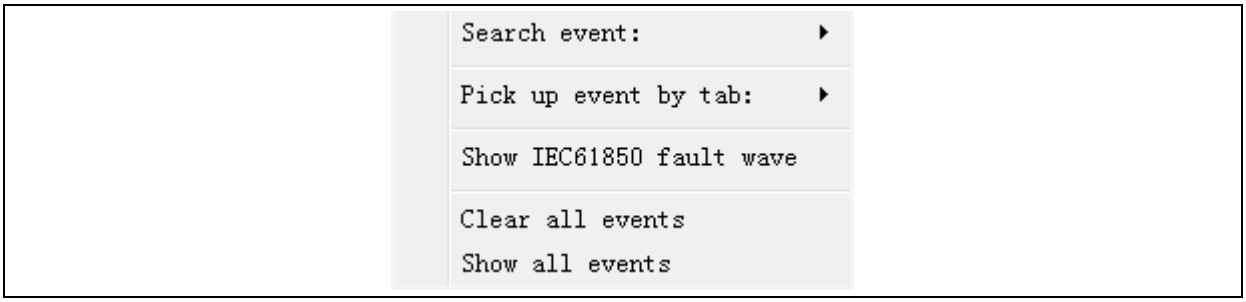


Figure 4.2-3 Right mouse key menu of alarm event list

Click “Search event” menu will pop a secondary menu show as below.

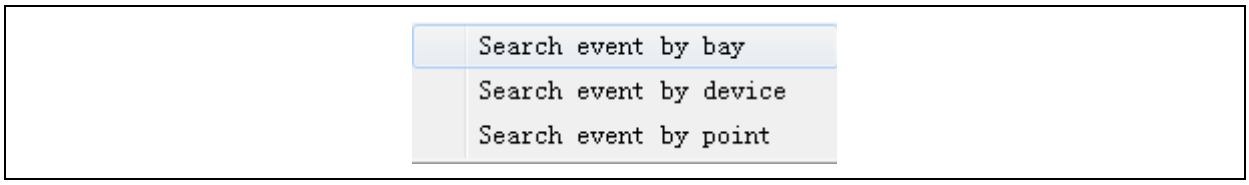


Figure 4.2-4 Search event menu

Click “Pick up event by tab” menu will pop a secondary menu shown as below.

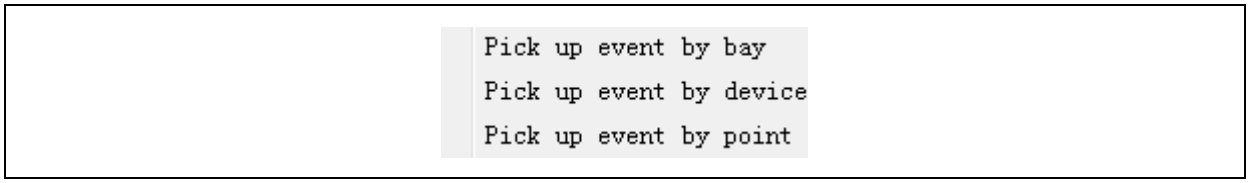


Figure 4.2-5 Pick up event menu

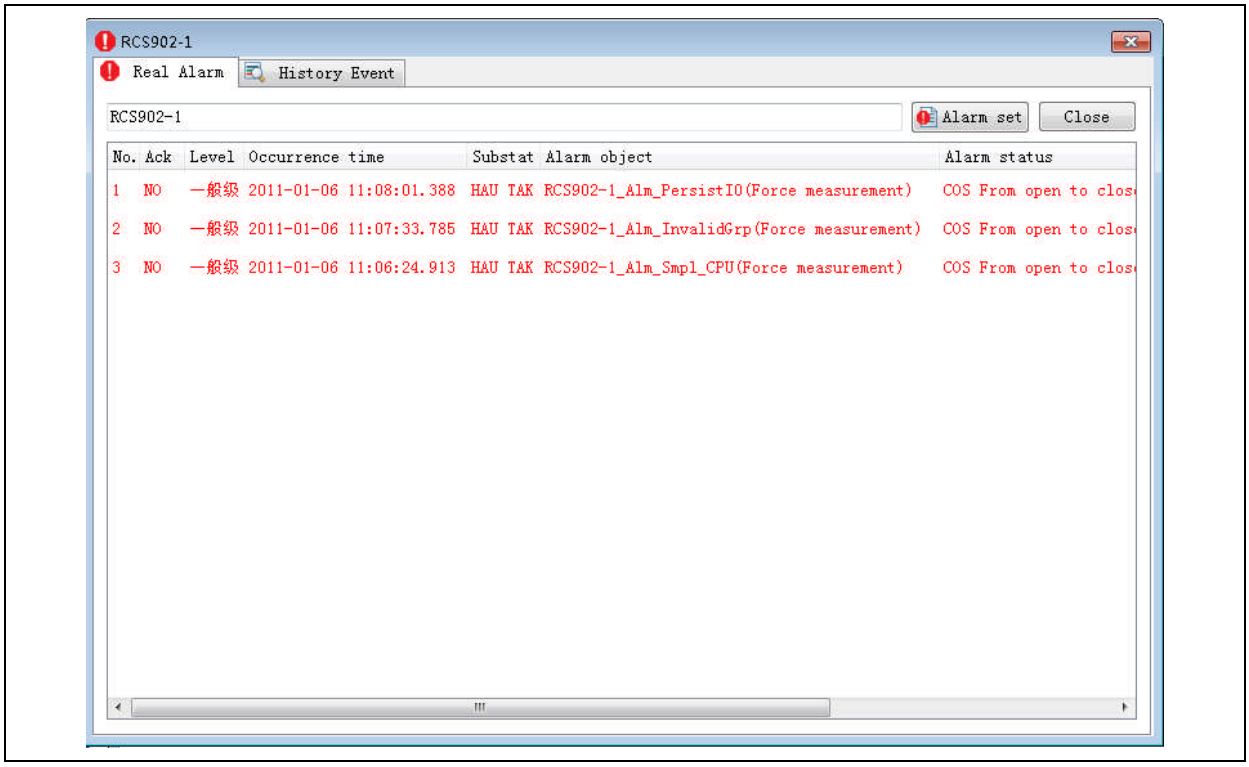


Figure 4.2-6 Search event window – Real alarm

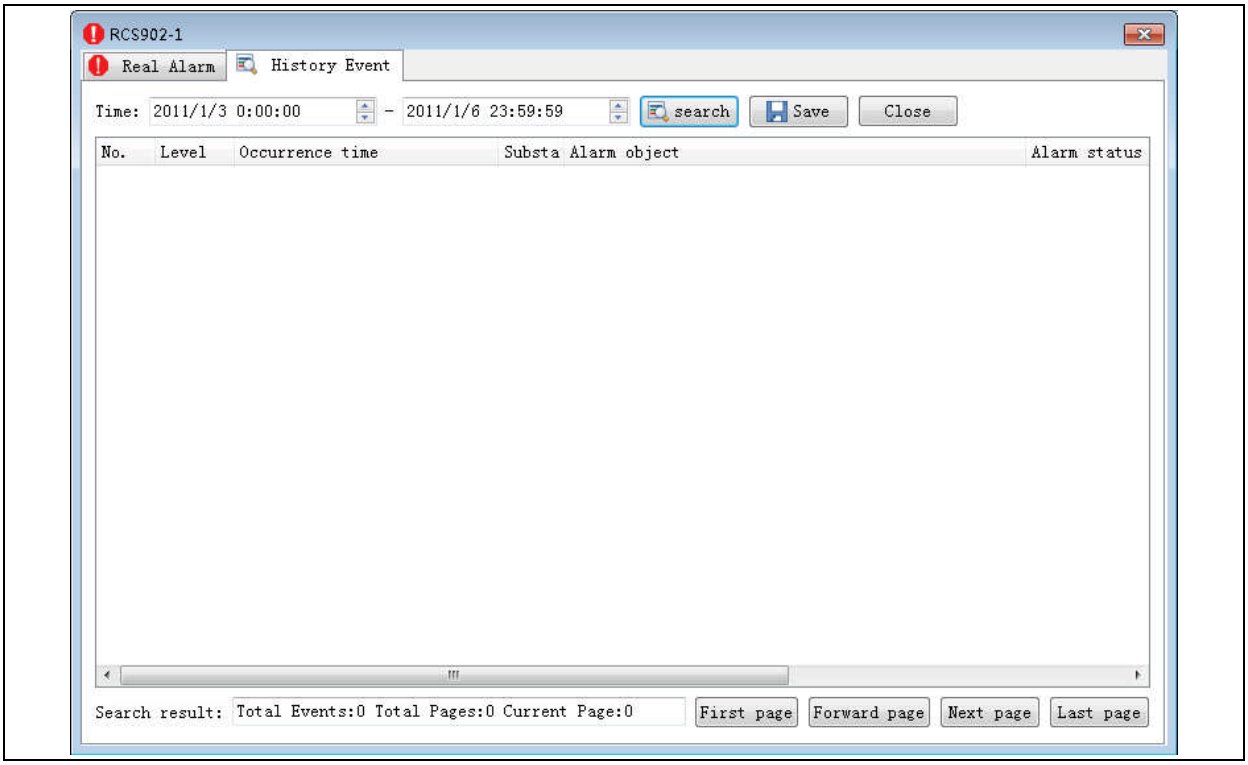


Figure 4.2-7 Search event window – History Event

Menu item	Function
Search event by bay	Pick up the corresponding bay information from selected alarm event, pop up search event window shown as *Figure 4.2-6*, which includes Real Alarm and History Event that lists related alarm events of this bay. If no bay information is detected in the selected alarm event, user will receive the warning 'Invalid bay OID of the event'.
Search event by device	Pick up the corresponding device information from selected alarm event, pop up search event window shown as *Figure 4.2-6*, which includes Real Alarm and History Event that lists related alarm events of this device. If no device information is detected in the selected alarm event, user will receive the warning 'Invalid device OID of the event'.
Search event by point	Pick up the corresponding point information from selected alarm event, pop up search event window shown as *Figure 4.2-6*, which includes Real Alarm and History Event that lists related alarm events of this point. If no point information is detected in the selected alarm event, user will receive the warning 'Invalid point OID of the event'.
Pick up event by bay	Pick up corresponding bay information from selected alarm event, create a new tab named after the bay and lists only the alarm events that are related to this bay. If no bay information is detected in the selected alarm event, user will receive the warning 'Invalid bay OID of the event'.
Pick up event by device	Pick up corresponding device information from selected alarm event, create a new tab named after the device and lists only the alarm events that are related

Menu item	Function
	to this device. If no device information is detected in the selected alarm event, user will receive the warning 'Invalid device OID of the event'.
Pick up event by point	Pick up corresponding point information from selected alarm event, create a new tab named after the point and lists only the alarm events that are related to this point. If no point information is detected in the selected alarm event, user will receive the warning 'Invalid point OID of the event'.
Show IEC61850 fault wave	If the current selected event is an IEC61850 fault recording event, a dialog box will pop up to display brief message of fault record in the .hdr file
Clear all events	With system time on current node as reference, alarm events before current time point will not be displayed; this is equivalent to filtering of events according to time.
Show all events	Cancel the function of clear screen of event, i.e. event filtering by time

4.2.7 Alarm Events Setup

4.2.7.1 Window Setup

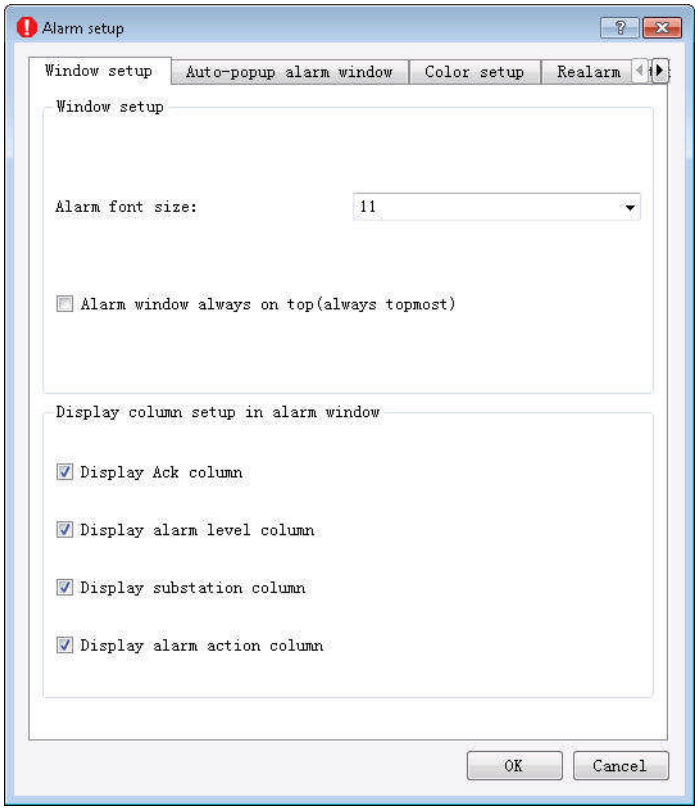


Figure 4.2-8 Alarm window setup

Table 4.2-3 Description of window attributes settings

Window setting	Description

Window setting	Description
Alarm font size	Set font size in event list
Alarm window at foremost	If alarm window is foremost. This option must be selected to realize automatic popup of alarm window.
Display acknowledgement column	If alarm event list box displays acknowledgement column
Display alarm class column	If alarm event list box displays alarm class column
Display station column	If alarm event list box displays station column; for single station system, display of station column is not recommended.
Display alarm action column	If alarm event list box displays alarm action column

4.2.7.2 Setup of Automatic Popup

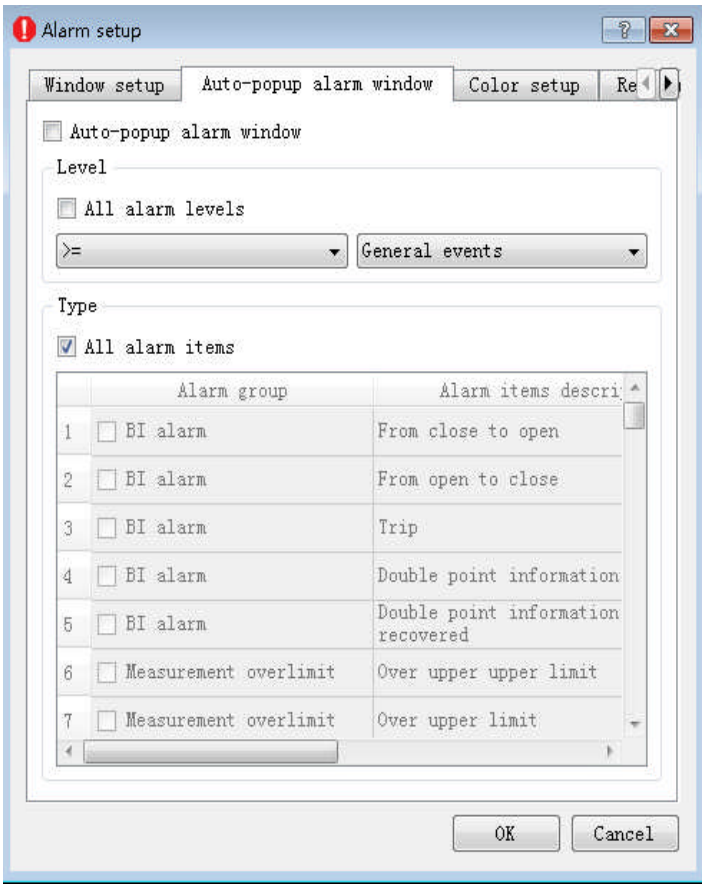


Figure 4.2-9 Setup of automatic popup

Table 4.2-4 Description of automatic popup settings

Automatic popup setting	Description
Automatic popup of alarm window	If checked, alarm window will automatically pop up in case of new alarm event
Class of automatic popup	Set up the minimum level of alarm that will automatically pop up a alarm window. New alarm event will only pop up the window if greater than or equal to a certain level.

Alarm item setup	User can set the auto-popup of the window during certain alarm events. Any event other than those will not cause a pop up.

4.2.7.3 Color Setup

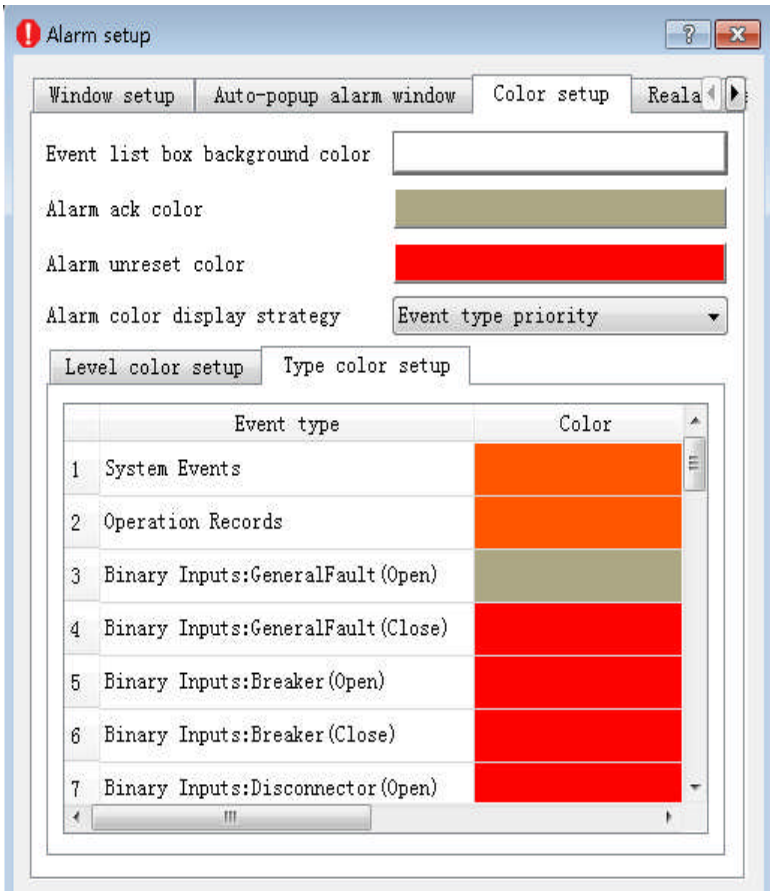


Figure 4.2-10 Color setup

Table 4.2-5 Description of color settings

Color setting	Description
Event list box background color	Set background color of event list box
Alarm ack color	Set color after acknowledgement of alarm event
Alarm unreset color	Set color of signal not reset
Alarm color display strategy	Displayed color of alarm event according to type or class
Level color setup	Set color of alarm event of different levels
Type color setup	Set color of alarm event of different type

4.2.7.4 Alarm Repeat Setup

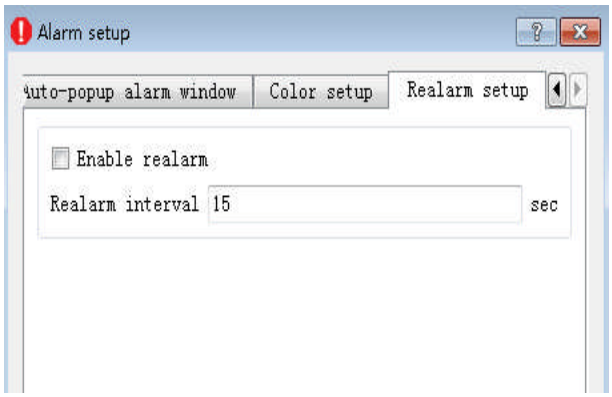


Figure 4.2-11 Alarm repeat setup

Set activation of alarm repeat function and interval of alarm repeat. Alarm repeat function generates a new alarm for alarm signals in the system that are not reset. A separate alarm window will pop up to list all events that are not reset.

4.2.8 Alarm Label Management

Click label management menu to pop up alarm label management dialog box.

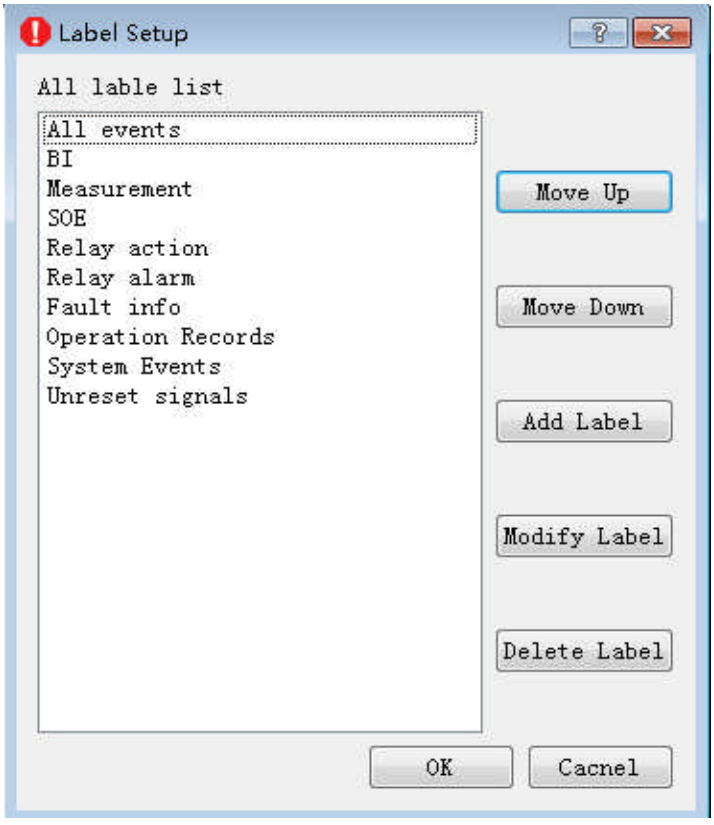


Figure 4.2-12 Alarm label management

In label management dialog box, user can adjust sequence of labels, and add, delete, and modify labels. Click Add or Modify to pop up “Label Manage” dialog box shown below.

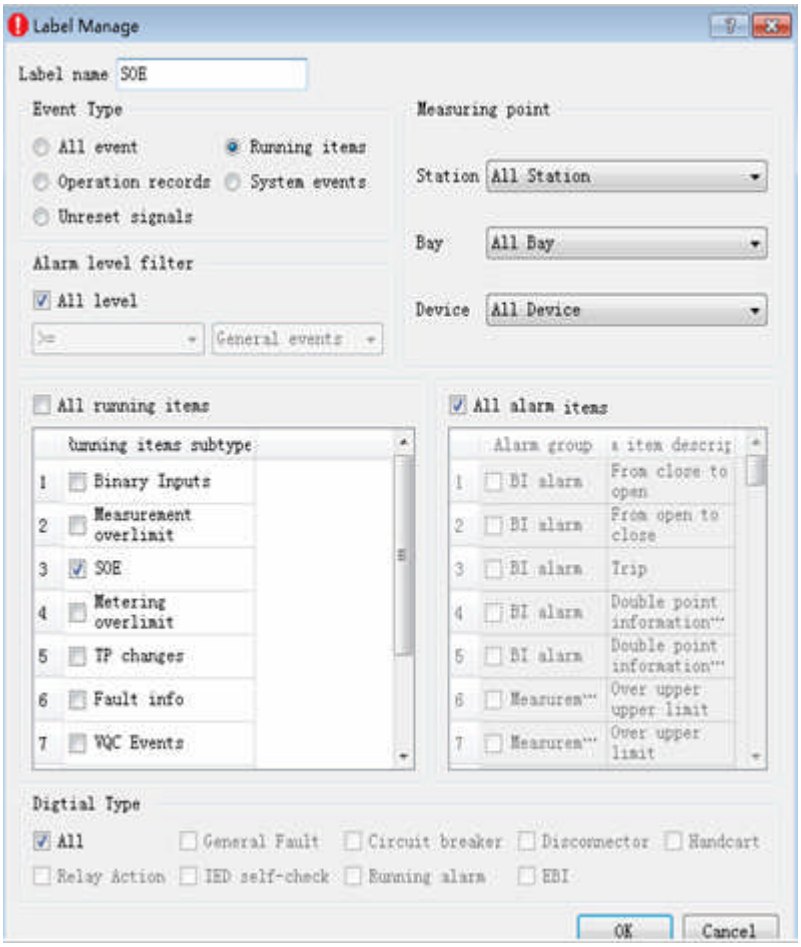


Figure 4.2-13 Label management dialog box

Table 4.2-6 Description of label management settings

Setting	Description
Label name	Set label name
Event type	Set event type displayed on the label page
Alarm level filter	Set event level displayed on this label page
Running item filter	If event type selected is ‘running’, subtype of specific running item can also be set to further classify alarm events.
Measuring point	Filter alarm events according to station, bay and device
Alarm item filter	If ‘All alarm item’ is unchecked, you can select one or more alarm items from alarm item list as filtering condition

4.3 Browsing of History Events

4.3.1 Main Interface

Click “History alarm” on console, or enter “hisalarm” at command terminal to pop up historical event retrieval window.

The historical event retrieval window includes a tools bar, retrieval conditions setup window at left side, and the event list window at right side.

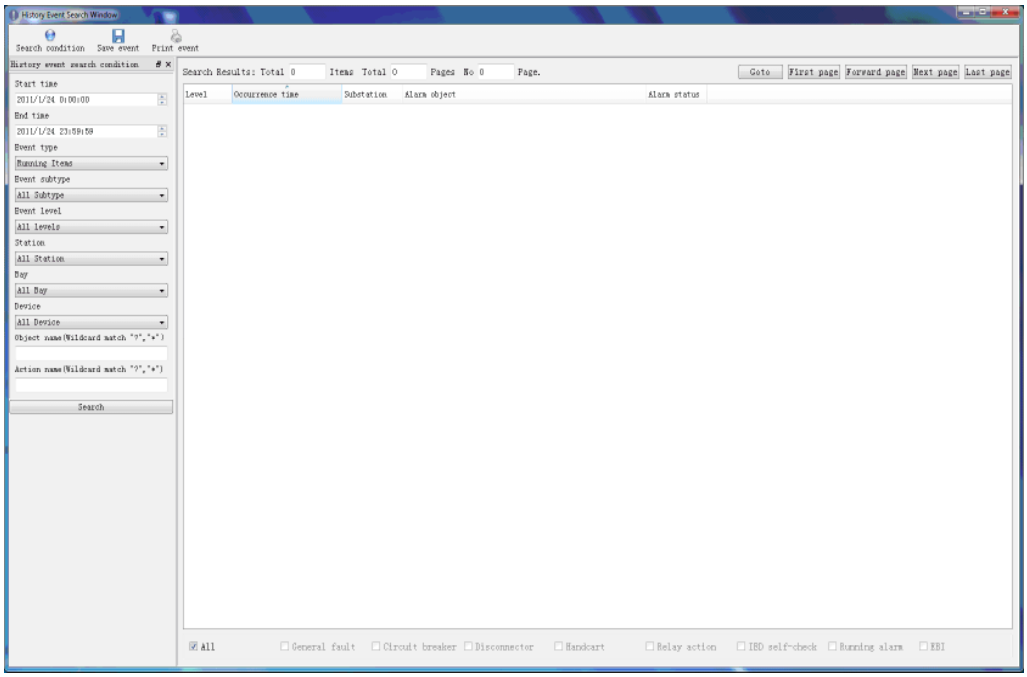


Figure 4.3-1 Historical event retrieval interface

4.3.2 Tools Bar

Search Condition: display retrieval conditions window at left side

Save event: save retrieved alarm event as text file

Print event: print retrieved alarm event.

4.3.3 Retrieval Conditions

Historical event retrieval conditions include time, event type, event sub-type, event class, station, bay, equipment, name of object, and name of operation. Event types include “operation item”, “operation record”, and “system event”. For operation item, event sub-type can be selected. Name of object includes matching, and a number of matching conditions can be divided by “:”.

5 Report Management

5.1 Characteristics of Report

1） Reports are realized based on cross-platform general purpose table class library autonomously developed by our company. Tables are directly drawn by means of plotting mode, and not based on any third party controls. Display is fast, use is flexible, and expansion is easy. No ancillary component needs to be installed. High performance is maintained for reports of large data quantity.

2） Acquisition and association of data are realized via interaction between data association class library of data platform and real-time/historical databases. Strong versatility and expandability are provided.

3） The main interface and all related class libraries are all realized by totally cross-platform mechanism. Various operating systems, e.g. WINDOWS and UNIX, are supported. Totally cross-platform deployment of report editing, browsing, and service is realized.

4） Operation and display of report tools are similar to EXCEL tools, hence easy to learn and use.

5） Report files are completely compatible with EXCEL. Import and export in EXCEL format are realized. In addition, common EXCEL file contents can be displayed on various operating systems such as WINDOWS and UNIX.

6） Distributed deployment: platform configuration program is used to configure machines on which reports need to be deployed. Report server can be deployed on any node of the system and can be easily switched.

7） Various functions of fast report generation are provided, e.g. find and replace, batch modification, drag-and-drop generation, and report models etc.

- Report generation by typical models and customized models;
- Batch replacement function with association and checking function with association are provided;
- Automatic addition of object name by data association, automatic addition of time marker by historical association;
- Automatic generation of statistic information (e.g. maximum value and minimum value).

8） Automatic saving of history versions of reports and restore of the same; simplifying version operation of common maintenance and hiding many useless intermediate versions, facilitating use.

9） Automatic generation and printing of reports: reports can be automatically generated or printed at specified time according to fixed time generation and printing rules defined, to provide effective historical report files. Such generation can adopt EXCEL format. Contents of

automatically generated reports can be easily viewed using report browsing tool or EXCEL tool.

10） Import and export of reports: report internal format and EXCEL format are supported.

11） Report printing and print preview: transverse and longitudinal paged printing of reports is supported. Printed page can ensure integrity of cells. 100% simulated print preview is provided.

5.2 Functions

Report tools include functions in 3 aspects: report editing, browsing, and service.

1） Report editing allows user to customize a report pattern on a 2D table as required, e.g. cell foreground color, background color, font, and style etc. Some attributes of report, e.g. fixed time generation and printing and scope of printing etc., can be defined. Later, cells where data need to be displayed can be associated with database (real-time or history), and rules of data fetching for report browsing can be defined.

- New report type can be created, and existing report type can be deleted, allowing flexible report classification, which is no longer limited to grouping according to applications;
- The function of report generation using typical models and customized models is provided;
- Version management is simplified: only two versions are formed, namely local version (draft) and network version (formal), hiding many useless intermediate versions;
- Report import and export functions are provided;
- History version import function is provided;
- Batched replacement function with association and checking function with association are provided, and information of error association can be listed and located to associated cell;
- Defined data association can automatically add object name and historical association can automatically add time marker;
- Historical association can define extension direction of association and quasi-real-time association (although historical data are taken, real-time refreshing is allowed);
- Historical association can select historical statistic information for association and generation along with;
- 3 different types of time association are provided.

2） Report browsing refers to acquisition of correct data from corresponding database according to data fetching rules defined, filling the same in associated cells of the report, and display of the report in customized pattern for browsing by user. The core of report browsing is how to fetch data from the database in an efficient, fast, and correct manner.

- Automatic report refreshing function is provided, at refreshing period that can be configured;

- Historical report files saved at fixed time can be opened.

3） Report service refers to automatic generation or printing of reports at specified time according to rules of fixed time generation and printing defined by report editing, to provide effective historical report files and reduce user work quantity.

- Report service is separate from report browsing. Configuration of a report server can realize automatic generation and printing of reports, as well as synchronization of report files saved at each node.

Based on above comprehensively, report tools can satisfy user demands, in that reports and report models can be edited using 2D table, and various data of system can be displayed, including historical data and real-time data. Automatic generation and printing of reports can be realized.

5.3 Start of Report

Report starting command is: report –e[b][s] –rpt reportname –ver reportversion –date reportdate

Description of parameters:

-e: open report in editing mode, which is default mode if no other optional parameter is provided

-b: open report in browsing mode

-s: open report in service mode (no user interface)

-rpt: automatically open a specified report (reportname) when Report Tools is activated

-ver: version of report automatically open (0: local version; >0: network version, which is default)

-date: time of report browsing in case the automatically opened report is a history report or mixed report; in the format of 2010.11.4 or 2010/11/4 or 2010-11-4

Besides, -help command can be used to view help.

5.4 Report Editor

5.4.1 Arrangement of Report Editor Main Interface

At the terminal, enter report [-e] to start report. The report editor main interface includes 4 parts: menu bar, tools bar, report list, and report editing area (refer to figure below).

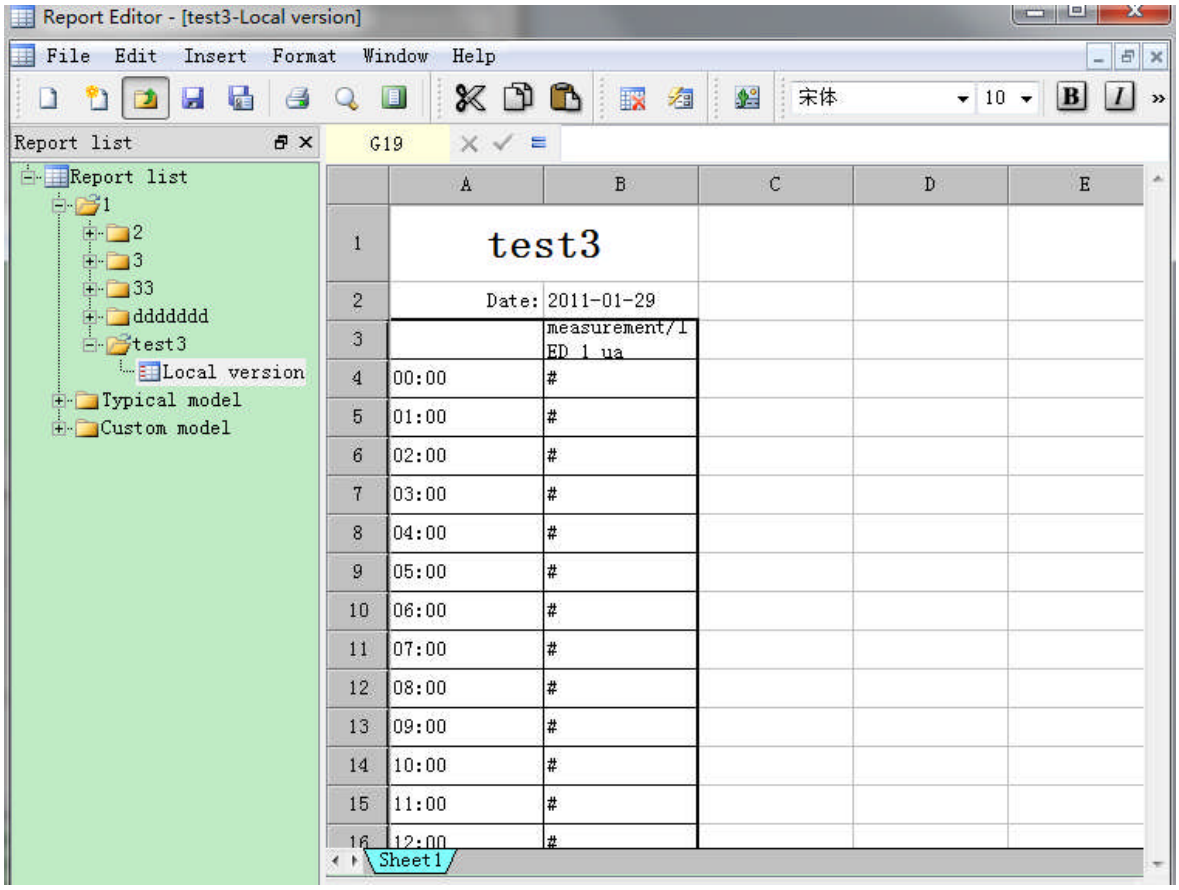


Figure 5.4-1 Report editor main interface

- The menu bar and tools bar provide all commands required for report editing.
- The report list lists all reports, their version information, and models. The “normal models” folder and “custom models” folder are complete with the tools and cannot be deleted.
- In the report editing area, report style can be edited, and data association and preview can be carried out.

5.4.2 New Report Group and Delete Report Group

On the report list tree, user can create a new report group or delete an existing report group. Grouping of reports can be carried out.

Create a new report group: select report list tree root node “Report list” and right click mouse. In the context menu popped up, select “New report group”; an input dialog box will pop up. Enter name of the group and press OK.

Delete report group: select the report group to be deleted and right click mouse. In the context menu popped up, select “Delete report group”. After confirming the inquiry, this report group will be deleted. If this report group is not empty (there is at least one report of this group attached), then this report group cannot be deleted.

Report groups “normal model” and “custom model” are automatically created when Report is started and user cannot delete them.

5.4.3 New Report

There are two modes to create a new report: create a new blank report and use the New Report wizard.

5.4.3.1 New Blank Report

Use menu “File”→“New” or click the button “ ” on the tools bar or select the report group in the Report List and select context menu item “New report”. The New Report dialog box (as shown below) will pop up.

- Report type: differentiate ordinary report and report model. Select ordinary report if not model as appropriate.
- Group name: new report group created by user.
- Report name: name of the new report being created.
- Model name: default is blank model; if report type is normal model, model under the normal model class can be selected to generate this report
- Rows and columns: for blank model, numbers of rows and columns can be configured for the new report; both normal models and custom models use numbers of rows and columns of the model as initial numbers of rows and columns of the new report, which cannot be set.
- Create_Time and Print_Time: set fixed time generation or printing; the report service will read fixed time settings of each report and carry out processing accordingly.
- Date(s) to antedate: reserved; there is no actual function.
- Fill out the report and click “OK” to generate a new report, saved as local version.

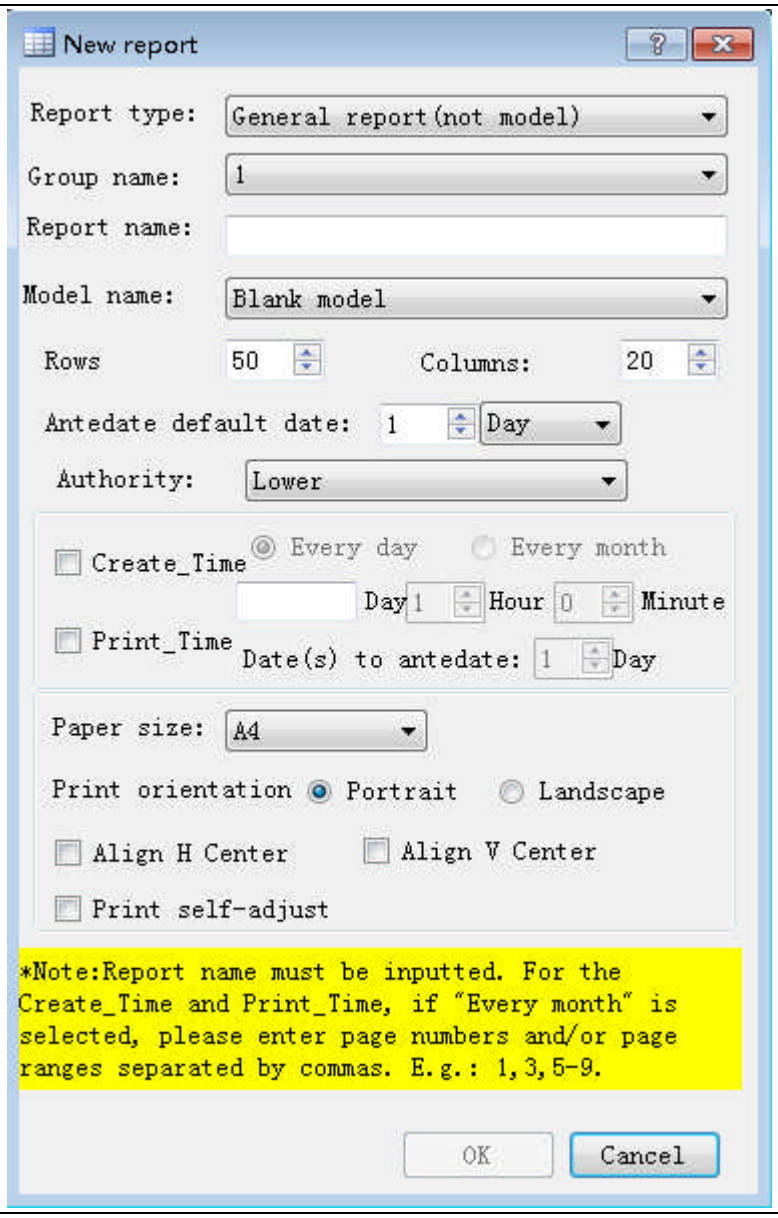


Figure 5.4-2 New blank report

5.4.3.2 Use the report wizard to Generate a Report

Use menu "File"→"New report wizard" or click the button "" on the tools bar or select the report group in the report list and right click mouse and select "New report wizard" in the context menu. The New Report Wizard dialog box (as shown below) will pop up.

- Group name: new report group created by user
- Report name: name of new report
- Report title: title of the new report
- Report model: the model used here is a custom model which can be customized; default model has fixed format and cannot be customized
- Object search: start object search; select object, and real-time or history attributes of object

- Landscape/Portrait: the object can be arranged transverse or longitudinal
- Association setup: single association generates one association of the object, while serial association generates a number of associations of the object (mainly used in history report)
- Serial setup: set time length and step of serial association
- Extension: forward or backward association with starting time as reference
- In the white box behind, some statistic information of the object is listed according to history attribute type of the object, e.g. extreme values and time of such values, for user selection; statistic information association can be added while generating a report
- Time setup: association start time in history report

After clicking OK, a new report will be generated. As report style of custom model is used and object data are associated, this is a formed report.

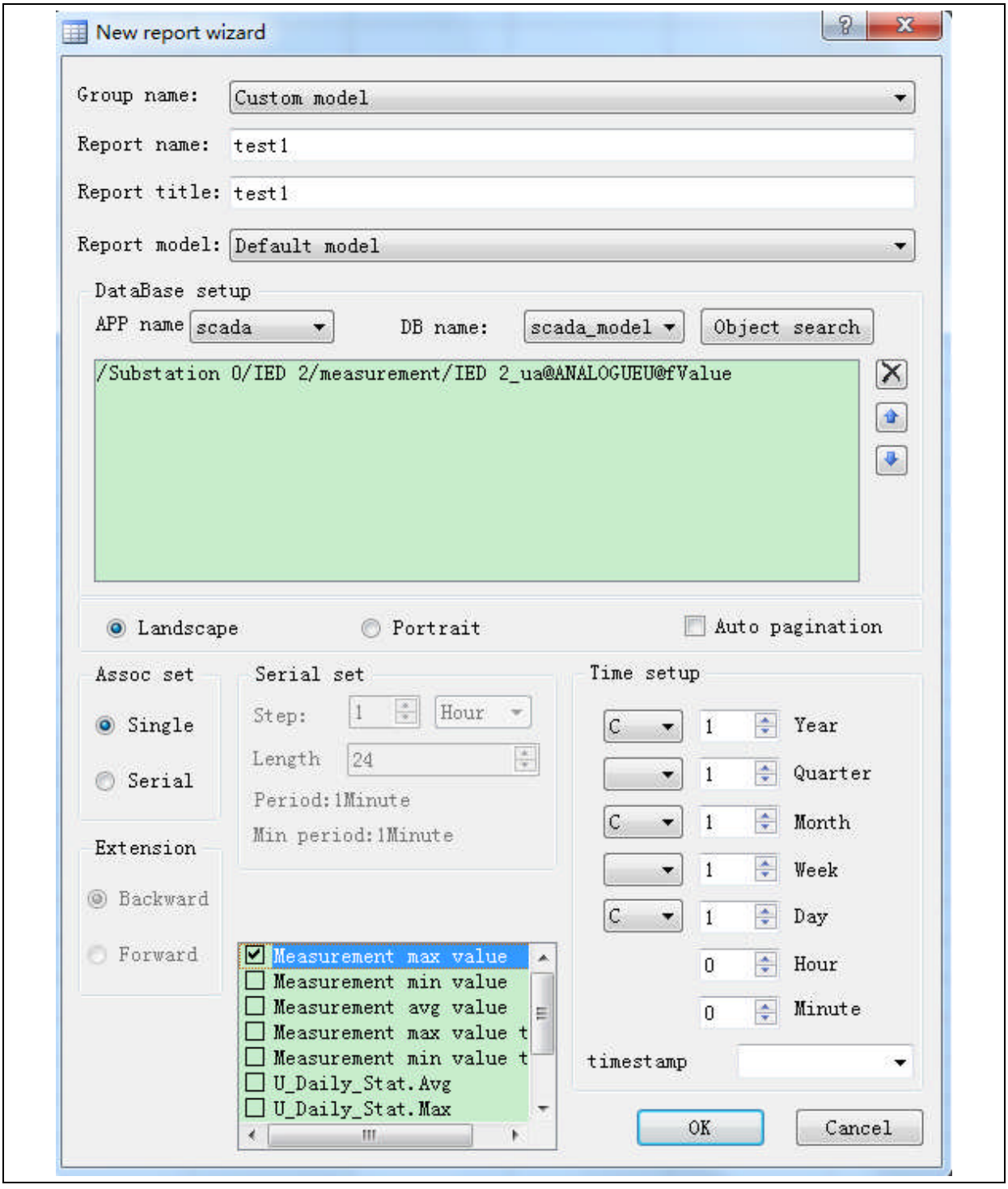


Figure 5.4-3 New report wizard

5.4.4 Modification of Report Attributes

Select a report in the report list tree and right click mouse. In the context menu, select “Modify report”. The Attributes Modification dialog box will pop up, in which user can modify attributes that can be modified. Click OK.

5.4.5 Delete Report

Select the report in the report list tree and right click mouse. In the context menu, select “Delete report”. After confirmation, this report will be deleted, as well as the report record, version record, and report file saved locally.

5.4.6 Generate Normal Model

Normal models are some typical reports. Since report style is the same or similar, and only data association is different, such reports can be saved as normal models. As report style has been edited, and data association is defined or not defined, a new report can be generated using a normal model, user only need to define or modify association, thus eliminating repeated labor of editing of report style. Therefore, normal models are normally generated by saving relatively typical ordinary reports (non-model) as models. Open an ordinary report (with or without data association), and then use menu “File”→“Save as” to open Save As dialog box. Just select report type of normal model and enter name of new model, and then click OK (as shown below).

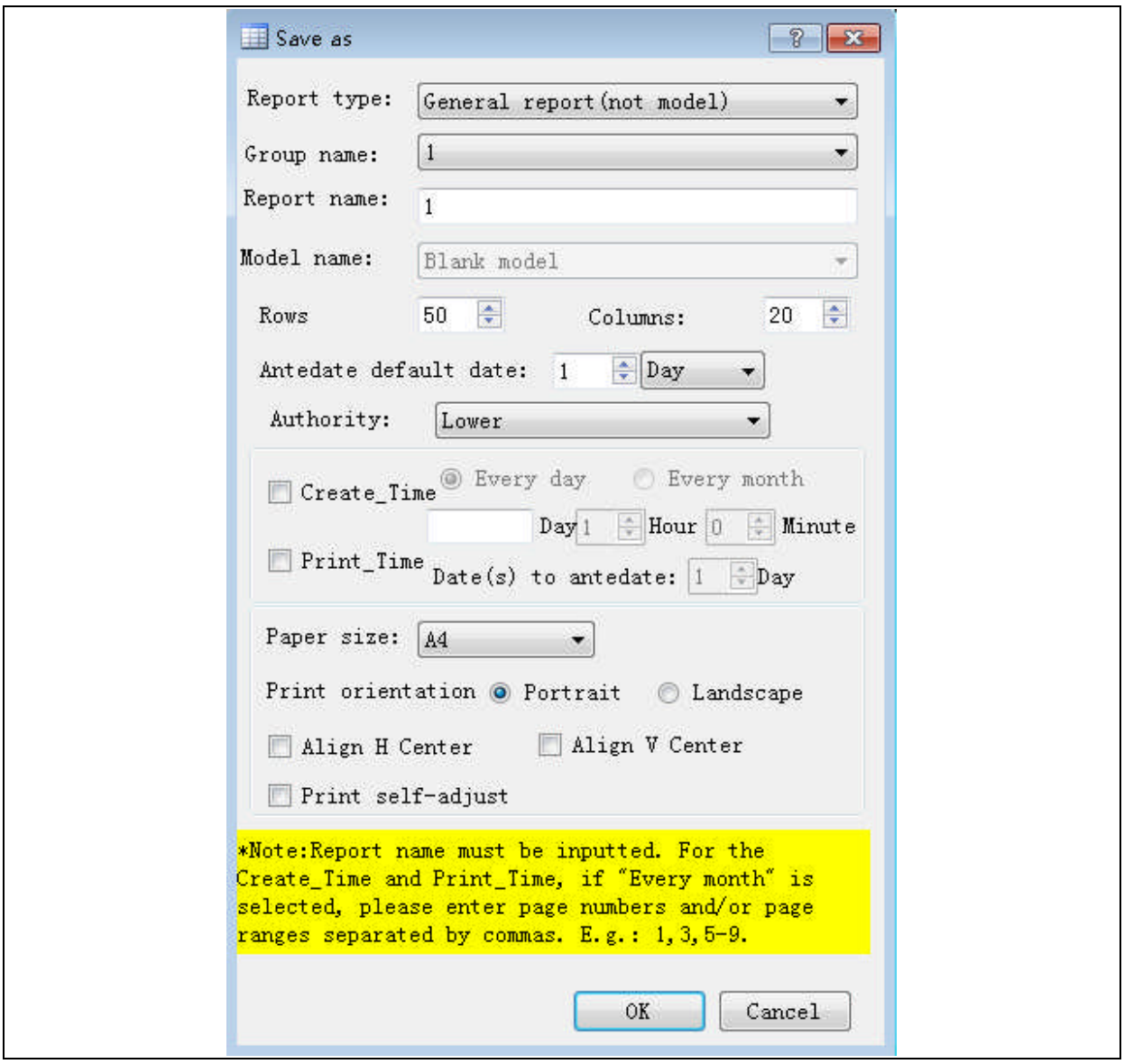


Figure 5.4-4 Save report as

5.4.7 Generate Custom Model

A custom model refers to the model for which user has defined position and style of title and table body in a simple manner, and used to generate new report according to user definitions. Style definition of such model is relatively simple. Custom models are mainly used to quickly generate some special reports, e.g. daily report and month report etc.

Creation of a new custom model is the same as creation of a new blank report, only that report type needs to be selected as custom model. This report generated will be attached under the custom models. At present, custom models only include wizard model, daily report model, monthly report model, and annual report model.

Definition of a custom model mainly defines two contents: report title position and table body setup. In the report, select a cell and right click mouse to pop up a context menu. In this menu, select "Define report model"→"Title" to define title position. Consequently, title content of reports generated later will be displayed in the defined cell. In the context menu, select "Define report model"→"Table body" to pop up the Model define dialog box (as shown below).

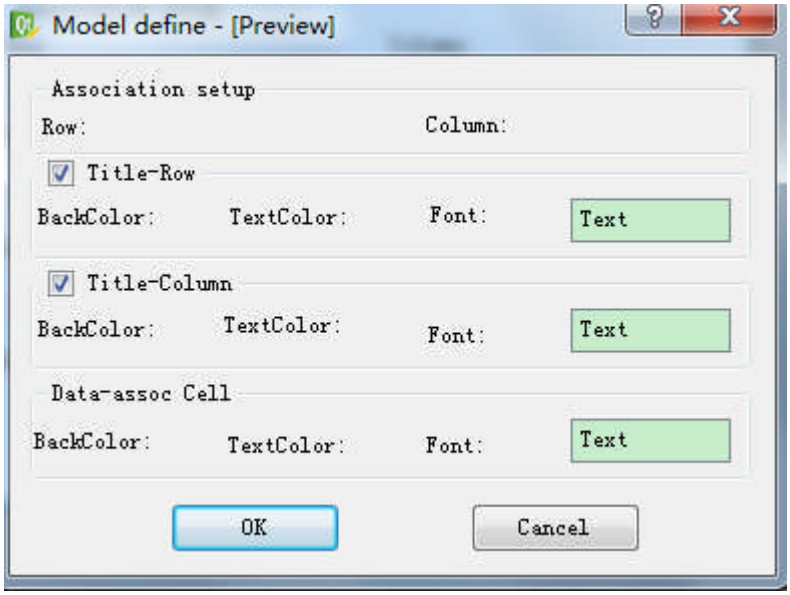


Figure 5.4-5 Definition of model association

- Association setup: table body scope, number of rows, and number of columns
- Word wrap or not: if there are many defined objects, word wrap can be configured
- Title row: set availability of title row and title row style
- Title column: set availability of title column and title column style
- Data association cell: set style of data association cell.

5.4.8 Report Version Management and Saving

5.4.8.1 Report Version

- Local version: only seen by local user. Local version of the same report at each node may

vary.

- Network version: network version at all nodes is consistent.

5.4.8.2 Saving of Reports

- Local saving: Style and data association of a report are saved in local version, not affecting network version. If network version is being edited, new local version will form. In case of local saving of report for which editing is not complete, this report will be saved on editing node. Each node can have a different local version.
- Network saving: Style and data association of a report are saved in network version and distributed to each active node in the network. If local version is being edited, while saving network version, local version will be deleted. If network version is being edited, it will be directly issued, without affecting original local version. Each network saving will increase version No. of network files. Report browsing uses last network version saved in default.
- Report save as: save the report being edited as a report of specified name. If a report of this name already exists, user will be asked to overlay existing report or not. If report of this name does not exist, a new report will be created and report style and data association being edited will overlay the new report.

5.4.8.3 Application of the Two Types of Saving

- Local saving: mainly used for editing of local draft and local temporary report.
- Network saving: mainly used for editing of formal report, modification of completed report, and saving local draft as formal report. For example, to again modify modified report, just click “Network saving”.

5.4.9 Import and Export of Report

The report import and export function can be applied among different systems. By means of export of report from old system and import it into new system, fast report generation can be realized. Or, user can use EXCEL to edit report style, import report style, and then use report tools to edit data association to generate report. This function can also be used to backup report, so that it can be imported again in case of incorrect operation. In a word, report import and export function provides additional methods to generate reports.

5.4.9.1 Export Report

Reports can be exported to local machine. File format that can be selected includes .rpt, .cgs, and .xls. Format .rpt exports only one file combining report style file and association definition file (recommended).

Format .cgs exports two files: report style file (.cgs) and association definition file (.xml).

Format .xls exports both report style file (.xls) and association definition file (.xml).

For exporting, first open the report to be exported. Select menu “File”→“Export”. In the Save File dialog box popped up, select path and enter name of file, and click OK.

5.4.9.2 Import Report

Report file saved in local machine can be imported to Report Tools. File format that can be selected includes .rpt, .cgs, and .xls.

Format .rpt imports report style and data association at the same time.

Format .cgs import requires that the association definition file (.xls) must have the same name as the report style file and be under the same directory; otherwise only the report style will be imported (not data association).

Format .xls can import report style and report association at the same time. If import fails, please check if file /deployment/etc/excel/blankmodel.xls is “read-only”. User need to remove read-only attribute of this file.

For import, select menu “File”→“Import”. The File Selection dialog box will pop up. Select the file to be imported. If a report is currently open by Report Tools, user will be prompted to select New import or Overwrite import. For New import, user need to select report group and enter name of report. Overwrite import will overwrite style and data association of current report. If no report is currently open by Report Tools, default is New import (as shown below).

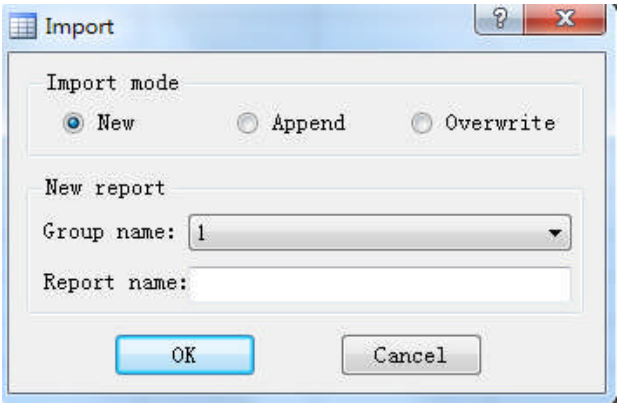


Figure 5.4-6 Import report

5.4.9.3 Import History Version

For report of network version >=2 (twice or more network saving), history version can be imported. Select menu “File”→“Import history version” to pop up Version Selection dialog box. Select the version to be imported. If there is no local version file, report file of this version will be downloaded from main node. If this file is not available on main node either, or download fails, import of history version will fail; otherwise current version will be overwritten (overwrite will truly occur only after saving) (as shown below).

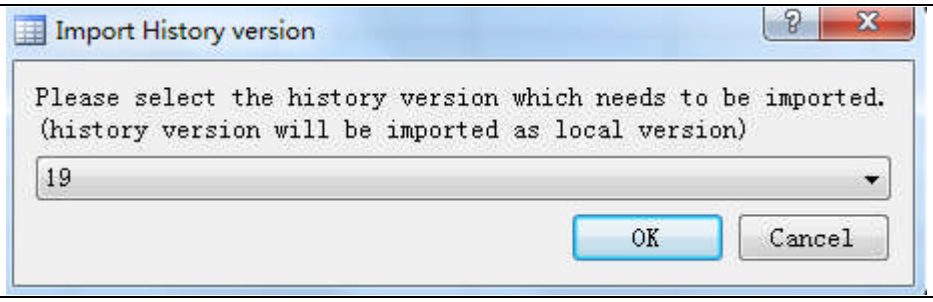


Figure 5.4-7 Import history version

5.4.10 Report Preview and Printing

Click button "" on the tools bar to preview a report. Click the button "" on the tools bar to print a report.

- Preview and printing of an area: open a report and drag mouse. If selected area is >=2 rows and >=2 columns, only contents of the selected area will be previewed or printed.
- Set print area for preview and printing: right click report and select "Print area setup" in the context menu; the Print Area Set dialog box will pop up (as shown below). Check to set print area. Adjust starting and ending rows and columns, and click OK. Uncheck print area to cancel print area setup. This setup can be viewed by "View print area" in the context menu.

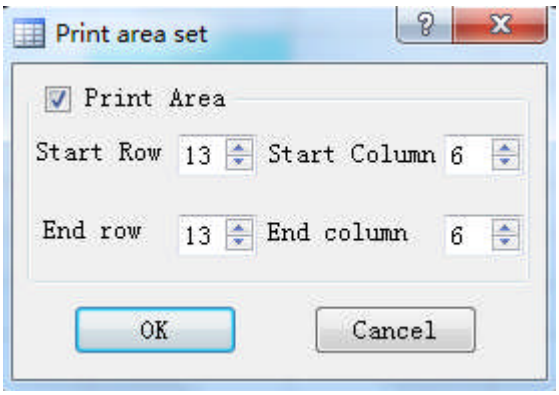


Figure 5.4-8 Set print area

- Preview and print all: in default, without above two operations, all the reports will be previewed and printed.

5.4.11 Editing Report Style

5.4.11.1 Operation of Rows and Columns

- Insert row/column: insert one row above or below selected row; insert a column left or right of a selected column.
- Delete row/column: delete selected rows or columns. If data association is defined for cell in such rows or columns, the association will be deleted along with.
- Set row height: set height of selected row; multiple selection is permitted

- Set column width: set width of selected column; multiple selection is permitted.

5.4.11.2 Operation of Cells

All cell operations can be started from main menu, the tools bar, or context shortcut menu:

- Copy ( ): copy cell(s), including cell style, content, and data association; copying of an area is permitted.
- Cut ( ): cut cell(s), including cell style, content, and data association; cutting of an area is permitted.
- Paste ( ): paste content of the clipboard; to paste after cutting, content of cutting area will be cleared.
- Delete: delete contents of cell(s); if a cell has data association, such data association will be deleted as well; if a cell has formula definition, such formula definition will be deleted along with. User can also use shortcut key “Delete”.
- Delete content: only cell content will be deleted; association will not be deleted and cell attribute will not be changed.
- Merge cells: drag mouse to select a number of cells and click button “ ” on the tools bar to merge cells. For merged cells, merging can also be canceled.
- Set cell attribute: 6 tab pages are provided: “Number”, “Align”, “Font”, “Border”, “BackColor”, and “Image setup”. At the same time, shortcut buttons of ”Font”, “Align”, and “Border” etc. are provided on the tools bar, and have the same functions as set in Cell Attributes dialog box (refer to the figure below).

Figure 5.4-9 Cell operations tools bar

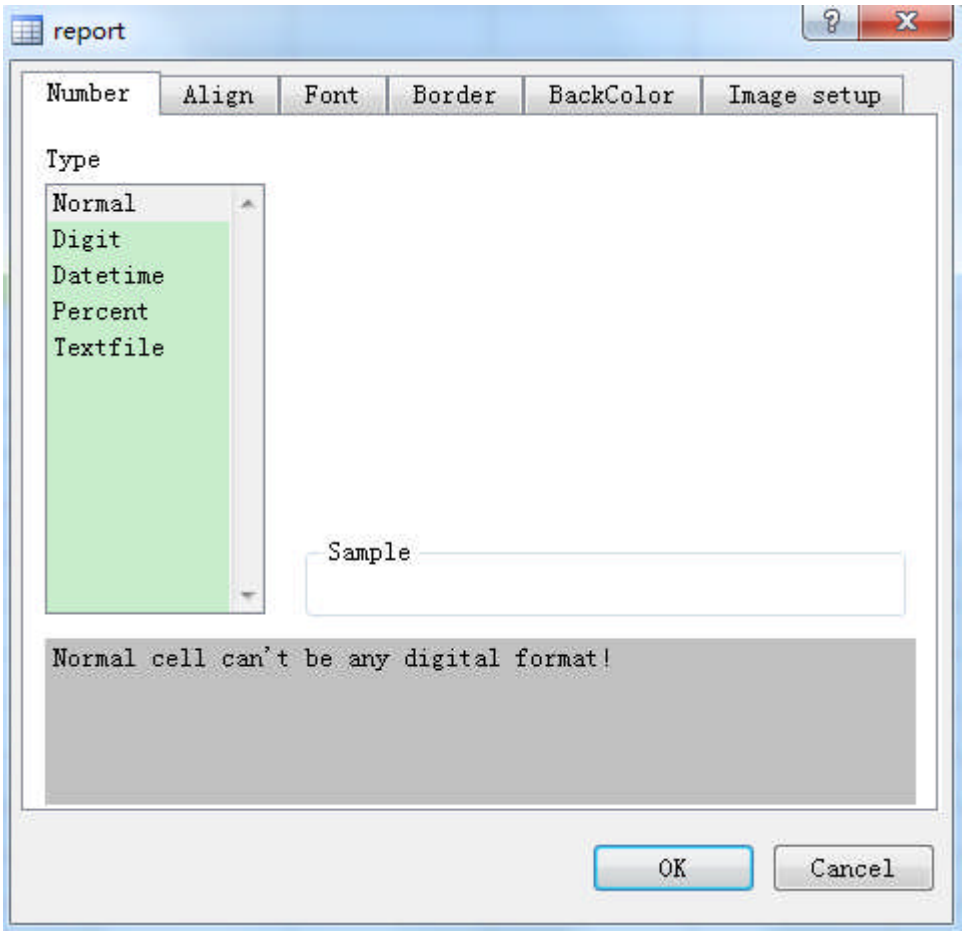


Figure 5.4-10 Cell attributes – Number

- Number (as shown above): set type of cell representation. Conventional representation is text mode. For numbers, decimal precision can be configured. For date and time, expressing mode can be configured. After setting percentage, numbers will be shown in "%" mode.
- Align (as shown below): set cell aligning mode. In case of multiple selection, user can select merging of cells. User can set automatic word wrap of text in cell.

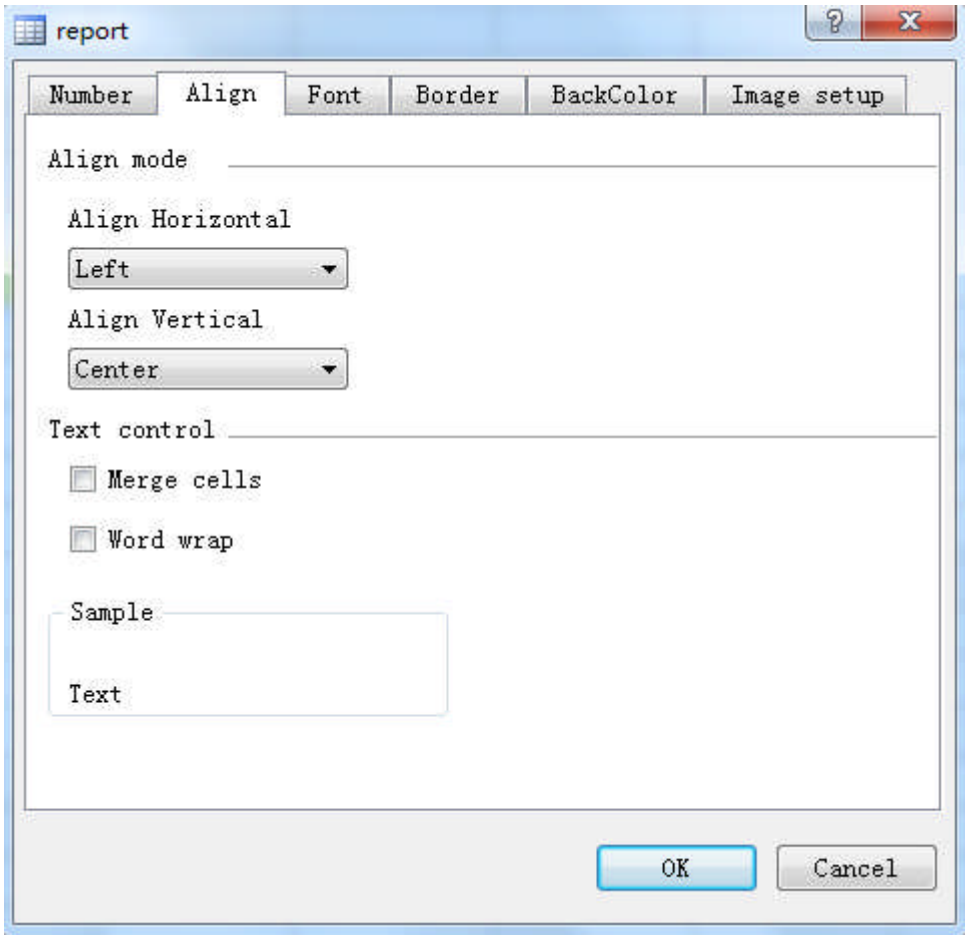


Figure 5.4-11 Cell attributes – Align

- Font (as shown below): set Font, Size, Style, and Font color.

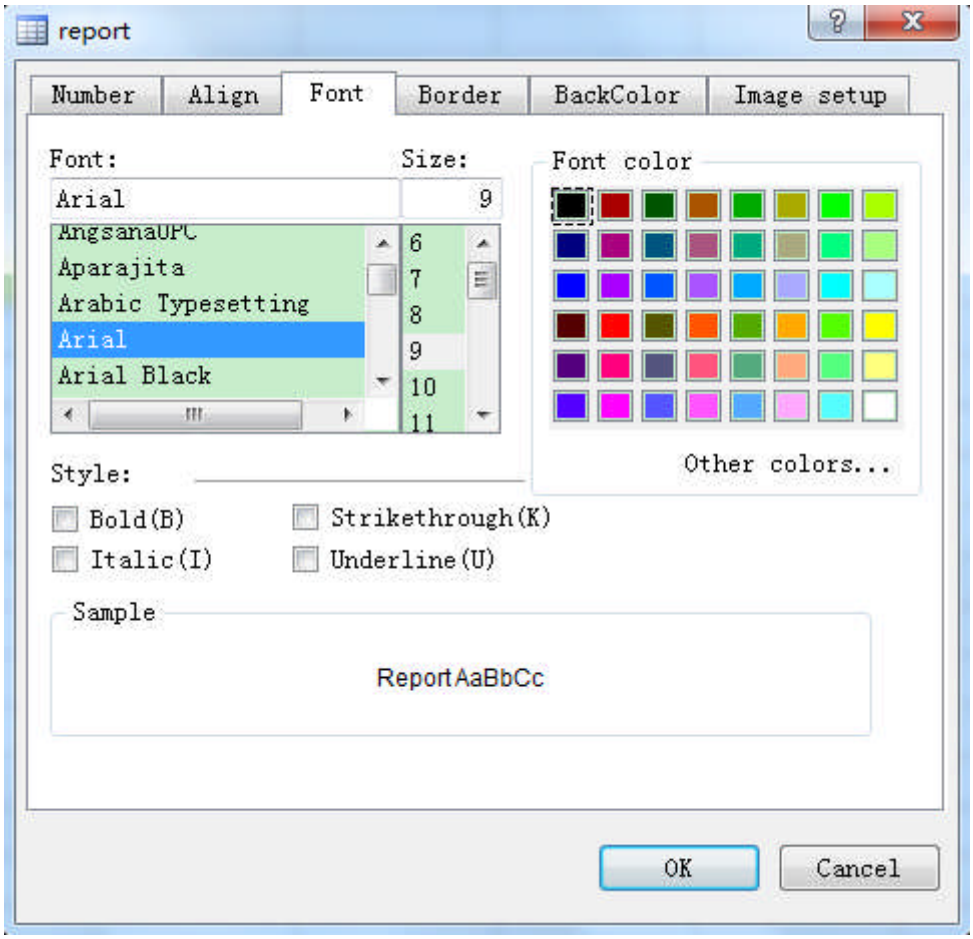


Figure 5.4-12 Cell attributes –Font

- Border (as shown below): set style of cell borders: border or no border, border line type, border line width, and line color.

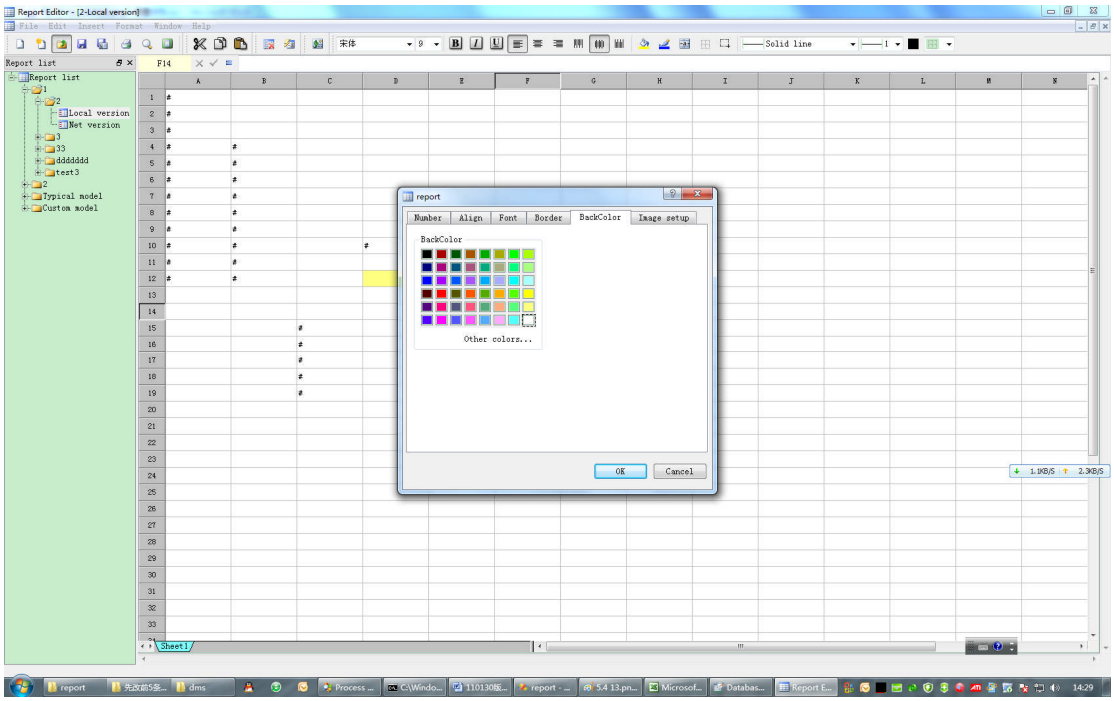


Figure 5.4-13 Cell attributes – Border

- BackColor (as shown below): set cell background color. User can click “Other color” button to call system color dialog box to select a color not listed.

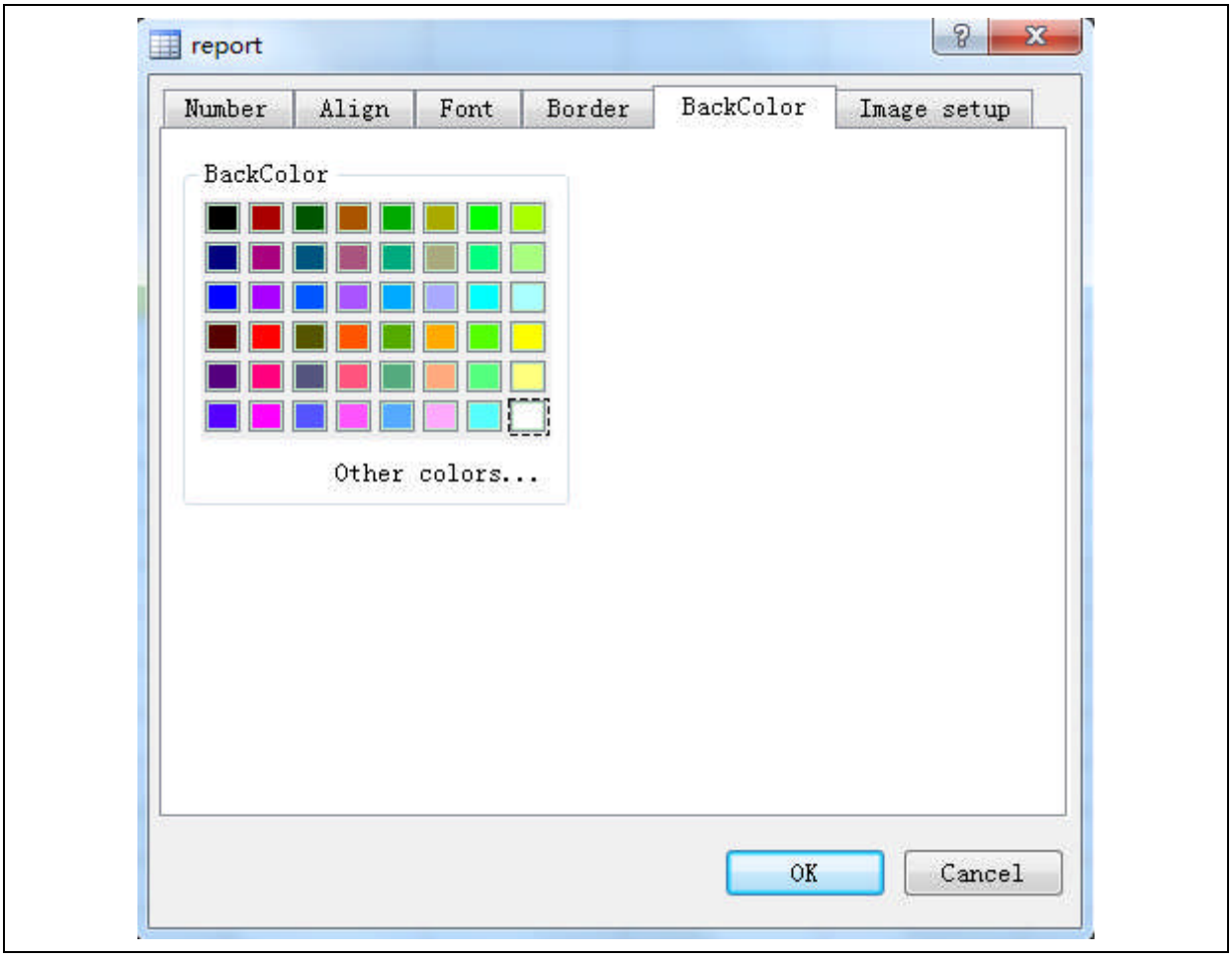


Figure 5.4-14 Cell attributes – Background color

- Image setup: set if picture is directly displayed and mode of display. If direct display is set, a picture inserted into a cell will be directly displayed; otherwise the picture will only pop up when clicked.

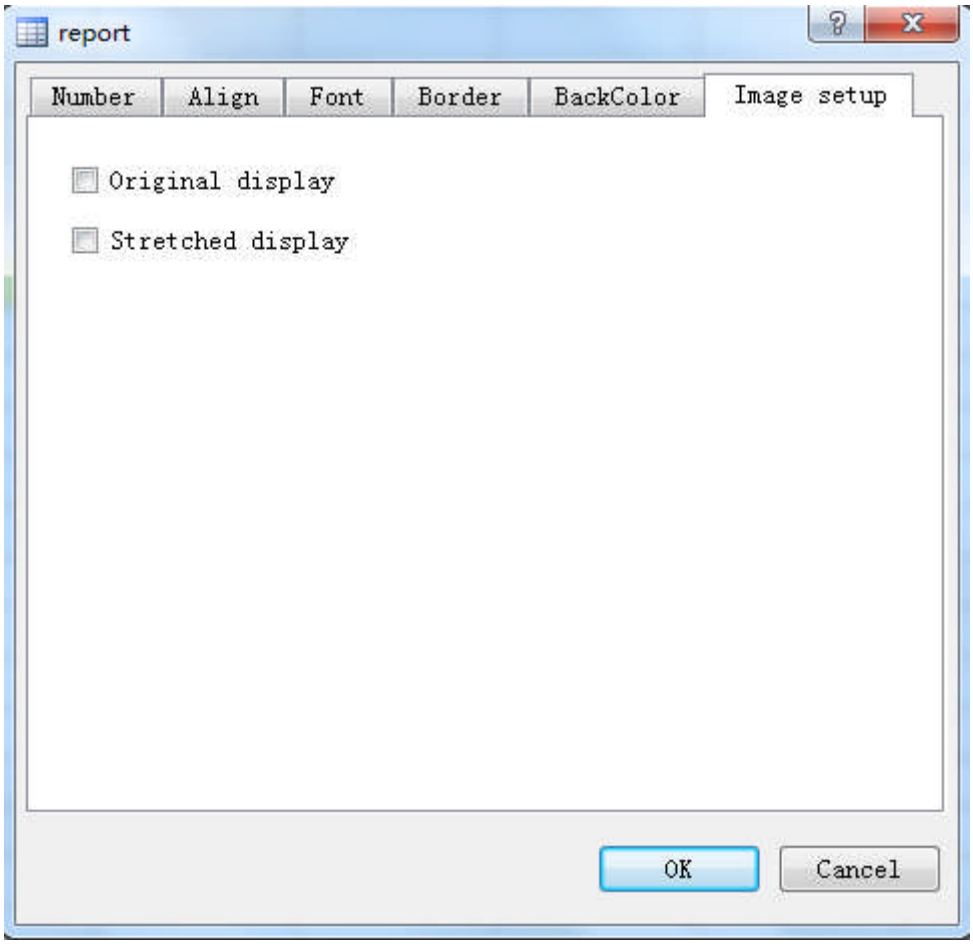


Figure 5.4-15 Cell attributes – Image setup

- Insert picture: select a cell and use menu "Insert"—>"Picture" or click button "" of the tools bar. Select picture file and click OK. User can set cell attributes to determine picture display mode.
- Definition of formula: formulae can be defined. Nesting of formulae is supported. Interface of formula definition is shown below.

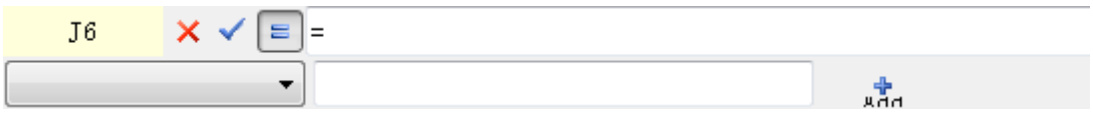


Figure 5.4-16 Formula editing 1

Select the cell for which formula needs to be defined (displayed in grey before end of formula definition), displayed at upper left corner and represented by row ＋ column (e.g. B7 represents second column, 7th row). Then click button "" to display algorithm list bar. Select algorithm and then select required cells on the report. Selected cells will be displayed in the edit box after the algorithm bar. Then click button "Add" to complete definition of a formula with calculation content. Formula can be added repeatedly and manually edited. After editing, click button ""; or click button "" to cancel. After confirmation, user will see the defined formula displayed on the defined cell. To view cells used for formula definition, just double click the cell of formula definition. Borders

of cells used in the formula will change to green (as shown below). Double click a cell for which no formula is defined can cancel such display in green. To delete a formula definition for a cell, just use “Delete” on right mouse key menu or directly click key “Delete”.

Batch definition of formula: After definition of one formula, press and hold “Ctrl” key, and select the defined cell and then drag mouse transversely or longitudinally to realize batch definition of the formula. Contents of the formula will be analogous according to content of defined formula.

Formulae can be defined and copied horizontally, e.g. define C9=SUM(A9,B9), and drag to copy this to generate D9=SUM(B9,C9), E9=SUM(C9, D9); and vertically, e.g. define A11=SUM(A9, A10), and drag to copy this to generate A12=SUM(A10, A11), and A13=SUM(A11, A12).

Caution: Formulae definition must not adopt nest of do, or self cell as calculation item; otherwise endless loop will occur. For example, user must not define SUM(C7, E7) for cell E7, or C7=SUM(D7, E7), D7=SUM(C7,E7), and E7=SUM(C7,D7) at the same time.

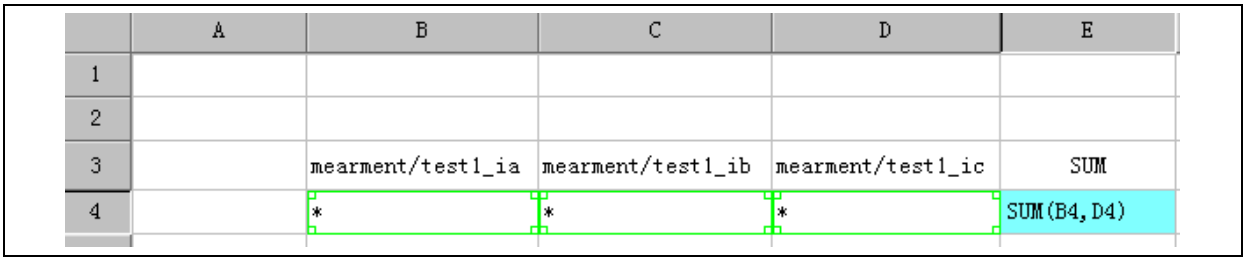


Figure 5.4-17 Formula editing 2

- Find and replace: user can find and replace ordinary text. This function can realize locating to cells (as shown below). User can also find association.

For replacement, if “Text” is selected, only text, not association, will be replaced.

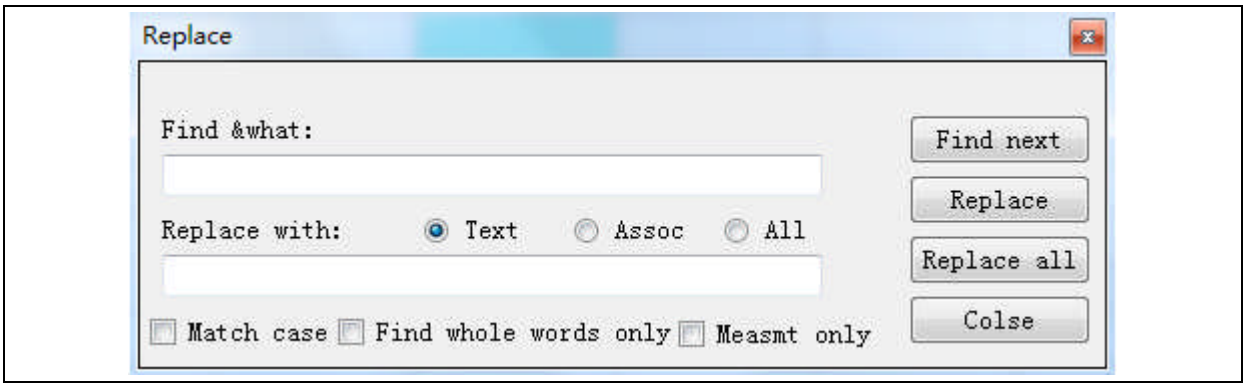


Figure 5.4-18 Replacement

Generation of number series: generation of data series. Data format can be integer, decimal number, and time. First, enter data in 2 continuous cells on the report. Then, press and hold “Ctrl”, and drag from the first cell transversely or longitudinally. A data series will be automatically generated according to interval between the first two data items. Time format will be hour:minute:second.

5.4.12 Report Association

Data association is the most important part of report creation. Only when data association is defined, can real-time data or history data be displayed during browsing of the report, hence realizing the function of report.

Data association is provided in 3 types: real-time association, history association, and time association.

5.4.12.1 Real-time Association

To acquire real-time data, use real-time association. During browsing of report, constantly changing real-time data will be displayed. Object of association is real-time attribute.

Right click mouse and select context menu item “Define real-time association” or select cell and click “” on the tools bar, to display Real-time Association Define dialog box (as shown below).

Select application and database. Click “Object search” to activate object searcher (as shown below). Reduce scope of selection by means of uppermost selection box. The list at left lists objects that can be selected. The list at right lists real-time attributes of objects. Select an object and attributes; multiple selection is permitted for both. Then, click “OK” button. Attributes of all objects defined will be listed in the object list box. Display format is: object attribute @ table name @ domain name.

Select objects arrangement mode: landscape or portrait.

Select Add title: if selected, object alarm name will be added at a suitable position near the cell for which object association is defined.

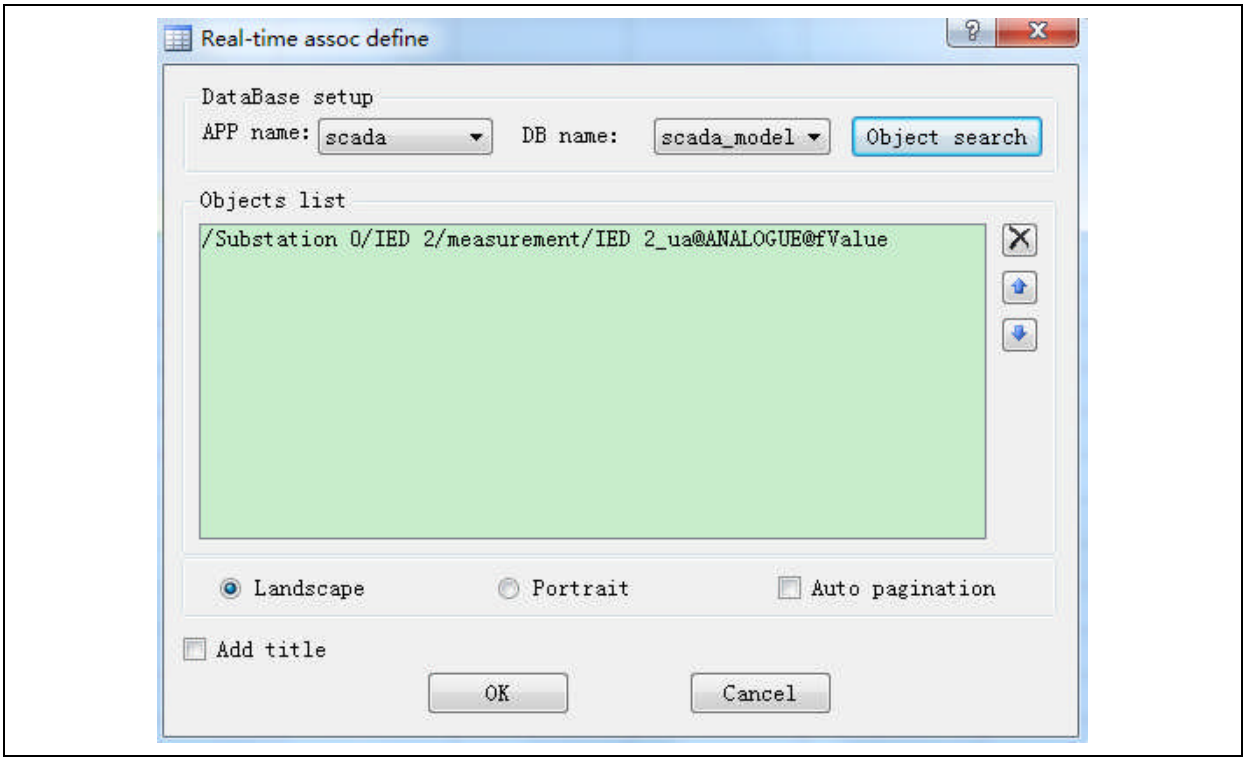


Figure 5.4-19 Real-time association define

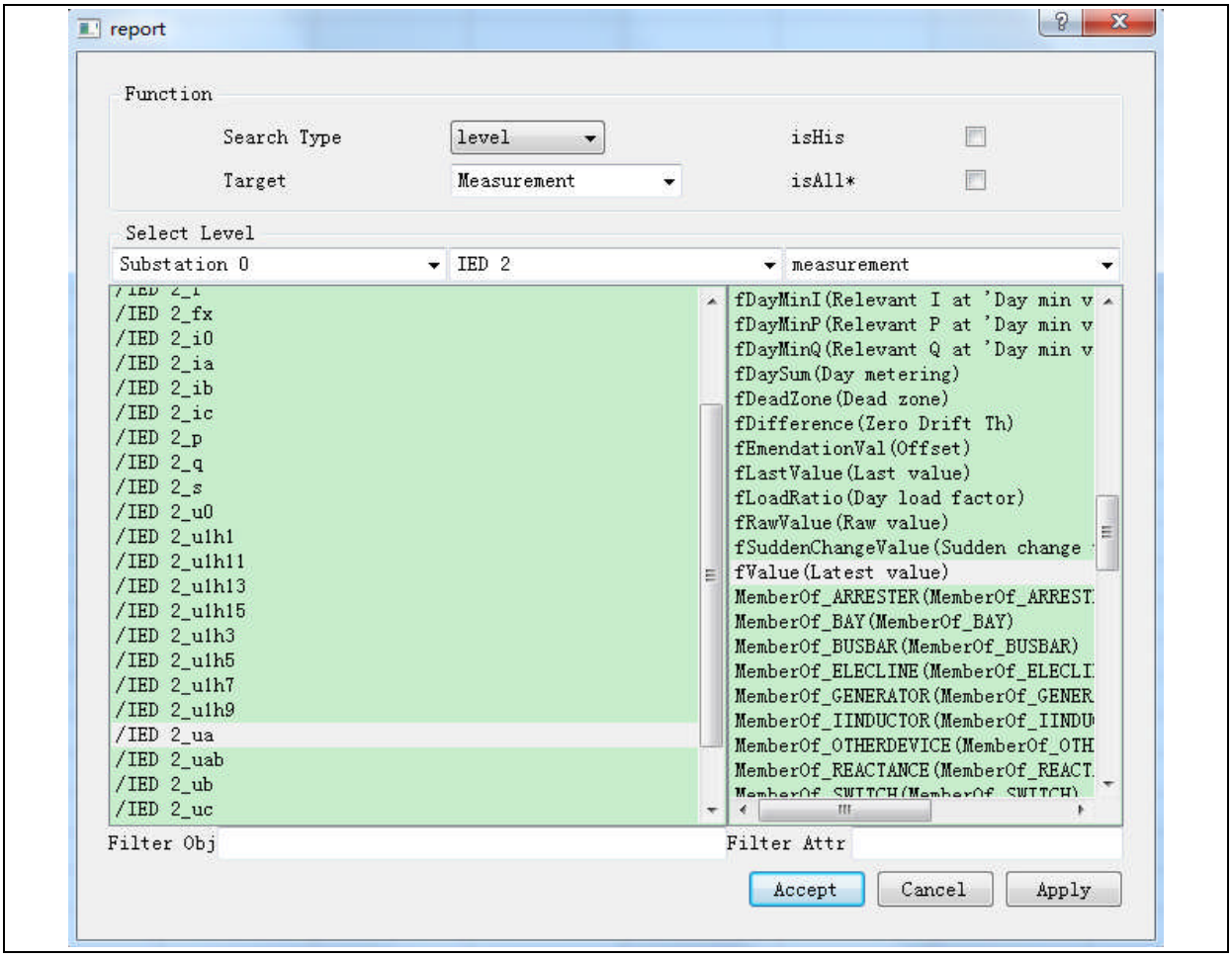


Figure 5.4-20 Data association

After clicking “Accept”, definition will be as shown below. In the cells with “*”, data association is defined. Above “*” is the object alarm name added when Add Title is selected. When a cell with “*” is selected, definition of association will be displayed in the cell information display bar.

	A	B	C	D	E	F
1						
2		measurement/IED 0_i0	measurement/IED 0_ia	measurement/IED 0_ib	measurement/IED 0_ic	measurement/IED 0_p
3		*	*	*	*	*
4						

Figure 5.4-21 Definition of real-time data association

After this association is defined, it can be browsed in editing status. Click button “  ” in the tools bar to take data from the real-time database and fill in associated cells with “*” (as shown below).

	A	B	C	D	E	F
1						
2		measurement/IED 0_i0	measurement/IED 0_ia	measurement/IED 0_ib	measurement/IED 0_ic	measurement/IED 0_p
3		0.000	0.000	0.000	0.000	0.000

Figure 5.4-22 Display of real-time data association

Click this button again to return to editing status.

5.4.12.2 History Association

History association allows association with object history attribute, and takes history data from the history database for display to user.

Right click mouse and select “Define history association” in the context menu popped up, or select the cell and click button “” on the tools bar, to display History Association Define dialog box.

Same as for real-time association, first select application and database. Click “Object search” button to activate the object searcher. However, as it is history association being defined, user need to select history attributes of the object. After selecting object in the left list (only one object can be selected for history association), click button “his” on the attributes list, which lists history attributes of the object. Again, only one history attribute can be selected. Therefore, add only one item in the object list of the History Association Define dialog box.

Select object arrangement mode: landscape or portrait.

Association setup: Since history association has timestamp, a series of history associations of the same object and the same history attribute with timestamp as reference can be defined. For this reason, user can set single association or serial association.

Serial setup: For serial association, user need to determine the step of the series and the length of the series. Object history attributes have time periods, hence step must be integer multiples of the period; otherwise data cannot be acquired.

Extension: push association forward or backward with starting time as reference.

The list box that follows lists statistic information that can be selected. Select the information by checking; history association of statistic information will be added at end of the series.

Time setup: set the time at which history association starts to fetch data.

Add title: after selecting this item, object alarm name will be added in the row or column where object association is located.

Add timestamp: after selecting this item, timestamp will be added in the row or column where object association is located.

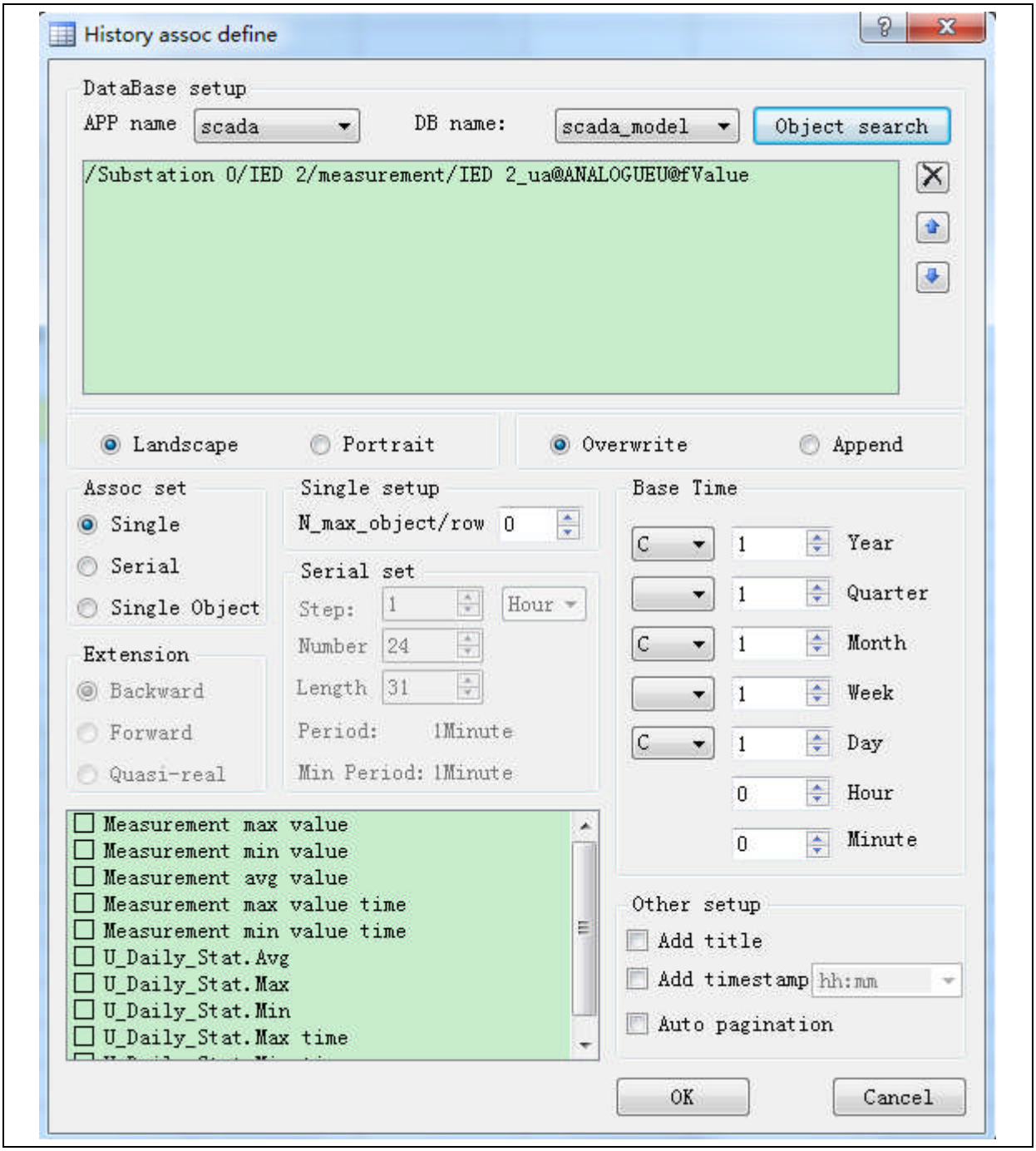


Figure 5.4-23 Definition of history data association

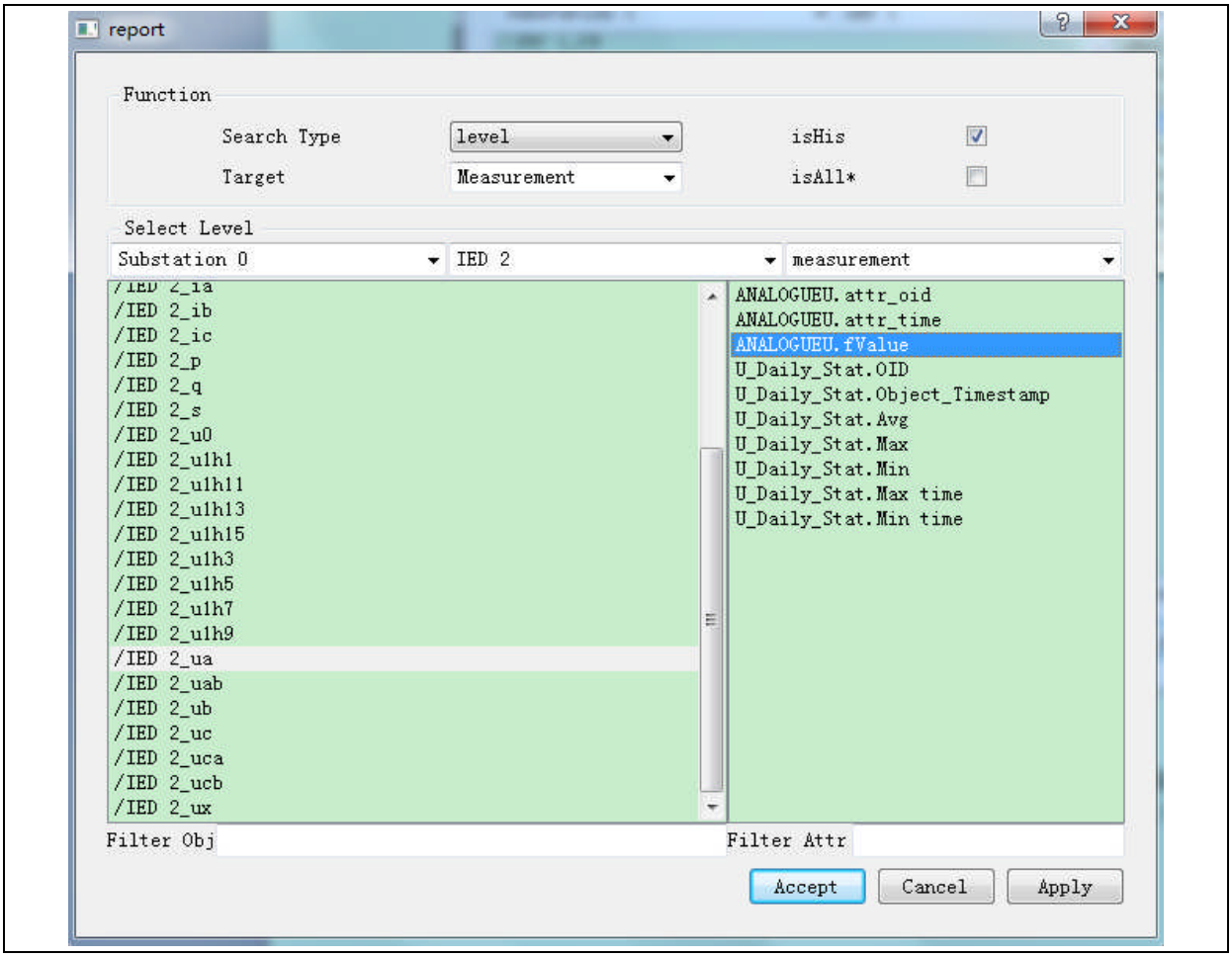


Figure 5.4-24 Association of history data

After selection of object history attribute, click “OK” to generate history association. Associated cell is indicated by “#” text. When a cell with history association is selected, definition of history association will be displayed in the cell information display bar (as shown below).

	A	B	C	D	E	F	G
1	test1						
2	Date:	2011-01-17					
3		measurement/test1_ia	measurement/test1_ib	measurement/test1_ic	measurement/test1_p	measurement/test1_q	measurement/test1_ua
4	00:00	#	#	#	#	#	#
5	01:00	#	#	#	#	#	#
6	02:00	#	#	#	#	#	#
7	03:00	#	#	#	#	#	#
8	04:00	#	#	#	#	#	#
9	05:00	#	#	#	#	#	#
10	06:00	#	#	#	#	#	#
11	07:00	#	#	#	#	#	#
12	08:00	#	#	#	#	#	#
13	09:00	#	#	#	#	#	#
14	10:00	#	#	#	#	#	#
15	11:00	#	#	#	#	#	#
16	12:00	#	#	#	#	#	#

Figure 5.4-25 Association of history data

After association is defined, it can be viewed in editing status. Click button "  " on the tools bar to fetch data from history database and fill them in associated cells with "#" (as shown below).

	A	B	C	D	E	F	G
1	test1						
2	Date:	2011-01-17					
3		measurement/test1_ia	measurement/test1_ib	measurement/test1_ic	measurement/test1_p	measurement/test1_q	measurement/test1_ua
4	00:00	--	--	--	--	--	--
5	01:00	--	--	--	--	--	--
6	02:00	--	--	--	--	--	--
7	03:00	--	--	--	--	--	--
8	04:00	--	--	--	--	--	--
9	05:00	--	--	--	--	--	--
10	06:00	--	--	--	--	--	--
11	07:00	--	--	--	--	--	--
12	08:00	--	--	--	--	--	--
13	09:00	--	--	--	--	--	--
14	10:00	0.000	0.000	0.000	0.000	0.000	0.000
15	11:00	0.000	0.000	0.000	0.000	0.000	0.000
16	12:00	0.000	0.000	0.000	0.000	0.000	0.000
17	13:00	0.000	0.000	0.000	0.000	0.000	0.000
18	14:00	0.000	0.000	0.000	0.000	0.000	0.000

Figure 5.4-26 Display of history data association

Click this button again to return to editing status (as shown below).

5.4.12.3 Time Association

Report Tools provide 3 types of time association as time elements that may be used when generating a report, namely:

- Selected time for browsing: Before browsing a history report or a mixed report (with both real-time association and history association), user need to first select the time. If this time association has been defined for the cell, the time filled will be the time selected by user.
- Current time: current time of local machine, updated by automatic or manual refreshing.
- Report generation time: time when the report was generated; neither user selected time nor current time; this time remains unchanged as long as this report is not closed.

5.4.13 Auxiliary Association Functions

5.4.13.1 Replace association

Use main menu “Edit”→“Replace” or shortcut key Ctrl+R to open Replace dialog box (as shown below).

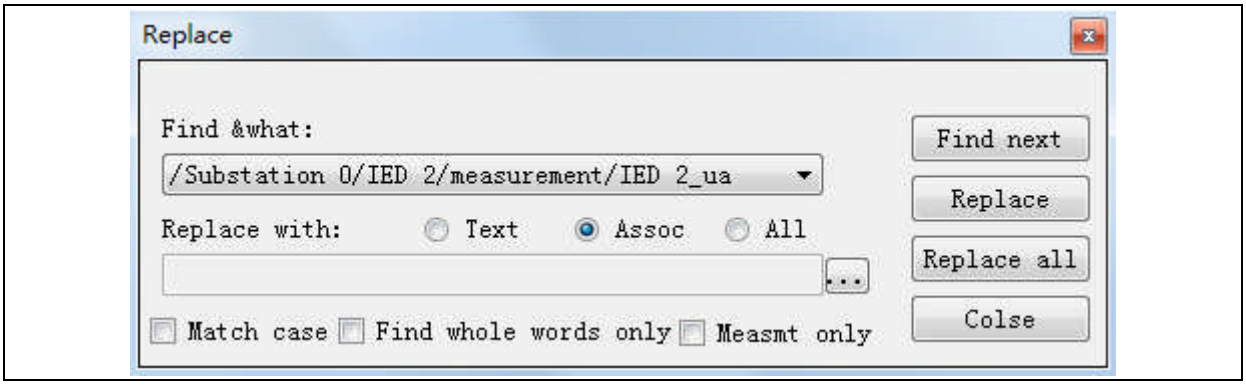


Figure 5.4-27 Replace association

Select “Association”; Find &what will list all associations defined in this report. Click button (…) of Replace With to pop up object searcher. Similar to definition of association, select object and object real-time or history attribute. Click button “Replace” to locate each defined cell one by one and replace original association. Click button “Replace all” to replace all associations meeting the condition.

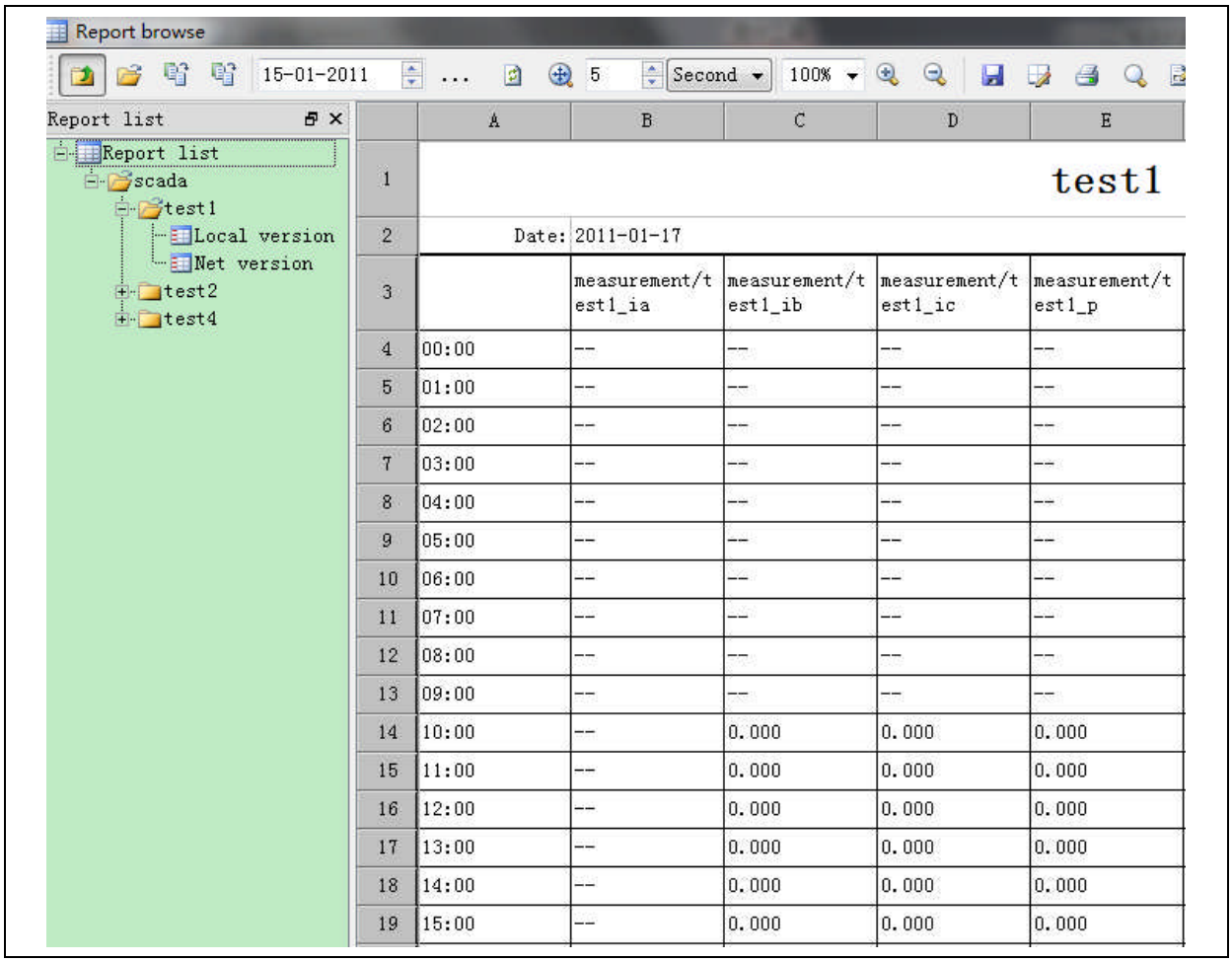
If selected Replace With is “All”, all texts and associations meeting the condition will be replaced. If an association after replacement does not exist, error information will be displayed in the error information bar.

5.5 Report Browser

5.5.1 Browsing Tools Interface Layout

After editing of a report, user can use report browser to check actual effect of the report. As introduced by Report Startup, use parameter –b to start report so as to enter the browsing interface (as shown below). The main interface includes a tools bar, report list window at left, and

report display window at right.



	A	B	C	D	E
1					test1
2	Date:	2011-01-17			
3		measurement/test1_ia	measurement/test1_ib	measurement/test1_ic	measurement/test1_p
4	00:00	--	--	--	--
5	01:00	--	--	--	--
6	02:00	--	--	--	--
7	03:00	--	--	--	--
8	04:00	--	--	--	--
9	05:00	--	--	--	--
10	06:00	--	--	--	--
11	07:00	--	--	--	--
12	08:00	--	--	--	--
13	09:00	--	--	--	--
14	10:00	--	0.000	0.000	0.000
15	11:00	--	0.000	0.000	0.000
16	12:00	--	0.000	0.000	0.000
17	13:00	--	0.000	0.000	0.000
18	14:00	--	0.000	0.000	0.000
19	15:00	--	0.000	0.000	0.000

Figure 5.5-1 Report browser main interface

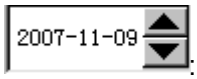
5.5.2 Introduction to Tools Bar Buttons

: display or hide report display window at left

: open local report file; file format includes .xls and .cgs

: pop up a dialog box to save to a folder specified by user; saving format includes .xls, .cgs, .txt, .html

: save to default path /deployment/table/reportfiles/



: select report browsing time; after a report is open, user can change date of data fetching here, and then click Manual Update to refresh data

: manual refreshing of data

: automatic refreshing of data

: period of automatic refreshing clock, in second

: update history database; for report browsing, faulty data can be manually modified. If necessary, such data modification can be updated to the history database. However, update of history database is only allowed if two persons of user authorized to modify the history database enter their passwords at the same time. This arrangement reduces the risk of modification of history database at will.

: print report

: preview report

: close the report currently open.

5.5.3 Browse Report

For browsing, data will be fetched from real-time database or history database according to type of data association defined by user, to replace association signs “*” and “#” etc. Timestamp of history report shall be updated according to user selected date. If a formula is defined, actual value will be calculated using such formula and displayed in the cell. If fetching of data from real-time or history database fails, display in associated cell will be blank.

- Double click report node (not version node) on the left list to open corresponding report. This mode will open network version of the report in default. If network version is not available, local version will be opened. If local version is not available either, user will be prompted that no version of the report is found.
- Double click report version node on the left list to open corresponding report version, in particular local version, so that actual browsing effect can be viewed during editing.

Real-time report will be directly opened to display real-time data. For history report or mixed report, before being opened, date selection dialog box will pop up to allow user select date of data to be browsed (as shown below).

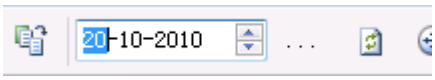


Figure 5.5-2 Date selection

5.5.4 Open/Save Report

Click button Open to pop up Open dialog box (as shown below). In the left list window, files defined and saved by report service are listed. Double click a report item to open the file for browsing. In the right window, all report files saved locally can be opened. User can select one mode to open and browse saved report as required. Report opened can be modified and saved again in the local machine. Modified data cannot be updated to the history database.

Report opening can open report in internal format or EXCEL format.

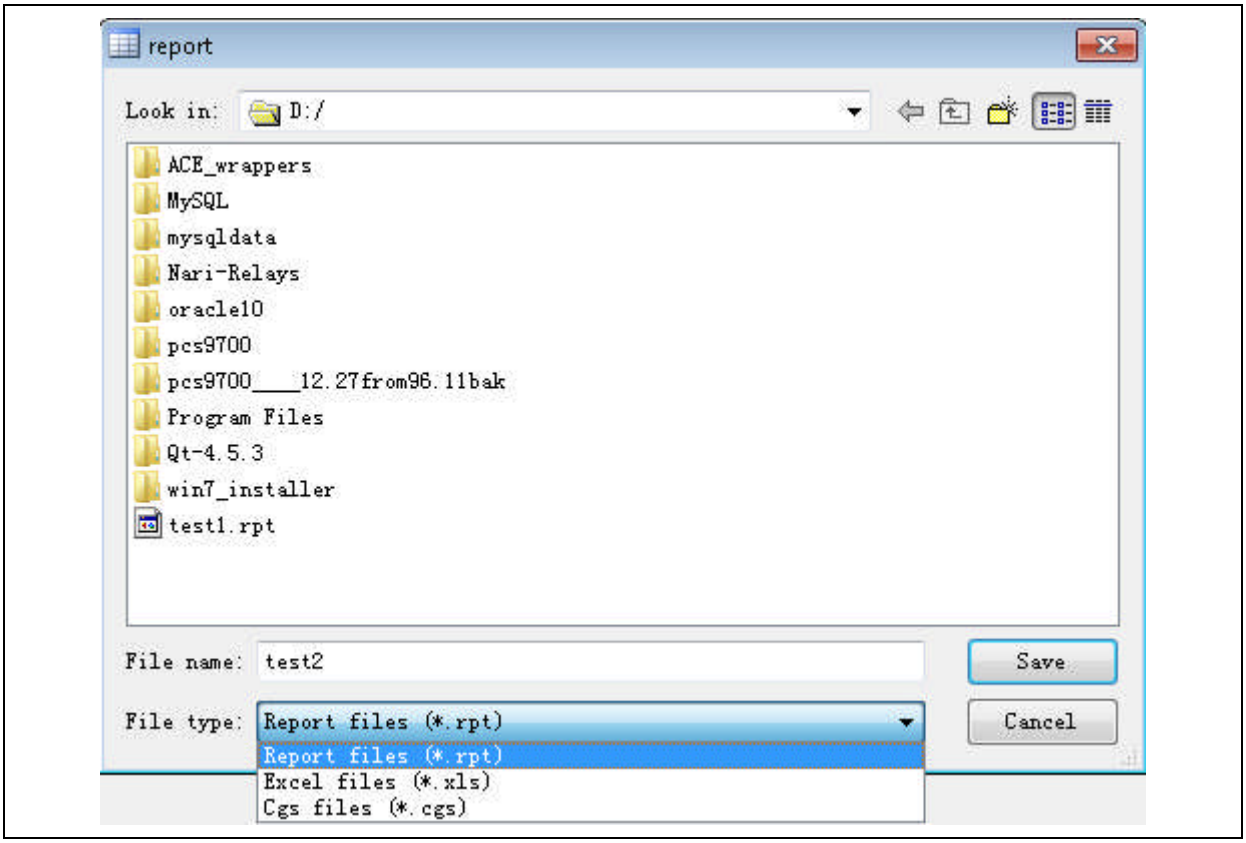


Figure 5.5-3 Open saved report

Click Save button to pop up Save File dialog box (as shown below). Select destination directory and enter name of the file saved, and click “Save”. The file saved can be found in the right window of the Open dialog box and opened for browsing.

Browsed report can be saved in internal format or EXCEL format.

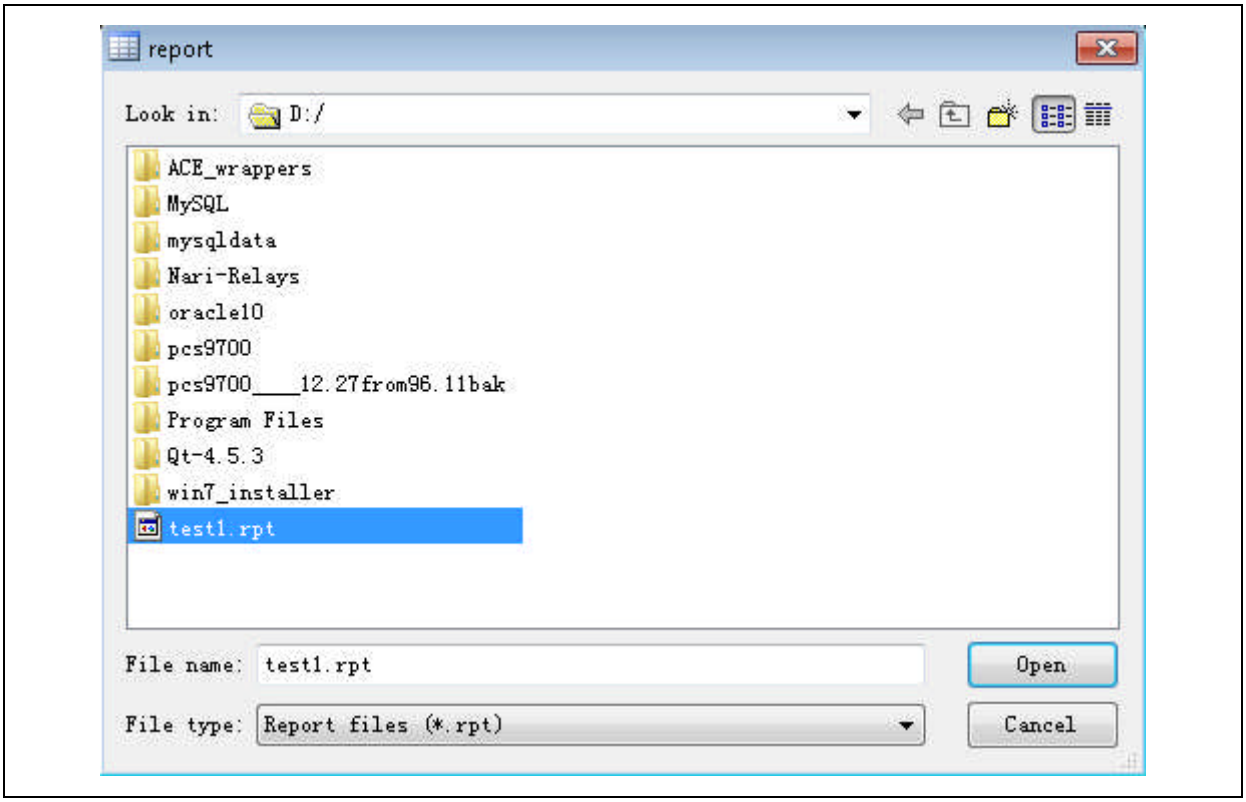


Figure 5.5-4 Save file

5.5.5 Cross-Platform EXCEL Format Interaction

Both Open and Save in the report browsing tools can be carried out for files in EXCEL format.

In UNIX and WINDOWS, EXCEL files can be opened to display their contents, to realize cross-platform browsing of EXCEL files.

Data of report browsing can be saved in EXCEL format in local machine using this function. For viewing, user can use Report Browser tool to open the file. User can also directly use OFFICE tool in WINDOWS to open the file, facilitating saving and viewing of report data.

5.5.6 Automatic Data Refreshing Function

For real-time report or mixed report, after being opened, refreshing clock will be automatically activated to automatically refresh data according to set period. That is to say, after report browsing automatic refreshing function is activated, at refreshing period, data will be automatically fetched from real-time or history database to update display of report data. For history reports, automatic refreshing function will not be activated automatically. User can manually start or stop automatic refreshing of report.

At the same time, user can define automatic refreshing period. To this end, automatic refreshing must be stopped. At end of setup, activate automatic refreshing again. Automatic data refreshing by report browsing tool will resume at new period.

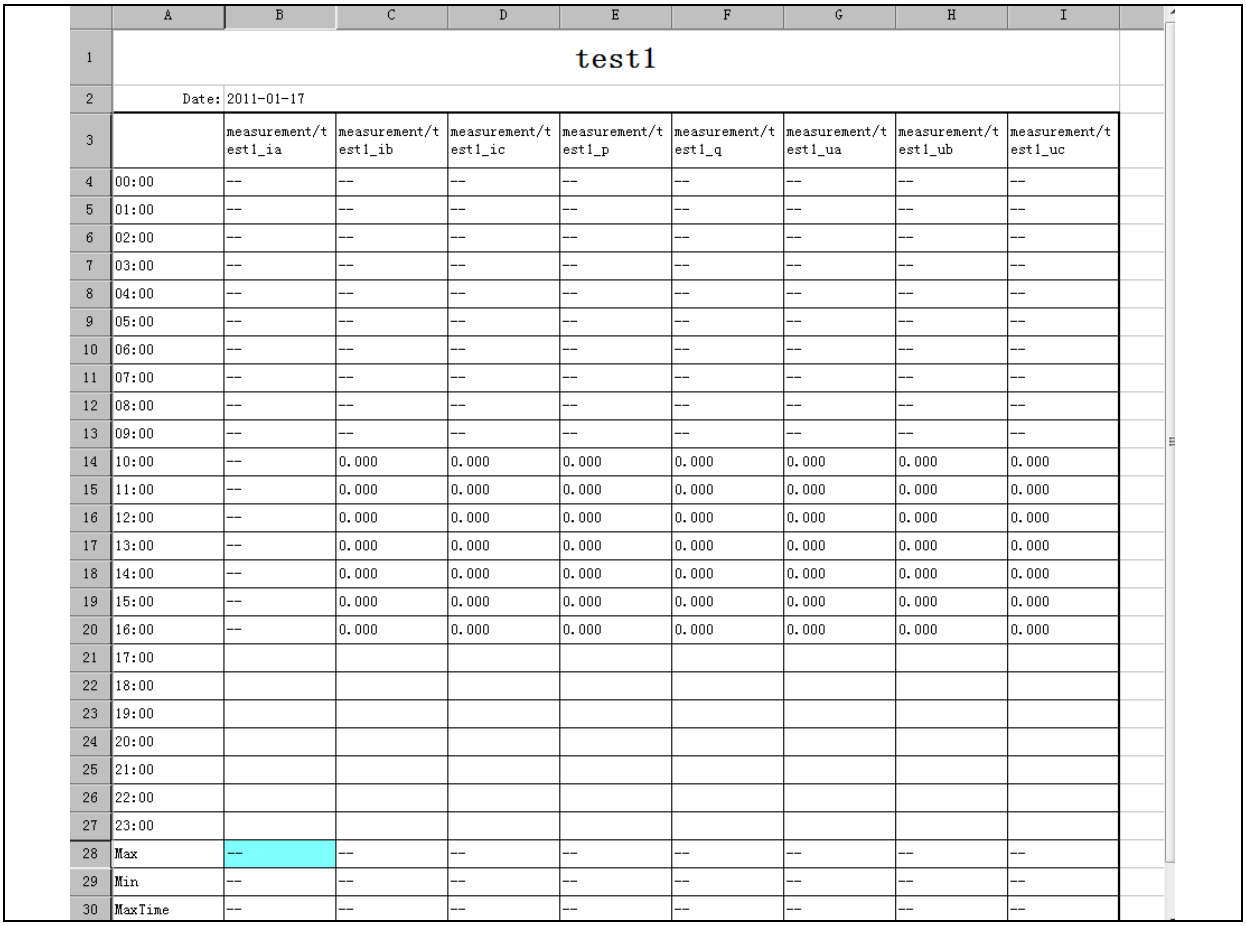
5.5.7 Print Report

If print range has been set during editing, such range will be followed for printing. If not, user can

print all or select a range by mouse for printing.

Landscape and portrait paged printing is supported.

Paged printing ensures integrity of cells. Contents printed adopt cell as the minimum unit and one cell will not be printed on two pages (except merged cell).



	A	B	C	D	E	F	G	H	I
1	test1								
2	Date:	2011-01-17							
3		measurement/test1_ia	measurement/test1_ib	measurement/test1_ic	measurement/test1_p	measurement/test1_q	measurement/test1_ua	measurement/test1_ub	measurement/test1_uc
4	00:00	--	--	--	--	--	--	--	--
5	01:00	--	--	--	--	--	--	--	--
6	02:00	--	--	--	--	--	--	--	--
7	03:00	--	--	--	--	--	--	--	--
8	04:00	--	--	--	--	--	--	--	--
9	05:00	--	--	--	--	--	--	--	--
10	06:00	--	--	--	--	--	--	--	--
11	07:00	--	--	--	--	--	--	--	--
12	08:00	--	--	--	--	--	--	--	--
13	09:00	--	--	--	--	--	--	--	--
14	10:00	--	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	11:00	--	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	12:00	--	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	13:00	--	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	14:00	--	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	15:00	--	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	16:00	--	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	17:00								
22	18:00								
23	19:00								
24	20:00								
25	21:00								
26	22:00								
27	23:00								
28	Max	--	--	--	--	--	--	--	--
29	Min	--	--	--	--	--	--	--	--
30	MaxTime	--	--	--	--	--	--	--	--

Figure 5.5-5 Preview Report

5.5.8 Report Print Preview

If print range has been set during editing, such range will be followed for preview. If not, user can preview all or select a range by mouse for preview.

Print preview realizes 100% simulation. First select printer. Printer parameters will be automatically adopted for print preview. Paged preview is realized. User can use buttons to turn over pages.

In print preview window, directly click “Print” button for printing.

Print preview window is shown below:

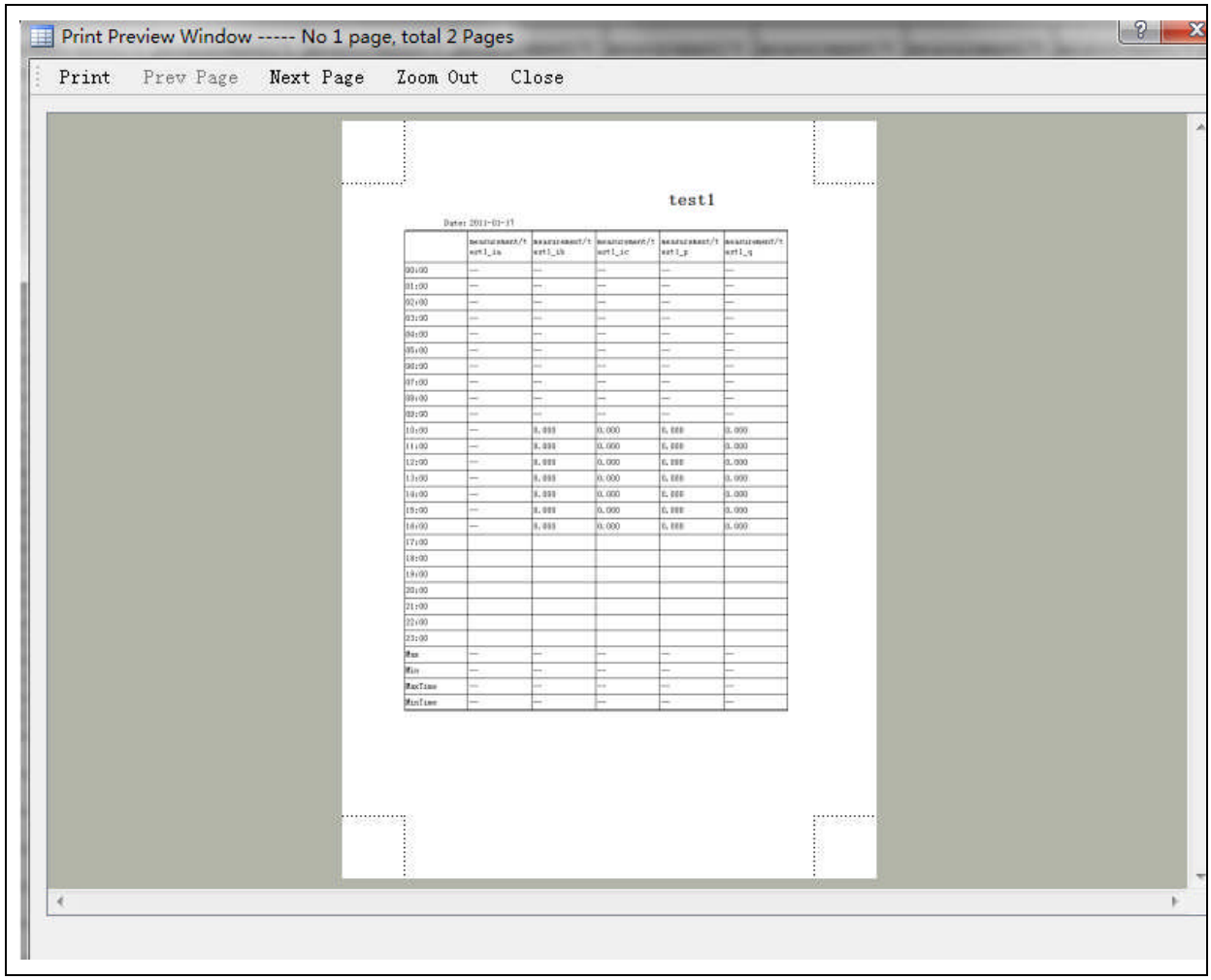


Figure 5.5-6 Print preview

5.5.9 Modify History Data

During report browsing, faulty history data can be modified on the report. Modified data will be displayed in red. If necessary, user can return modified data into the history database, subject to certain authorization conditions, that is to say, two persons of user authorized to modify history database must enter their passwords at the same time (as shown below).

Double click the cell for which data need to be modified to enter editing mode. After modification, return to browsing status; user can see modified data in red. Click button “Modify history data” on the tools bar to pop up Update Login dialog box and enter passwords of user 1 and user 2 (must not be the same person) respectively, and click “OK”. If passwords are correct, modified data will be written into the history database.

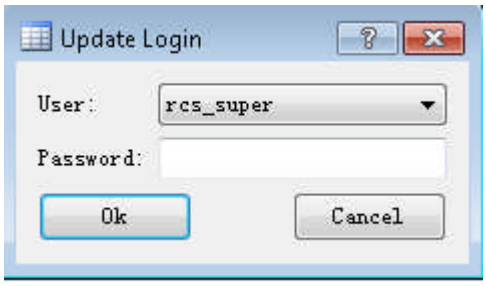


Figure 5.5-7 Update history database

5.6 Report Service

5.6.1 Print Report

Main function of report service is to read report attributes at fixed time. For report for which generation or printing at fixed time has been set, once the set time is reached, report will be automatically generated or printed (if a printer is connected to the server that activates report service), and the automatically generated report will be saved in corresponding directory of $SOPHIC_DEPLOY_DIR/table/time_save/, with date and time as name of file.

5.6.2 Configuration of Report Service

Start and stop of report service will be managed by report_manager process.

Start sm_cfg and create a new key process for “report” application in “Task definition”. task_name will be report_mananger. In “Node application definition”, user only need to define one node for “report” application. If special report service node is available, just define this node; if not, user can select and define other service node.

Use “dbiop report” to open “report” physical database. In “report” tiling package→”node branch”, find nodes that require automatic printing and generation for configuration of report service, and set ”Activity” to True.

5.6.3 Setup of Report Automatic Generation and Automatic Printing

This can be defined during creation of new report and modification of report attributes. Refer to “New blank report” and “Modify report attributes” in report editor.

5.6.4 View Reports Automatically Generated

Automatically generated reports are saved in $SOPHIC_DEPLOY_DIR/table/reportfiles/ directory, with date and time as file name. Report generated on report service node will be synchronized to each other node.

6 Protection Information Management

6.1 General

Protection information management system features two main functions: one is the acquisition, analysis, and processing of protection information and data; the other is the display of protection information and various operations of protection device via man-machine interaction interface.

Protection information management functions are mainly used to realize monitoring, management, setting, and analysis of protection device.

- Call operation parameters of protection device;
- Monitor protection device operating status, active group settings, setting group No., and EBI status;
- Remote online switching of setting groups, modification of settings, and switching VEBI on and off;
- Remote reset of protection signals;
- View status changes, operations, alarms, and other history events uploaded by protection device;
- Receive and analyze fault waveform files of protection device;
- Generate real-time alarms for protection device operation reports, alarm events, change of EBI, and fault information;
- Analyze faults and generate fault analysis reports.

Protection management functions of both protocol 103 and protocol 61850 can be supported at the same time.

6.2 Main Interface

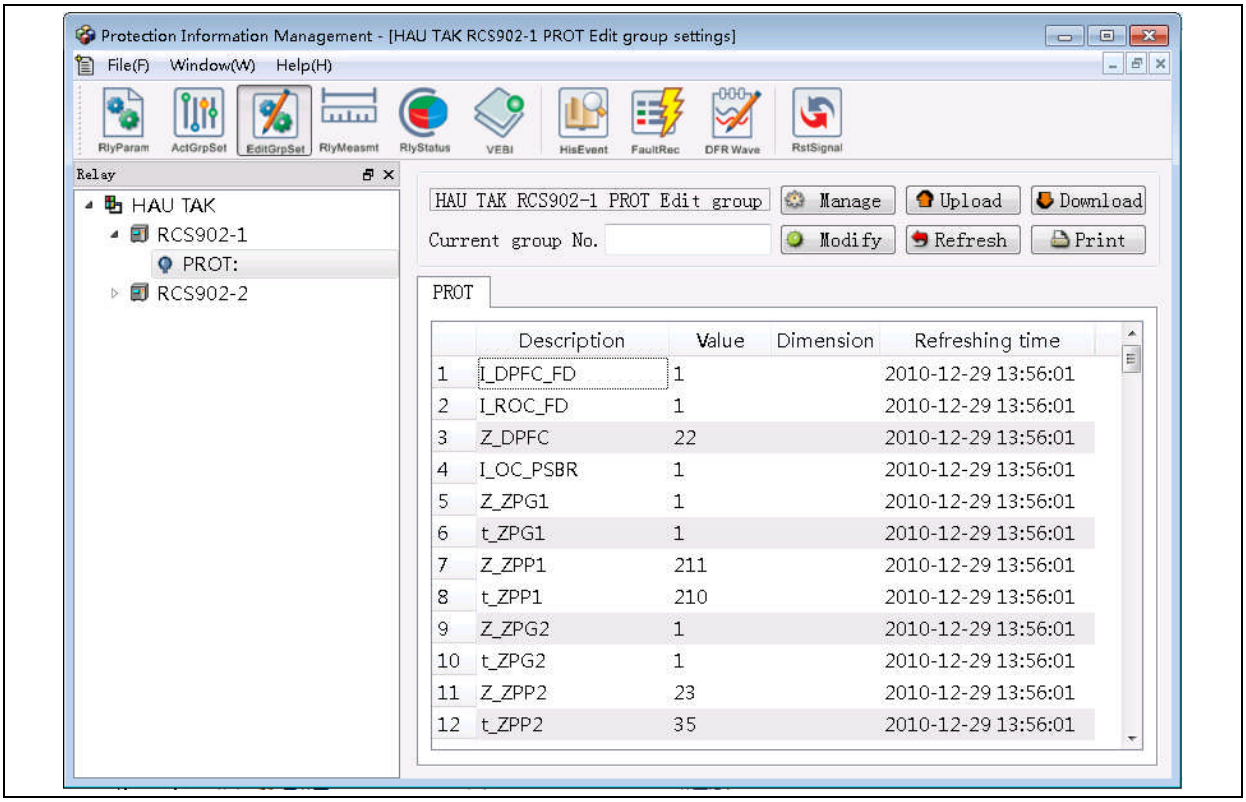


Figure 6.2-1 Main interface

The title bar is used to display name of software and name of current window.

The menu bar includes menu items of File, Window, and Help etc.

The type selection tools bar is used to classify and display various items of relay information. Buttons in the Tools bar can be configured according to “etc/relay/relaymmi.ini”, including device description, active group settings, edit group settings, relay measurement, relay status, VEBI, history events, fault record, and recorded waveform etc.

“Reset signal” button can be used to realize remote resetting of protection signals.

Left side of the main window is device list, displayed in the tree type hierarchy of “Substation → Device→Logic device”. This view adopts single selection, i.e. only one device or one logic device can be selected at same time. Device of protocol 103 has no logic device. For device of protocol 61850, when selected button of Tools bar is of the type of relay information such as “setting”, user can only select logic device on the device tree; when selected type is “DFR wave”, user can only select device on the device tree.

Right side of the main window shows the protection data display view, which displays corresponding protection data according to selected type and device information.

6.3 Tools Bar

Figure 6.3-1 Tools bar

Functional buttons: Relay parameter(RlyParam), Active group settings(ActGrpSet), Edit group settings(EditGrpSet), Relay measurement(RlyMeasmt), Relay status(RlyStatus), VEBI, History events(HisEvent), Fault record(FaultRec), and DFR wave.

Operation button: Reset signal (RstSignal).

- 

Relay parameter: including device description and operation parameters etc.
- 

Active group settings: current operating settings of protection device
- 

Edit group settings: settings in protection device editing group (protocol 61850 device only)
- 

Relay measurement: analog quantities of protection device
- 

Relay status: binary quantities related to protection device, including operation alarm, device self-check, operation elements, and EBI etc.
- 

VEBI: enabling/disabling protection functions (protocol 103 device only)
- 

History event: history events uploaded by protection device and saved to background historical database, including status changes, operations, and alarms etc.
- 

Fault record: combined fault analysis report consisting of information related to primary fault of protection device, e.g. waveform analysis, protection operation, and related

events etc. (protocol 103 device only).

- 

DFR wave: waveform record of protection device or disturbance and fault recorder.

- 

Reset signal: remotely reset signal indicators on protection device.

6.4 Protection Information

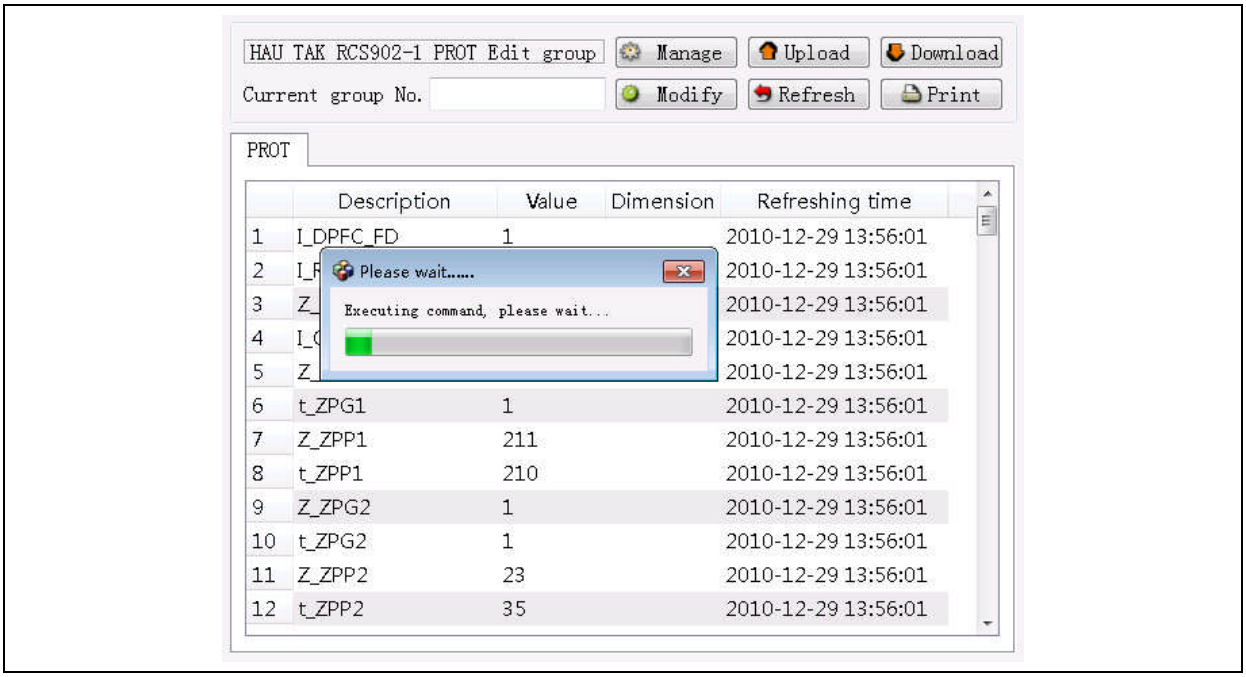


Figure 6.4-1 Protection information

6.4.1 Description of Interface

According to different group type selected, protection information browsing can display protection device information of relay parameters, active group settings, edit group settings, relay measurement, relay status, and VEBI.

The protection information interface includes an upper part and a lower part, which are commands view and display view respectively.

In the commands view, name of current window and current setting group No. are displayed. It includes 6 buttons: “Manage”, “Modify”, “Upload”, “Download”, “Refresh”, and “Print”. If selected type is not setting, setting group No. will not be displayed, and buttons “Manage” and “Modify” will not show.

- Manage: including import setting, export setting, and surveil setting
- Modify: change current setting group No.

- Upload: call actual values of current protection information
- Download: modify settings and enable/disable VEBI
- Refresh: call all attributes of current protection information, including description, range, dimension, precision, and actual values etc.
- Print: output current protection information to a printer.

For protocol 61850 device, refreshing of relay parameters, active group settings, and edit group settings is supported. For relay measurement and relay status, only upload is supported.

Click button “Upload”, “Download”, “Refresh” or “Modify” will pop up a waiting box. When the command is complete, fails, or is overtime, this waiting box will disappear, with result of command execution displayed. If the waiting box is closed during execution of the command, this command will be deemed canceled.

In the display view, current protection information is displayed in pages according to groups. Display contents include description, values, dimension, and refreshing time. These vary with different types selected, for example, protection information such as relay status and VEBI have no dimension.

6.4.2 Modify Settings

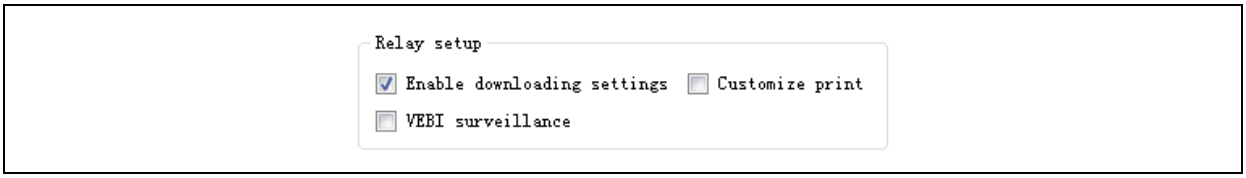


Figure 6.4-2 Enable downloading settings

In case modification of settings, switching of setting group No., or VEBI switch-on/off is required, user needs to check option “enable downloading settings” in the SCADA setup page in system configuration tools; otherwise “Modify” and “Download” buttons will be grey and unusable.

For protocol 103 device, user can switch active group settings group No., modify active group settings, and switch VEBI on/off. For protocol 61850 device, user can switch current group setting group No., editing group setting group No. and modify editing group settings only.

Modification of settings, setting group No., and VEBI can only be proceeded after refresh. If an item has no actual value or range, modification is not permitted.

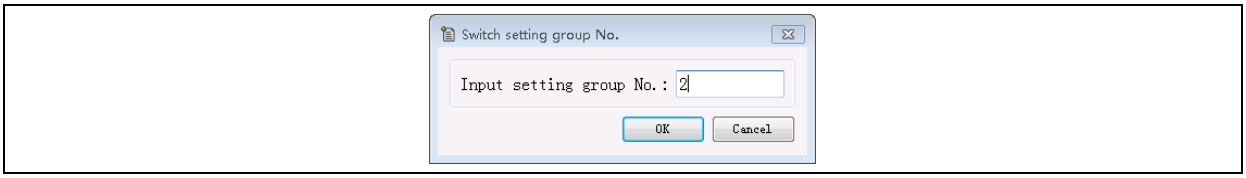


Figure 6.4-3 Switch setting group

After clicking Modify, Switch setting group No. dialog box will pop up. Enter group No. and click “OK”; current protection device setting group No. will be changed to the No. entered.

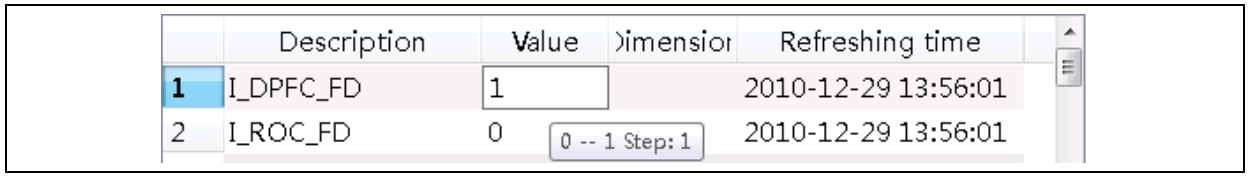


Figure 6.4-4 Modify setting

In the Display view, double click actual value column of the setting to be modified to pop up an Edit box and a range label, including minimum value, maximum value, and step length. Enter the value to be downloaded and click an area outside the Edit box for confirmation. If the value entered exceeds the range, a prompt box will pop up to request entering again.

6.5 Management of Settings

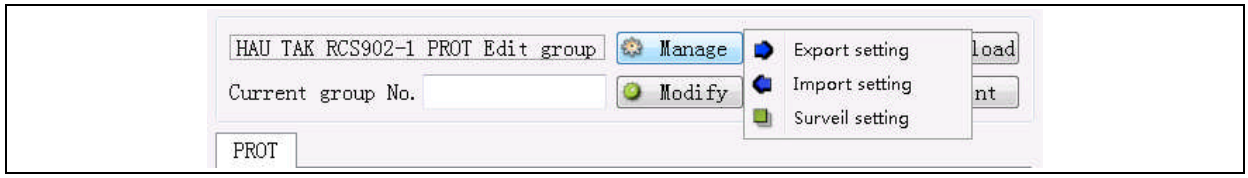


Figure 6.5-1 Management of settings

Management of settings includes “export setting”, “import setting”, and “surveil setting”.

- Export setting: export current settings to a setting list
- Import setting: import settings from historical setting list
- Surveil setting: compare current settings with settings in historical setting list

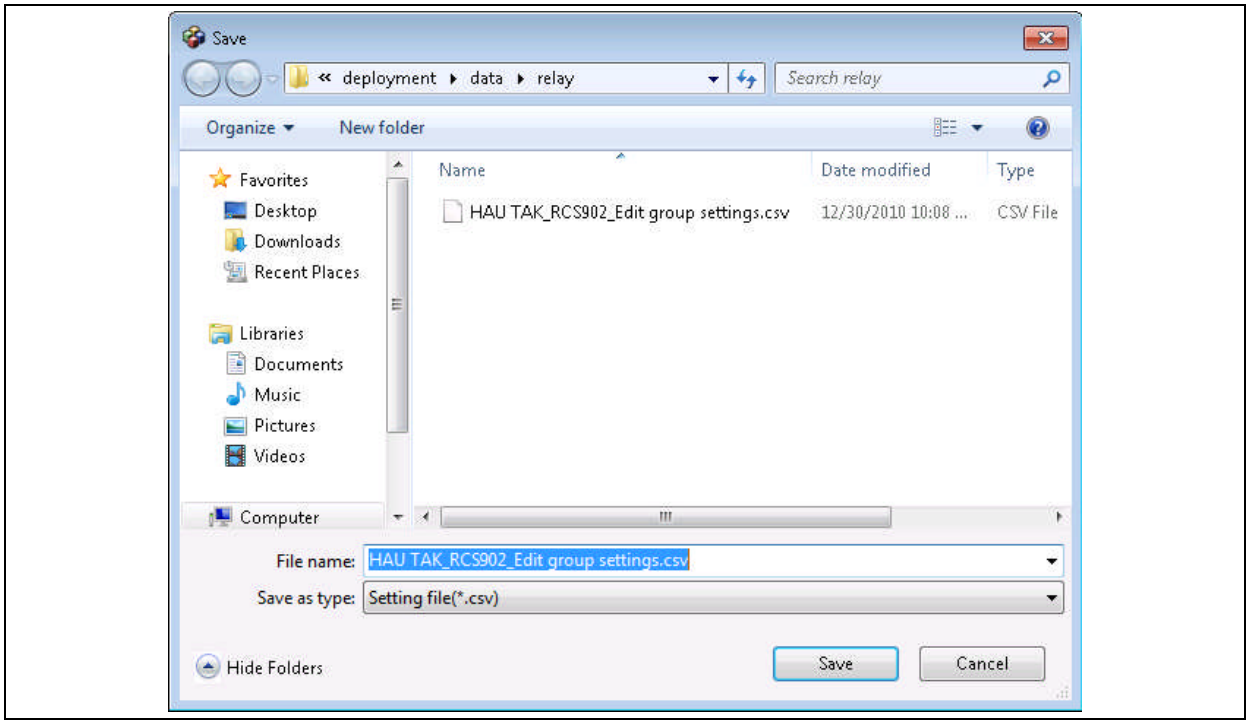


Figure 6.5-2 Export setting

Enter the file that saves historical setting list and click “Save”. A completion prompt will be displayed when export is succesful.

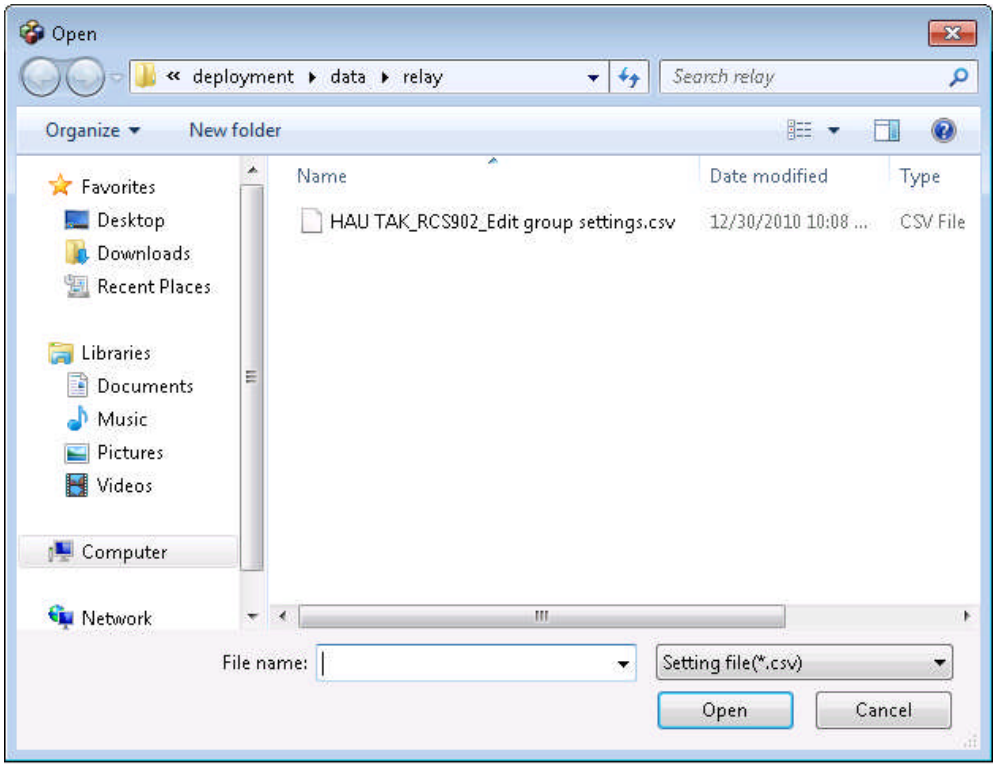


Figure 6.5-3 Import setting

Select a historical setting list file and click “Open”. A completion prompt will be displayed when import is successful. If value imported to the setting list is different from current setting, downloading will be prepared.

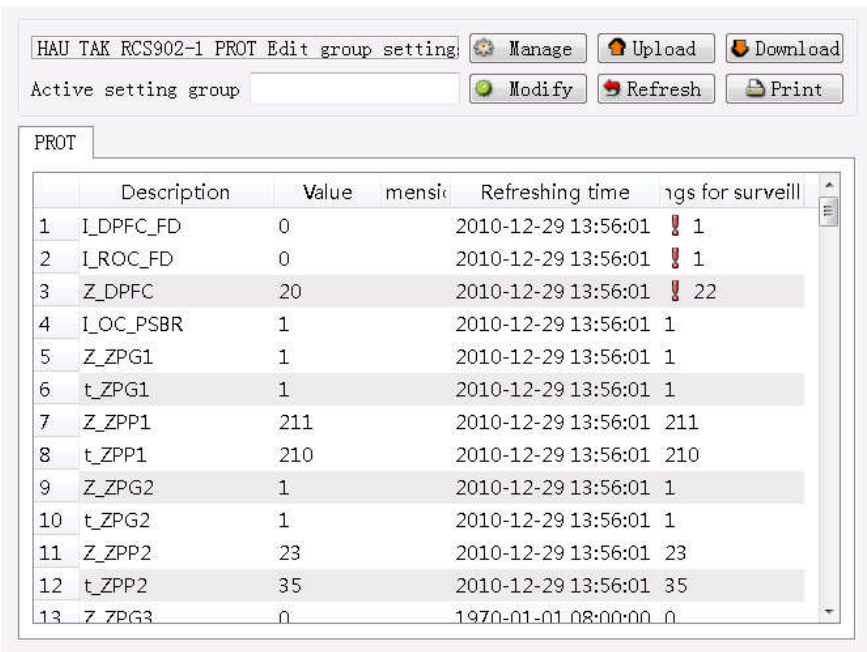


Figure 6.5-4 Surveil settings

Select a historical setting list file and click “Open”. A completion prompt will be displayed when surveillance is successful. At the same time, a comparison setting list will be added at right most position. If value of the setting list is different from current setting, a ‘!’ icon will be shown. Right click this comparison list and select “Close” in the menu popped up to close this column.

6.6 History Events

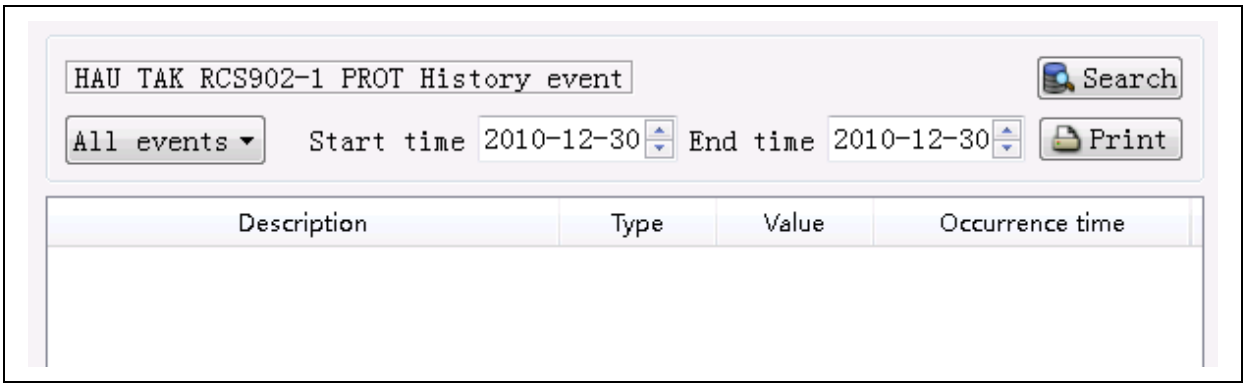


Figure 6.6-1 History events

The history event interface includes commands view and display view.

In the commands view, name of current window and type and time range of the searched event are displayed. This view includes two buttons: “Search” and “Print”. Types of event include circuit breaker status change, operation of protection, and operation alarm etc. For searching, all events can be selected.

- Search: search history event saved in current system database
- Print: output current history event to printer

The Display view includes description, type, operation, and occurrence time.

6.7 Fault Record

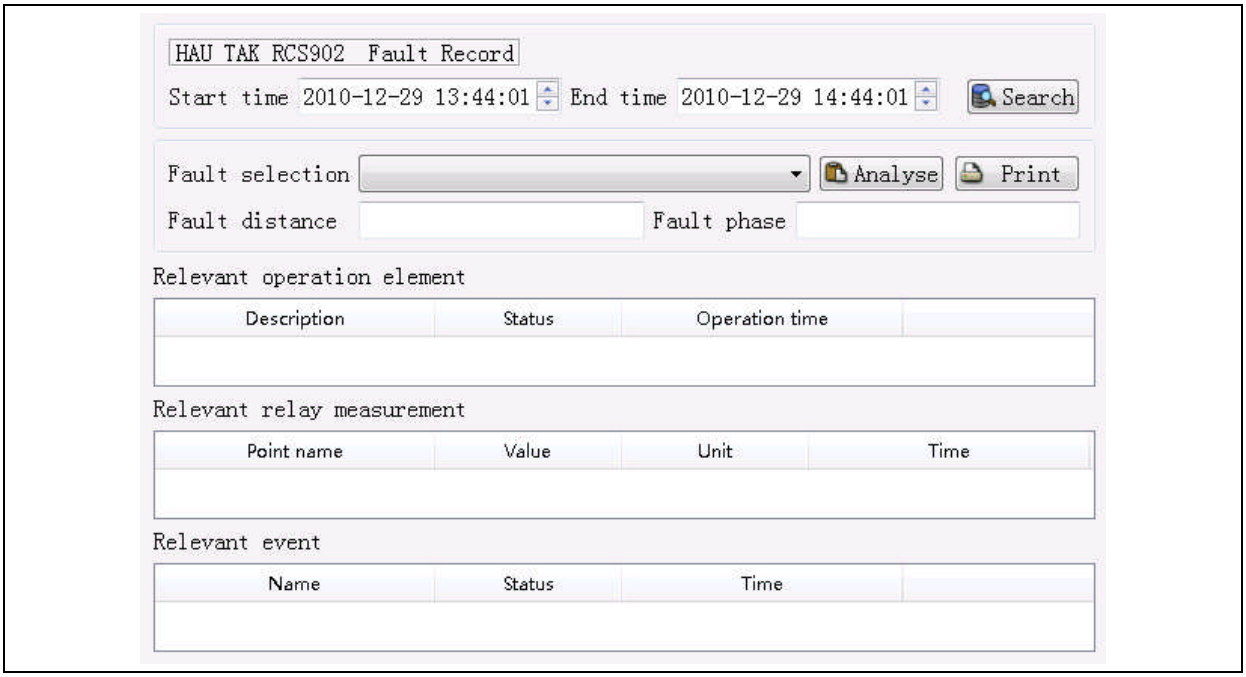


Figure 6.7-1 Fault record

The fault record interface includes (from top to bottom) commands view, fault selection view, and display view.

In the commands view, name of current window and time range of fault search are displayed. Enter start time and end time then click “Search” to search fault.

All fault records are displayed in the Fault Selection pull-down box in the fault selection view. After selecting a fault record, the Edit box will display its fault distance and fault phase. Click Analyze to call waveform analysis software to display details of the waveform corresponding to this fault. Click Print to output complete information of this fault to the printer.

The display view includes 3 parts of display: relevant operation element, relay measurement, and event of selected fault.

6.8 DFR Wave

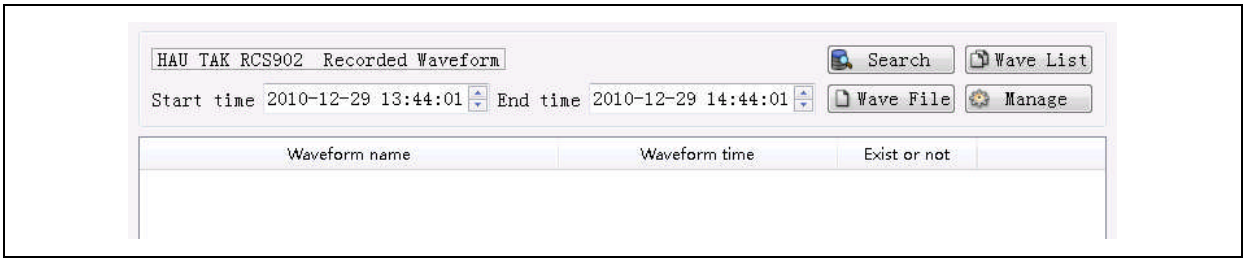


Figure 6.8-1 DFR Wave

The DFR Wave interface includes a commands view (upper part) and display view (lower part).

In the commands view, name of current window and time range of waveform search are displayed. This view includes 4 buttons: “Search”, “Wave list”, “Wave file”, and “Manage”.

- Search: search waveform saved in system database
- Wave list: call waveform list from protection device
- Wave file: call waveform file from protection device
- Manage: including waveform analysis and display of header file

Contents displayed in the Display view include “Waveform name”, “Waveform time”, and “Exist or not”. “Exist or not” indicates whether this waveform is saved in background database. For waveforms searched locally, “Exist or not” displays “Yes”. For waveform list called from protection device, if this waveform is saved locally, “Exist or not” column will be “Yes”; otherwise it will be “No”. Waveform file can only be called for waveform with ‘No’ in “Exist or not” column. If the call is successful, this column will become “Yes”. Waveform analysis and display of header file are only available for waveforms with this column being “Yes”.

Waveform analysis calls waveform analysis software to display details of the waveform corresponding to this fault. Display of header file requires that .hdr file of this waveform is in XML format. Open this XML file to display name of waveform file, start time, hold time, Relevant status quantity, and relevant analog quantity. Click “Print” button to output aforesaid information to a printer.

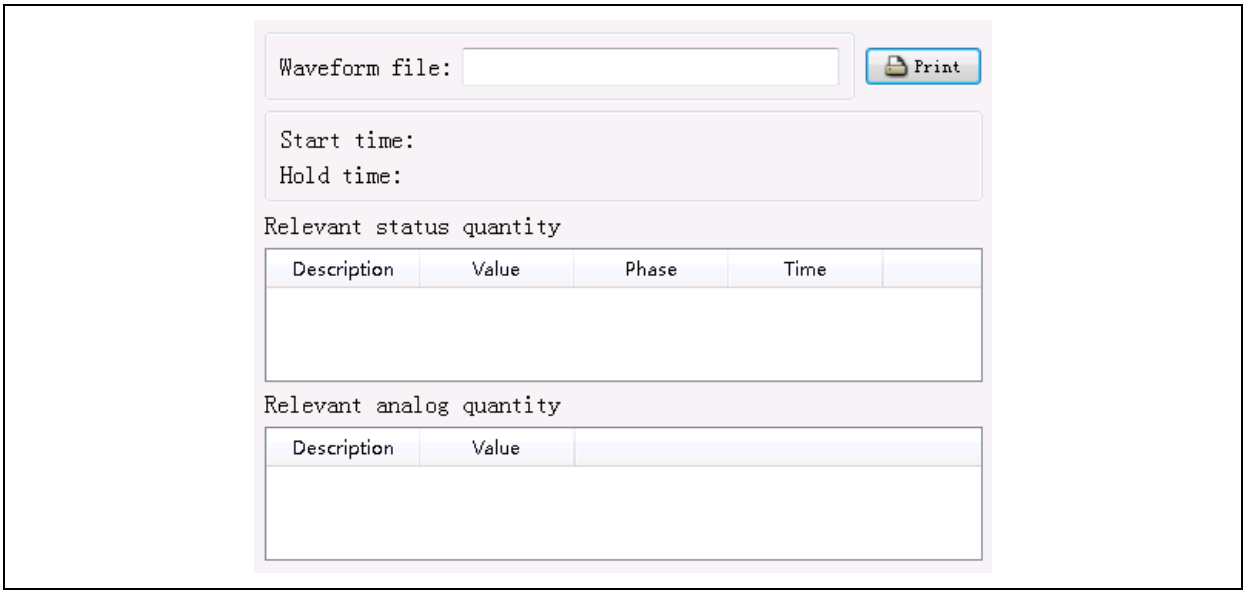


Figure 6.8-2 Display of header file

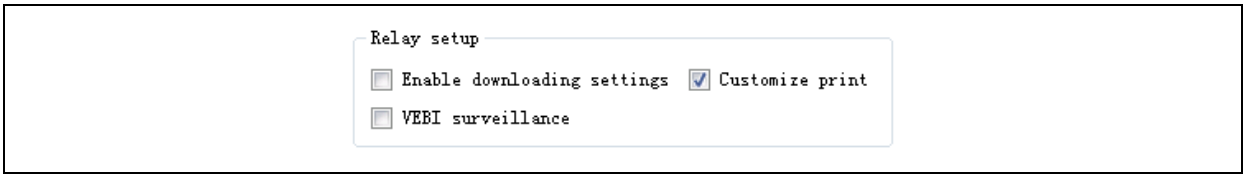


Figure 6.8-3 Customize print setup

The DFR Wave interface also provides a fast and easy method to print waveform file according to channels. To access this facility, user needs to check “Customize print” in the SCADA setup page of system configuration. After clicking Analyse, the Customize Print dialog box will pop up and display the print scheme generated according to protection configuration file. After selection of print scheme and clicking OK, waveform analysis software will be called to print the waveform in channels according to the print scheme. Protection configuration files are the “.pst” file saved under directory “etc/relay/XXX” (in which “XXX” is device model).

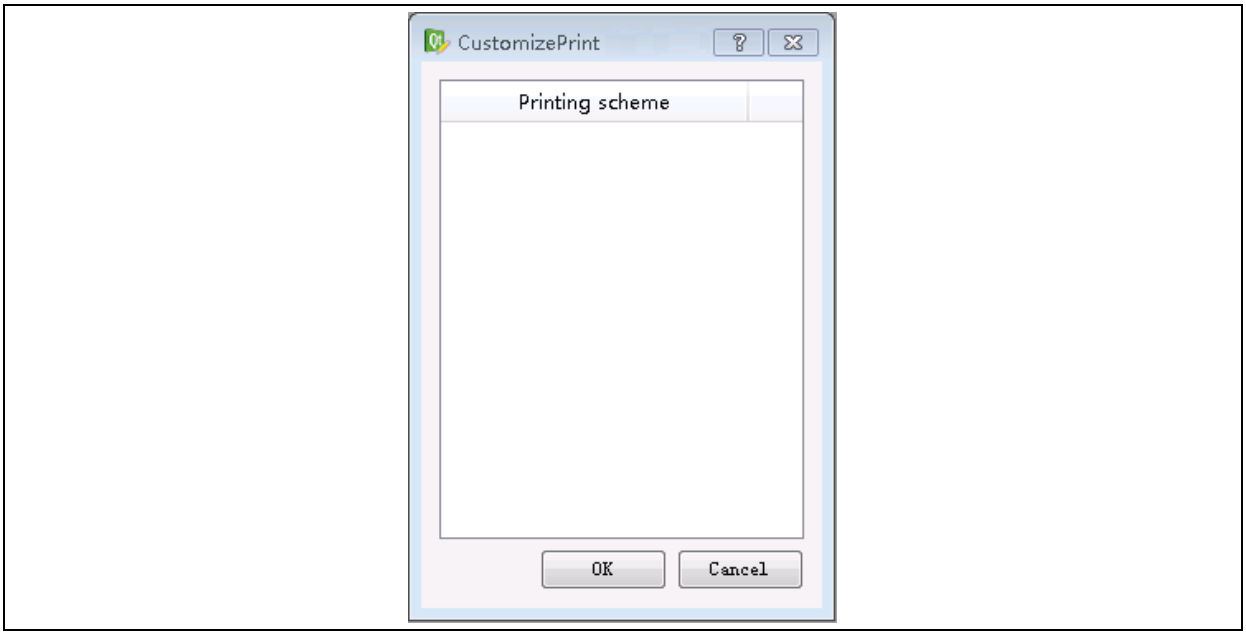


Figure 6.8-4 Customize print

6.9 Reset signal

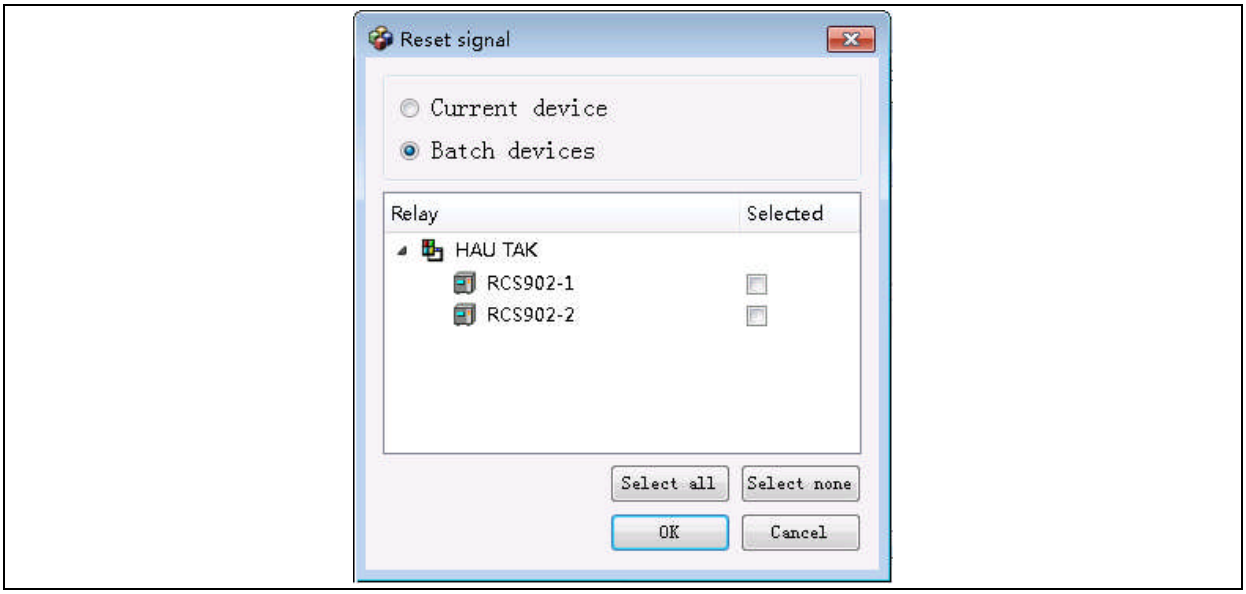


Figure 6.9-1 Reset signal

For Reset signal, reset of current device and reset of batch devices can be selected. Default is

reset of current device, and user can directly click “OK” to remotely reset protection signal of current protection device. In single selection box, select Batch Devices; all devices will be displayed in the list below in the form of tree type structure. Select the protection devices to be reset and click “OK” to perform remote resetting of protection signals of selected protection devices. Multiple selection, select all, and select none are available.

6.10 VEBI surveillance

VEBI surveillance is a function for VEBI of 61850 devices. Surveillance values pre-set in real-time database are compared with actual values of device VEBI. If a difference occurs, an alarm prompt will be generated. In relay status of 61850 devices, if current data set is VEBI data set, a “surveillance value” column will be added at the end, and surveillance values can be configured in corresponding entries of this column. Two surveillance modes are provided: manual upload of actual values of VEBI of current device for surveillance; and automatic daily surveillance of whole station starting at midnight.

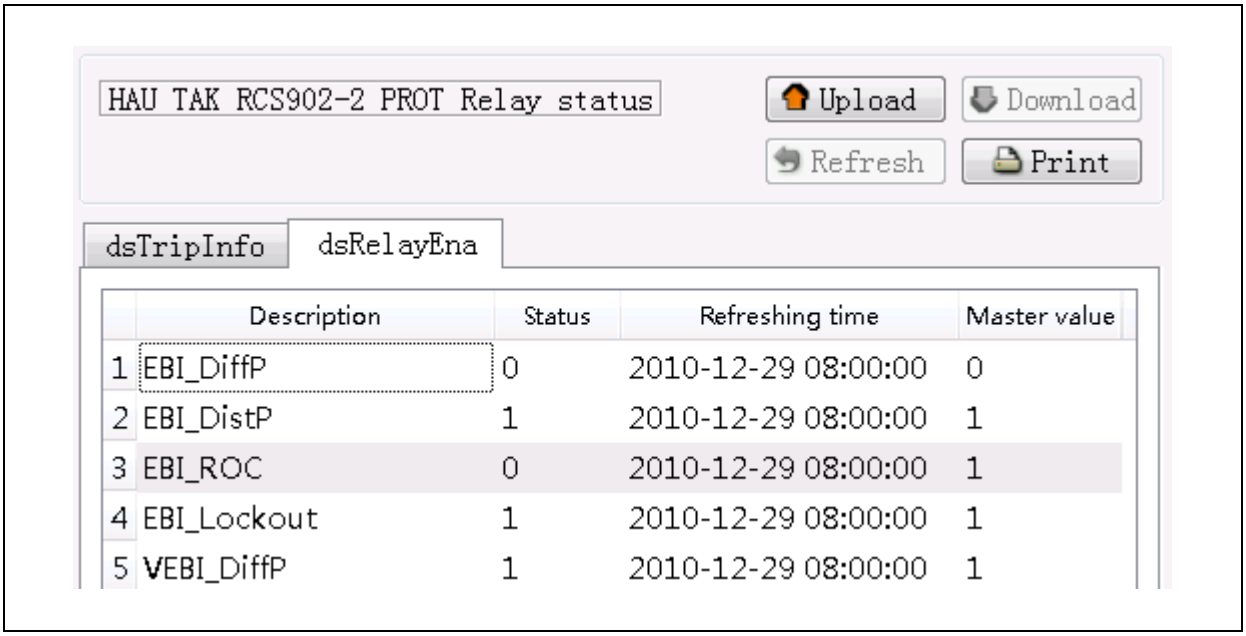


Figure 6.10-1 VEBI surveillance

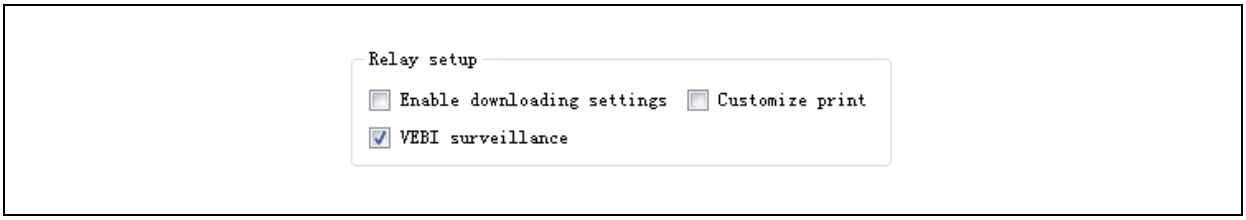


Figure 6.10-2 VEBI print setup

To enable VEBI surveillance function, user need to check option “VEBI surveillance” in SCADA setup page of system configuration tools.

7 Anti-maloperation

7.1 General

This document is the instruction manual of PCS operation sheet system.

7.2 Main Interface of PCS Operation sheet System

After PCS operation sheet system starts, the un-logged vision of main interface of PCS operation sheet system will be displayed, as shown below.

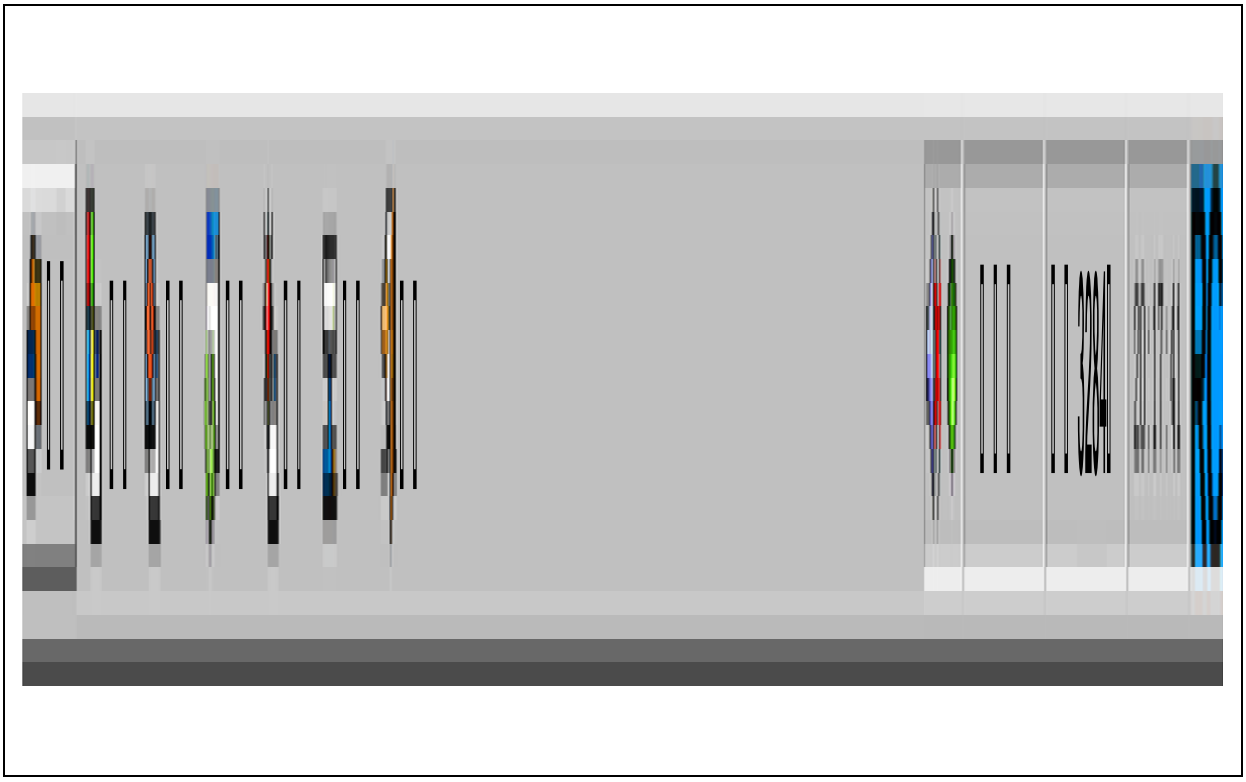


Figure 7.2-1 main interface of PCS operation sheet system-----un-logged

At this moment, the user has not logged on yet, and the tools bar only displays 3 buttons: “User log-on”, “About”, and “Exit”. The prompt on status bar indicates “Not logged on” status. In this status, user can only browse graphs but cannot perform operations such as sheet creation.
Click button “User log on” to pop up login window, users can enter username and password to log on. After log-on, several advanced bars will be added into main interface of PCS operation sheet system, including a menu bar, a tools bar, an operation sheet dock window, a wiring diagram window, and a status bar. On the status bar, information of the current user, including username and login time, will be displayed as shown below:

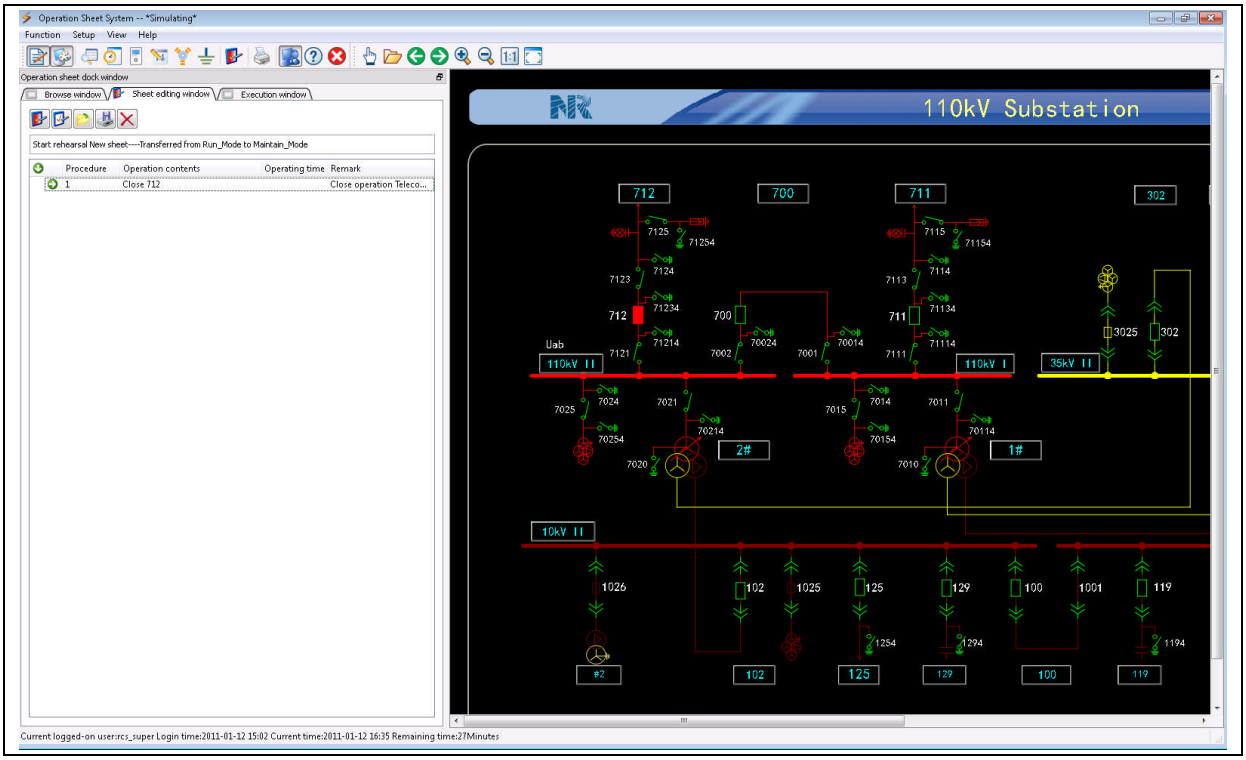


Figure 7.2-2 PCS operation sheet system main interface-----logged on

7.2.1 Menu Bar

The menu bar is at topmost position of the main interface and includes all operation functions of the PCS operation sheet system.

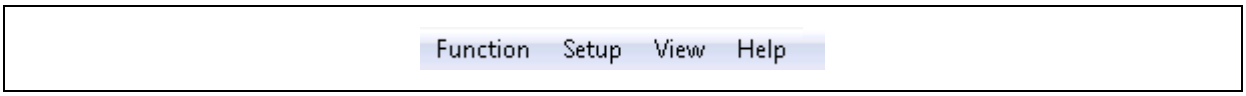


Figure 7.2-3 Menu bar

7.2.1.1 Function Menu

Click “Function” button on the menu bar to pop up Function menu, as shown below:

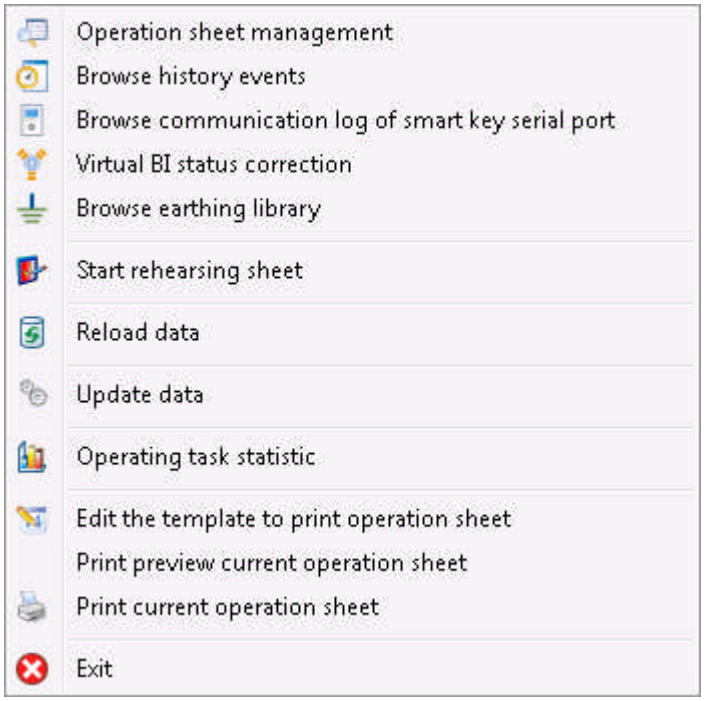


Figure 7.2-4 Function menu

Table 7.2-1 Description of Function menu items

Function menu item	Description
Operation sheet management	Display operation sheet management interface
Browse history events	Display history events browsing interface
Browse communication log of smart key serial port	View smart key serial port communication log file
Virtual BI status correction	Enter virtual BI status correction state
Browse earthing library	Display earthing library viewing interface
Start rehearsing sheet	Enter sheet rehearsing status
Reload data	Reconnect database to reload data of anti-maloperation and refresh simulation database
Update data	Stop simulation application, refresh simulation database, and start simulation application again
Operating task statistic	Display operating task statistic interface
Edit the template to print operation sheet	Display operation sheet printing template editing interface
Print preview current operation sheet	Preview effect of printing of current operation sheet in the preview window
Print current operation sheet	Print the operation sheet currently viewed
Exit	Exit PCS operation sheet system

7.2.1.2 Setup Menu

Click button “Setup” on the menu bar to pop up the Setup menu, as shown below:

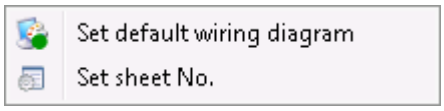
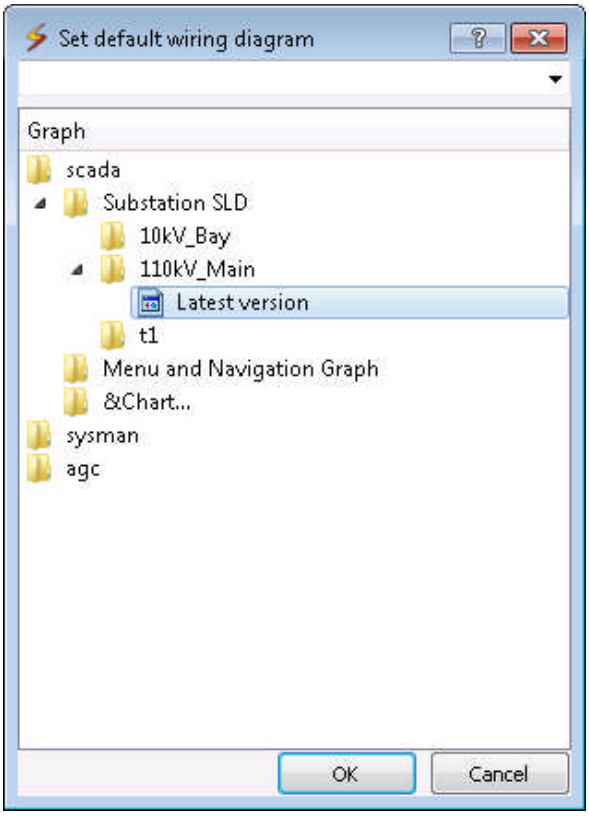


Figure 7.2-5 Setup menu

Table 7.2-2 Description of Setup menu items

Setup menu item	Description
Set default wiring diagram	Open Set default wiring diagram dialog box, as  *Figure* **7.2-6** shows
Set sheet No.	Open Set sheet No. dialog box, as *Figure 7.2-7* shows

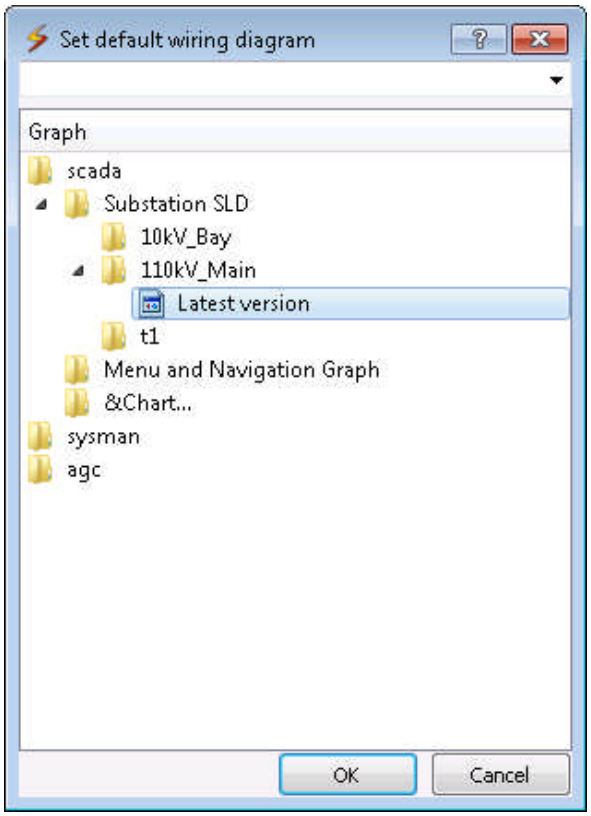


Figure 7.2-6 Set default wiring diagram dialog box

After setting of default wiring diagram, each time after PCS operation sheet system is started, this wiring diagram will be displayed in the wiring diagram window at right side of the interface.

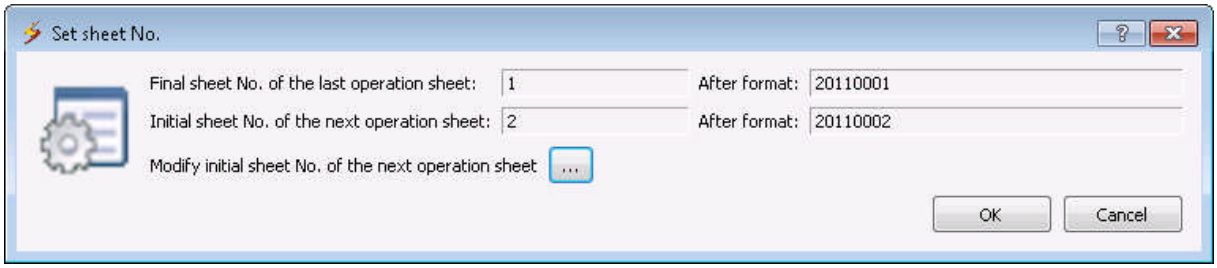


Figure 7.2-7 Set sheet No. dialog box

Click the button at right side of Modify initial sheet No. of the next operation sheet to pop up the dialog box as shown below:

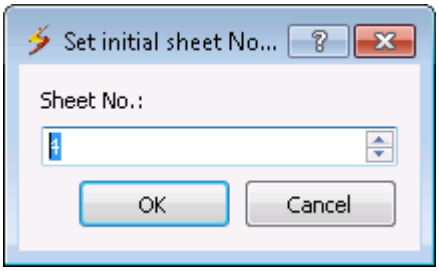


Figure 7.2-8 Set initial sheet No. of the next operation sheet

After setting of this sheet No., close the dialog box. The initial sheet No. of the next operation sheet has been modified, as shown below:

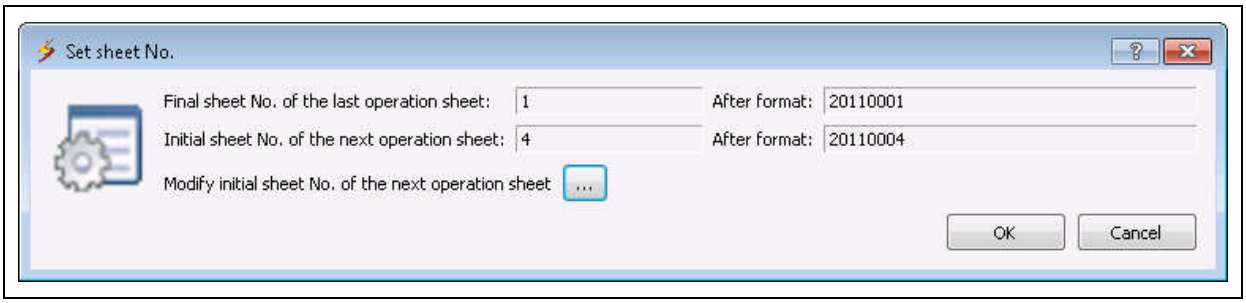


Figure 7.2-9 Initial sheet No. of next operation sheet modified

7.2.1.3 View Menu

Click button “View” on the menu bar to pop up the View menu as shown below:

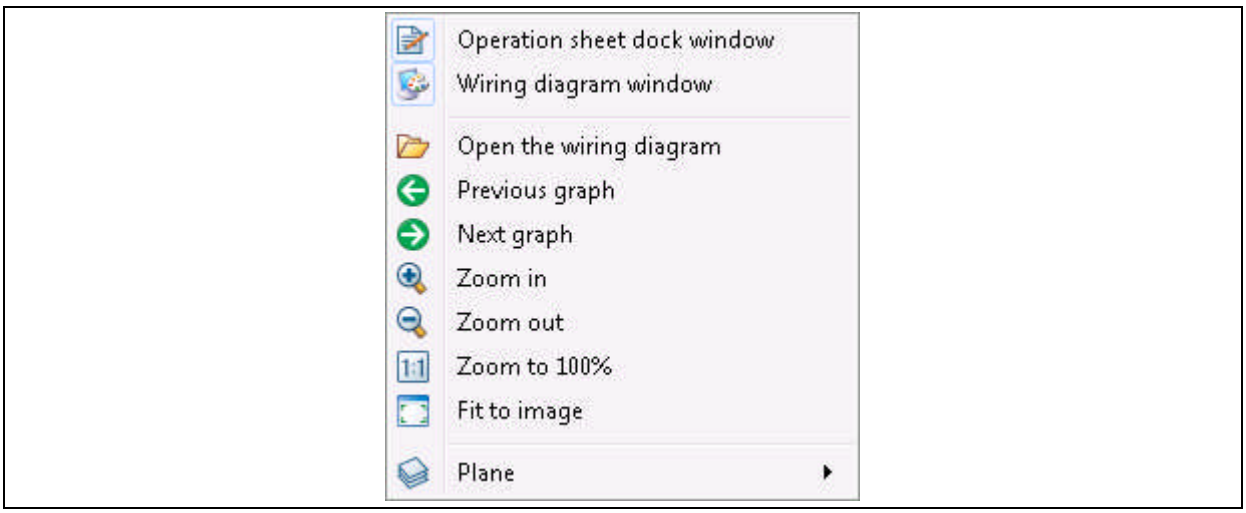


Figure 7.2-10 View menu

Table 7.2-3 Description of View menu items

Menu item	Description
Operation sheet dock window	Display or hide operation sheet dock window
Wiring diagram window	Display or hide wiring diagram window
Open the wiring diagram	Pop up Open wiring diagram dialog box
Previous graph	Display previous wiring diagram in the wiring diagram window
Next graph	Display next wiring diagram in the wiring diagram window
Zoom in	Amplify wiring diagram shown in the wiring diagram window
Zoom out	Reduce wiring diagram shown in the wiring diagram window
Zoom to 100%	Reset wiring diagram shown in the wiring diagram window to 100%
Fit to image	Adapt wiring diagram to the size of current wiring diagram window

Menu item	Description
Plane	Display different planes, e.g. anti-maloperation and SCADA. The operation sheet system and the HMI system use the same graphic. Graphics can be displayed in layers. For example, the same graphic can display lockout doors and no measurement in operation sheet system, and display measurement and no lockout door in the HMI system.

7.2.1.4 Help Menu

Click button “Help” on the menu bar to pop up Help menu. Click About menu item to pop up About dialog box to view version information, as shown below:

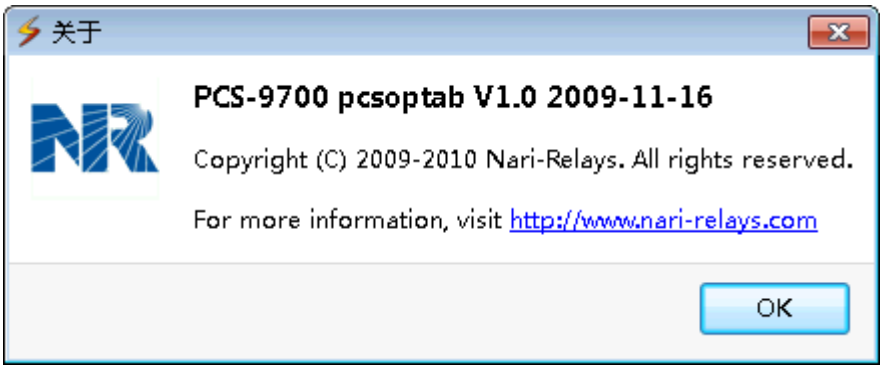


Figure 7.2-11 About dialog box

7.2.2 Tools Bar

The tools bar is below the menu bar. Common operation functions of the PCS operation sheet system are collected here.

Figure 7.2-12 System tools bar

Table 7.2-4 Description of system tools bar functions

No.	Description
1	Display or hide operation sheet dock window
2	Display or hide wiring diagram window
3	Display operation sheet management interface
4	Display history events browsing interface
5	Browse smart key serial port communication log file
6	Display operation sheet printing template editing interface
7	Enter BI status correction state

No.	Description
8	Display earthing library viewing interface
9	Enter sheet rehearsing status
10	Print the operation sheet currently viewed
11	User log off
12	Pop up About dialog box, displaying of version information
13	Exit PCS operation sheet system

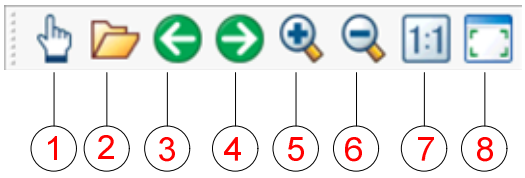


Figure 7.2-13 Graph tools bar

Table 7.2-5 Description of graph tools bar functions

No.	Description
1	After clicking this button, press left mouse key to translate the graph
2	Pop up Open wiring diagram dialog box
3	Display previous wiring diagram in the wiring diagram window
4	Display next wiring diagram in the wiring diagram window
5	Amplify wiring diagram shown in the wiring diagram window
6	Reduce wiring diagram shown in the wiring diagram window
7	Reset wiring diagram shown in the wiring diagram window to 100%
8	Adapt wiring diagram to the size of current wiring diagram window

7.2.3 Operation sheet Dock Window

Operation sheet dock window is at left side of the main window. View, Edit, Rehearse, and Execute operations of operation sheet are performed here.

7.2.3.1 Browsing Window

The browsing window is shown below:

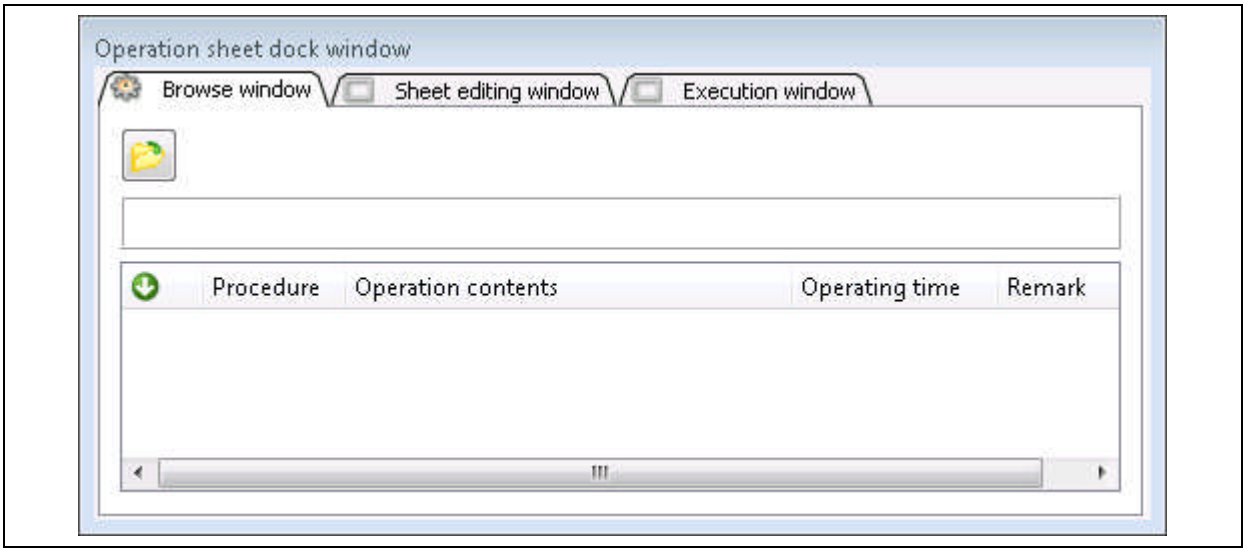


Figure 7.2-14 Browse window

Click button Open to open an operation sheet to view operation steps, as shown below:

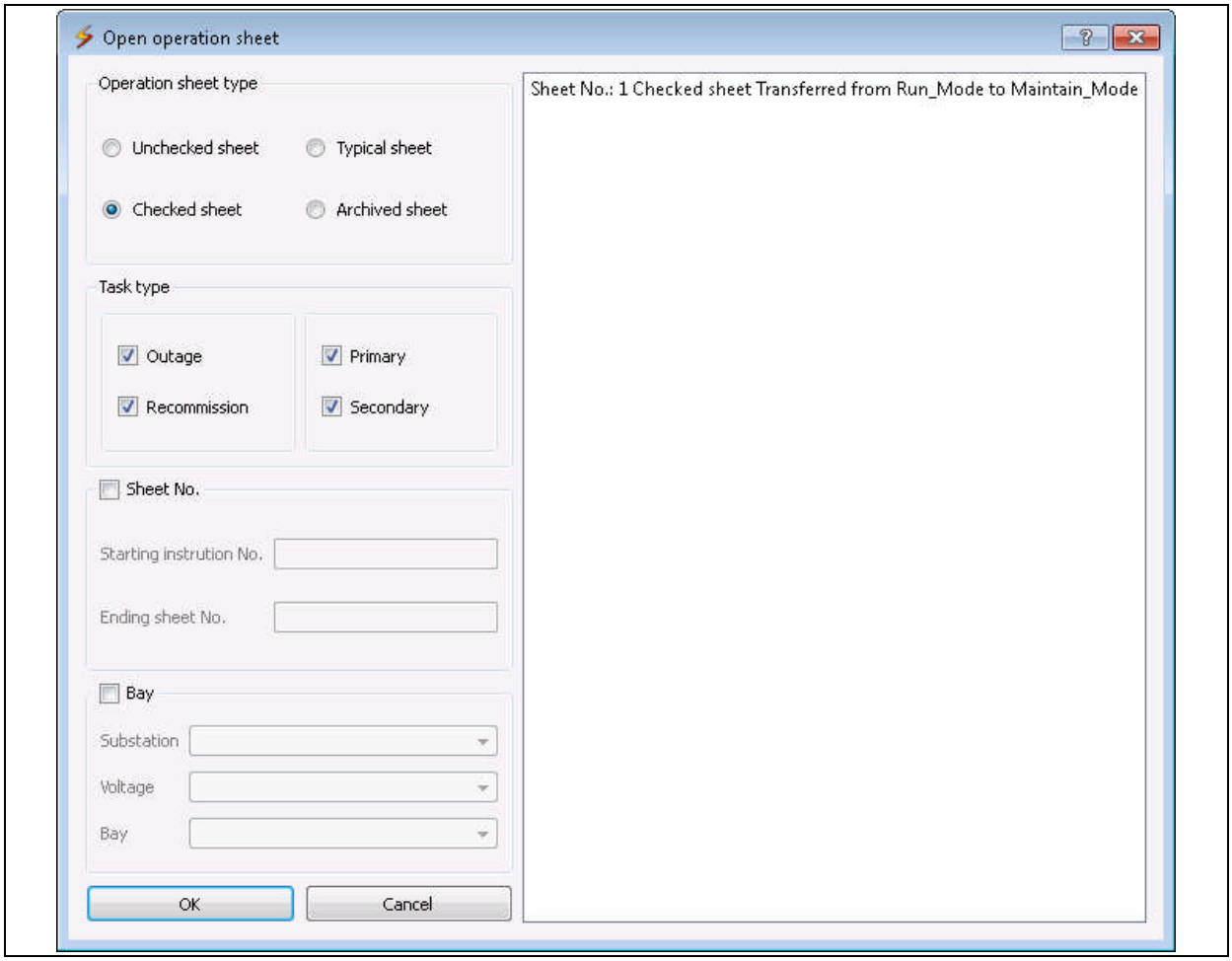


Figure 7.2-15 Open operation sheet dialog box

User can quickly find specified operation sheet according to operation sheet type, task type, sheet No., and bay.

After an operation sheet is opened, the browse window is shown as below:

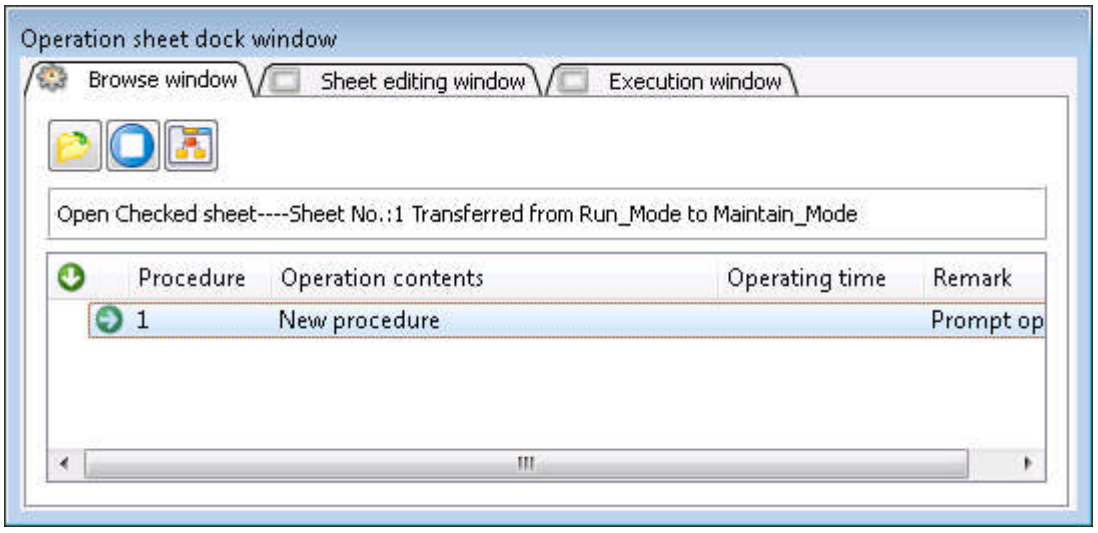


Figure 7.2-16 Open operation sheet in browse window

User can see new buttons in the browse window. During the service life of an operation sheet, various functional buttons affecting the operation sheet will only be displayed when effective.

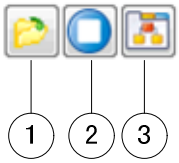


Figure 7.2-17 Browse window tools bar

Table 7.2-6 List of browse window tools bar functions

No.	Description
1	Pop up Open operation sheet dialog box
2	Close the operation sheet which is currently open
3	If the sheet currently open has been checked, click this button to jump to the execution window to execute this sheet. If the sheet currently open is of other types, click this button to jump to sheet editing window to edit this operation sheet.

7.2.3.2 Sheet editing Window

The sheet editing window has the following functions:

1) Sheet creation with rehearsal

   Create a new operation sheet for rehearsal. During sheet creation, operation object status will be changed to target status. In case current operation rules check or status check does not satisfy requirements, detailed error message will be prompted.

2) Sheet creation without rehearsal

A new operation sheet can be created for sheet creation. User can also open a saved sheet for editing. Operation items can be added, deleted, modified, inserted, moved up, and moved down etc. There is no rehearsal during editing.

For sheet creation both with and without rehearsal, two modes of sheet creation, i.e. graphic sheet creation and manual sheet creation are provided:

(1) Graphic sheet creation

Left click operation object on the graph to generate operation procedure. Right click operation object to add operable items and prompting operation of current equipment.

Operation procedure generated by graphic sheet creation is shown below:

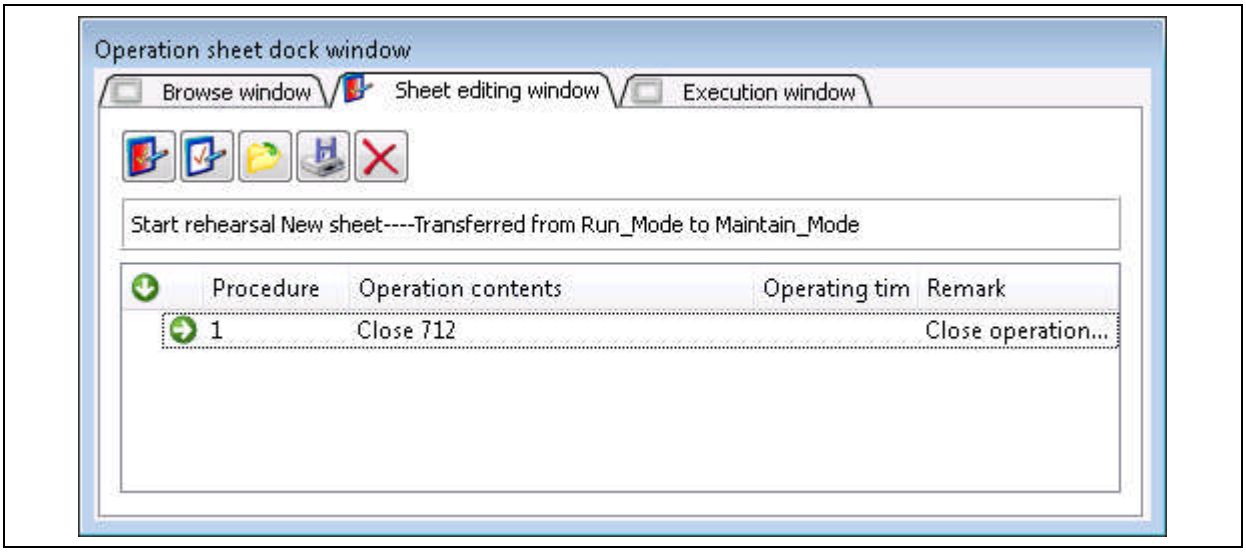


Figure 7.2-18 Generation of operation procedure

(2) Manual sheet creation

User can manually compile operation sentence, select operation object, and specify operation type, to perform Add, Delete, Modify, Insert, Move up, and Move down of operation item.

During sheet creation, rehearsal and execution of other sheets will not be affected. In case it is found that the operation object already has operation task or logic association in other operation sheet rehearsed and executed, conflict message will pop up.

For sheet creation, operation sentences are generated according to operation glossary of operation object in database configuration. For example, check tripping and check closing operation sentence can be automatically generated after tripping/closing operation sentence.

3) Open operation sheet

Open a saved operation sheet for editing. Inquiry can be performed according to conditions such as operation sheet type, task type, sheet No., and bay etc.

4) Save operation sheet

Save the sheet at end of editing. When saving, user can specify operation sheet type, task

name, corresponding bay, and task type etc.

5) Cancel rehearsal

During sheet creation with rehearsal, user can cancel rehearsal. After canceling, the system will be restored to the status before operation sheet rehearsal.

6) Close opened sheet

User can close the operation sheet already open.

7) Cite sequential control flow definition

User can cite sequential control flow definition analyzed by the sequential control server to generate sequential control procedure.

Sheet editing window is shown as below:

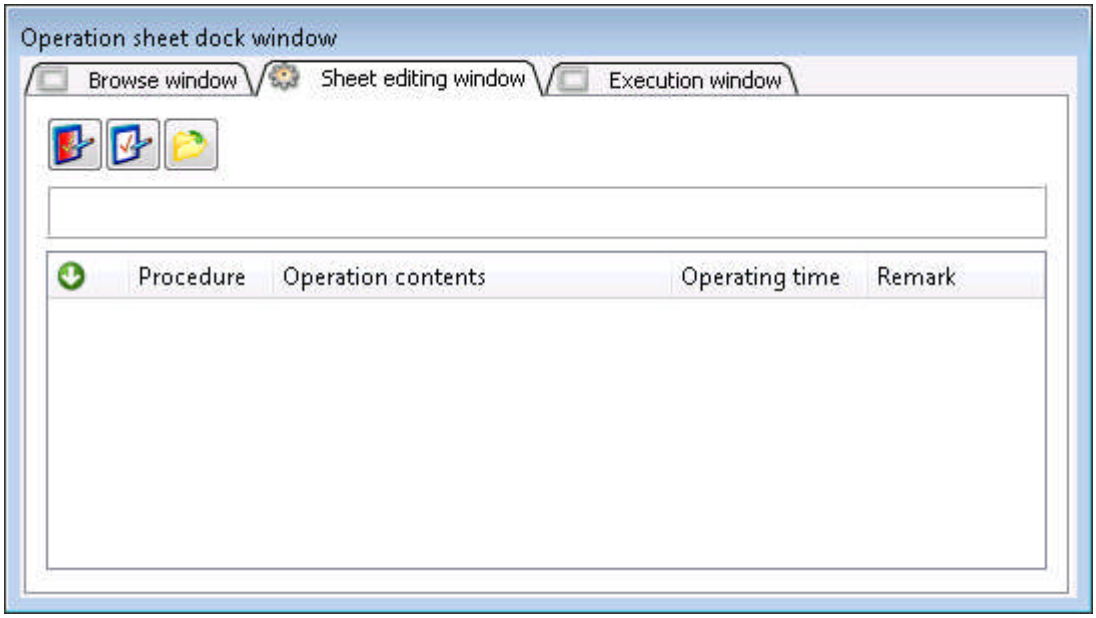


Figure 7.2-19 Sheet editing window

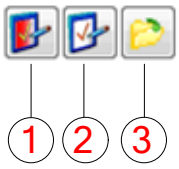


Figure 7.2-20 Sheet editing window tools bar

Table 7.2-7 Description of sheet editing window tools bar functions

No.	Description
1	Rehearsing operation sheet creation, i.e. perform rehearsal during sheet creation
2	Create sheet without rehearsal, i.e. no rehearsal during sheet creation
3	Pop up Open operation sheet dialog box

After clicking Open button to open an operation sheet, sheet editing window tools bar will display as shown below:

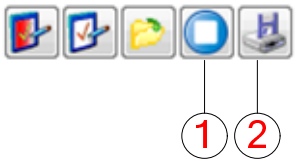


Figure 7.2-21 Sheet editing window tools bar

No.	Description
1	Close the currently open operation sheet
2	Pop up Save operation sheet dialog box

To continue the editing of a finished operation sheet, user can click Open operation sheet button to open the operation sheet, and then click Sheet creation without rehearsal button to enter editing status which allows edit of operation procedure.

When creating a new operation sheet, the task name input dialog box will pop up, as shown below:

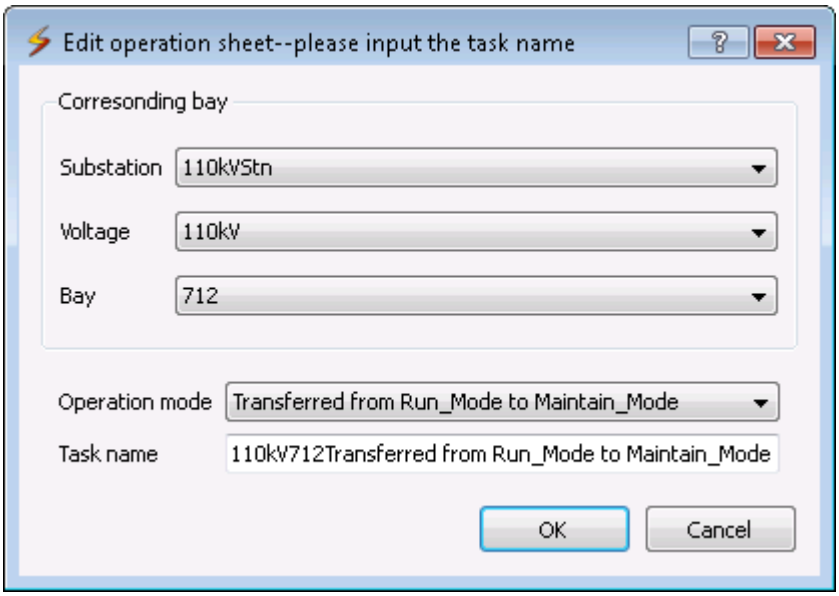


Figure 7.2-22 Enter task name dialog box

Content of operation mode list box can be configured in the configuration file pcs9700/deployment/etc/wufang/operatemode.ini. Task name must be inputted.

After creating a new operation sheet, sheet editing window tools bar will be shown as below:

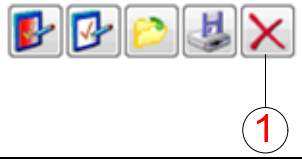


Figure 7.2-23 Sheet editing window tools bar

No.	Description
1	Cancel editing or cancel sheet creation

After clicking Cancel edit button, the tools bar will restore to its original status.

During sheet creation or editing, right click Operation procedure list to pop up the Edit menu, as shown below:

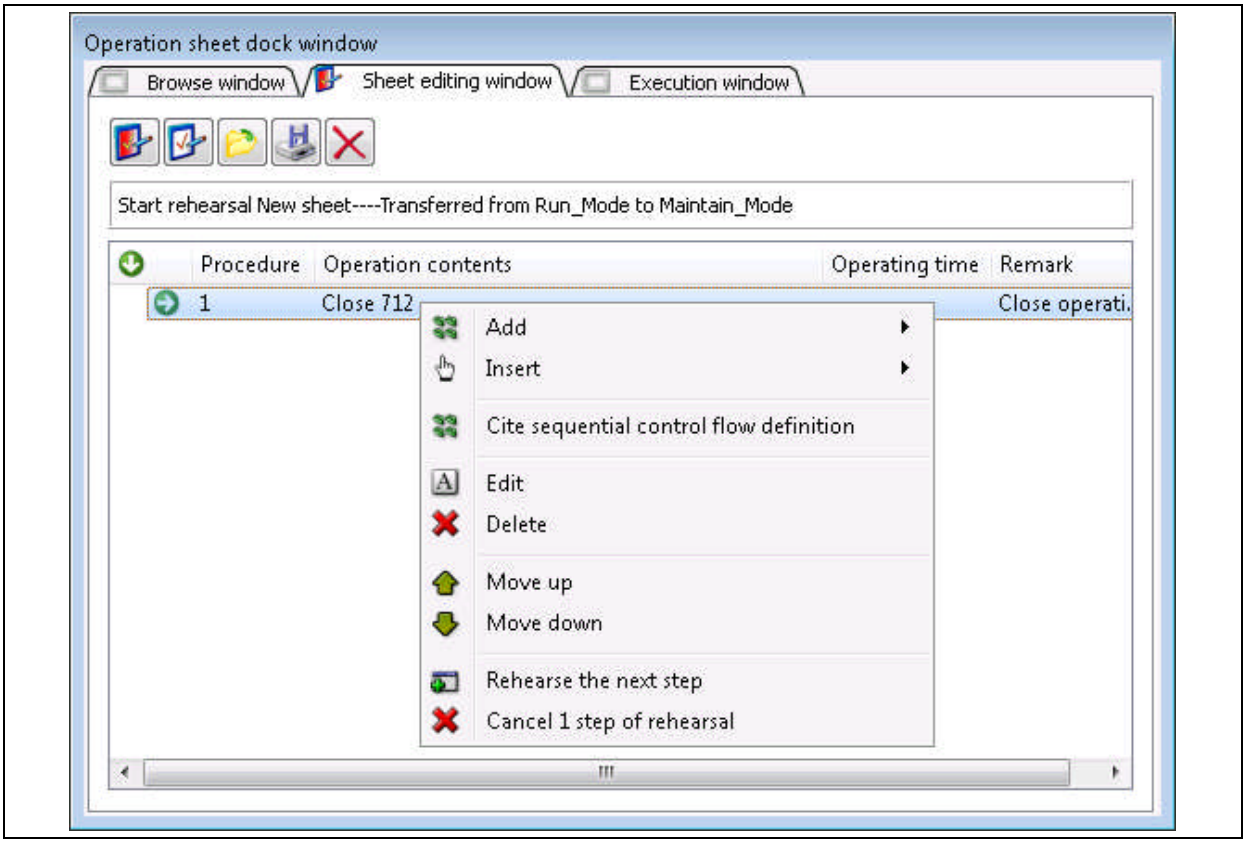


Figure 7.2-24 Edit operation procedure menu

Table 7.2-8 Description of Edit operation sheet menu items

Edit operation procedure menu items	Description
Add	Add one or more lines of operation procedure at end of operation step list
Insert	Insert one or more lines of operation procedure before currently selected operation step
Cite sequential control flow definition	Pop up a dialog box to cite sequential control flow definition
Edit	Pop up operation sentence definition dialog box
Delete	Delete selected operation step
Move up	Move selected operation step up by one line
Move down	Move selected operation step down by one line
Rehearse the next step	Pop up a dialog box to select a circuit breaker/switch to rehearse

	generation of an operation step
Cancel 1 step of rehearsal	Cancel 1 operation step generated by rehearsal; status before rehearsal of this step will be restored

After selection of Edit menu, operation sentence definition dialog box will pop up, as shown below:

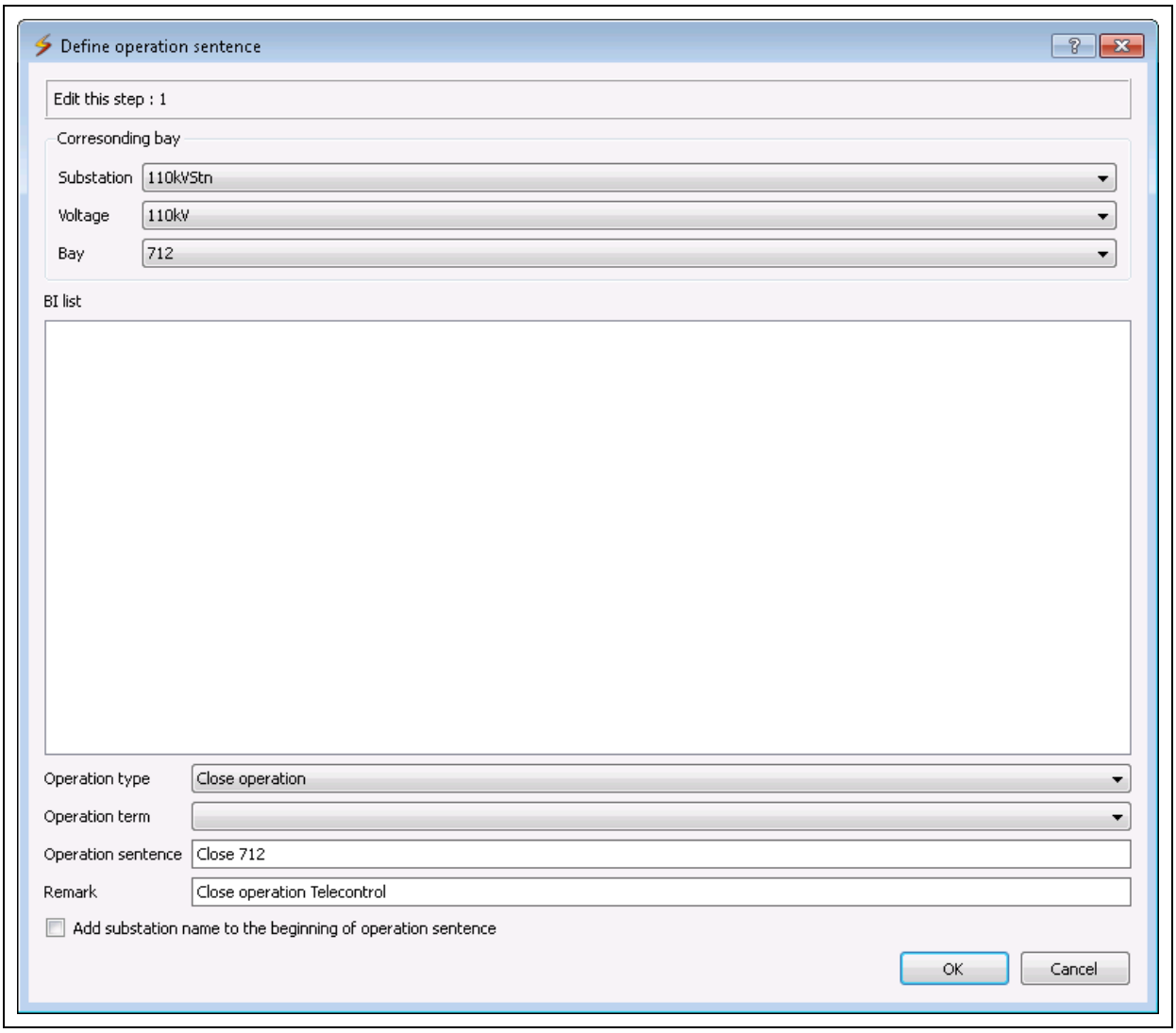


Figure 7.2-25 Action statement definition dialog box

After the selection of BI under some bay, user can set operation type and operation term, to automatically generate operation sentence. Clicking OK to complete editing of this operation step.

After finishing edit, click Save button to pop up Save operation sheet dialog box as shown below:

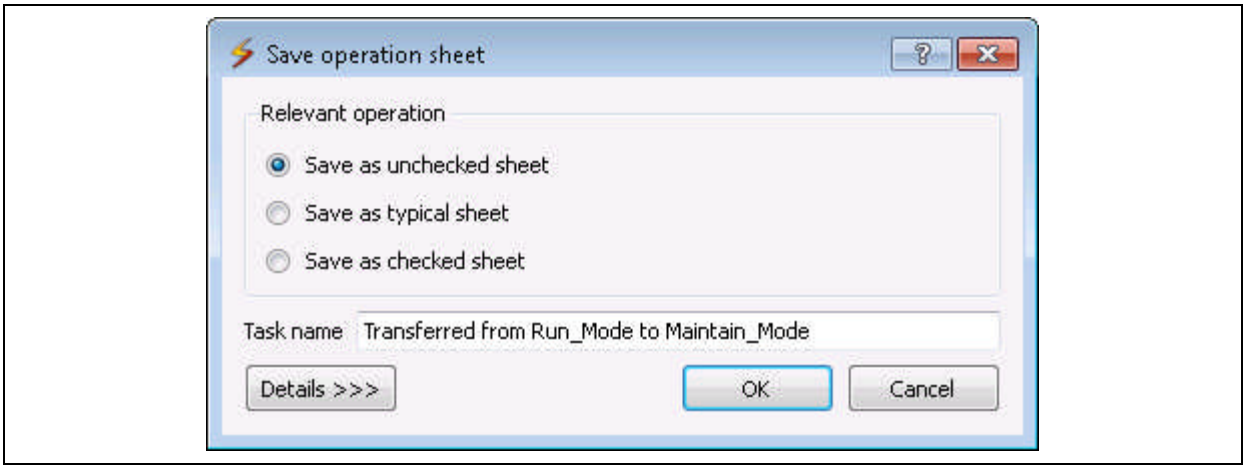


Figure 7.2-26 Save operation sheet dialog box

User can select type of saving. Click Details button to set more attributes of operation sheet, as shown below:

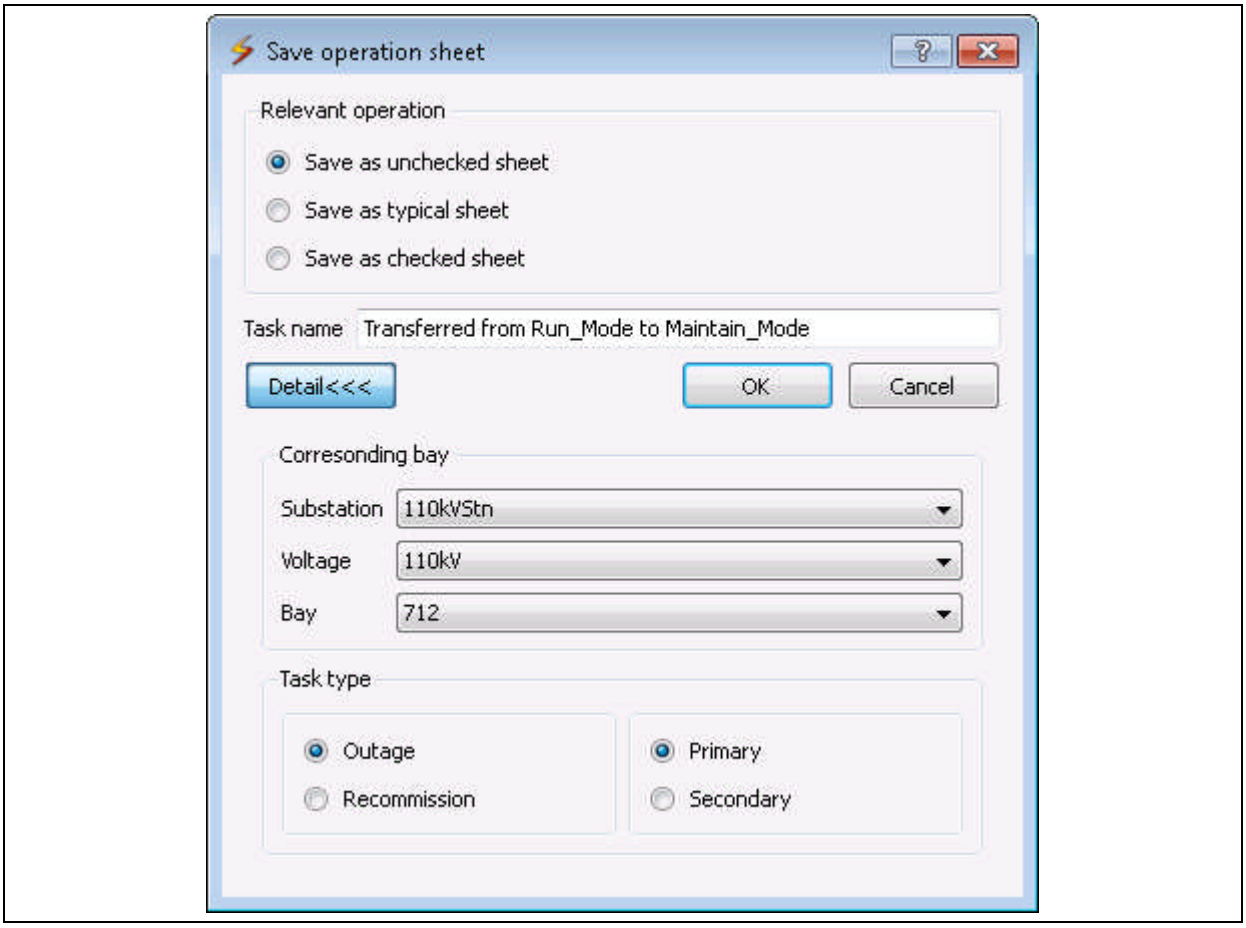


Figure 7.2-27 Save operation sheet expanded dialog box

If Save as checked sheet is selected, user can set operator and guardian, as shown below:

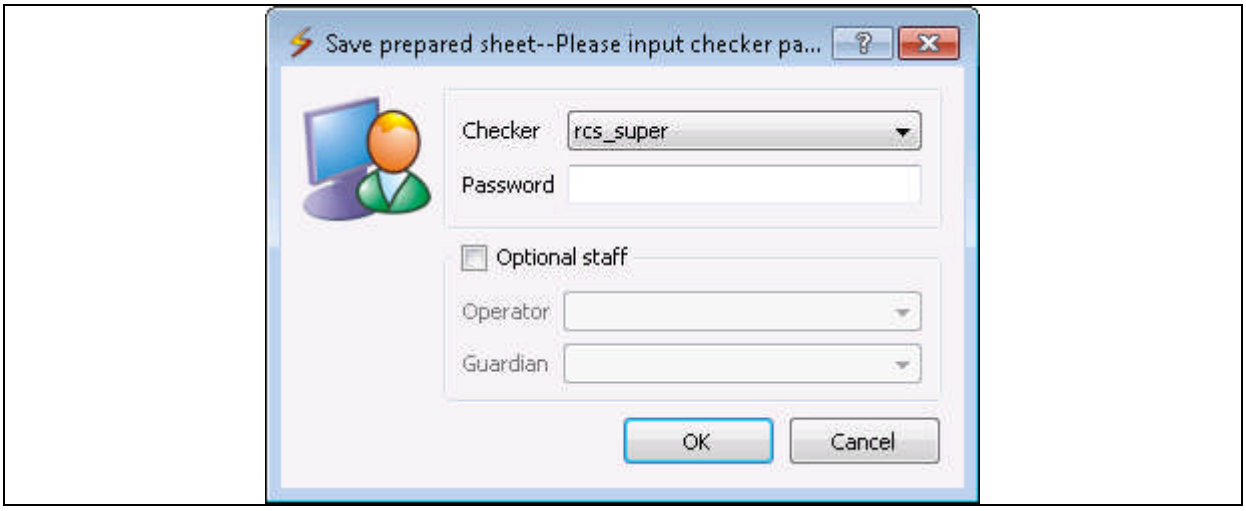


Figure 7.2-28 Save prepared sheet dialog box

If operator and guardian have been set, authorities of operator and guardian can be checked when executing the operation sheet.

7.2.3.3 Execution Window

Execute the checked sheet in the execution window.

All actual operations will be forced in strict accordance with operation sheet procedure generated by rehearsal. In addition, rehearsal is required before execution of operation sheet and operation sheet execution function will only be open after successful rehearsal.

Simultaneous execution of a number of operation sheets is permitted (setting of the number of execution windows is available). In this case, check of conflict will be performed. Simultaneous operation of the same equipment or equipments with logic relation in a number of tasks is not permitted.

Self-restore function is provided. During execution, section is saved in real-time. Next time when this checked sheet is open, user can select execution from this section. After restart of operation sheet system upon abnormity, user can restore to the status before restart according to the section and execution of original operation sheet can be continued.

For site operation, operation sheet will be downloaded to the smart key, which will be used to open the coded lock. This lock can only be opened for operation if No. and type of the coded lock are fully consistent with those corresponding to the operation sheet in smart key. The smart key features status detection function. Only when required operation has truly been carried out will the smart key confirms completion of this operation, and the next operation will be allowed. In this way, operation sheets have one-to-one correspondence with site actual operations, eliminating incorrect use of bay and empty operation accidents, thus ensuring correct site operations.

When time comes for the operator to operate on computer or site operation is complete, the smart key will report operation conditions to the operation sheet system. The operation sheet system will judge if telecontrol operation on computer is needed according to operation message uploaded by smart key along with operation sheets being executed. If yes, the operation sheet system will perform telecontrol operation on equipment corresponding to current operation step (if wrong

operation element is selected, telecontrol will be disabled; at the same time, it is required that name and password of operator and guardian entered for telecontrol are consistent with those entered for generation of operation sheet, to prevent incorrect tripping/closing of circuit breaker). Next operation can only be carried out if the telecontrol operation is complete and returned real-time BI status is correct.

After telecontrol, if smart key is required to open the lock on site, the operation sheet system will transfer current operation step to the smart key to allow operation of the key. This cycle will be repeated till the whole operation is complete.

Click Open button to pop up Open operation sheet dialog box. In the execution window, only checked sheet can be opened, as shown below:

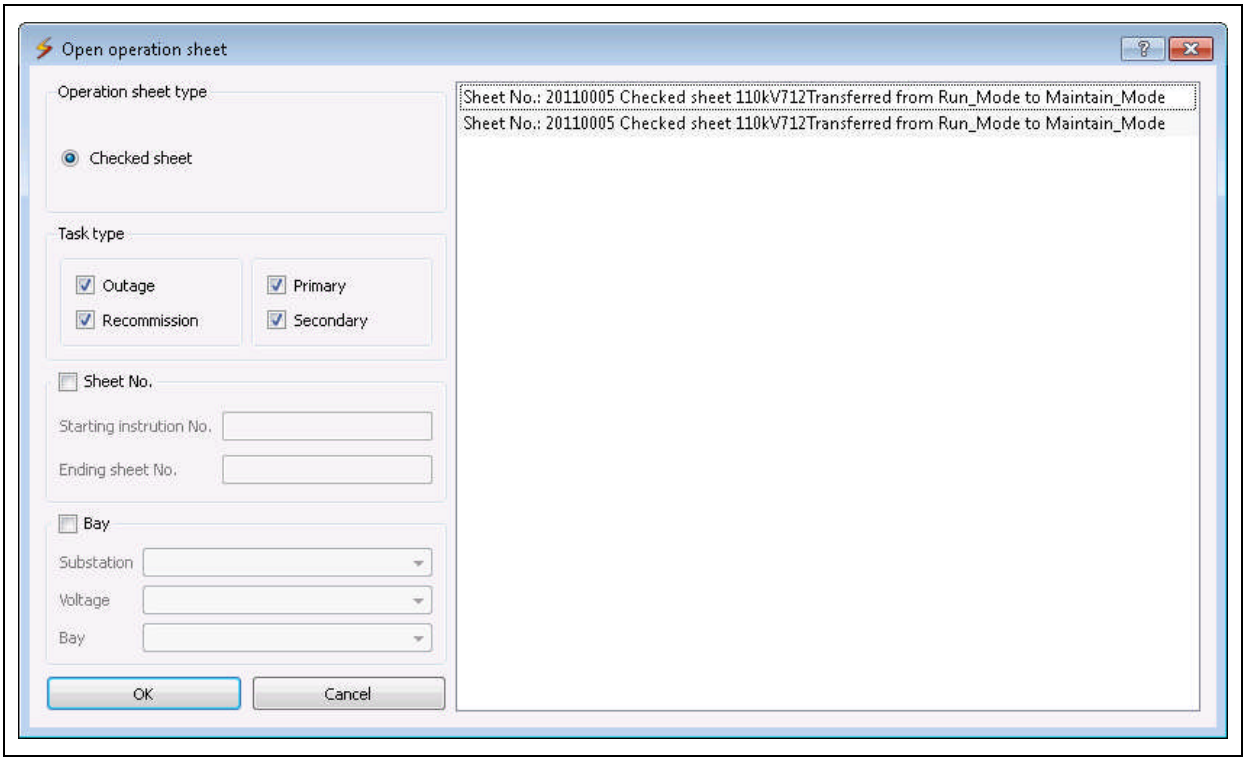


Figure 7.2-29 Open checked sheet dialog box

After the checked sheet is opened, execution window will be as shown below:

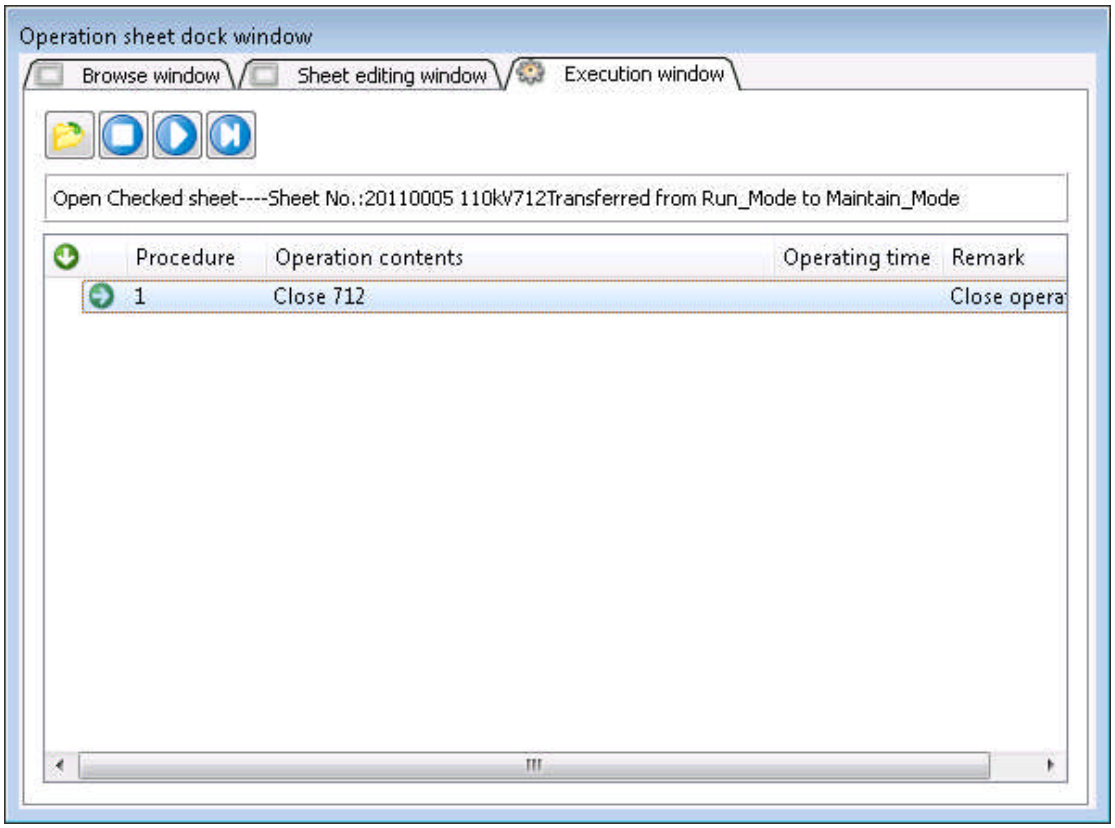


Figure 7.2-30 Open checked sheet

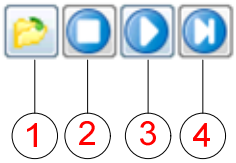


Figure 7.2-31 Execution window tools bar

Table 7.2-9 Execution window tools bar functions list

No.	Description
1	Pop up Open operation sheet dialog box
2	Close currently opened operation sheet
3	Simulate prepared sheet; execution is only permitted after successful simulation
4	Single step simulation

Click button Simulate prepared sheet to start simulation. After successful simulation, the tools bar will be as shown below:

Figure 7.2-32 Execution window tools bar

Table 7.2-10 List of functions of execution window tools bar

No.	Description
1	Execute checked sheet

Click Execute button to start execution, as shown below:

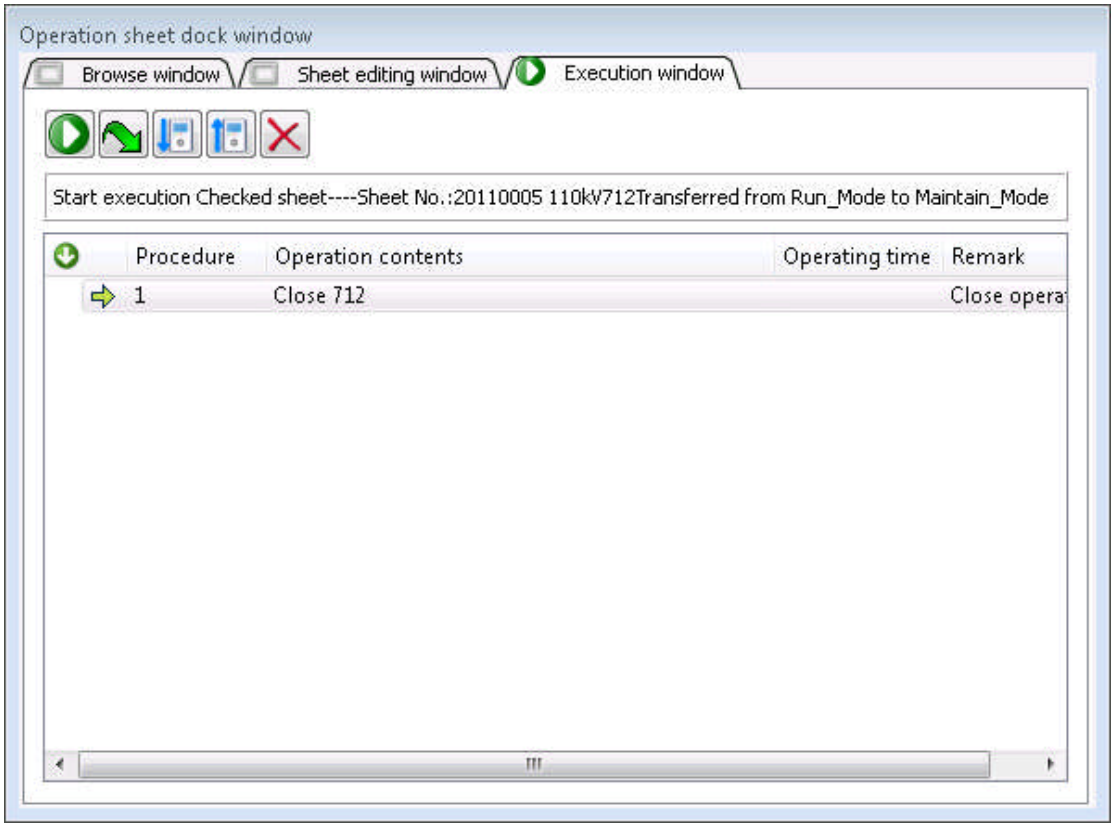


Figure 7.2-33 Execute checked sheet

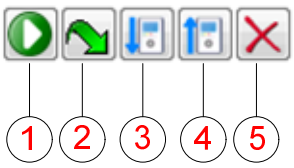


Figure 7.2-34 Execution window tools bar

Table 7.2-11 List of functions of execution window tools bar

No.	Description
1	Execute checked sheet
2	Skip
3	Download operation step to smart key
4	Upload operation step from smart key
5	Cancel execution

For prompting step, the dialog box shown below will pop up:

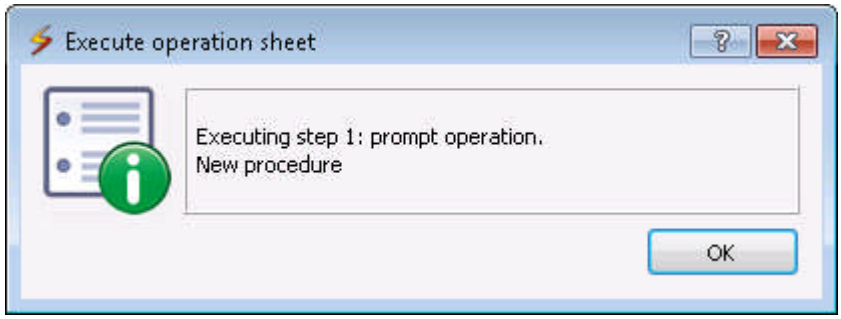


Figure 7.2-35 Execute prompting step

After execution, the dialog box shown below will pop up:

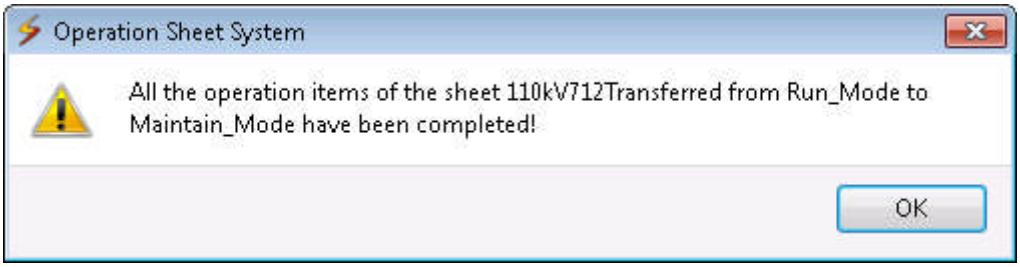


Figure 7.2-36 Execution complete prompting dialog box

7.2.4 Wiring Diagram Window

Wiring diagram window is located at right side of the main window and mainly includes the following functions:

1） Graphic sheet creation

When the mouse is moved onto an operation object, it will change to . Left click the operation object to automatically add operation term targeted at reverse of current operation object status in the sheet editing window. For sheet creation with rehearsal, after clicking, the operation object status will become object status. If the whole graph cannot be fully displayed in current interface, user can drag the graph to display wanted content. Right click operation object to add operable items and prompting operation of current equipment. During graphic sheet creation, user can switch between wiring diagram and bay sub-diagram, and select specific operation object for sheet creation.

2） Graphic rehearsal

During graphic rehearsal, the graph will enter rehearsal status. For rehearsal of each operation step, the operation object will change to target status after rehearsal on the graph. After rehearsal is canceled, the graph will be restored to the status same as monitoring.

3） Number setting operation

User can set tripping and closing operation of operation object on the graph.

Click a blank place on the wiring diagram to pop up a menu as shown below:

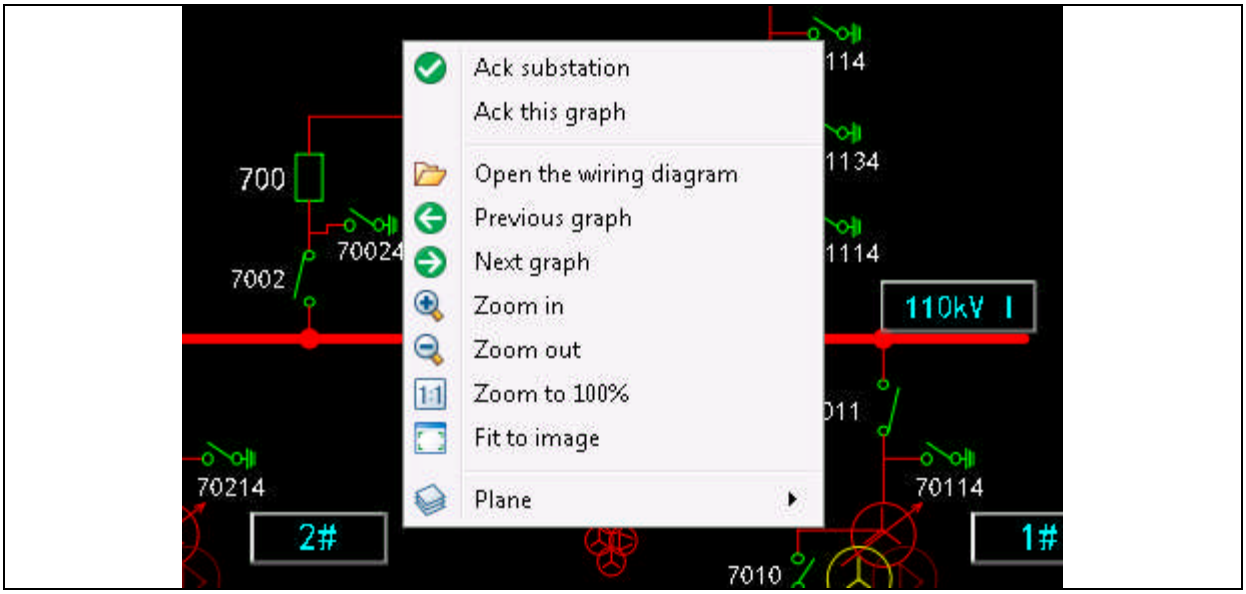


Figure 7.2-37 Pop up wiring diagram operation menu

For functions of each menu, refer to *7.2.1.3*.

When in editing or rehearsal status, click a circuit breaker or switch on wiring diagram to pop up the menu as shown below:

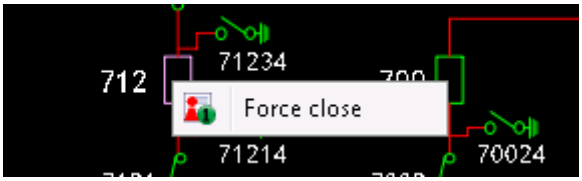


Figure 7.2-38 Pop up object operation menu

“Force close” and “force trip” can change status of circuit breaker/switch in the database. For rehearsal, status in the rehearsal database will be changed. If not in rehearsal mode, status in the real-time database will be changed.

7.3 Operation sheet Management

Operation sheet management tools can manage all operation sheets in the database. Main

functions are described below:

1） Conditional filtering can be carried out to easily locate a target for management. Filtering conditions include:

- Bay: including substation, voltage level, bay
- Time: including start time and end time
- Sheet No.: including starting instruction No. and ending sheet No.
- Staff: including sheet creator, operator, guardian
- Task type: including outage, recommission, primary, secondary
- Operation sheet type: including unchecked sheet, checked sheet, invalidated sheet, typical sheet, completed sheet, abandoned sheet

2） Filtered operation sheet list is displayed in the table. Contents displayed in operation sheet list can be customized.

3） Different types of operation sheets can be differentiated by different colors.

4） Operation sheets can be registered, invalidated, abandoned, modified, or deleted.

5） User can select an operation sheet for printing.

6） Operation steps can be managed, i.e. added, inserted, edited, deleted, moved up, or moved down.

Operation sheet management interface is shown below:

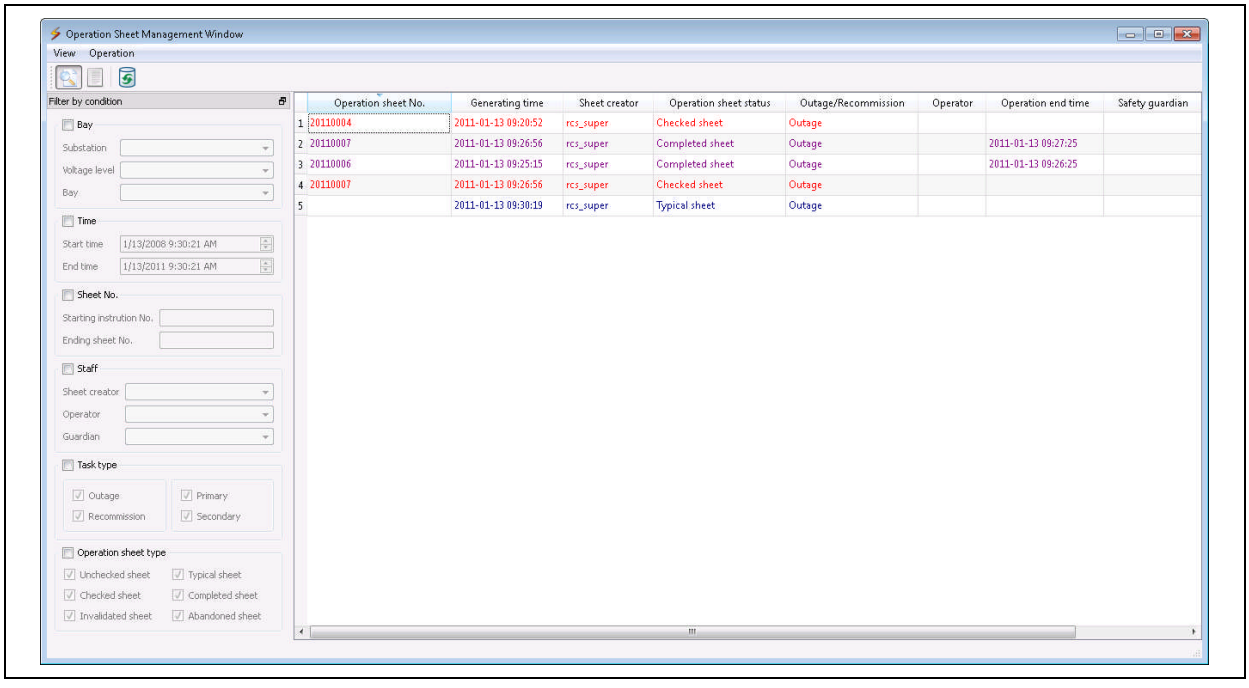


Figure 7.3-1 Operation sheet management interface

7.3.1 Menu Bar

The menu bar is at uppermost position of the operation sheet management interface. Click button “View” on the menu bar to pop up the View menu, as shown below:

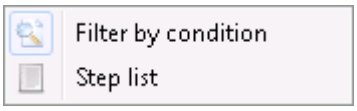


Figure 7.3-2 View menu

Table 7.3-1 Description of View menu items

View menu item	Description
Filter by condition	Display or hide Filter by condition dock window
Step list	Display or hide operation step list window

Click button “Operation” on the menu bar to pop up the Operation menu, as shown below:

Figure 7.3-3 Operation menu

Table 7.3-2 Description of Operation menu items

Operation menu item	Description
Refresh operation sheet list	Refresh operation sheet list that can be managed

7.3.2 Tools Bar

The tools bar is below the Menu bar, as shown below:

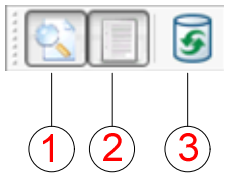


Figure 7.3-4 Operation sheet management tools bar

Table 7.3-3 Description of functions of operation sheet management tools bar

No.	Description
1	Display or hide Filter by condition dock window
2	Display or hide operation step list window
3	Refresh manageable operation sheet list

7.3.3 Filter by condition dock window

The Filter by condition dock window is located at left side of the operation sheet management main window. Operation sheets can be filtered according to conditions of bay, time, sheet No., staff, task type, and operation sheet type etc., to facilitate quick locating.

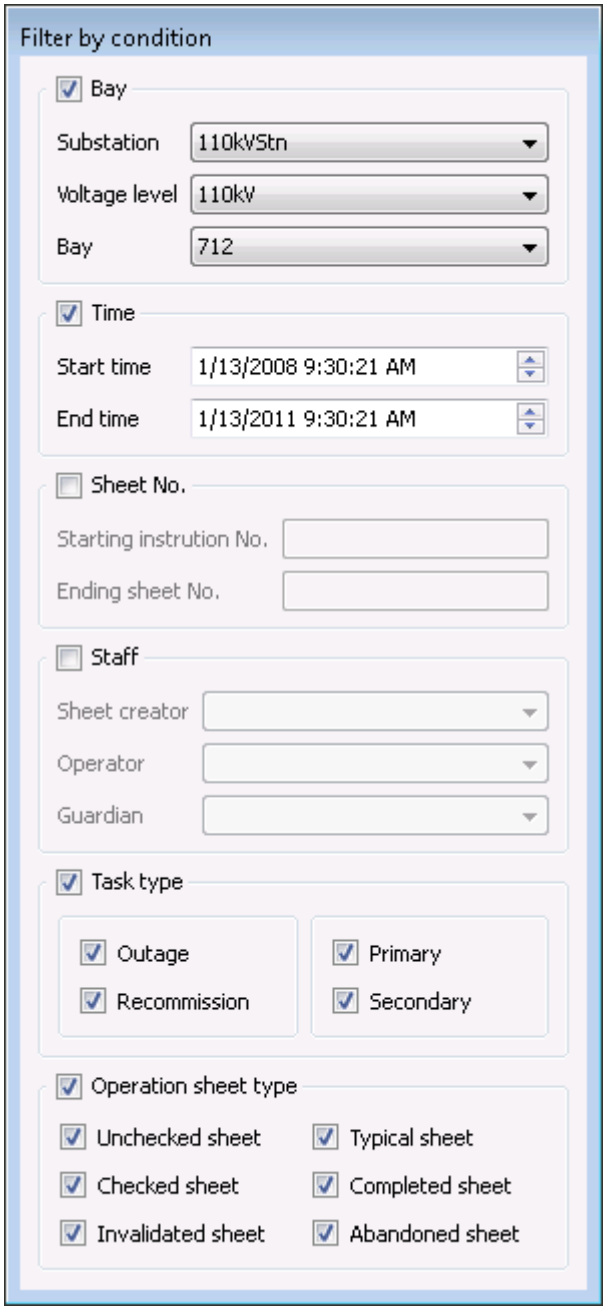


Figure 7.3-5 Filter by condition dock window

7.3.4 Operation sheet list window

The operation sheet list window is located at right side of the operation sheet management main window, and it displays the operation sheet list obtained by filtering. Different types of operation sheets can be differentiated through colors.

Right click an unchecked sheet to pop up the menu as shown below:

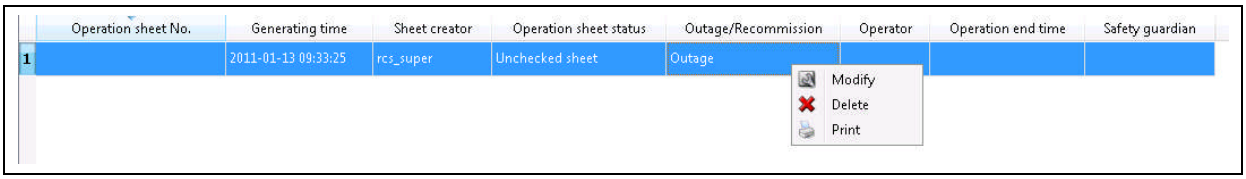


Figure 7.3-6Unchecked sheet management menu

Table 7.3-4 Description of unchecked sheet management menu items

Unchecked sheet menu item	Description
Modify	Open Maintain operation sheet dialog box
Delete	Delete an operation sheet from database
Print	Print operation sheet

Click Modify menu to pop up the dialog box as shown below:

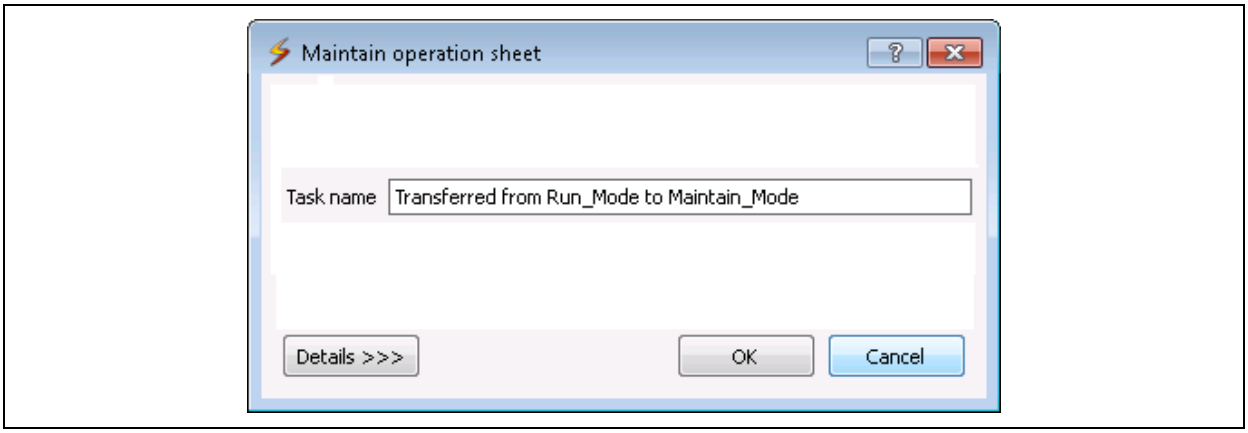


Figure 7.3-7 Maintain operation sheet dialog box

User can modify name of task of the operation sheet. Click button Details to expand this dialog box. User can modify more attributes of the operation sheet, as shown below:

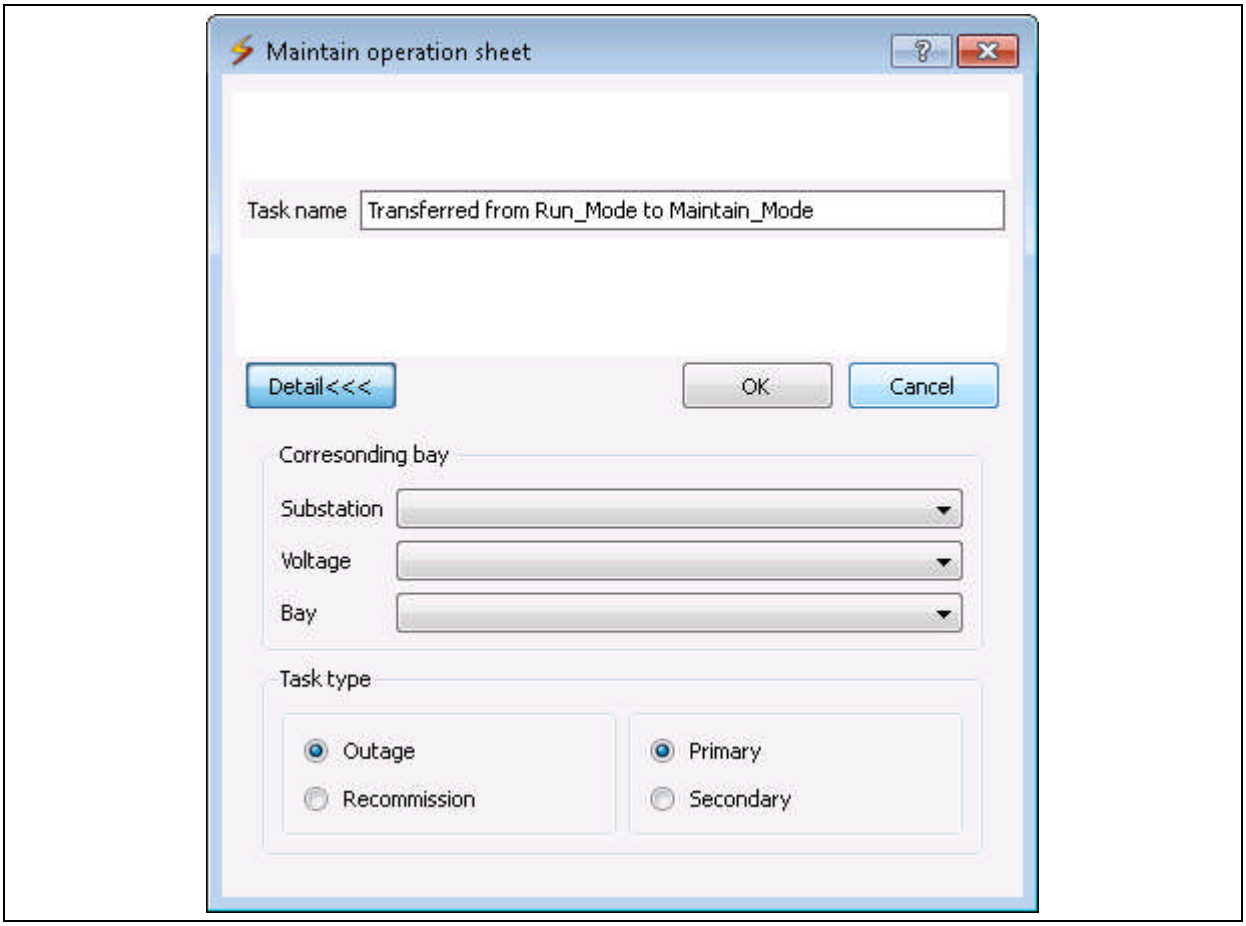


Figure 7.3-8 Expansion of maintain operation sheet dialog box

Right click a checked sheet to pop up the menu shown below:

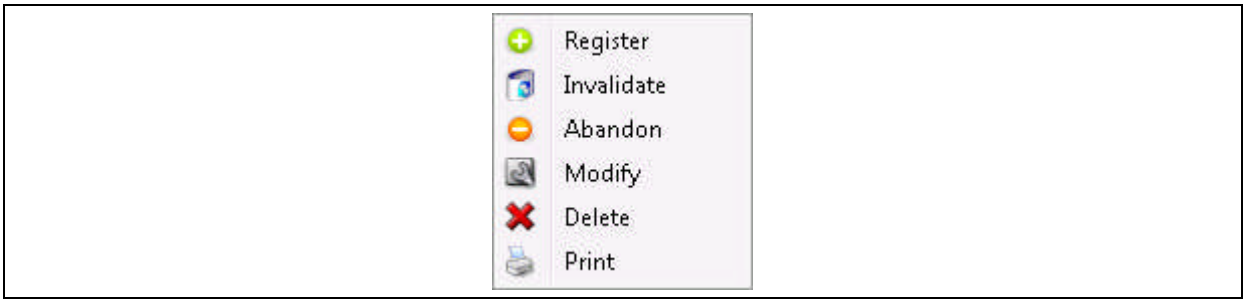


Figure 7.3-9 Checked sheet management menu

Table 7.3-5 Description of checked sheet managemment menu items

Checked sheet menu item	Description
Register	Open Register operation sheet dialog box
Invalidate	Invalidate an operation sheet
Abandon	Abandon an operation sheet
Modify	Open Maintain operation sheet dialog box
Delete	Delete an operation sheet from the database

Checked sheet menu item	Description
Print	Print an operation sheet

User can register attended person in charge, safety guardian, onsite checker, commander, command receiver, commanding time, start time of operation, and end time of operation. Refer to the figure below:

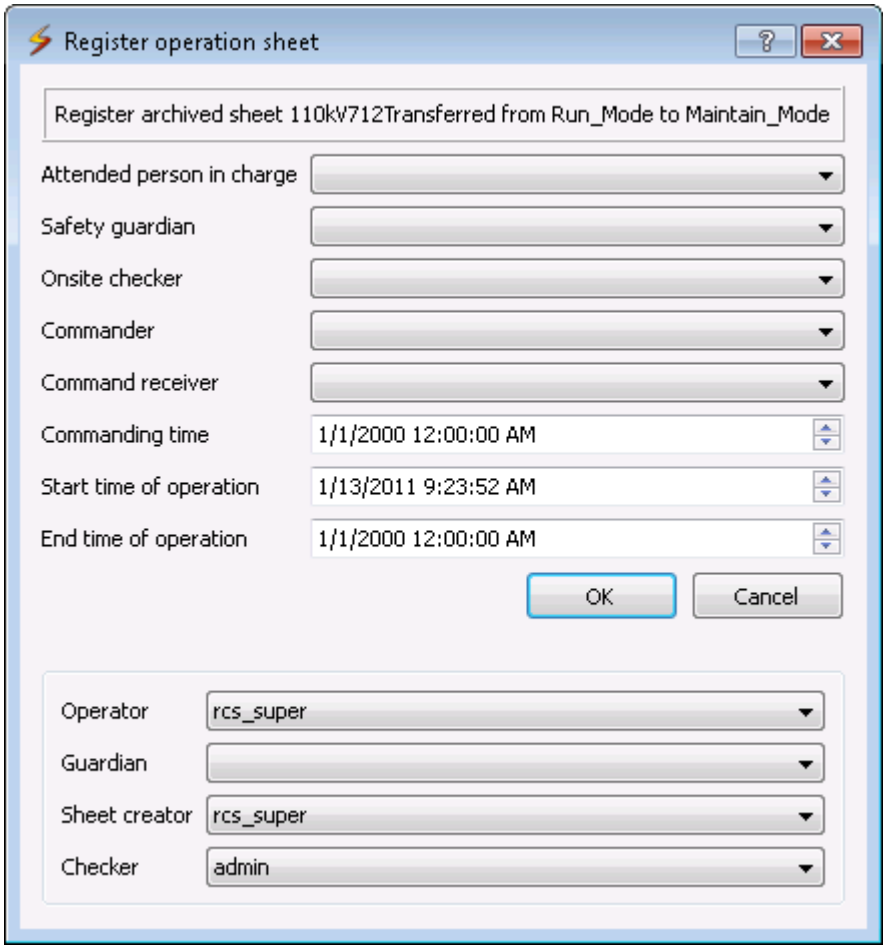


Figure 7.3-10 Register operation sheet dialog box

Remark is required to cancel an operation sheet, as shown below:

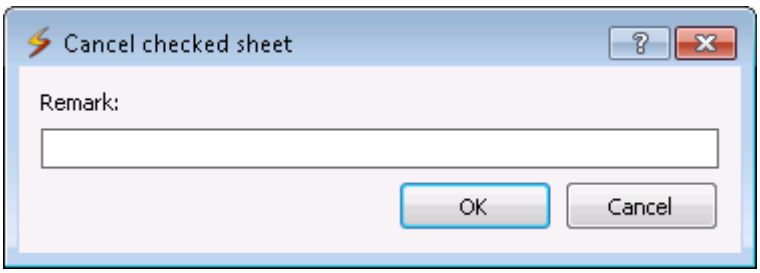


Figure 7.3-11 Invalidate operation sheet dialog box

Columns displayed in the operation sheet list can be customized. Right click head of operation sheet list to pop up the customizing menu, as shown below:

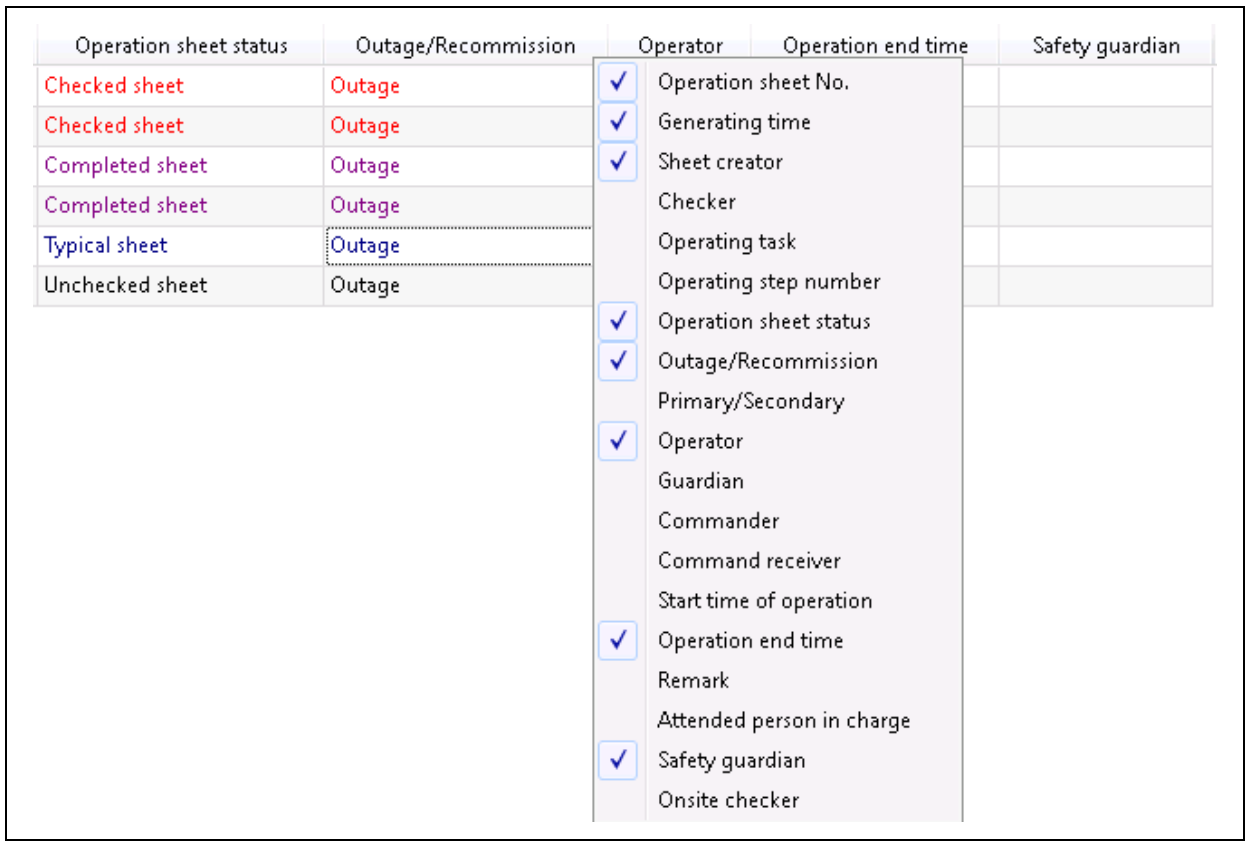


Figure 7.3-12 Display customizing menu for operation sheet list

7.3.5 Operation Step List Window

The operation step list window is located at lower right side of the operation sheet management main window and displays list of operation steps of currently selected operation sheet, as shown below:

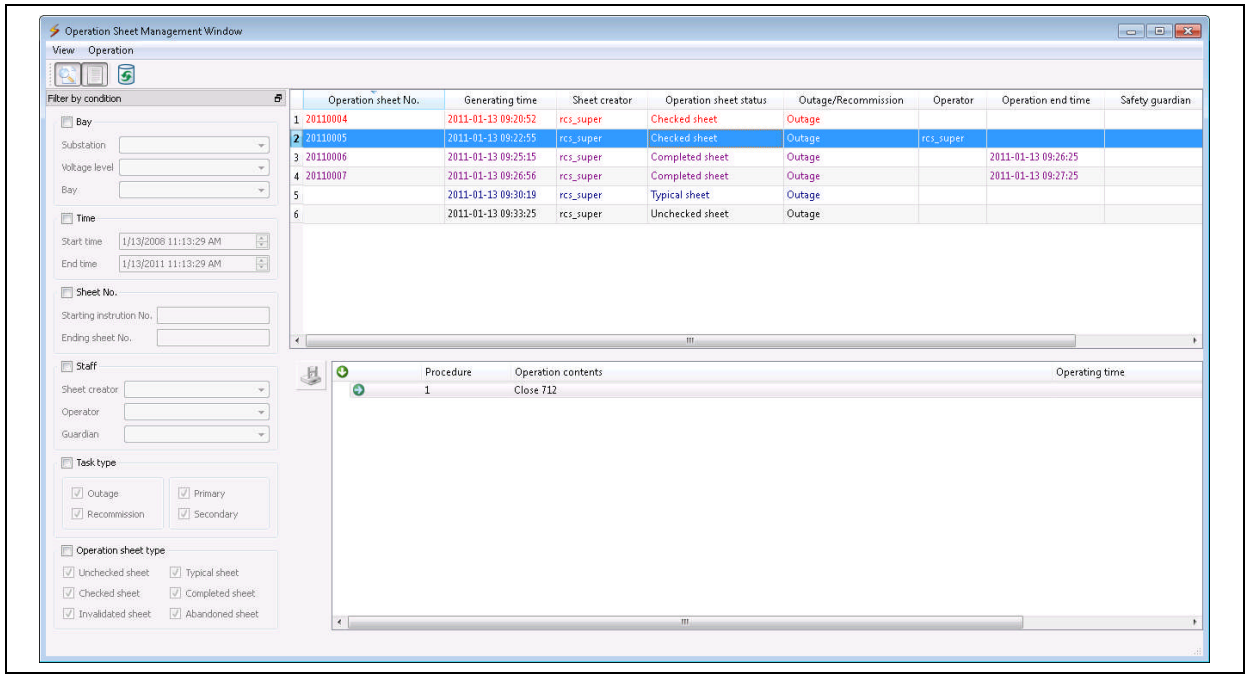


Figure 7.3-13 Operation step list displayed in the operation sheet management interface

Right click operation step list to edit operation steps, as shown below:

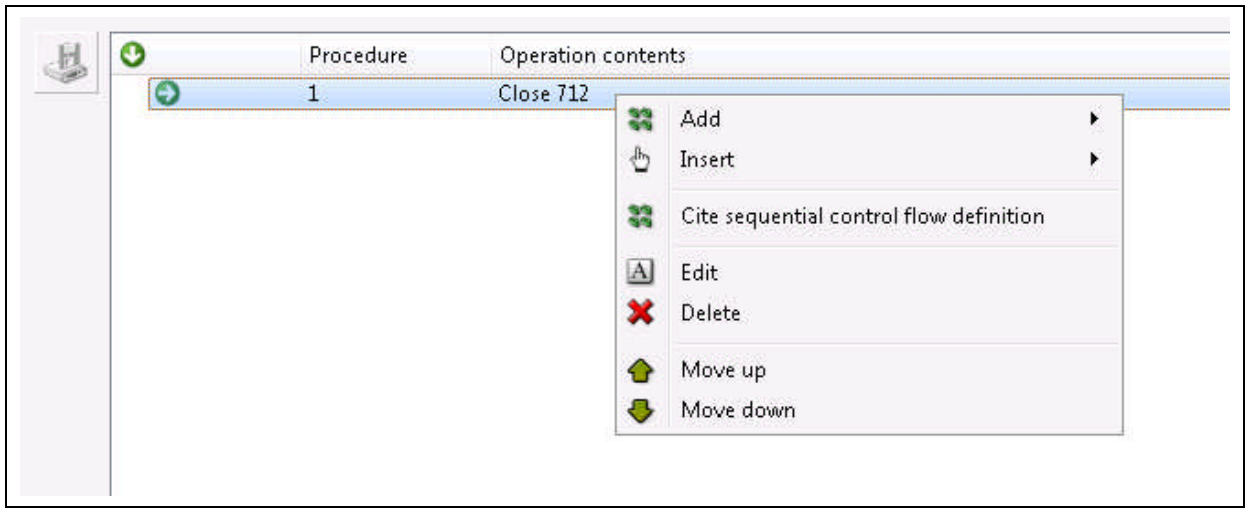


Figure 7.3-14 Operation step list editing menu

7.4 Inquire History Events

Inquire history event interface is shown below:

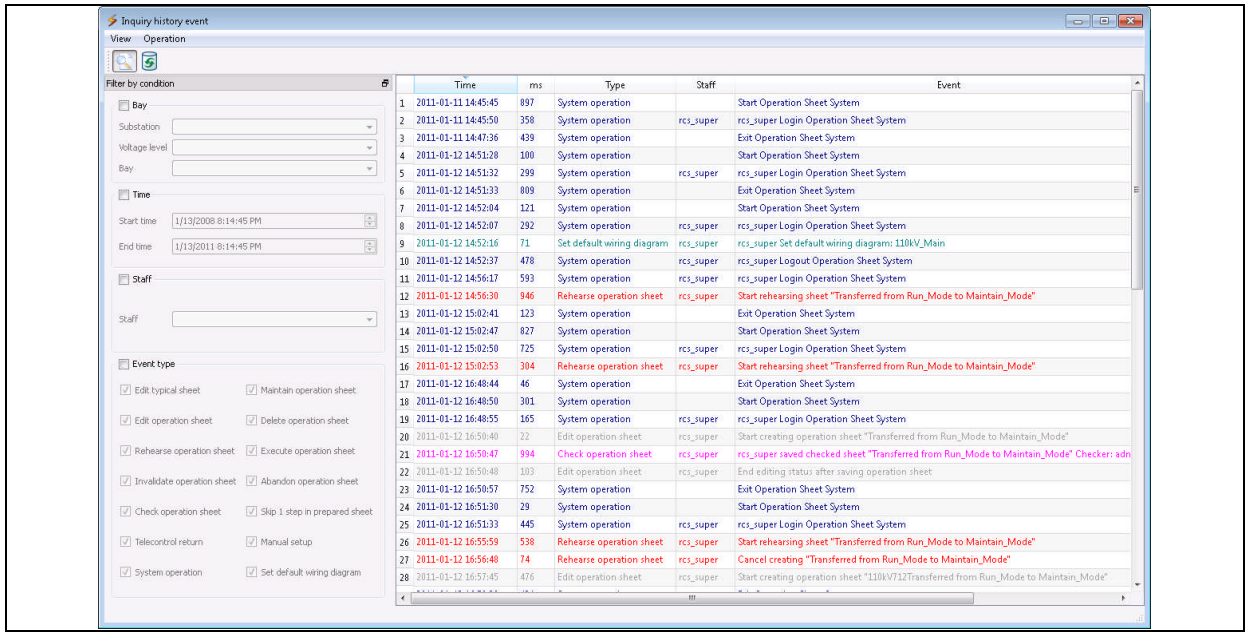


Figure 7.4-1 Inquire history event

7.4.1 Menu Bar

Click button “View” on the menu bar to pop up View menu, as shown below. Menu item “Filter by condition” is used to display or hide Filter by condition dock window.

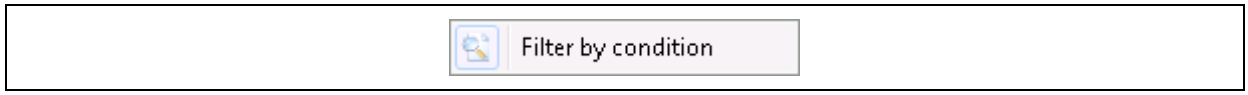


Figure 7.4-2 View menu

Click button “Operation” on the menu bar to pop up Operate menu, as shown below. “Refresh event list” menu item is used to refresh operation sheet system history event list.

Figure 7.4-3 Operation menu

7.4.2 Filter by condition dock window

The Filter by condition dock window is located at left side of the Inquire history event main window. User can filter operation sheet system history events according to bay, event, staff, and event type etc. to facilitate quick locating.

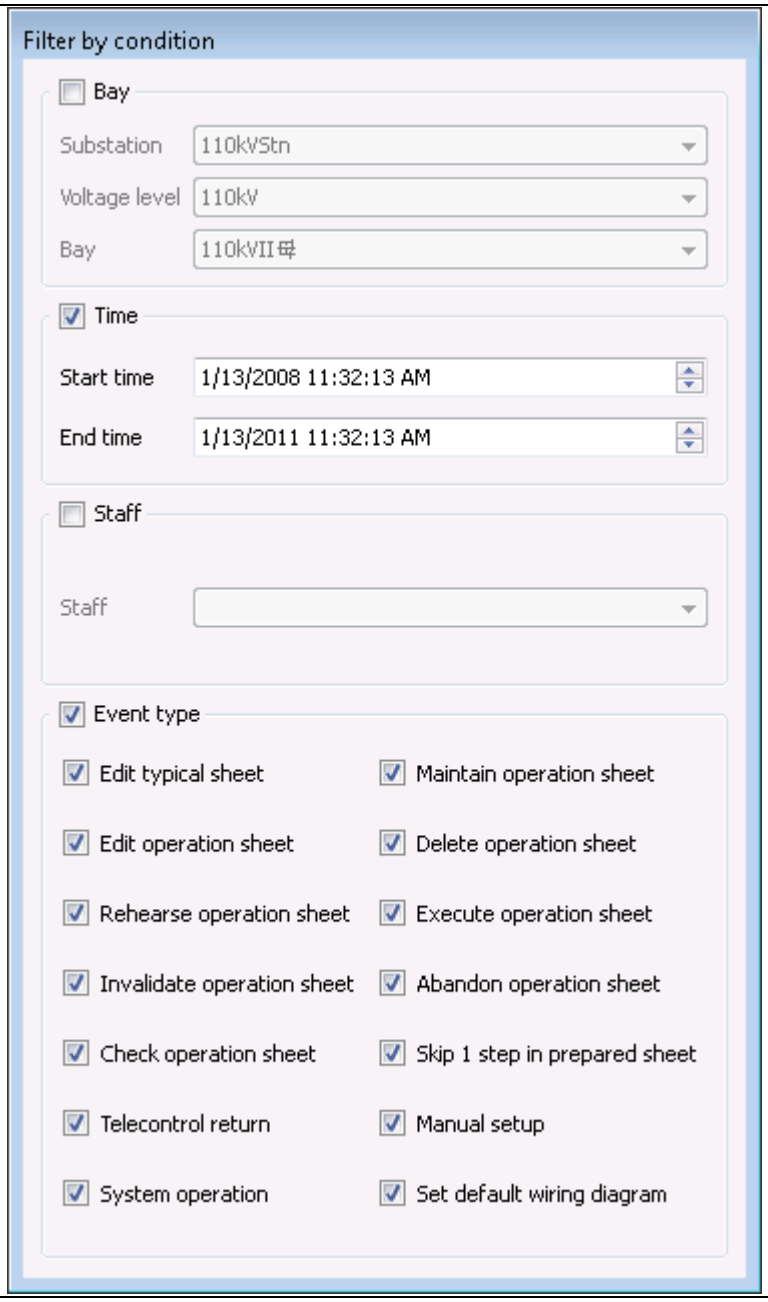


Figure 7.4-4 Filter by condition dock window

7.4.3 Event List Window

The event list window is located at right side of the Inquire history event main window and displays event list obtained by filtering. Different types of events are displayed in different colors.

Columns displayed in the event list can be customized. Right click head of event list to pop up the customizing menu, as shown below:

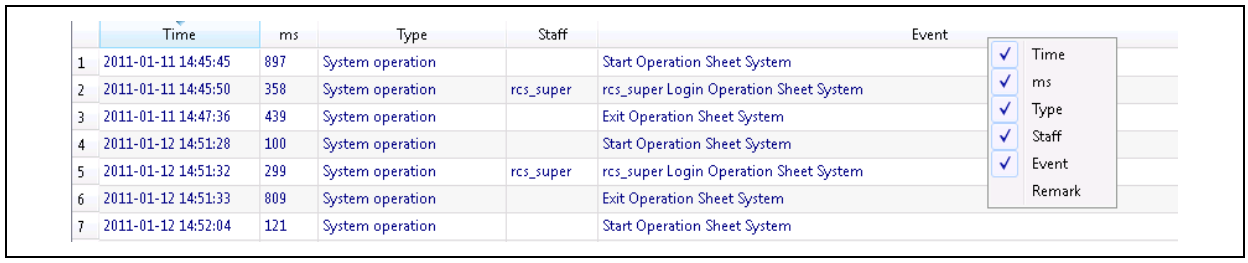


Figure 7.4-5 Customizing menu for display of event list columns

7.5 Browse Communication Log of Smart Key Serial Port

The communication log of smart key serial port is under path /deployment/log/wufang/SerialLog/ of installation directory. Click Browse smart key serial port communication log menu to open log file for viewing.

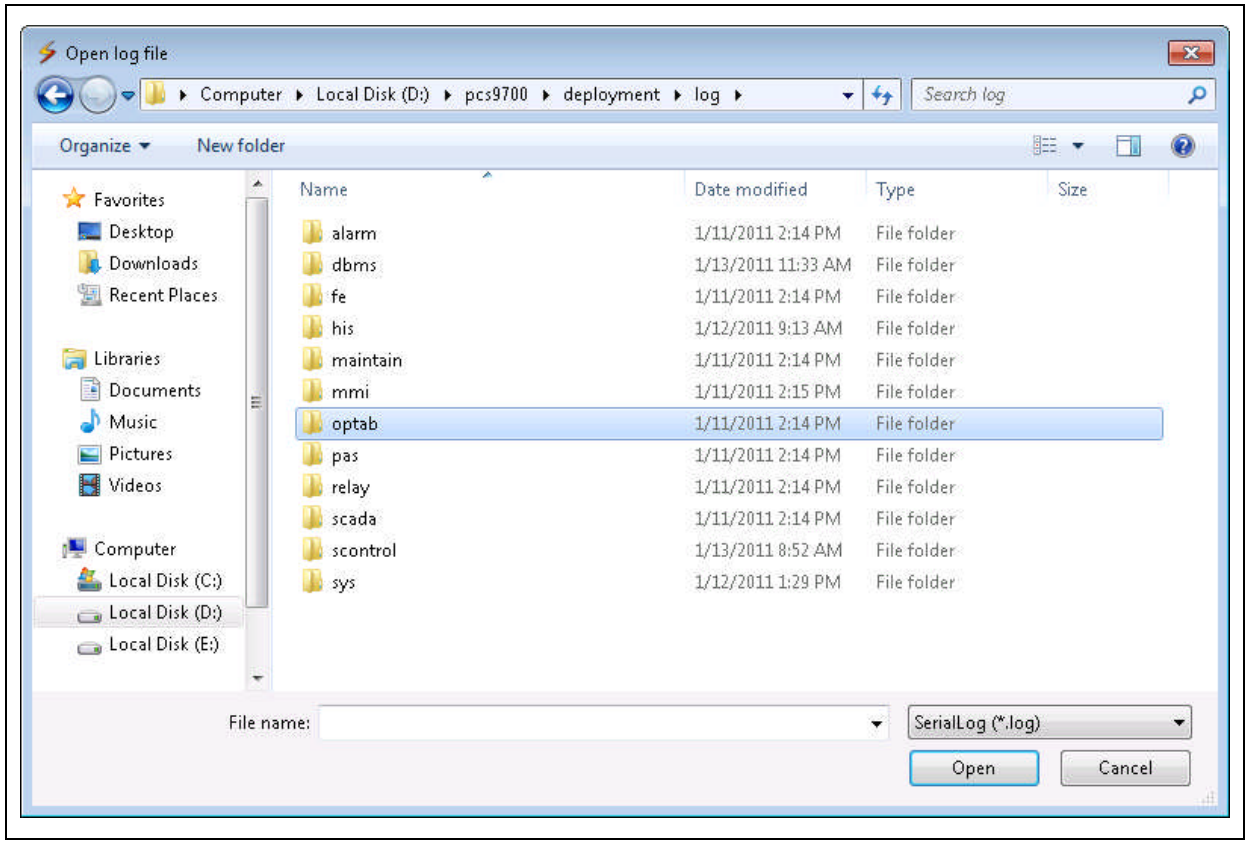


Figure 7.5-1 View smart key serial port communication log

7.6 Virtual BI status correction

Click button Virtual BI status correction on the Tools bar to enter the state of virtual BI status correction. When the mouse is moved onto virtual BI on the wiring diagram, it will change to the shape of a small hand. At this time, click virtual BI to directly change status of virtual BI, as shown below:

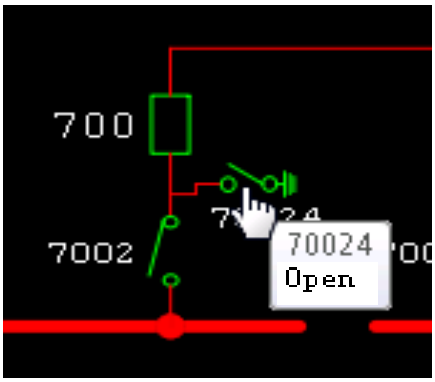


Figure 7.6-1 Virtual BI status correction

At end of virtual BI status correction, again click the Virtual BI status correction button on the tools bar to exit virtual BI status correction state.

7.7 Browse Earthing Library

Click button Browse earthing library on the Tools bar to open Browse earthing library interface. User can view earthing No., status, and attached position of earthing in the database, as shown below:

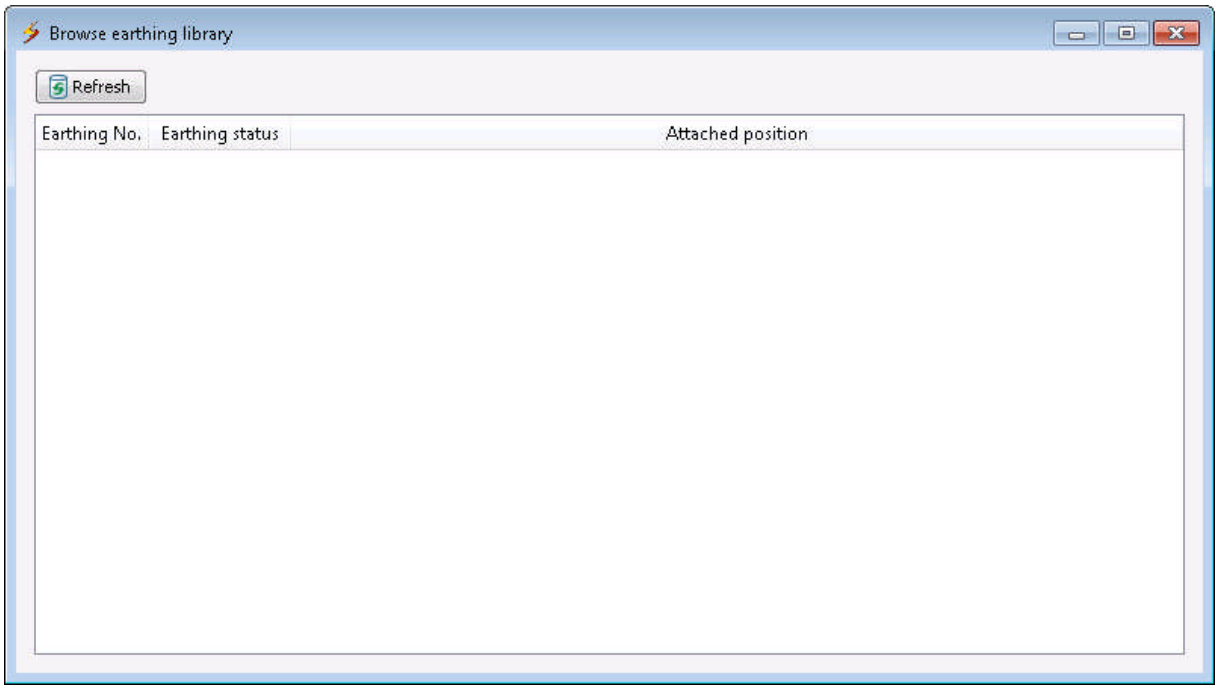


Figure 7.7-1 Browse earthing library window

7.8 Operation Task Statistic

Click the Operation task statistic menu to display Operation task statistic dialog box as shown below:

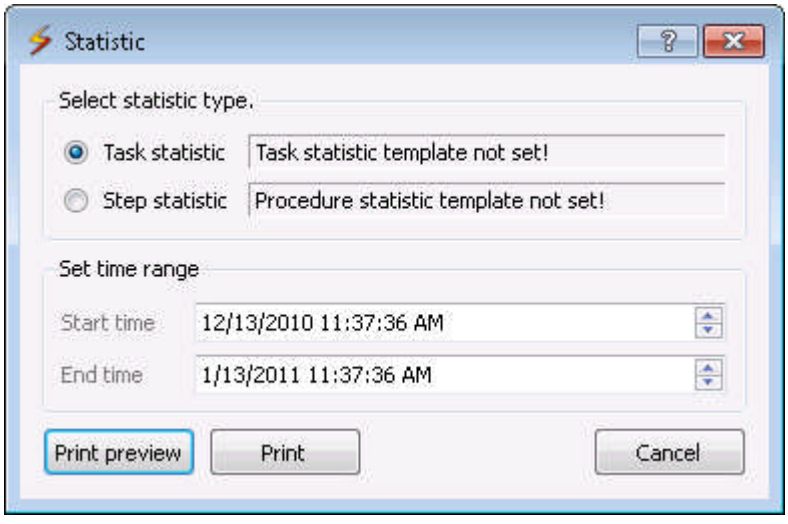


Figure 7.8-1 Operation task statistic dialog box

User can perform task statistic and step statistic. The statistic template is configured in the operation sheet system configuration tools. If no statistic template is configured, a notification will be prompted showing “no task statistic template set”. For statistics, user can set start time and end time. Statistic results can be previewed. User can directly print statistics results.

7.9 Edit the template to print

Edit the template to print mainly includes the following functions:

1） Create, edit, and save the template to print operation sheet. Saving path is under the directory \pcs9700\deployment\data\wufang\template.

2） Add and delete row/column, and set row height and column width.

3） Add and delete foreground point, and set font and format of foreground point. Foreground point can be attribute of operation sheet or operation step, or text/picture etc. Foreground point text is displayed in red.

4） Merge and split cell.

5） Set cell borders.

6） Preview edited template.

7） Set display format of sheet No. and page sequence number. User can set page format such as page header, footer, and tones for endup etc.

8） Load an operation sheet for printing.

The Edit the template to print main interface is shown below:

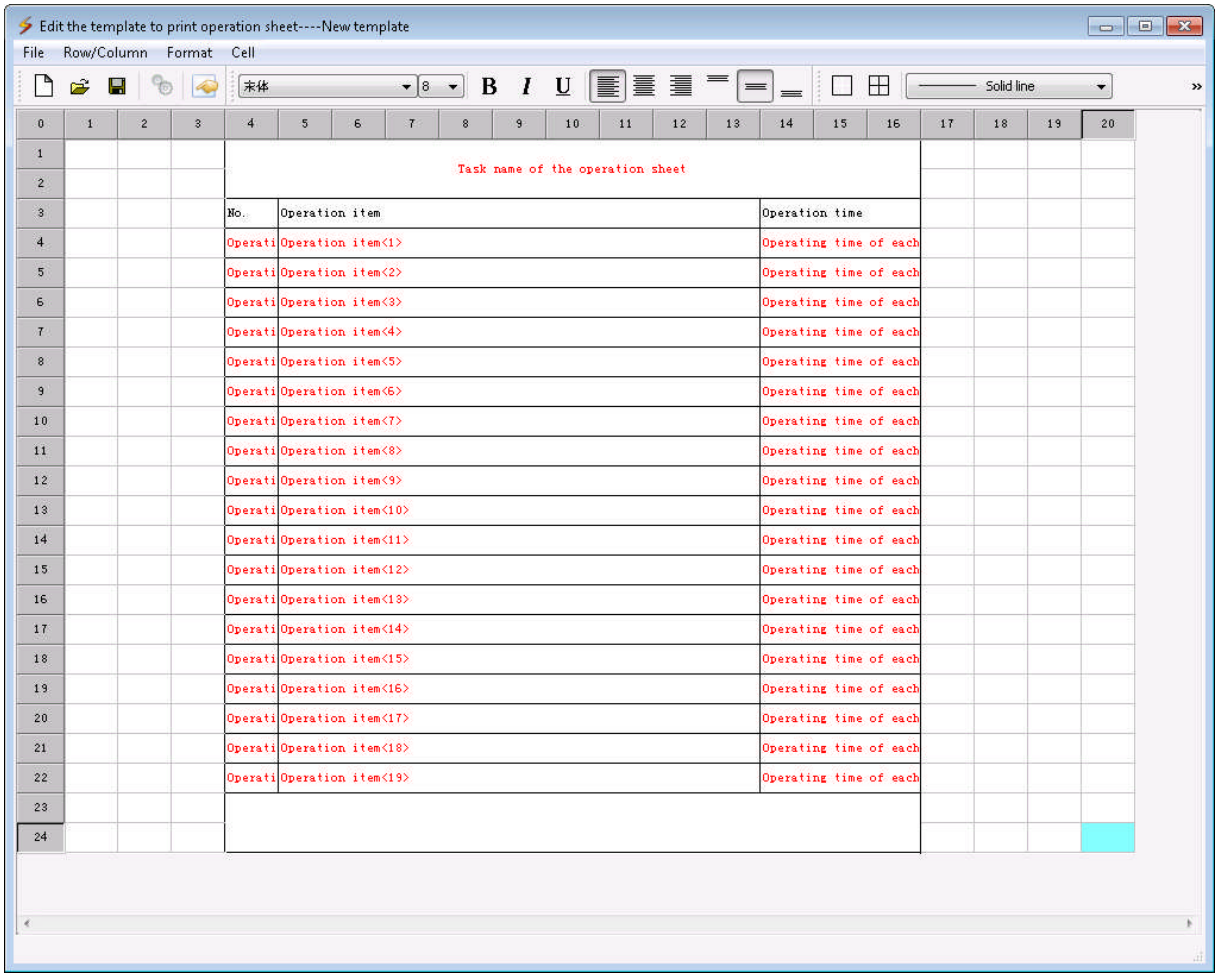


Figure 7.9-1 Edit the template to print

7.9.1 Menu Bar

The menu bar is at upper most position of the “Edit the template to print” main interface.

7.9.1.1 File Menu

Click button “File” on the menu bar to pop up File menu, as shown below:

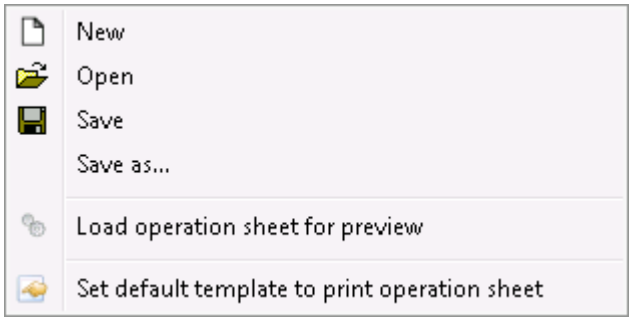


Figure 7.9-2 File menu

Table 7.9-1 Description of File menu items

File menu item	Description
New	Create a new print template
Open	Open saved print template
Save	Save results of editing
Save as	Save edited template as a new template
Load operation sheet for preview	Load an operation sheet to preview effect of template
Set default template to print operation sheet	Set edited template as default print template

7.9.1.2 Row/Column Menu

Click button “Row/column” on the menu bar to pop up Row/column menu, as shown below:

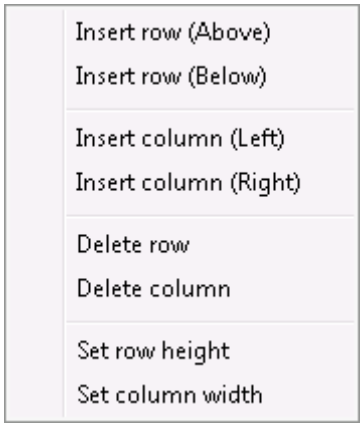


Figure 7.9-3 Row/column menu

Table 7.9-2 Description of row/column menu items

Row/column menu item	Description
Insert row (above)	Insert a row above currently selected row
Insert row (below)	Insert a row below currently selected row
Insert column (left)	Insert a column left of currently selected column
Insert column (right)	Insert a column right of currently selected column
Delete row	Delete currently selected row
Delete column	Delete currently selected column
Set row height	Set height of all selected rows to a memorized value
Set column width	Set width of all selected columns to a memorized value

7.9.1.3 Format Menu

Click button “Format” on the menu bar to pop up the Format menu, as shown below:

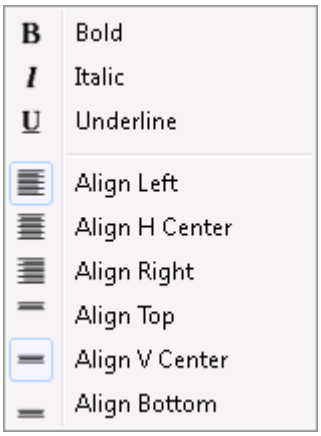


Figure 7.9-4 Format menu

Table 7.9-3 Description of format menu

Format menu item	Description
Bold	Set cell font to bold
Italic	Set cell font to italic
Underline	Set cell font to underline
Align left	Set cell font to align left
Align H center	Set cell font to align horizontal center
Align right	Set cell font to align right
Align top	Set cell font to align top
Align V center	Set cell font to align vertical center
Align bottom	Set cell font to align bottom

7.9.1.4 Cell Menu

Click button “Cell” on the menu bar to pop up Cell menu, as shown below:

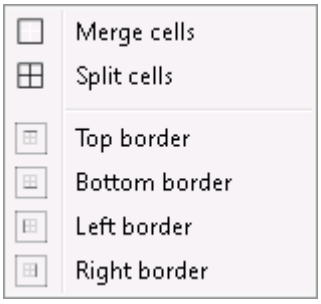


Figure 7.9-5 Cell menu

Table 7.9-4 Description of Cell menu items

Cell menu item	Description
Merge cells	Merge selected cells to one cell

Cell menu item	Description
Split cell	Split merged cell to a number of cells
Top border	Display top border of selected cell
Bottom border	Display bottom border of selected cell
Left border	Display left border of selected cell
Right border	Display right border of selected cell

7.9.2 Tools Bar

The tools bar is located below the menu bar.

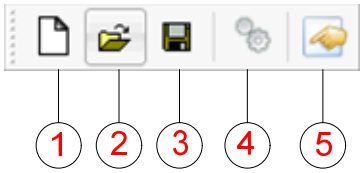


Figure 7.9-6 File tools bar

Table 7.9-5 Description of functions of File tools bar

No.	Description
1	Create a new print template
2	Open saved print template
3	Save results of editing
4	Load an operation sheet to preview effect of template
5	Set edited template as default print template

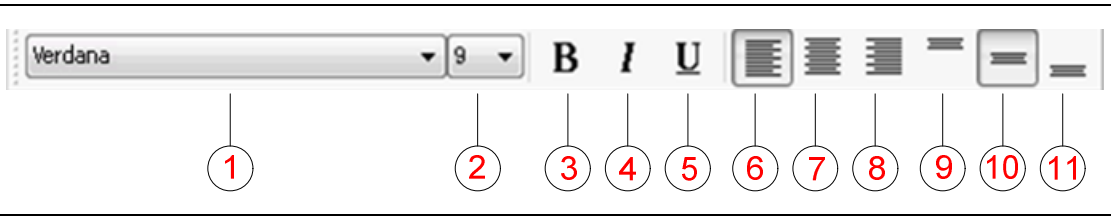


Figure 7.9-7 Format tools bar

Table 7.9-6 Description of Format tools bar functions

No.	Description
1	Set font
2	Set character size
3	Set cell font to bold
4	Set cell font to italic
5	Set cell font to underline

No.	Description
6	Set cell font to align left
7	Set cell font to align horizontal center
8	Set cell font to align right
9	Set cell font to align top
10	Set cell font to align vertical center
11	Set cell font to align bottom

Figure 7.9-8 Cell tools bar

Table 7.9-7 Description of functions of Cell tools bar

No.	Description
1	Merge selected cells to one cell
2	Split merged cell to a number of cells
3	Set cell border line type
4	Set cell border line thickness
5	Display top border of selected cell
6	Display bottom border of selected cell
7	Display left border of selected cell
8	Display right border of selected cell

Available line types are shown below:

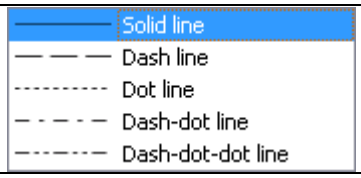


Figure 7.9-9 List of line types

Available line thicknesses are shown below:

Figure 7.9-10 List of line thicknesses

7.9.3 Create template

Click button New on the tools bar to pop up create template dialog box as shown below:

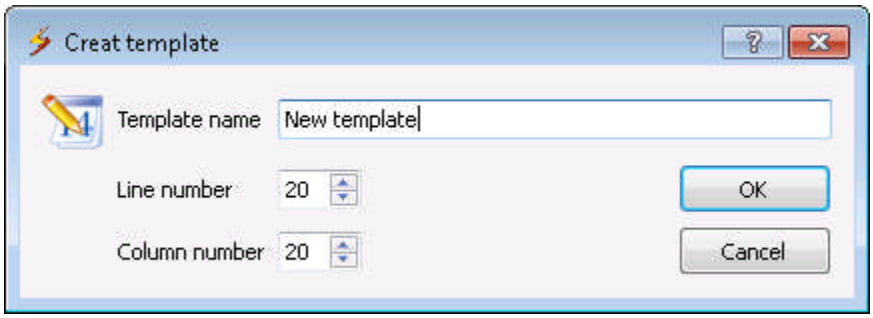


Figure 7.9-11 New template dialog box

Right click a blank place on the table of the template to pop up an Edit menu, as shown below:

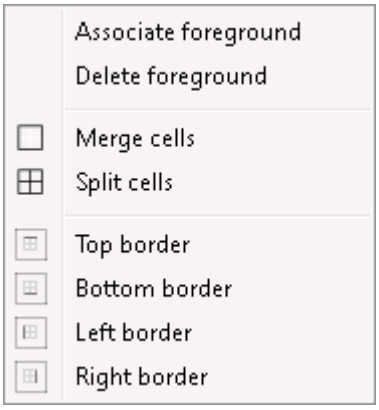


Figure 7.9-12 Edit table pop-up menu

Table 7.9-8 Description of Edit table pop-up menu items

Edit table menu item	Description
Associate foreground	Pop up foreground point definition dialog box
Delete foreground	Delete foreground point associated to selected cell
Merge cells	Merge selected cells to one cell

Edit table menu item	Description
Split cell	Split merged cell to a number of cells
Top border	Display top border of selected cell
Bottom border	Display bottom border of selected cell
Left border	Display left border of selected cell
Right border	Display right border of selected cell

Click Associate foreground menu to pop up Foreground point definition dialog box as shown below:

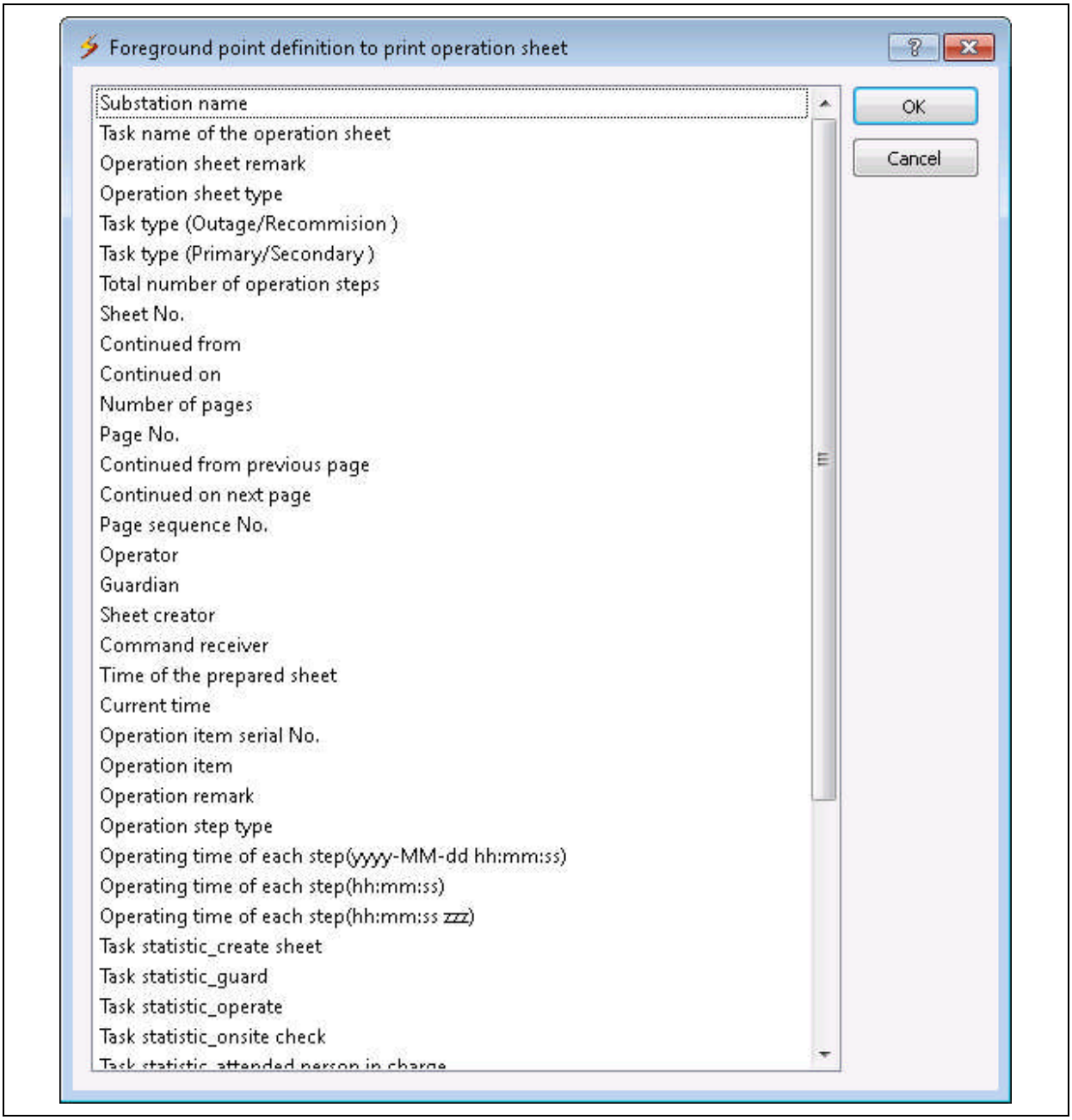


Figure 7.9-13 Foreground point definition dialog box

After selection of a foreground point, user can see in the table that a cell or a column of cells have

been associated to this foreground point. Font of cells associated to this foreground point will be red.

After editing, user can save the edited template as default print template, as shown below:

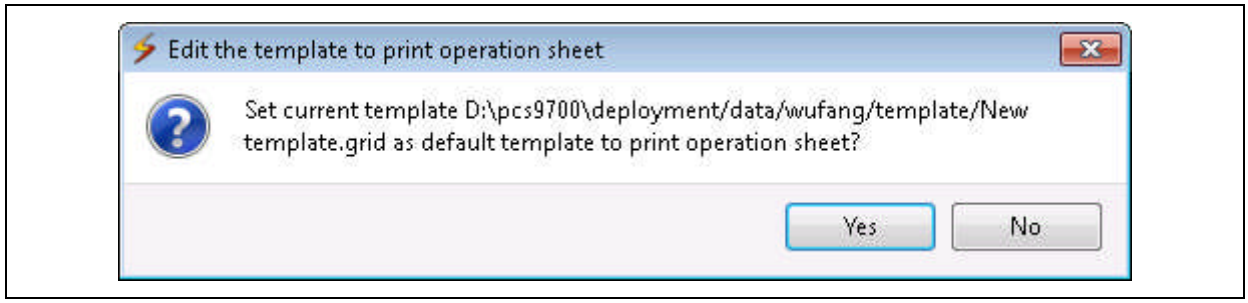


Figure 7.9-14 Set default print template

7.9.4 Load Operation sheet for Preview

Click Load operation sheet for preview menu to pop up the preview window as shown below:

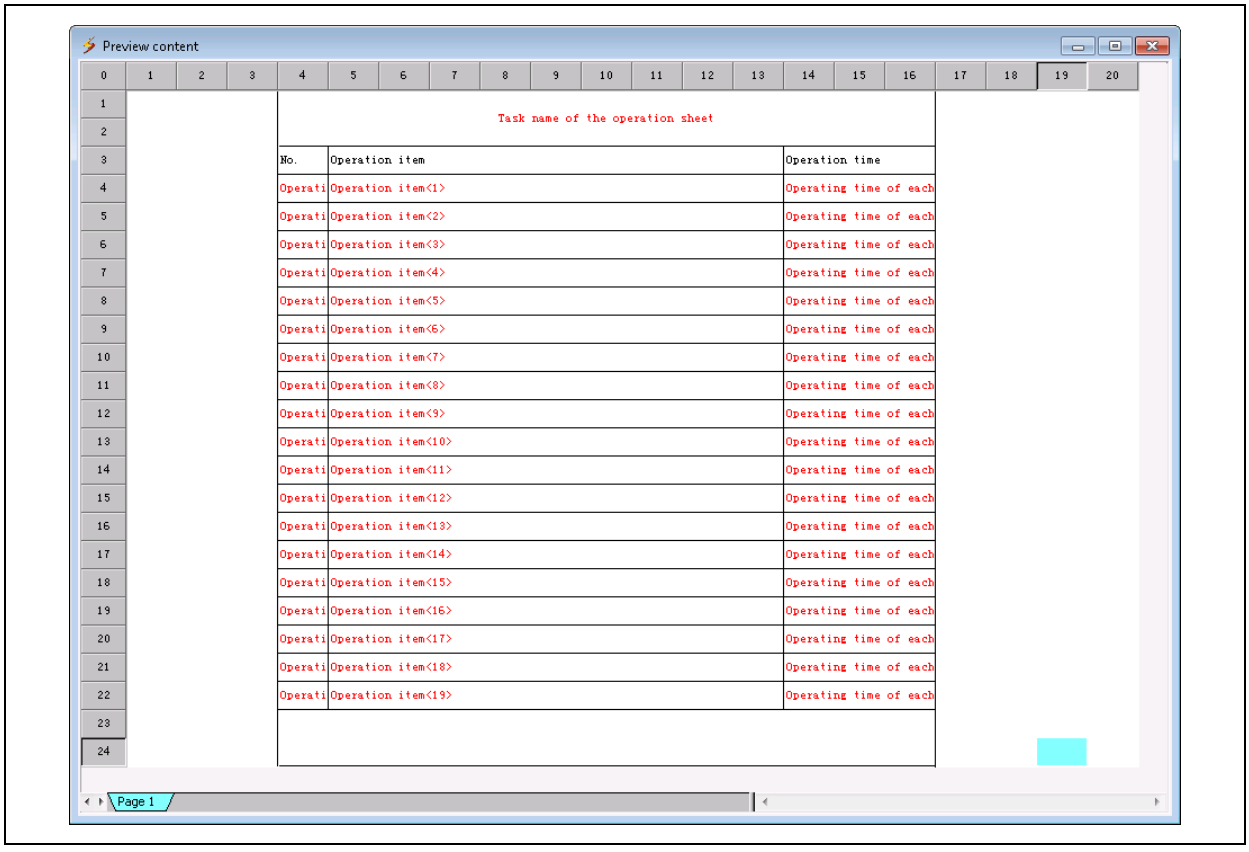


Figure 7.9-15 Preview window

Right click the preview window to pop up a menu as shown below:

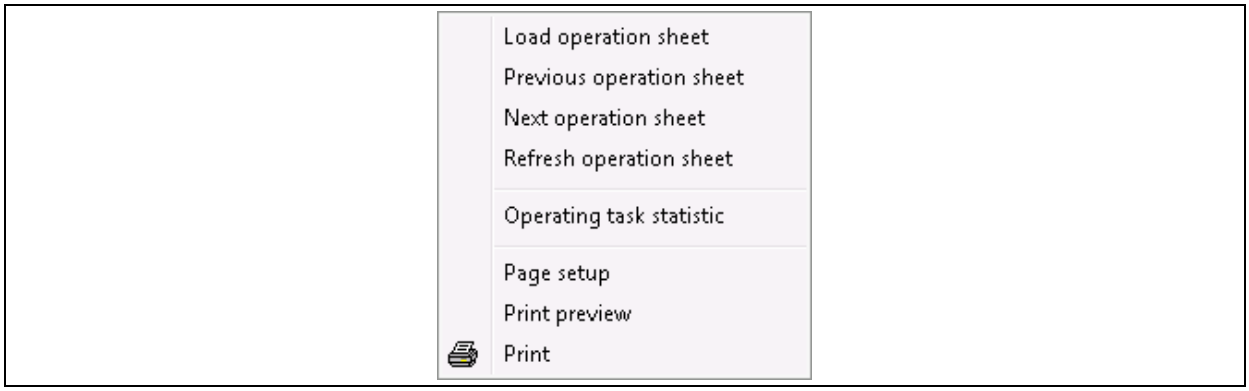


Figure 7.9-16 Preview window menu

Table 7.9-9 List of functions of preview window menu

Preview window right mouse key menu item	Description
Load operation sheet	Load an operation sheet into current print template to preview its content
Previous operation sheet	Open previous operation sheet in current print template to preview its content
Next operation sheet	Open next operation sheet in current print template to preview its content
Refresh operation sheet	Reload current operation sheet in current print template to preview its content
Operation task statistic	Preview operation sheet task statistic results in current print template
Page setup	Set print page
Print preview	Preview printing effect
Print	Print operation sheet or statistic results

After loading an operation sheet, preview its content in current print template, as shown below:

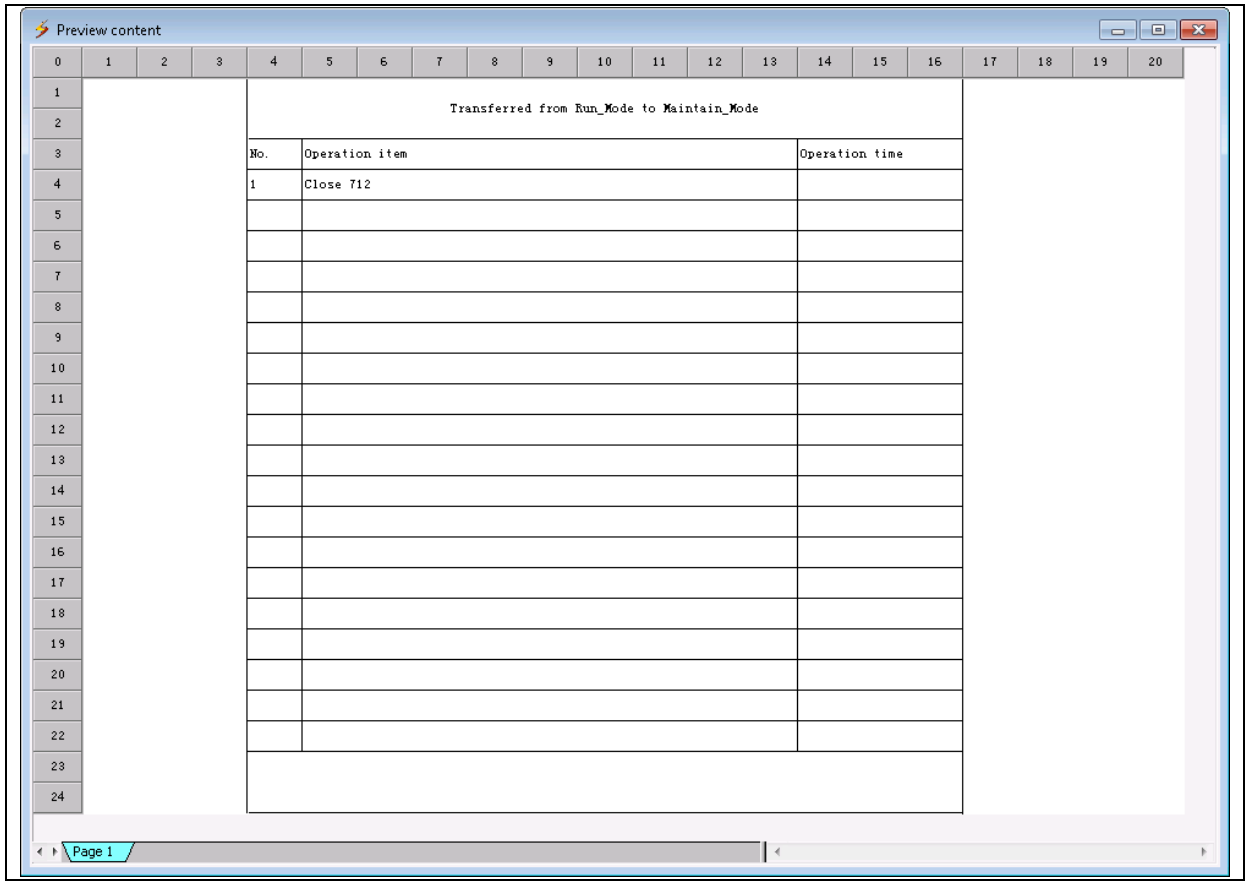


Figure 7.9-17 Preview operation sheet

Print preview is shown below:

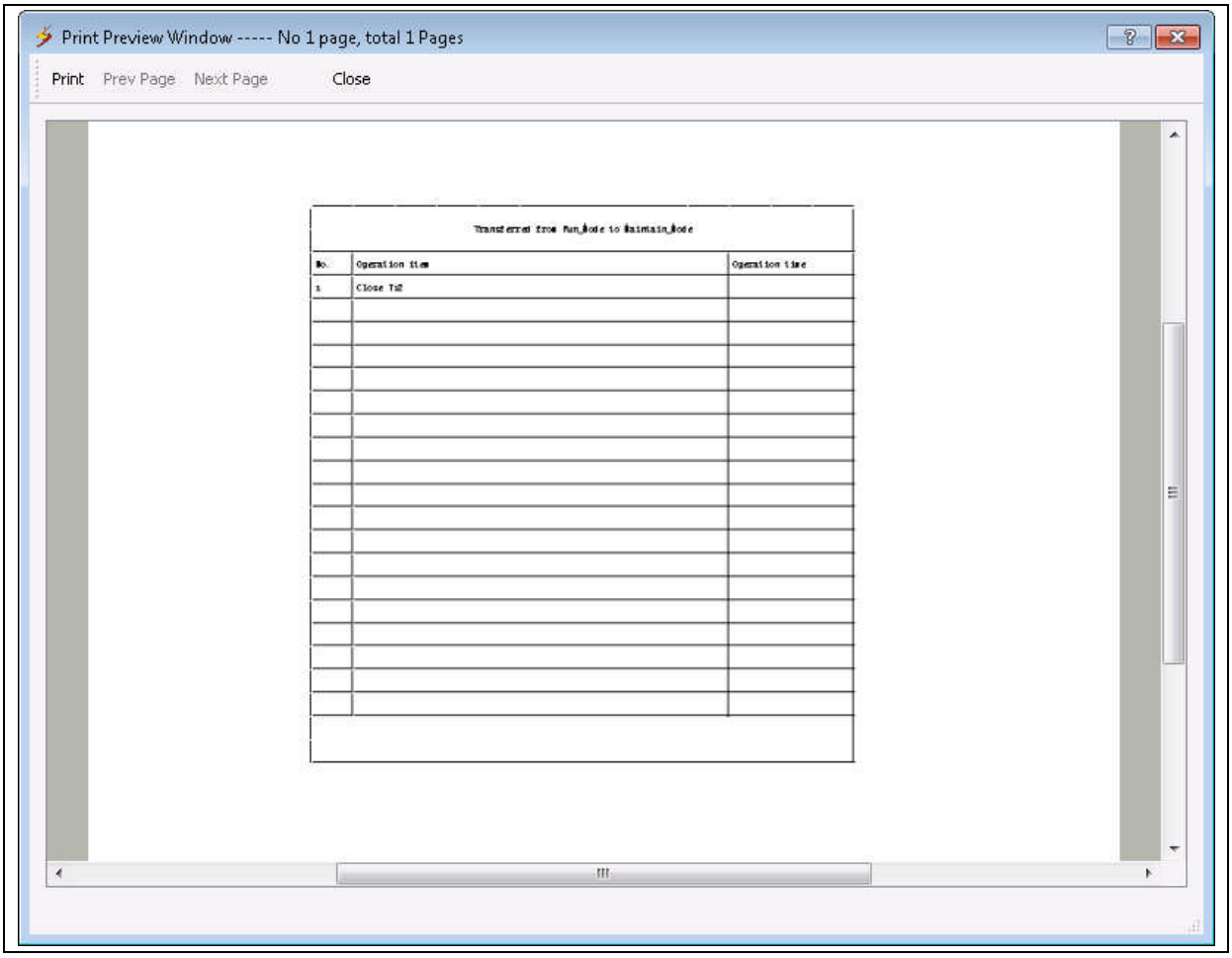


Figure 7.9-18 Print preview

Operation task statistic dialog box is shown below:

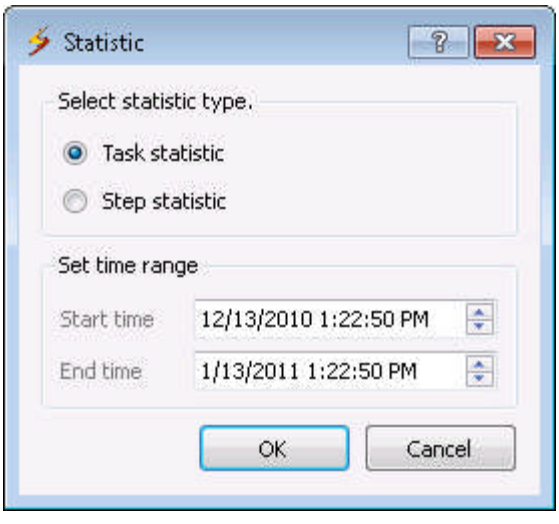


Figure 7.9-19 Operation task statistics dialog box

7.10 Configuration of Operation Sheet System

7.10.1 General Setup

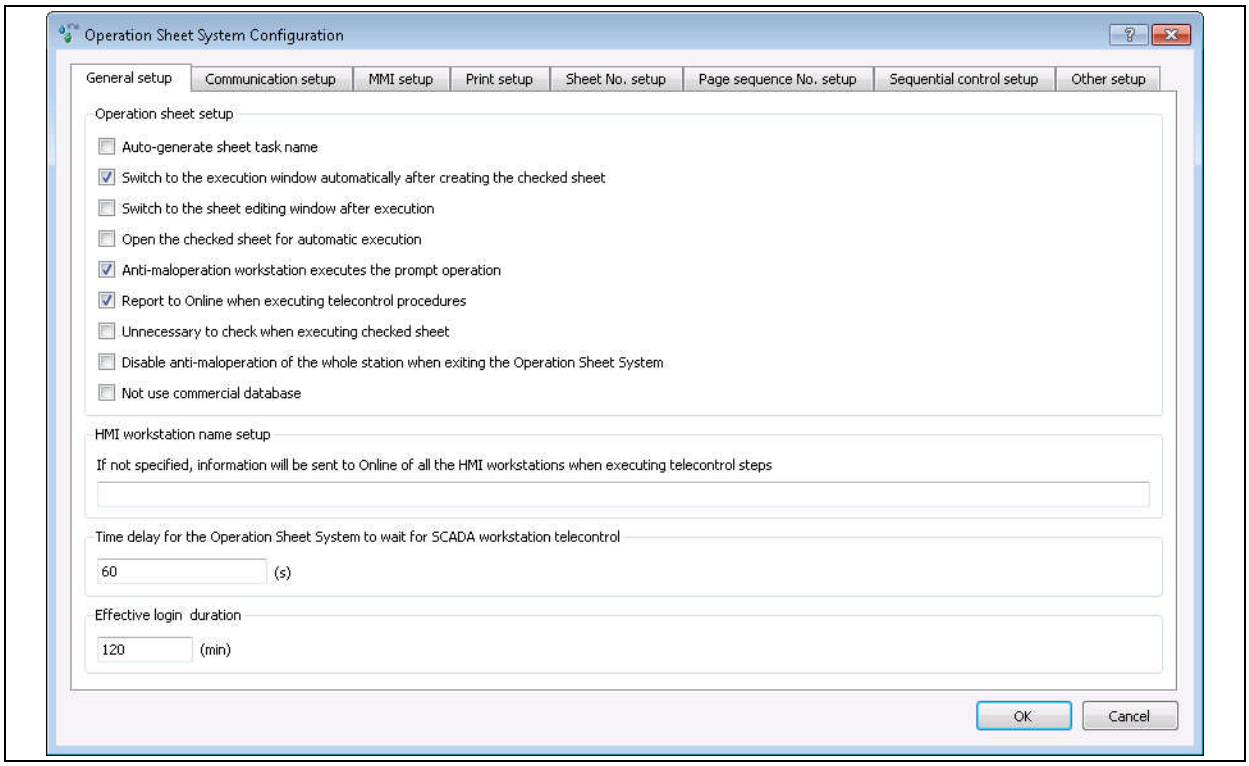


Figure 7.10-1 General setup

Table 7.10-1 Description of general setup

General setup	Description
Auto-generate sheet task name	If checked task name will be automatically generated during creation of new operation sheet without manual control
Switch to execution window automatically after creating the checked sheet	If checked, after creating the checked sheet, system will automatically switch to the execution window (no longer staying in the sheet editing window)
Switch to sheet editing window after execution	If checked, after execution of operation sheet, system will automatically switch to the sheet editing window (no longer staying in the execution window)
Open the checked sheet for automatic execution	If checked, checked sheet will automatically execute upon opening without clicking Execute button.
Anti-maloperation workstation executes the prompt operation	If checked, when executing a prompt step, a dialog box will pop up for user confirmation before next step; if not selected, prompt step will be directly skipped.
Report to Online when executing telecontrol procedures	If checked, when executing a telecontrol procedure, a message will be sent to Online. After receiving this message, Online will pop up a dialog box to prompt user which object needs telecontrol.

General setup	Description
Unnecessary to check when executing checked sheet	If checked, check of rules and status will not be required when executing checked sheet
Disable anti-maloperation of the whole station When exiting the Operation Sheet System	If checked, exiting PCS operation sheet system will also exit anti-maloperation of the whole station. If unchecked, anti-maloperation will remain enabled after PCS operation sheet system exits.
Not use commercial database	If checked, PCS operation sheet system will no longer save log into commercial database
HMI workstation name setup	Send telecontrol execution information to specified HMI workstation. If not specified, this information will be sent to Online of all the HMI workstations.
Time delay for the Operation Sheet System to wait for SCADA workstation telecontrol	For execution of telecontrol procedure, if the operation sheet system judges no successful execution of telecontrol of circuit breaker/switch within a set time, Delay overtime prompt dialog box will pop up.
Effective login duration	Duration in which logged-in status is maintained after user successfully logs in. When this duration expires, user needs to log in again.

7.10.2 Communication Setup

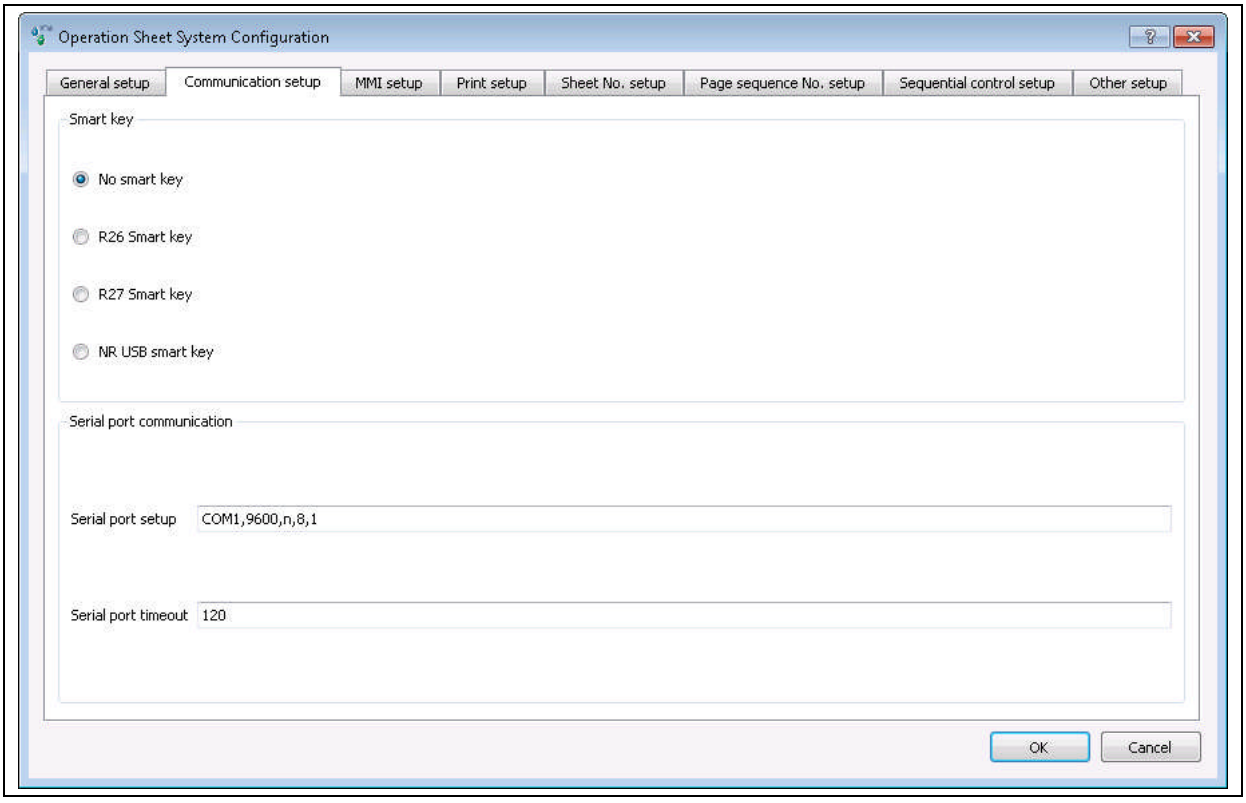


Figure 7.10-2 Communication setup

Table 7.10-2 Description of communication settings

Communication setting	Description
Smart key	Select if smart key is used or what type of smart key is used.

Communication setting	Description
	Smart keys of multiple series of multiple manufacturers are supported. According to configuration, smart key communication protocol is dynamically loaded. For example, Contron version 26 smart key and Contron version 27 smart key etc. Smart key communication message log is generated for analysis. Log path is directory pcs9700\deployment\log\wufang\SerialLog\.
Serial port communication	Set serial port No., communication rate, and timeout etc. for connection of smart key.

7.10.3 MMI Setup

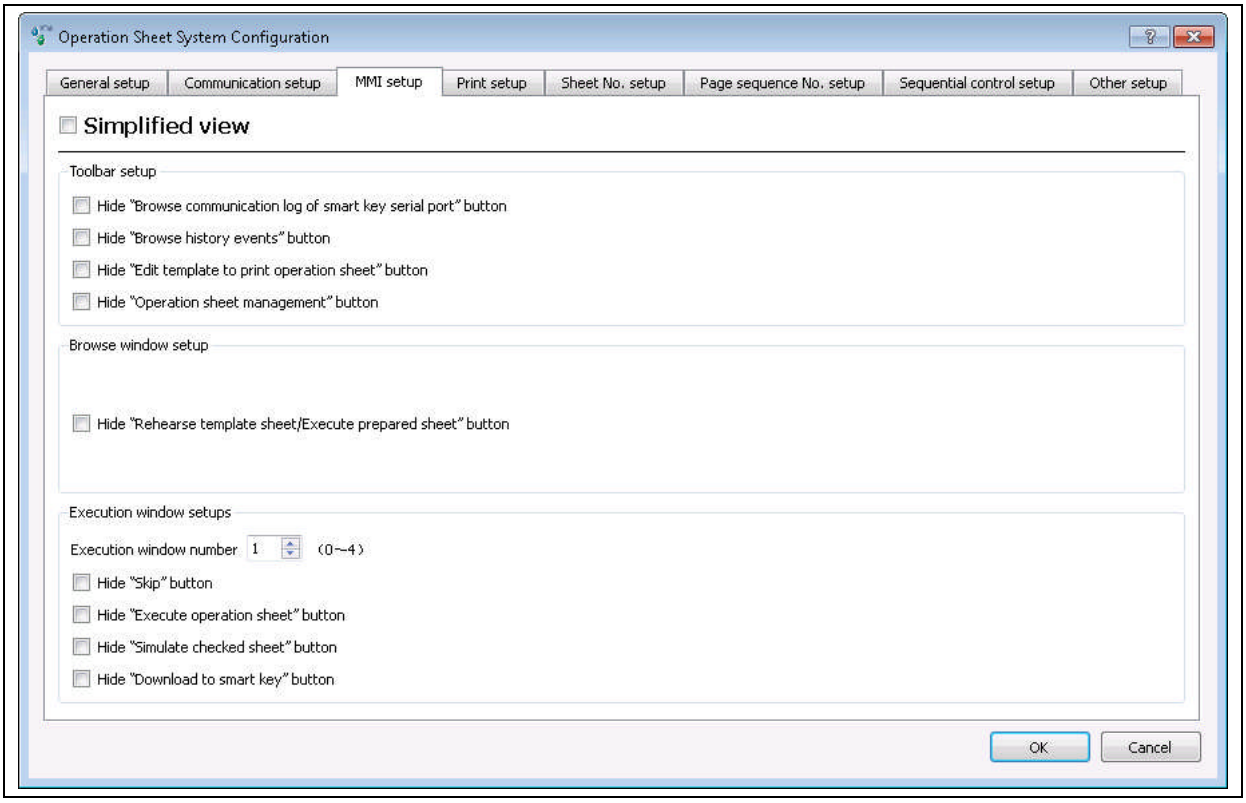


Figure 7.10-3 MMI setup

Table 7.10-3 Description of MMI settings

MMI setting	Description
Simplified view	If checked, all check boxes on this page will be checked. Sub check boxes can be only selected separately if 'Simplified view' is unchecked.
Execution window number	The operation sheet dock window can hide execution window (set number of windows to 0), or display 1~4 execution windows. Simultaneous execution of a number of operation sheets is permitted.

7.10.4 Print Setup

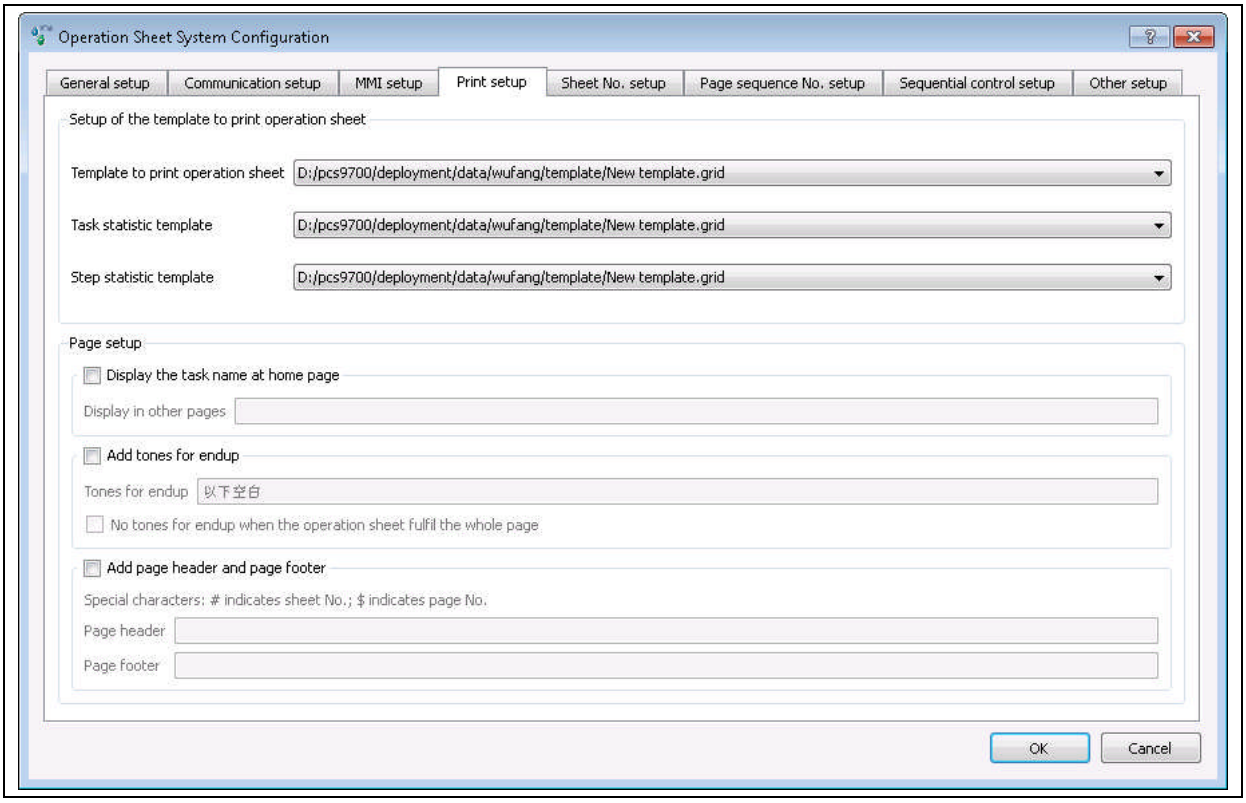


Figure 7.10-4 Print setup

Table 7.10-4 Description of print settings

Print setting	Description
Setup of the template to print operation sheet	Set default template to print operation sheet, task statistic template, and step statistic template
Display the task name at home page	If checked, when printing, foreground point “operation sheet task name” on the home page will show operation task, and this point on other pages will not show operation task. Content of “operation sheet task name” foreground point on other pages can be configured in the “display on other pages” editing box. If unchecked, foreground point “operation sheet task name” on each page will show operation task.
Add tones for endup	If checked, a line of tones for endup will be printed after the last line of operation step. Content of tones for endup can be configured.
No tones for endup when the operation sheet fulfill the whole page	If addition of tones for endup is checked, but operation steps fill a whole page, addition of tones for endup in a new page can be decided according to this option
Add page header and page footer	If checked, first line of operation procedure will be replaced by header and last line by footer. Special characters, e.g. “#” for sheet No. and “$” for page No. can be used to set header and footer.

7.10.5 Sheet No. Setup

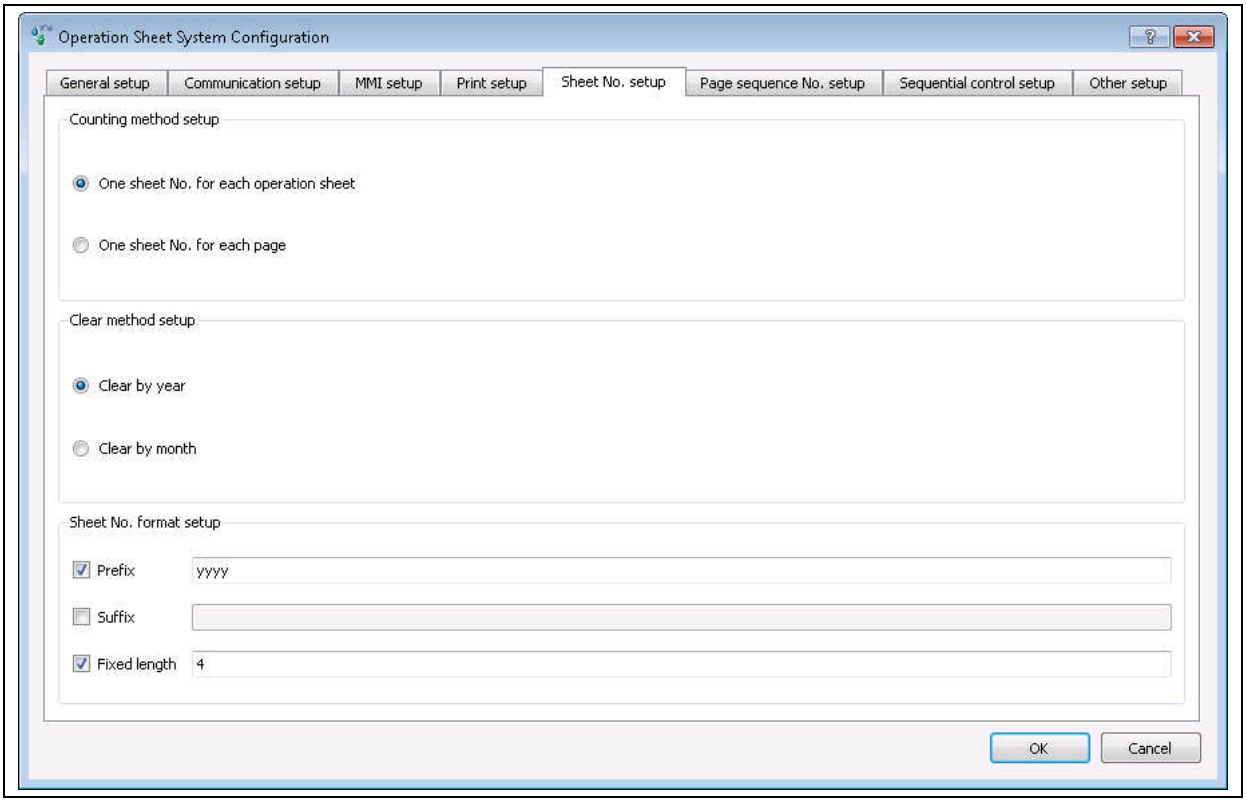


Figure 7.10-5 Sheet No. setup

Table 7.10-5 Description of sheet No. settings

Sheet No. setting	Description
Counting mode setup	One sheet No. for each sheet or for each page can be configured.
Clear method setup	Clear by year or clear by month can be configured.
Sheet No. format setup	Set format of sheet Nos.: addition of prefix and suffix, and if fixed length is used. For example, sheet No. is 18, generated on Sept.25, 2009. In self-defined format, prefix is yyyyMM and fixed length is 3. Therefore, printed sheet No. will be “200909018”. Prefix can be defined as an ordinary character string, e.g. “NR”, or date-time format.

The following expressions can be used in prefix of date type:

Table 7.10-6 Description of expressions

Expression	Output
d	Use numbers 1 to 31 to represent dates in a month. One digit dates have no leading zero.
dd	Use numbers 1 to 31 to represent dates in a month. One digit dates have leading zero.
ddd	Use abbreviations "Mon” ...”Sun” to represent weekdays.
dddd	Use full names "Monday”...”Sunday” to represent weekdays.
M	Use numbers 1 to 12 to represent months. One digit months have no leading zero.
MM	Use numbers 1 to 12 to represent months. One digit months have leading zero.

Expression	Output
MMM	Use abbreviations “Jan” ...”Dec” to represent months.
MMMM	Use full names "January”... ”December” to represent months.
yy	Use 2 digits to represent years. If a year has more than 2 digits, only lower 2 digits are used. If a year is less than 2 digits, add a leading zero (00-99).
yyyy	Use 4 digits to represent years. If a year has more than 4 digits, only lower 4 digits are used. If a year is less than 4 digits, add leading zero(s) to reach 4 digits (1752-8000).

7.10.6 Page Sequence Number Setup

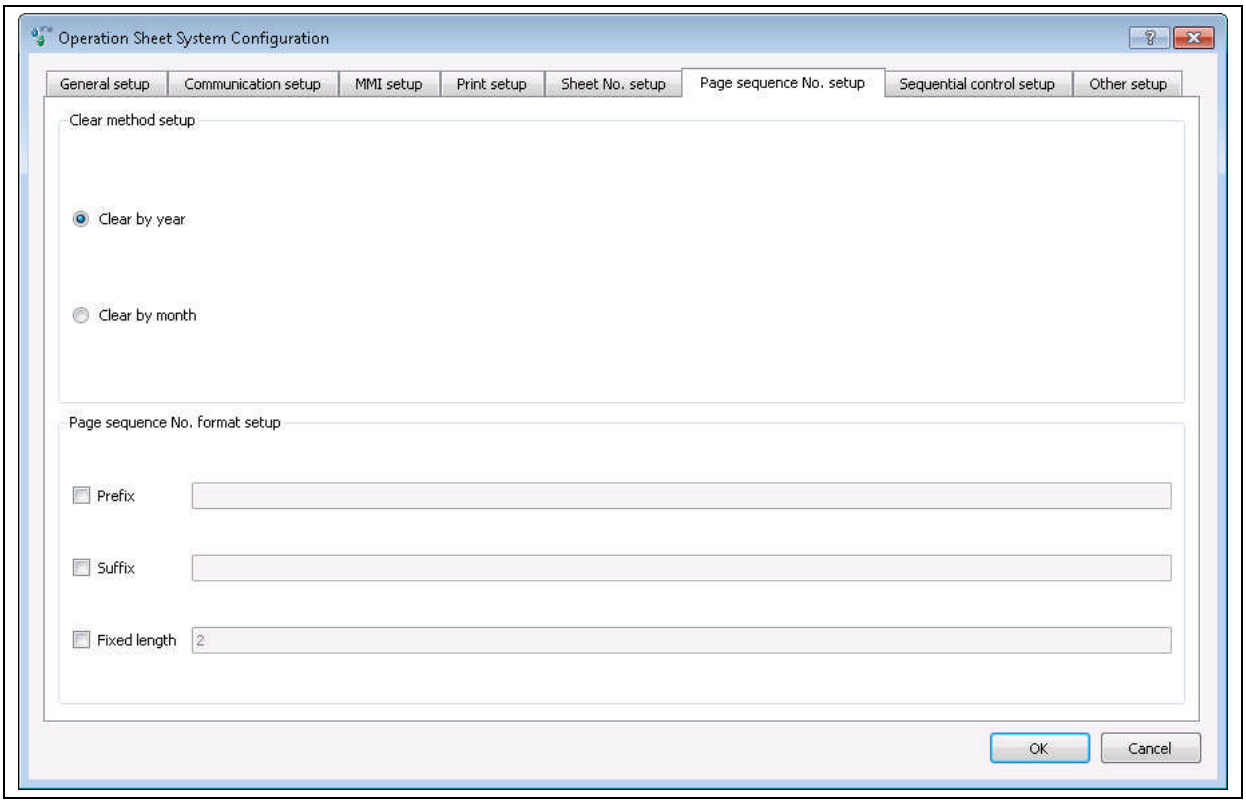


Figure 7.10-6 Page sequence number setup

Table 7.10-7 Description of page sequence number settings

Page sequence number setting	Description
Clear method setup	Clear by year or clear by month can be configured.
Page sequence number format setup	Set format of page sequence number: addition of prefix and suffix; if fixed length is used.

7.10.7 Sequential Control Setup

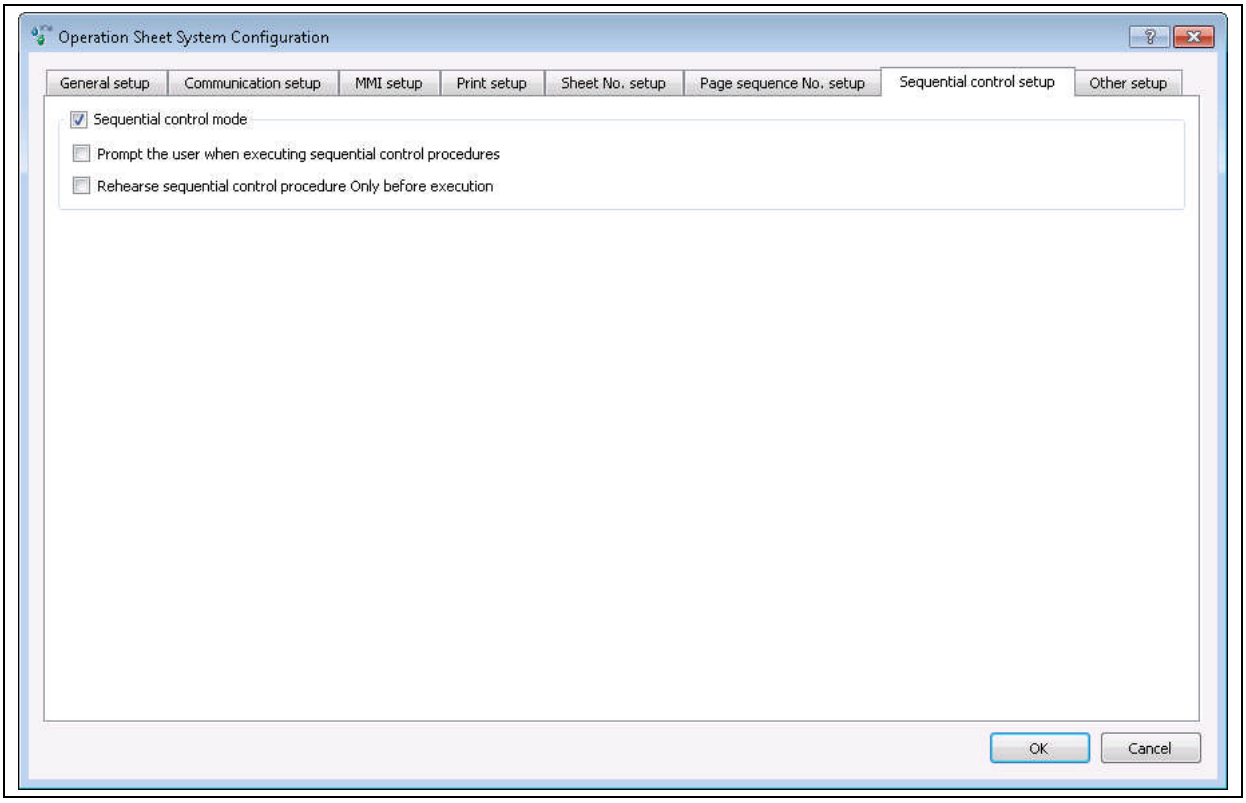


Figure 7.10-7 Sequential control setup

Table 7.10-8 Description of sequential control settings

Sequential control setting	Description
Sequential control mode	Determines if PCS operation sheet system adopts sequential control mode. If checked, sequential control procedure can be adopted to execute sequential control tasks.
Prompt user when executing sequential control procedure	If checked, when executing sequential control procedure, a dialog box will pop up to prompt user confirmation.
Rehearse sequential control procedure only before execution	If checked, sequential control procedure is only rehearsed before execution of operation sheet in the execution window; during simulation sheet creation, such procedure is not rehearsed and equipment status is directly set.

7.10.8 Other Settings

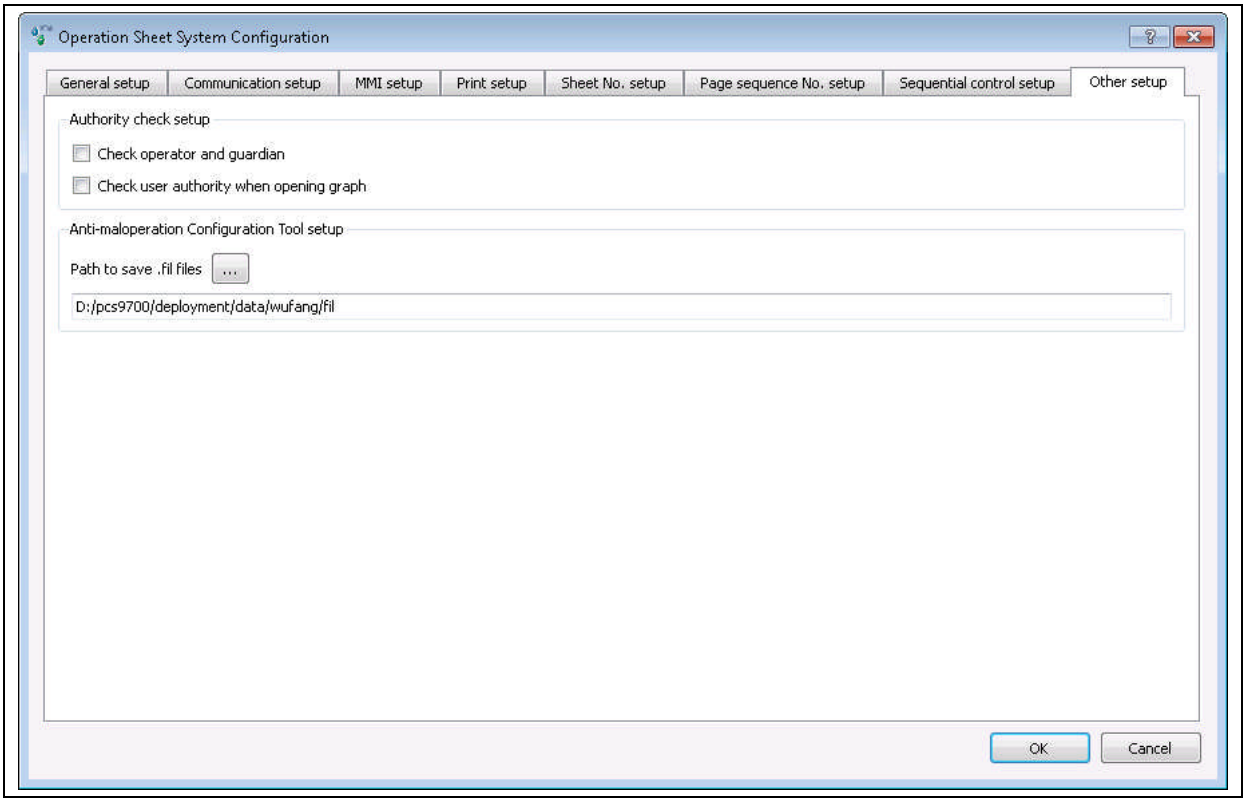


Figure 7.10-8 Other settings

Table 7.10-9 Description of other settings

Other setting	Description
Authority check setup	Check of operator and guardian during sheet creation can be configured. Set check of authorities when opening a graph.
Path to save .fil files	Set saving path for .fil files

Click the button at right side of .fil file saving path to pop up Browse folder dialog box as shown below:

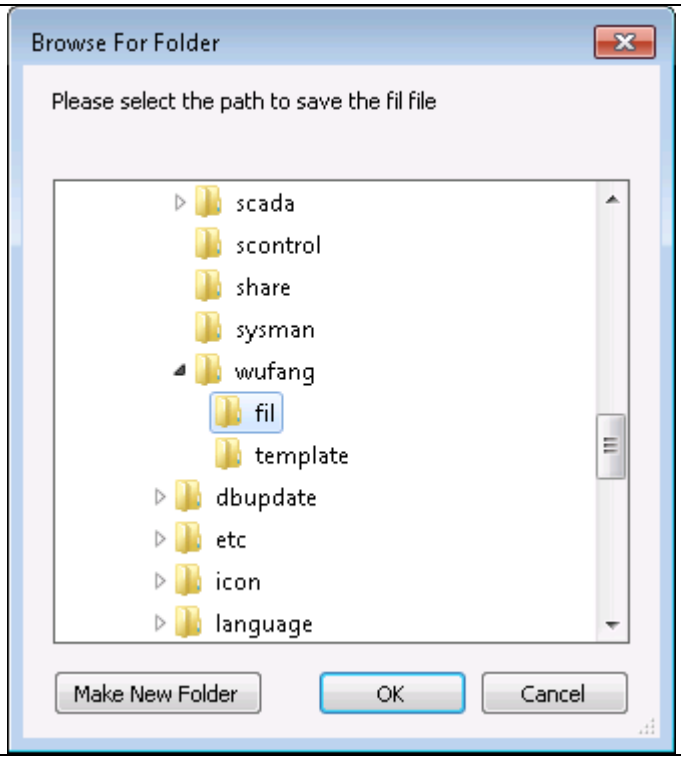


Figure 7.10-9 .fil file saving path selection dialog box

8 Post Disturbance Review(PDR)

8.1 General

The post disturbance review (PDR) function records operating conditions of power system during a relatively long period from before the event to after the event, to allow later truthful and easy analysis, study, or replay by operator. Post disturbance review and replay are used to reproduce conditions of the moment when an event happened.

8.2 Start PDR

PDR controller is the tool to control post disturbance review and replay. There are two methods to start this controller:

- Open command line terminal and enter **PDR Controller**. After carriage return, PDR controller will be started;
- On interface manager, start PDR controller from the Start menu.

8.3 PDR Controller Main Interface

After PDR controller is started, main interface is shown as below:

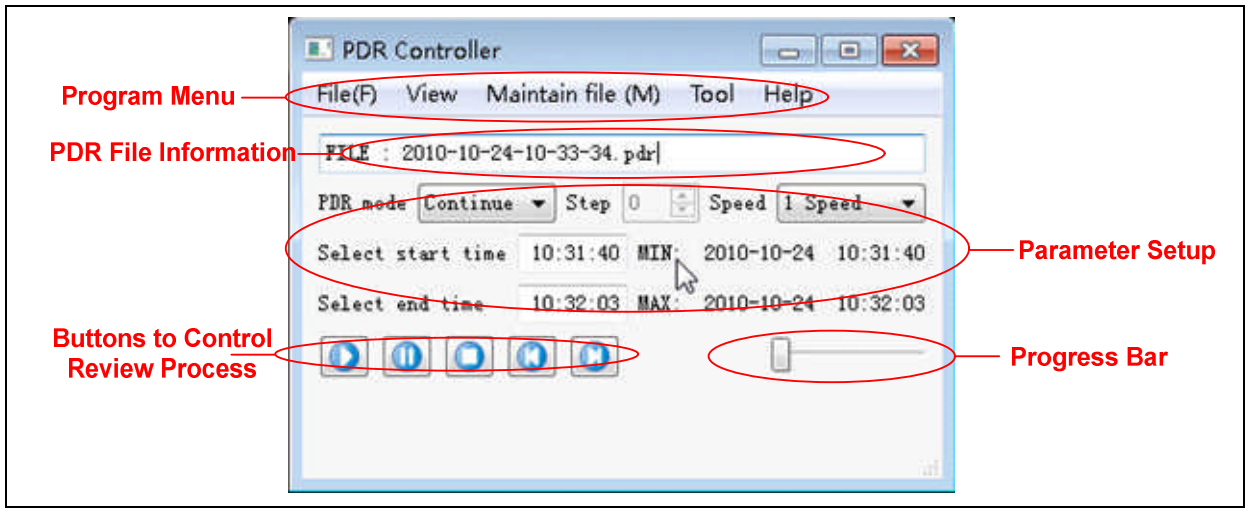


Figure 8.3-1 PDR main interface

1) Menus

File menu

- Open file: pop up PDR files list window for selection. If this node has no PDR file, the controller will find such file on other computer nodes of the same site, and copy PDR files found to local node for replay.

- Exit: exit PDR controller.

View menu

- Open: open PDR view, including PDR alarm monitoring window and PDR main graphic

Maintain file menu

- PDR File Maintain: used to clear PDR files no longer used, as shown below:

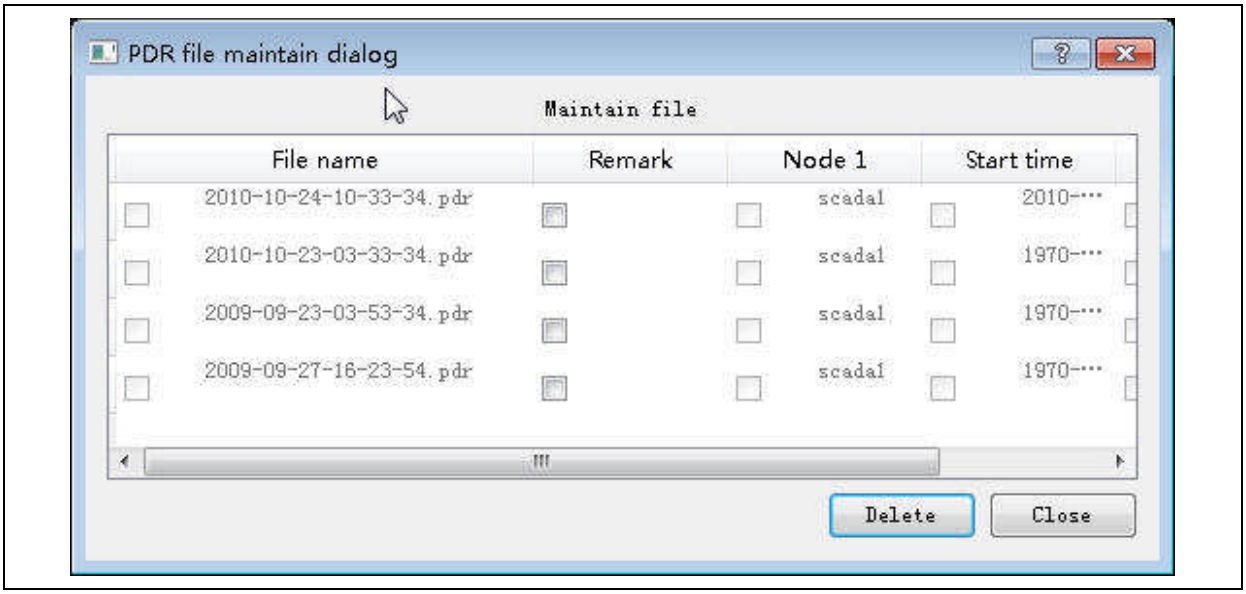


Figure 8.3-2 PDR file maintain dialog box

Tool menu

- Hide: hide PDR tools interface
- Event: pop up event searching dialog box as shown below:

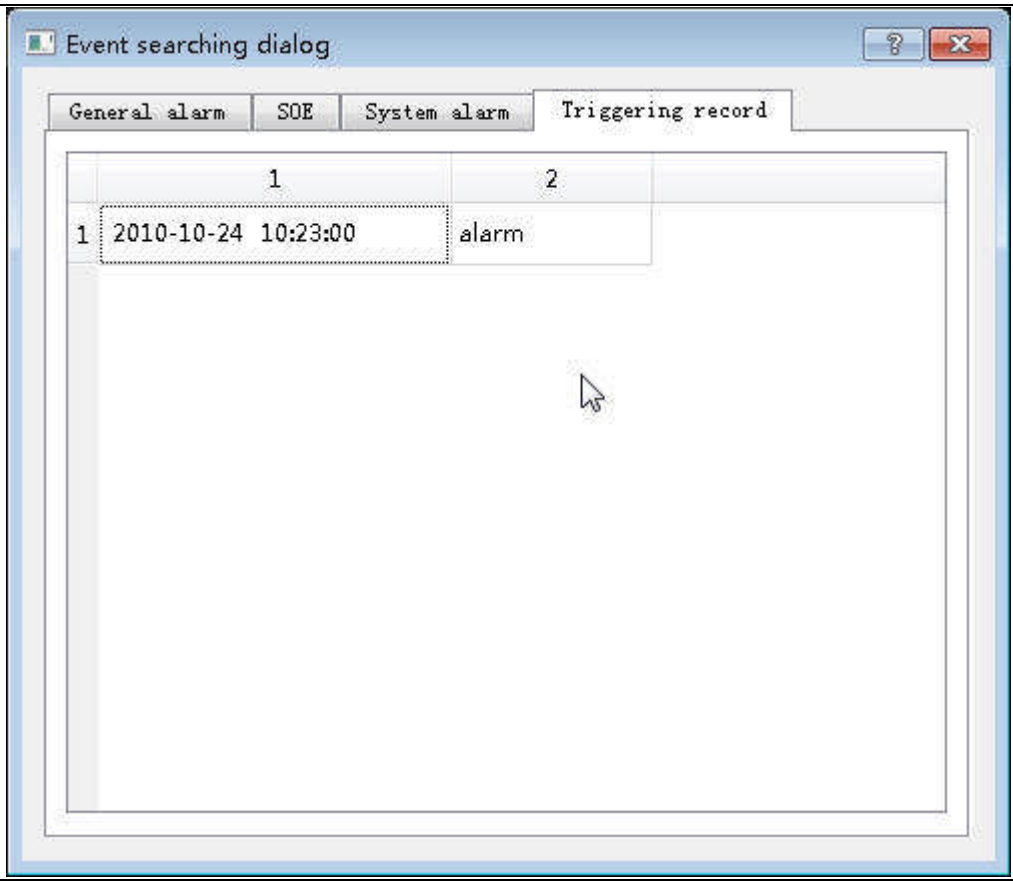


Figure 8.3-3 Event searching dialog box

2) PDR file information

This bar displays information related to the PDR file currently selected.

3) Replay parameters setup

There are two replay modes: continuous and single step

If “continuous” is selected, replay will be automatic.

If single step is selected, user also needs to set step length. Replay in single step mode can be controlled manually. Each time “Start” button is clicked, replay will move forward for a period of unit step length.

Replay mode can be switched even during replay process.

4) Control of replay process

Replay process control tools bar (from left to right): “Start”, “Pause”, “Stop”, “Back”, and “Forward”.

5) Progress bar

Display progress of replay; user can drag this bar to a certain time point.

8.4 Use of PDR Controller

1） First, click button “Open file” to pop up PDR file selection dialog box as shown below. Select the PDR file (files with suffix .pdr) to be replayed.

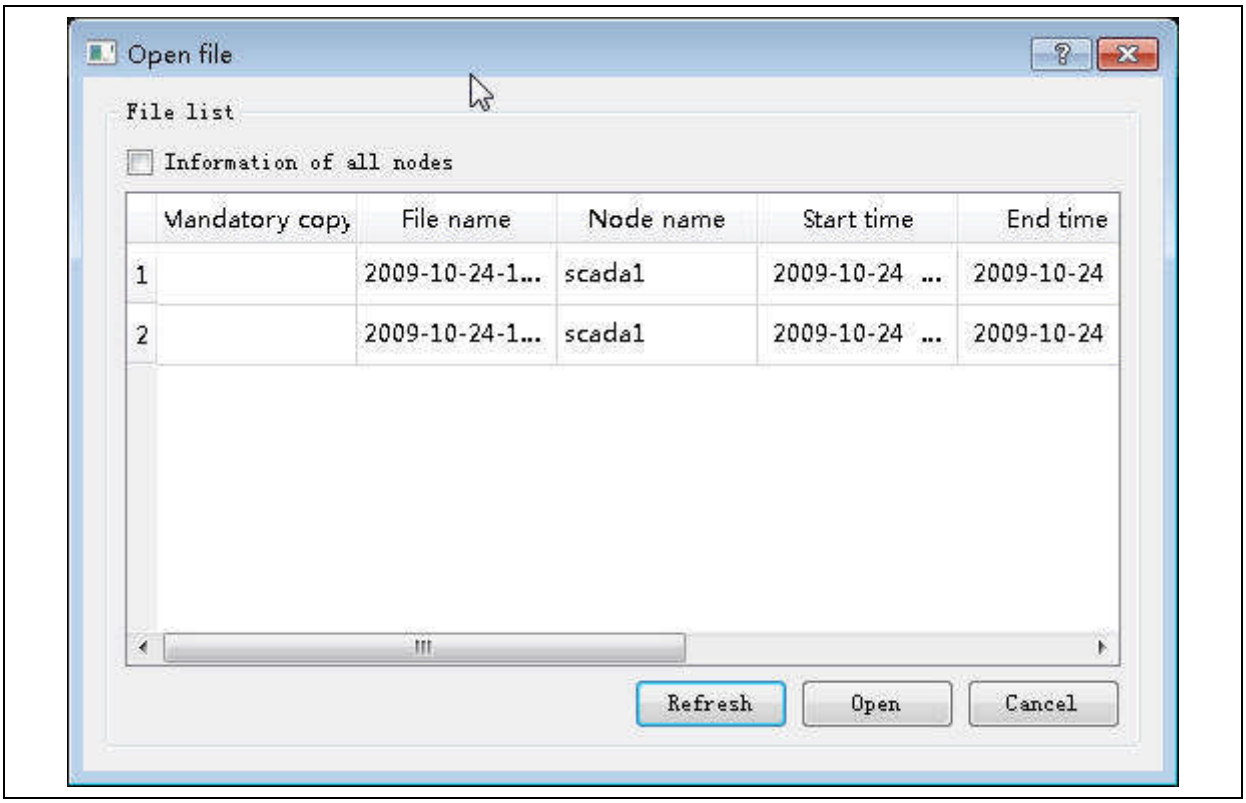


Figure 8.4-1 Open file dialog box

Click and open a PDR file. Please wait while replay environment is being prepared, this may last a few seconds.

2） After preparation of replay environment is finished, information of current file will be shown on controller main interface, and each parameter setting and the replay control button will be activated, as shown in *Figure 8.3-1* efore start of replay, user can select replay mode and speed. For single step mode, user still needs to set single step length. After setting these parameters, user can start replay.

3） From menu “File”→“Open” to pop up PDR alarm monitor and PDR graphic main table of contents. Then, click button “Start” to start replay.

4） If current replay mode is continuous, replay will be automatic. In single step mode, user needs to constantly click “Start” button. Each time this button is clicked, replay will progress by step length of one unit.

5） During replay, replay mode, single step length, and replay speed can all be switched and adjusted as requested. User can also use buttons Pause, Stop, and Fast Forward etc. to control replay.

6） If user needs to directly jump to a time point, or move backward in replay, user can drag the progress bar to a position and then release the mouse. After short environment preparation, event replay will resume from current position of progress bar.

7） During replay, user can view alarms in the PDR alarm monitor window. User can also view status of each object on PDR graphic.

At end of replay, user can select another PDR file and start a new replay process.

8.5 Hide PDR Controller and Exit PDR Controller

On the controller main interface, use menu “Tools”→“Hide” to temporarily hide PDR controller. To display this window again, click button “Lift PDR” in “Command buttons zone” of the interface manager to lift PDR controller.

When finished, user can simply close the PDR controller. This will close all PDR replay windows at the same time, including PDR alarm monitor and PDR graphic.

9 Sequential Control

9.1 General

To adapt to very fast development of grid and increase labor productivity, many unattended automatic substations have been put into operation. At present, electrical operation mode generally adopted by conventional substations is still step-by-step key-controlled operations. Most operations still need to be implemented by operator at substation site, wasting much labor and time, and compromising the advantage of “personnel reduction and efficiency increase” of unattended substation. On the other hand, with increase of substation operation density, during switching operation, extent of manual intervention is too high, bringing ever greater pressure on operators. Expansion of grid coverage and frequent capital construction greatly increase operation work quantities, and also increase safety risk of operation; this in turn increases probability of incorrect switching to some extent, thus affecting grid safe operation level.

The sequential control of substation proposed by us breaks traditional operation mode and adopts sequential switching operations to avoid human errors during operations as much as possible, reduce or eliminate manual operations, and increase operation efficiency, thus provide a completely new way to realize true unattended operation, solve the contradiction of less personnel and more substations, and raise substation safe operation level.

9.2 Sequential Control Modules

The sequential control module mainly includes the following definition and configuration modules and operation interface modules:

1） Equipment status editor module

2） Sequential control editor module

3） Sequential control server module

4） Graph sequential control editor and online operation module

5） Anti-maloperation sequential control integrated sheet creating module

The following describes each module and its method of use.

9.3 Equipment status editor

9.3.1 Brief Introduction

9.3.1.1 The Concept of Equipment Status Editor

Equipment status editor adopts drawing mode to generate bay equipment status in substation

system. This both meets requirements by new generation integrated automation discipline configuration, and achieves the effect of integrated editing of graphs and models.

Equipment status is generated completely by graph mode. In the process of drawing, basic objects of equipment status can be defined, edited, and modified. For example, user can double click a primitive of an equipment status, and in the dialog box popped up, modify its attributes, create, delete or associate actual data objects, or enter type data that require automatic association, matching, and finding.

Equipment status editor mainly includes two operations: generation of equipment status and association of bay equipment status. To use this tool, just right click mouse and in the menu popped up, select generation of equipment status, generation of bay equipment status association, or modification or deletion of bay equipment status.

9.3.1.2 Editing Equipment Status

Editing of equipment status mainly performs the following work:

Definition and generation of contents of equipment status, or suitable addition, deletion, and modification of such contents.

All equipment status contents are defined and generated in the graph editor. Template graphs generated by the graph editor can be inquired in the equipment status tree type list at left side.

In the equipment status maintenance tool, both equipment status and bay equipment status adopt the structure of hierarchy plus relation. Hierarchy is reflected in equipment status group access levels: system equipment status group is defined at 3 levels: substation definition, equipment status group definition, and equipment status definition. The relation type structure of bay equipment status is reflected in that bay equipment and equipment status group in the system are associated, for example, a bay in the system can be associated with an equipment status group.

Equipment status maintenance tool includes various primitives such as line, transformer, circuit breaker/switch, capacitor-reactor, generator\motor, bus, BI, measurement, and telecontrol etc., consistent with objects defined in the system. Definition of a few equipment status relevant primitives has been added to satisfy definition of equipment status and bay equipment status.

A graph includes two types of primitives: background primitives and foreground primitives. When being defined, background primitives do not affect equipment statuses or equipment status definitions, e.g. line segments, characters, and bit maps in graph are background primitives. Foreground primitives mainly refer to data foreground primitives. According to needs by equipment status editor, data foreground primitives can represent actual data objects or type data objects associated to and matched with current template.

The graph editor provides convenient editing functions. Use of graphs to define equipment statuses features high efficiency, concise and straightforward viewing of equipment status, and easy and fast drawing.

9.3.1.3 Generation of Association of Bay Equipment status

The bay equipment status association mainly performs the following work:

- Select or clear association of bay equipment status group
- Upload or download bay equipment status definition file
- Check version and contents of bay equipment status definition file
- View each equipment status definition graph file under a bay.

9.3.1.4 Start Equipment Status Editor

There are two methods to start substation equipment status editor.

Method 1: run executable program devstaeditor at command terminal.

Figure 9.3-1 Start equipment status editor (method 1)

Method 2: activate RCS console program and then select "Start"→"Maintenance tool"→ "Equipment status editor". User login dialog will pop up. User need to enter a password. If user has no authority or incorrect password is entered, the system will refuse login.

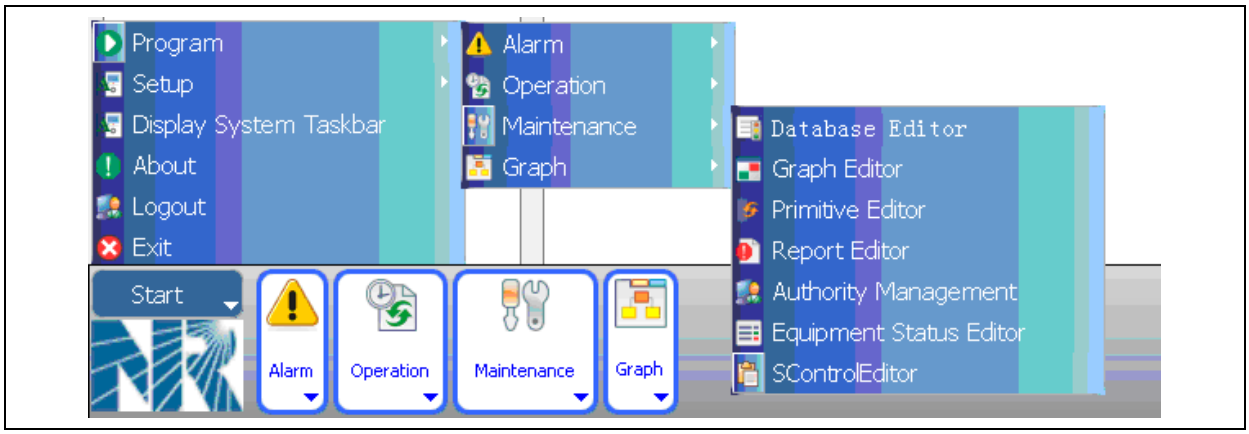


Figure 9.3-2 Start equipment status editor (method 2)

After successful login, equipment status editor main interface is shown as below:

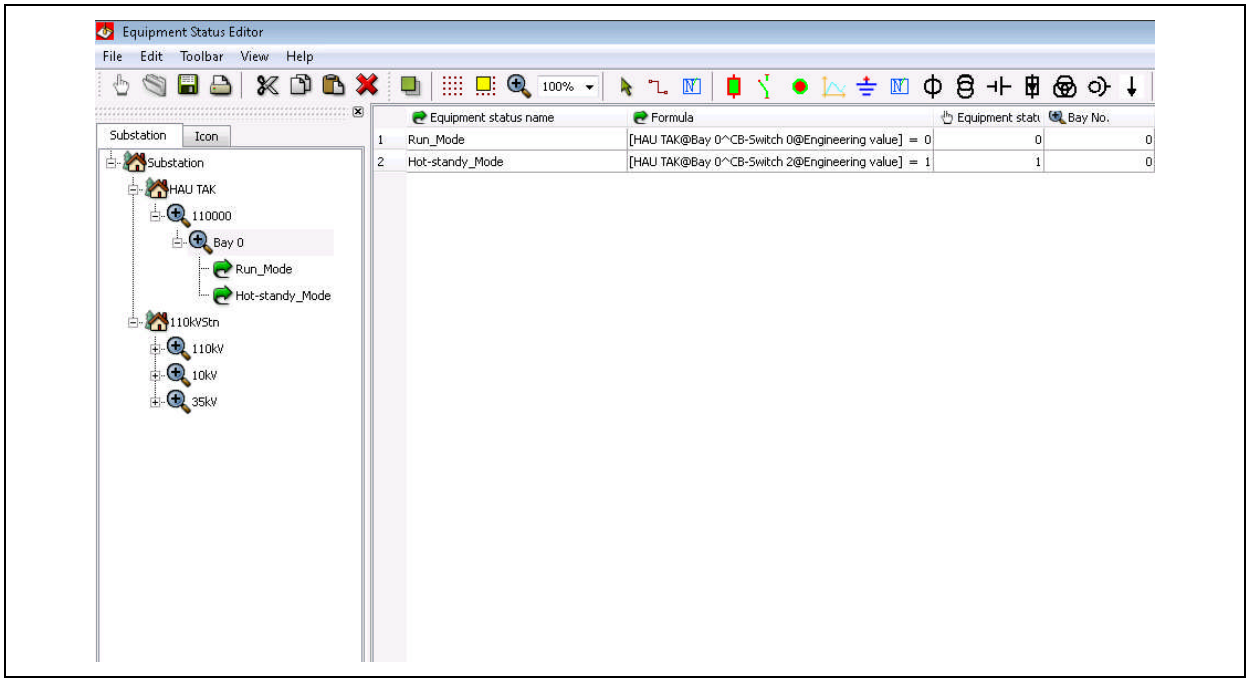


Figure 9.3-3 Equipment status editor main interface

Title bar: located at topmost of the window and displays name of equipment status editor.

Status bar: located at bottom-most of the window and displays various status messages.

Menu bar: located below the title bar and displays main menus of substation equipment status editor.

Tools bars: normally located below the Menu bar or above the Status bar. The Tools bars include some common tools. Without using menu commands, user can directly click tool buttons on a Tools bar to execute corresponding operations. Tools bar can appear at any of the 4 sides of the window, e.g. Edit tools bar and Font tools bar, or float in the window, e.g. Drawing tools bar.

Tree type list: display substation node list upon initialization and startup. User can click to switch to equipment status list under substation list and bay list. By double clicking and context menu operations, user can add, delete, and modify equipment statuses and bay equipment statuses.

9.3.2 Tools Bars Operations

Equipment status editor includes the following tools bars: system basic tools bar, system expanded tools bar, basic drawing tools bar, common graph editing tools bar, zoom tools bar, grid tools bar, line form processing tools bar, window tools bar, and equipment status definition primitives tools bar.

Some tools in tools bars have corresponding menu items, e.g. system basic tools bar and common graph editing tools bar. By means of menu item operations, the same functions can be performed, but use of tools bars can accelerate operations.

A tools bar can be placed at any position on any of the 4 sides of the graph editor main window, or become floating. In default, graph editor tools bars are mainly placed at upper and lower positions of the screen.

9.3.2.1 System Basic Tools Bar

Save: save modified equipment status definition into the database. If equipment status model has been modified, associated bay equipment statuses will be forced updated, with equipment status updating progress bar appeared.

9.3.2.2 System Expanded Equipment status Definition Tools Bar

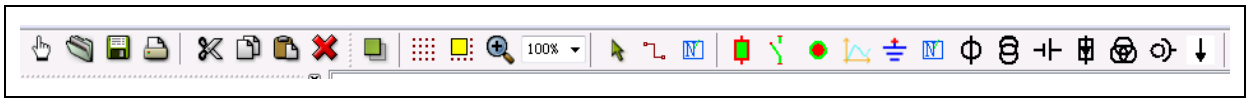


Figure 9.3-4 Equipment status definition tools bar

This tools bar includes relevant equipment primitives required for definition of equipment status, e.g. circuit breaker, switch, line, and capacitor-reactor etc.

9.3.2.3 Basic Icons Tools Bar

Connecting line: used for connections among graph components

Earthing node: used for earthing

Label: add a label to graph component

9.3.2.4 Basic Operations Tools Bar

Select mode: select this button to switch current graph operation to **Select** mode. At this time, user can move mouse to the graph editing window, and click to select a component. After a component is selected, a blue handle will appear around it. By dragging this handle, user can change dimensions or shape of the selected object. Selected component can be moved, deleted, or have its attributes modified. Besides, user can select a number of graph components at the same time. There are two methods: first, press and hold SHIFT key, and use mouse to select these objects one by one; second, press and drag left mouse key to generate a stretching rectangle that moves with the mouse. When the mouse is released, all primitives inside this rectangle will be selected at the same time. During editing operations of graphs, many functions are preformed in such selected status. Therefore, to realize these functions, user must first set this button to “Selected”.

9.3.2.5 Common Graph Editing Tools Bar

Cut: copy currently selected primitive to clipboard and delete it from the graph.

Copy: copy currently selected primitive to the clipboard.

 Paste: copy the primitive in clipboard to current graph.

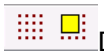
 Delete: delete currently selected primitive from the graph.

9.3.2.6 Zoom Tools Bar

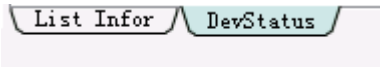
 Amplify by one step: amplify the graph currently being edited by 25%

 Self-defined zoom: zoom the graph currently being edited by a proportion entered

9.3.2.7 Grid Tools Bar

 Display in grid: set display of grid lines or not in current graph editing window

9.3.2.8 Status Bar



The status bar mainly displays contents of current graph editing window.

9.3.2.9 View Equipment Status Attributes

In “Set equipment status attributes” interface, user can view name of equipment status.

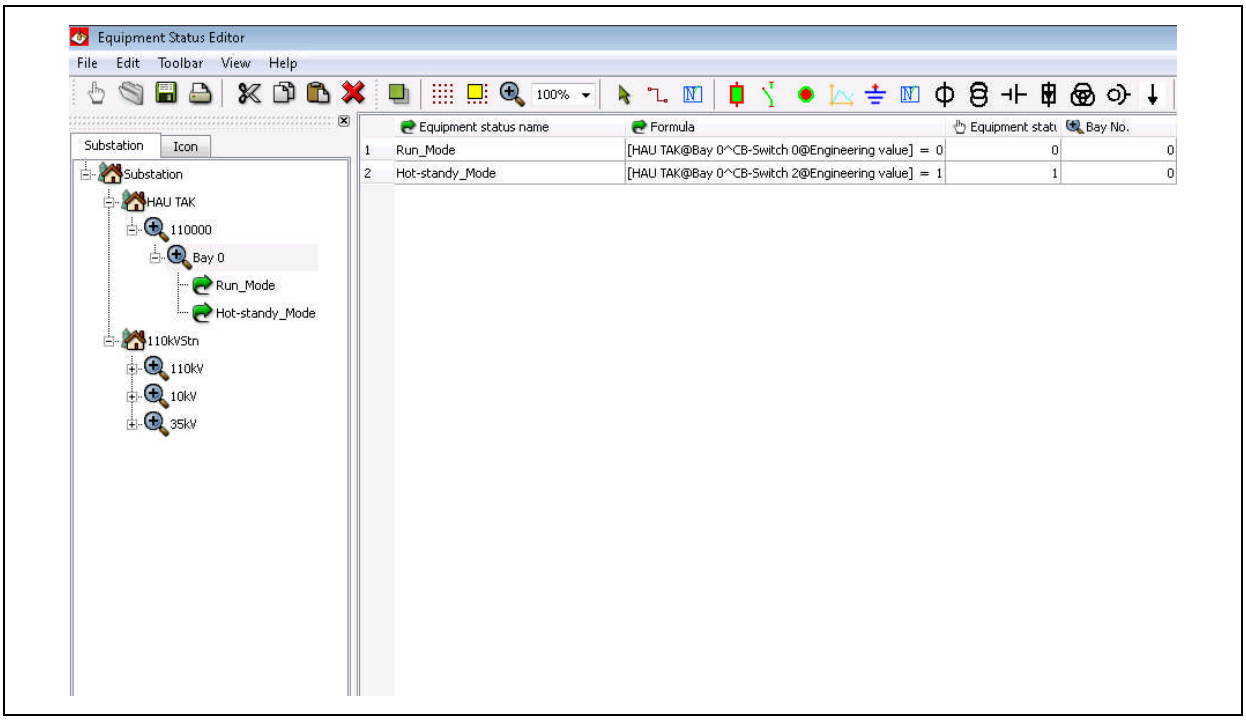


Figure 9.3-5 Equipment status attributes page

9.3.2.10 Primitive Attributes Editing Window

The primitive attributes window is used to display and modify attribute parameters of each graph component on the graph——i.e. primitive parameters. Select and double click a component, the system will pop up attributes setup dialog box of this primitive. This dialog box provides various attributes of the component in Tabs. Click different Tab page to set each attribute of the component.

1) Measuring Point Data Source Selection Attribute

Definition of measurement data: in the tools bar, click to select a measurement primitive  , to draw a measurement point in the Equipment Status Editor. Double click this primitive to pop up Edit Attribute window, as shown below.

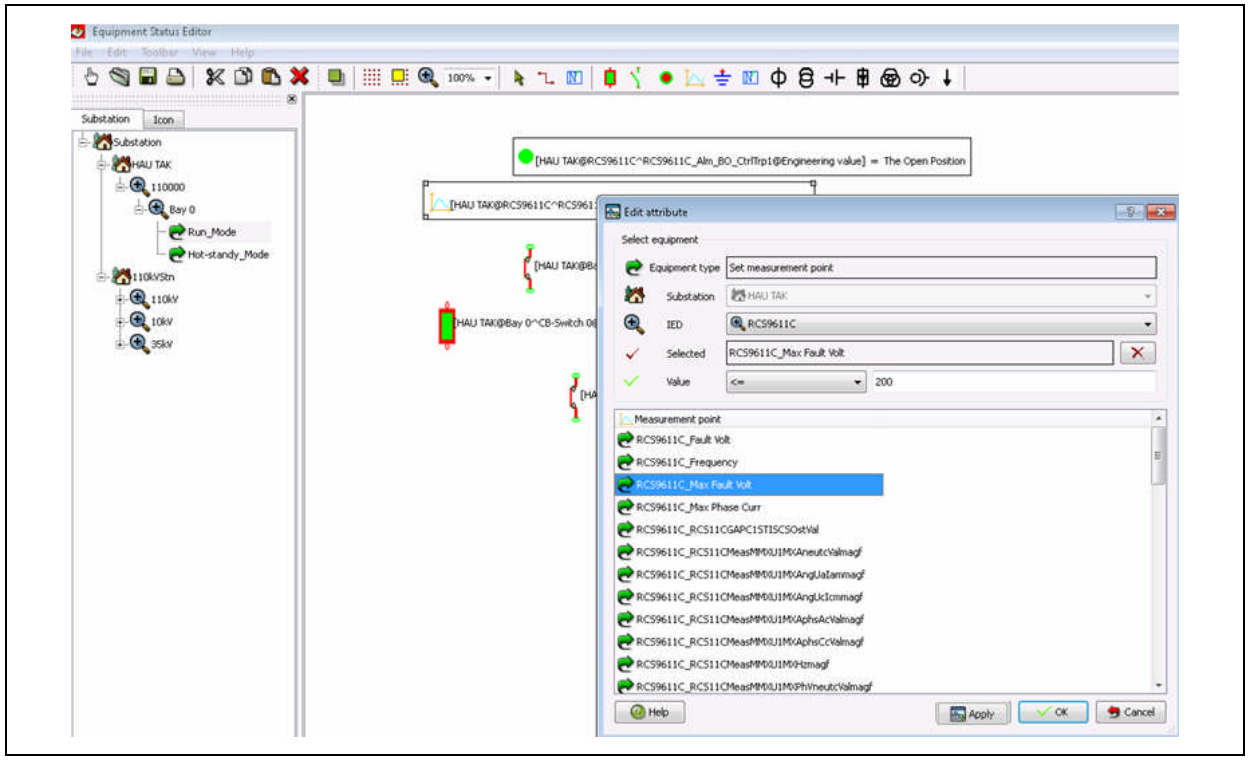
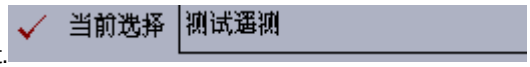


Figure 9.3-6 Edit attributes of measurement data source

Table 9.3-1 Description of measurement data attributes definition items

Attribute	Description
Equipment type	Display type of current measuring point — measurement
Substation	Display name of current substation
IED	When data type is “actual object”, use IED to search relevant measuring point.
Selected	Selected measuring point
Value	Value of selected measuring point is equal to, larger than, or smaller than a floating value
	Delete selected measuring point

Measuring point	When type of data is “actual object”, this list displays all measuring points under some bay. User can select “Selected” from this list. 

Definition of BI data: in the tools bar, click to select BI primitive  to draw a BI point in the Equipment Status Editor. Double click this primitive to pop up the Edit Attribute window as shown below.

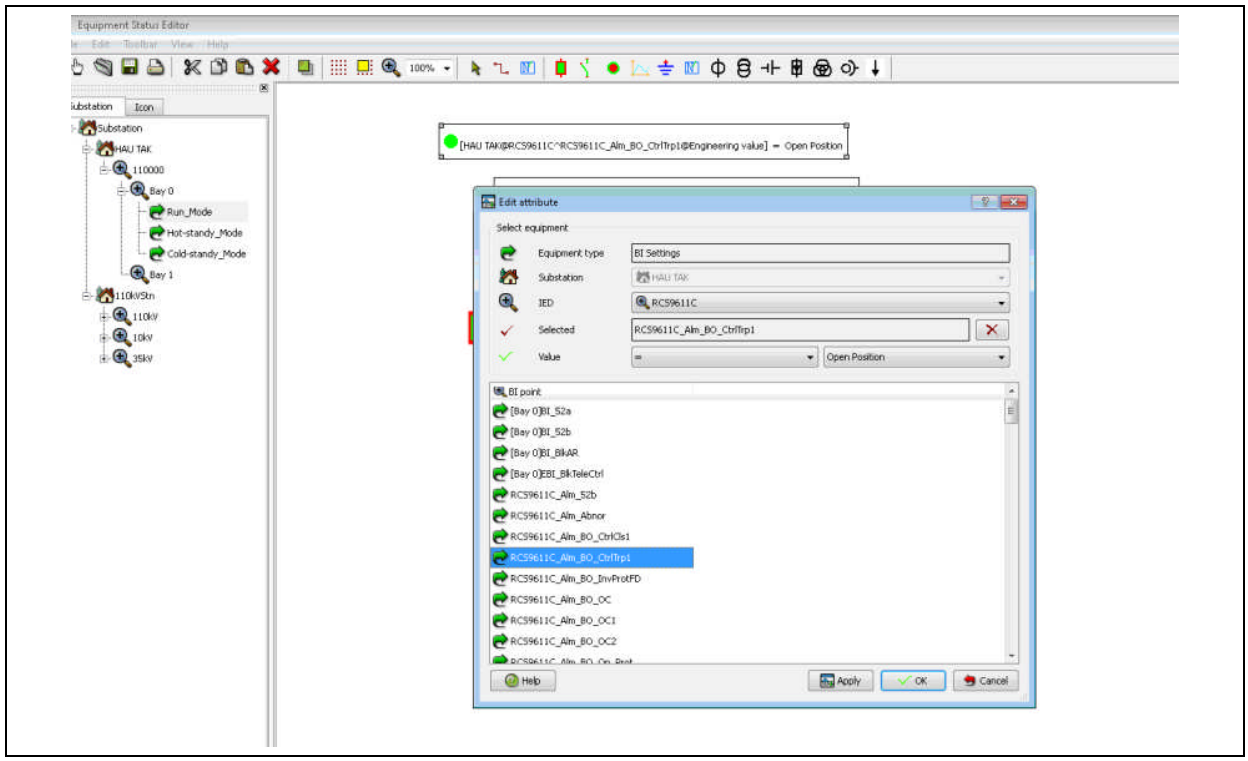


Figure 9.3-7 Edit attributes of BI data source

Table 9.3-2 Description of BI data attributes definition items

Attribute	Description
Equipment type	Display type of current measuring point — BI
Substation	Display name of current substation
IED	When data type is “actual object”, use IED to search relevant measuring point.
Selected	Selected measuring point
Value	If status of selected measuring point is “close position” or “open position”
	Delete selected measuring point
BI list	When type of data is “actual object”, this list displays all measuring points under some bay. User can select “Selected” from this list.

2) Equipment Data Source Selection attribute

Only primitives “switch” and “circuit breaker” have “equipment data source selection” attribute.

In the tools bar, click to select switch primitive  or circuit breaker primitive  . In the Equipment Status Editor, draw a circuit breaker or switch. Double click this primitive to pop up Edit Attribute window, as shown below.

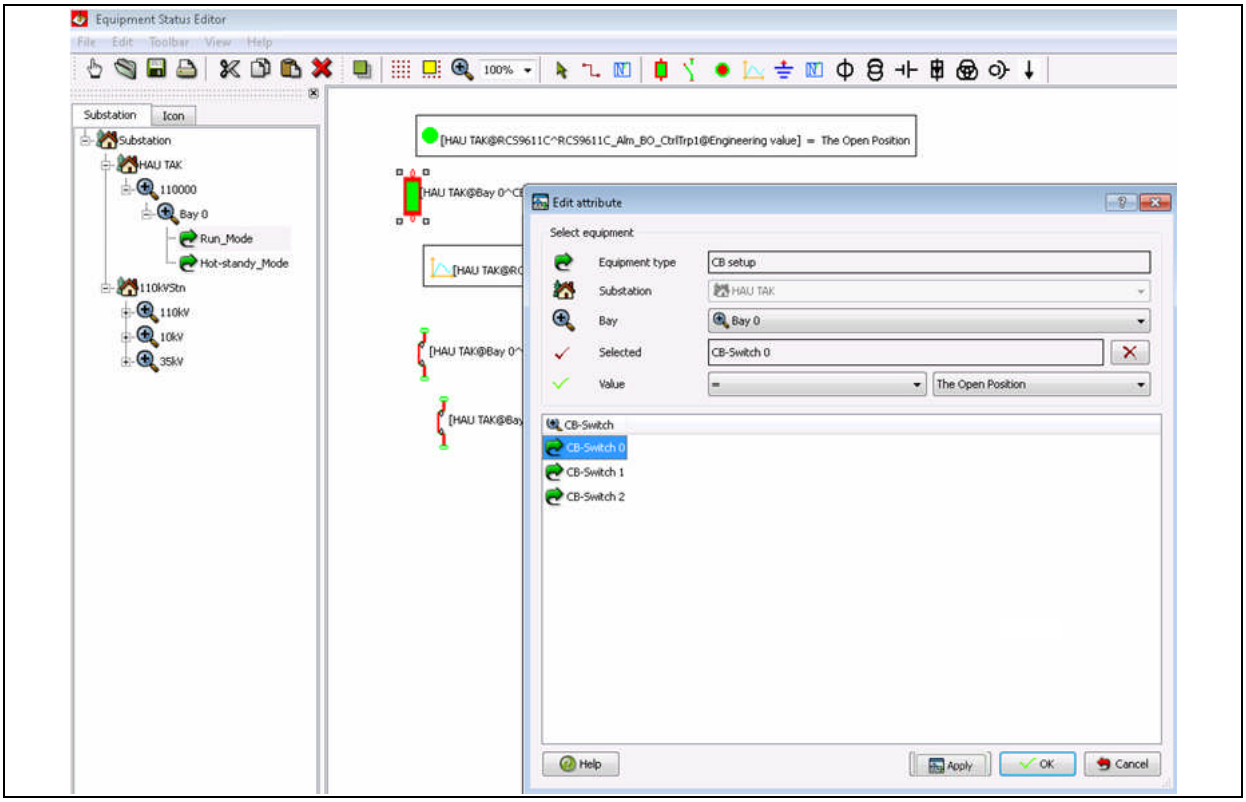


Figure 9.3-8 Edit attribute of "switch" and "circuit breaker" data sources

Table 9.3-3 Description of equipment data attribute definitions

Attribute	Description
Type of measuring point	Display type of current measuring point — circuit breaker or switch
Substation	Display name of current substation
Bay	When type of data is "actual object", bay can be used to search relevant circuit breaker or switch
Selected	Selected measuring point
Value	Selected equipment status is "close position" or "open position"
	Delete selected circuit breaker/switch
CB-switch	When type of data is "actual object", this list displays all circuit breakers/switches under some bay. User can select "Selected" from this list.

9.3.3 System Menu Operations

In addition to menus, this chapter also introduces method to use shortcut keys. Some menu items correspond to shortcut keys, the use of which can eliminate 2-step operation (open menu and then

select menu item). On the keyboard, one key stroke can complete corresponding operation, thus accelerating drawing. In the menus, many functions have the same functions as buttons on tools bars, this chapter will not discuss them again.

9.3.3.1 File Menu

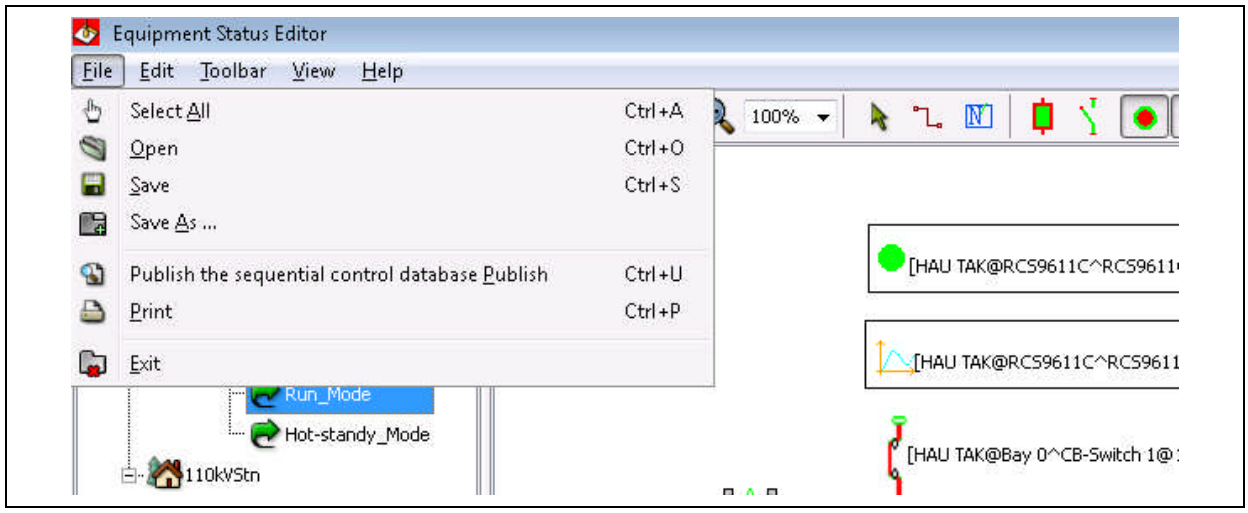


Figure 9.3-9 File menu

Table 9.3-4 Description of File menu items

Menu item	Description
Select All	Select all primitive objects on Equipment Status Editor
Open	Open any equipment status graph file
Save	User saves modified data after modification
Save As	Save current equipment status definition graph in other name/directory
Publish the sequential control database	Publish sequential control database; system will pop up a dialog box to prompt user results of publishing
Exit	Exit the system. If user has not saved the file after modification, when exiting, the system will prompt user: “Editing of sequential control has modified some data! Save modification?”

9.3.3.2 Edit Menu

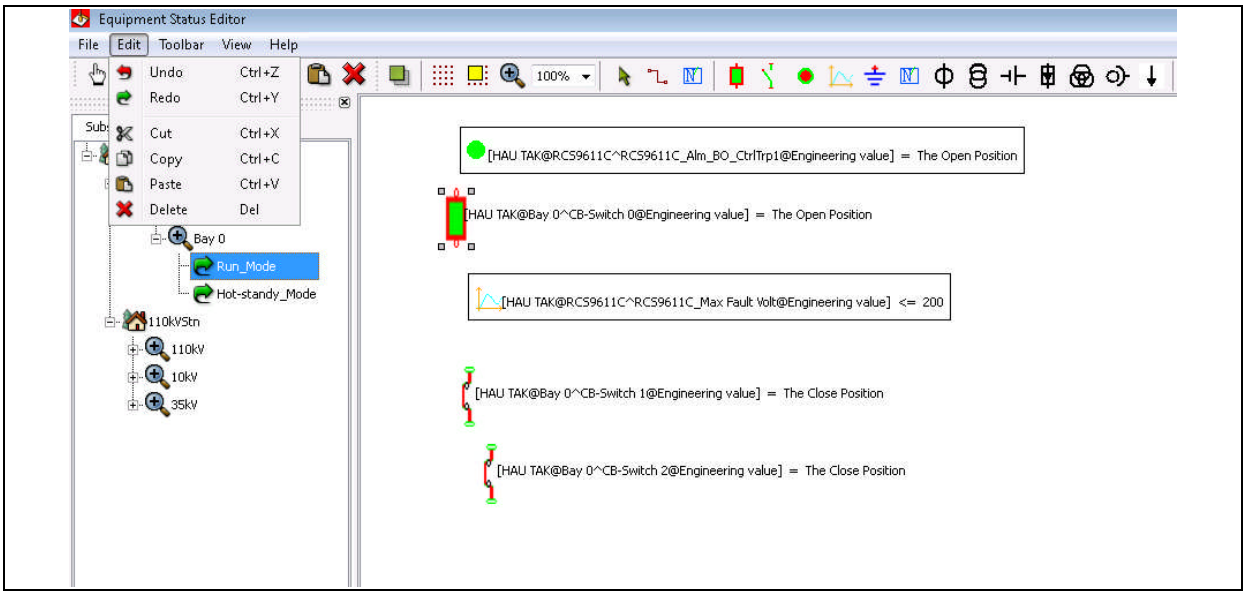


Figure 9.3-10 Edit menu

Table 9.3-5 Description of Edit menu items

Menu item	Description	Shortcut
Cut	Copy a primitive to clipboard and delete it from the graph	Ctrl+X
Copy	Copy primitive to clipboard	Ctrl+C
Paste	Copy primitive in clipboard to the graph	Ctrl+V
Delete	Delete currently selected primitive from the graph	Delete

9.3.3.3 View Menu

Table 9.3-6 Description of View menu items

Menu item	Description
View	Display/hide substation view list at left side; displayed in default
Abnormal information	Open/close abnormal information window; hidden in default

9.3.4 Tree Type List

9.3.4.1 Brief Introduction to Model of Substation Tree Type List

Substation equipment status list is mainly used to view equipment statuses under a bay, as shown below.

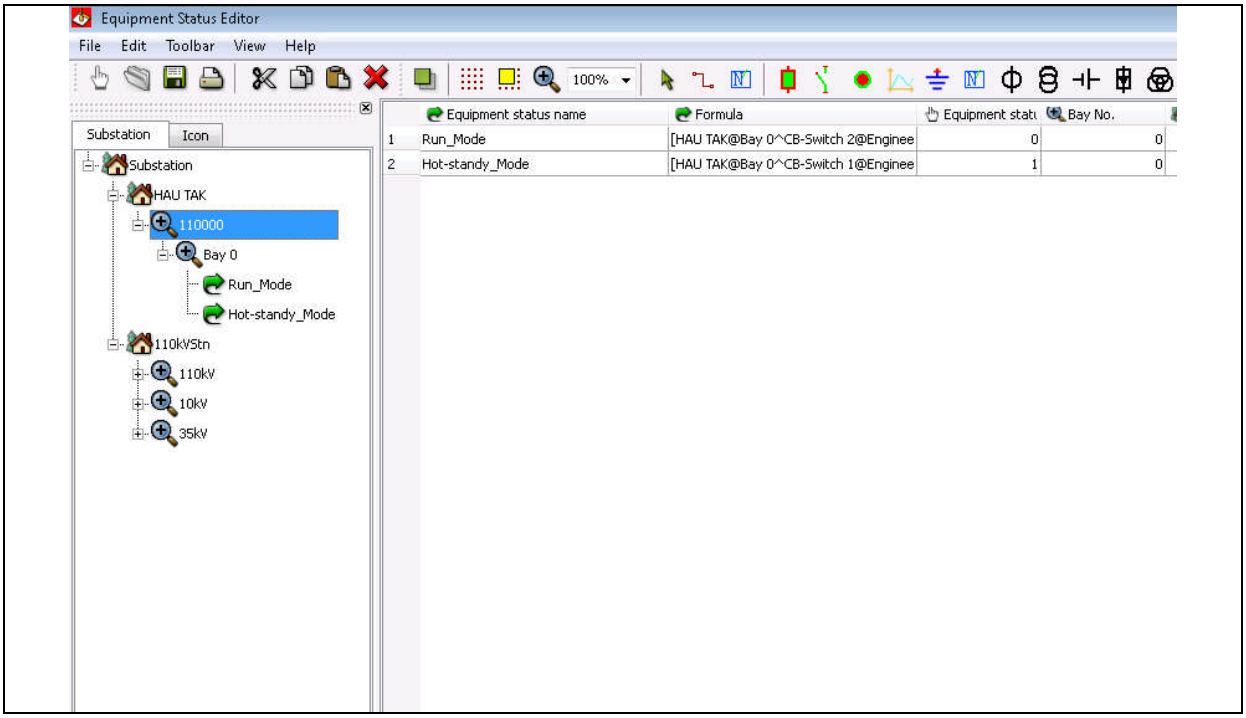


Figure 9.3-11 Substation equipment status list

When Equipment Status Editor is in Edit equipment status graph, click “+/-” before a node can expand or fold display of sub-nodes. Double click a node can open corresponding equipment status graph.

9.3.4.2 Menu and Operations Relevant to Equipment status List

The equipment status list menu is mainly used to display and operate equipment statuses under a bay, as shown below.

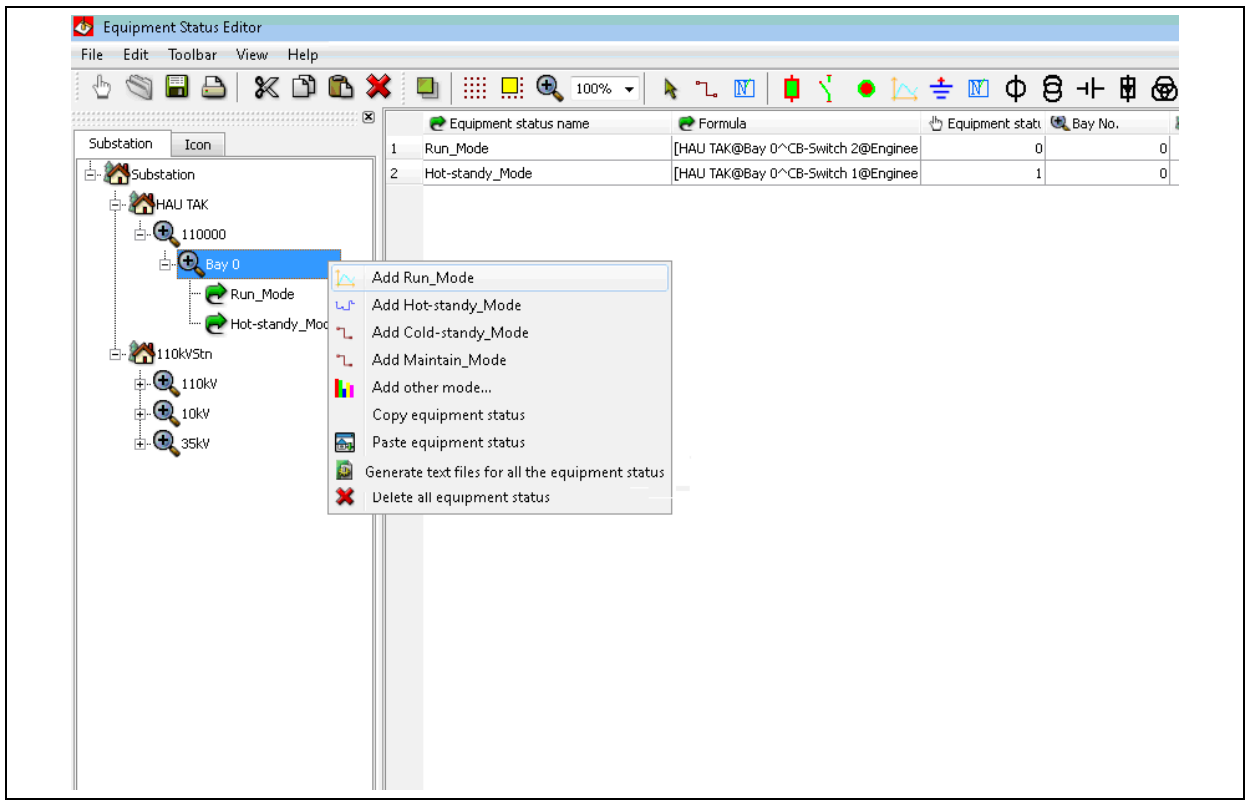


Figure 9.3-12 Equipment status list menu

1) Add other equipment status

On “Equipment status list” node, right click mouse to pop up a menu. Select “Add other state” from this menu.

The system will pop up “User-defined equipment status…” dialog box as shown below.

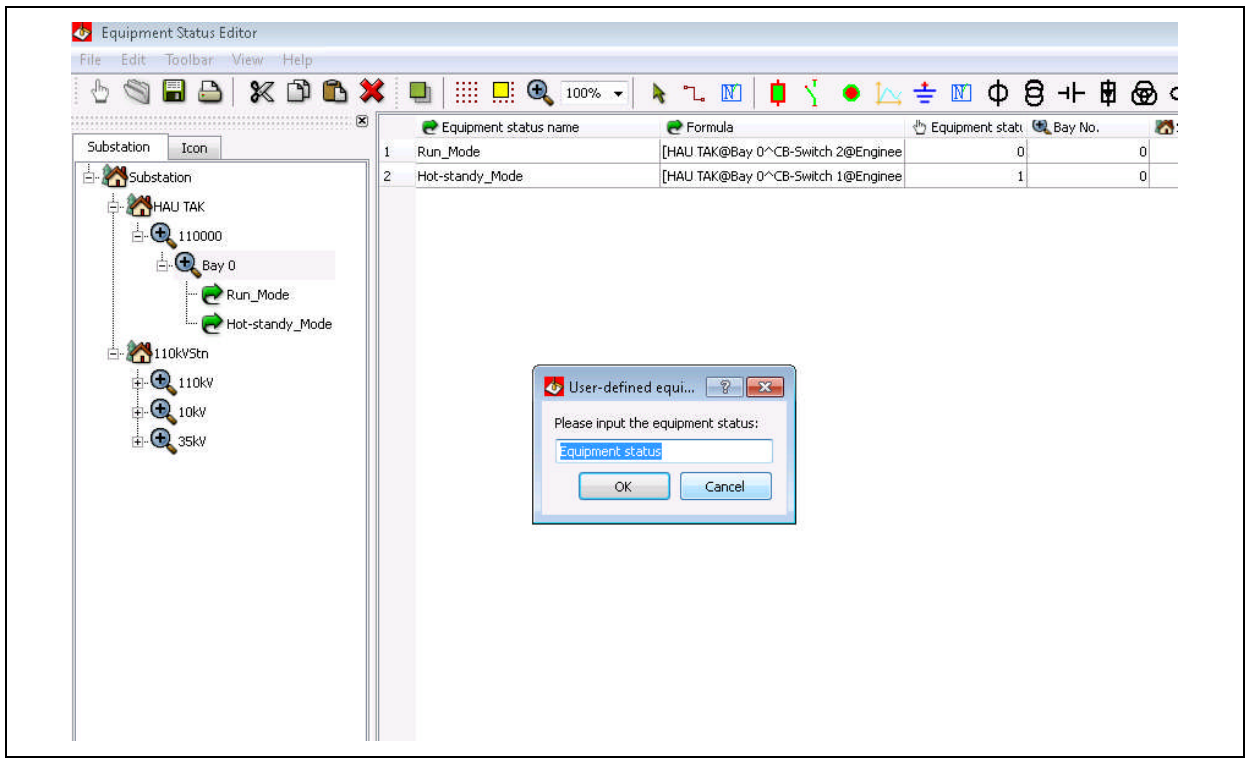


Figure 9.3-13 User-defined equipment status

In the editing box, enter equipment status name. After confirmation, new equipment status can be generated under “Equipment status list”.

NOTE: Name of equipment status must be unique.

2) Add default definition of equipment status

Select an item of bay equipment and right click mouse to pop up menu items as shown below. User can select “Add Run_Mode”, “Add Hot-standby_Mode”, “Add Cold-standby_Mode”, and “Add Maintain_Mode” that are set by the system in default.

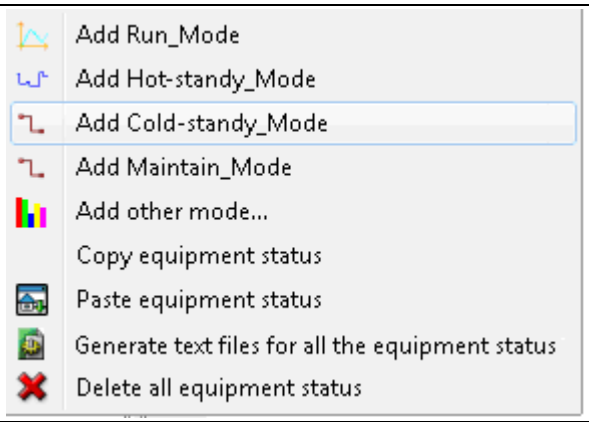


Figure 9.3-14 Add Run_Mode

After confirmation, a new equipment status will be generated in the equipment status group.

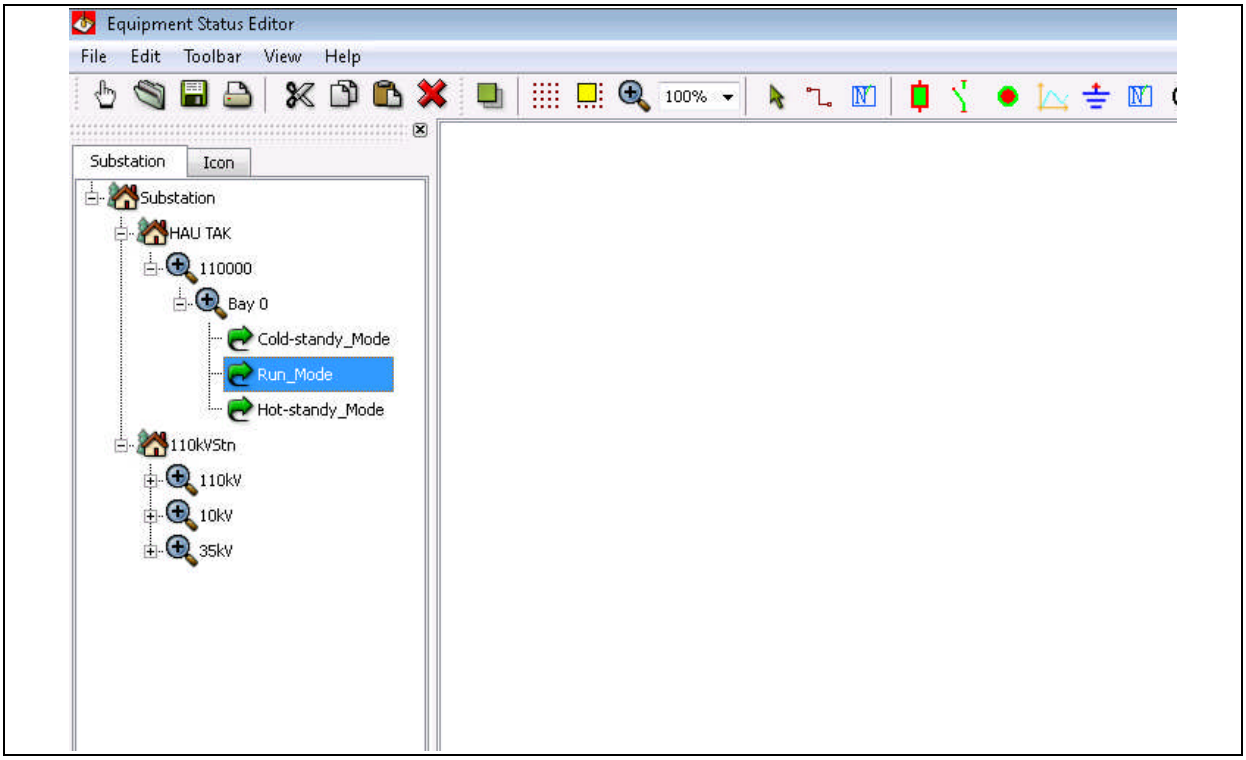


Figure 9.3-15 General new Run_Mode

3) Delete equipment status

Select an equipment status and right click mouse. In the context menu popped up, select “Delete equipment status”. The system will pop up a prompting dialog box as shown below:

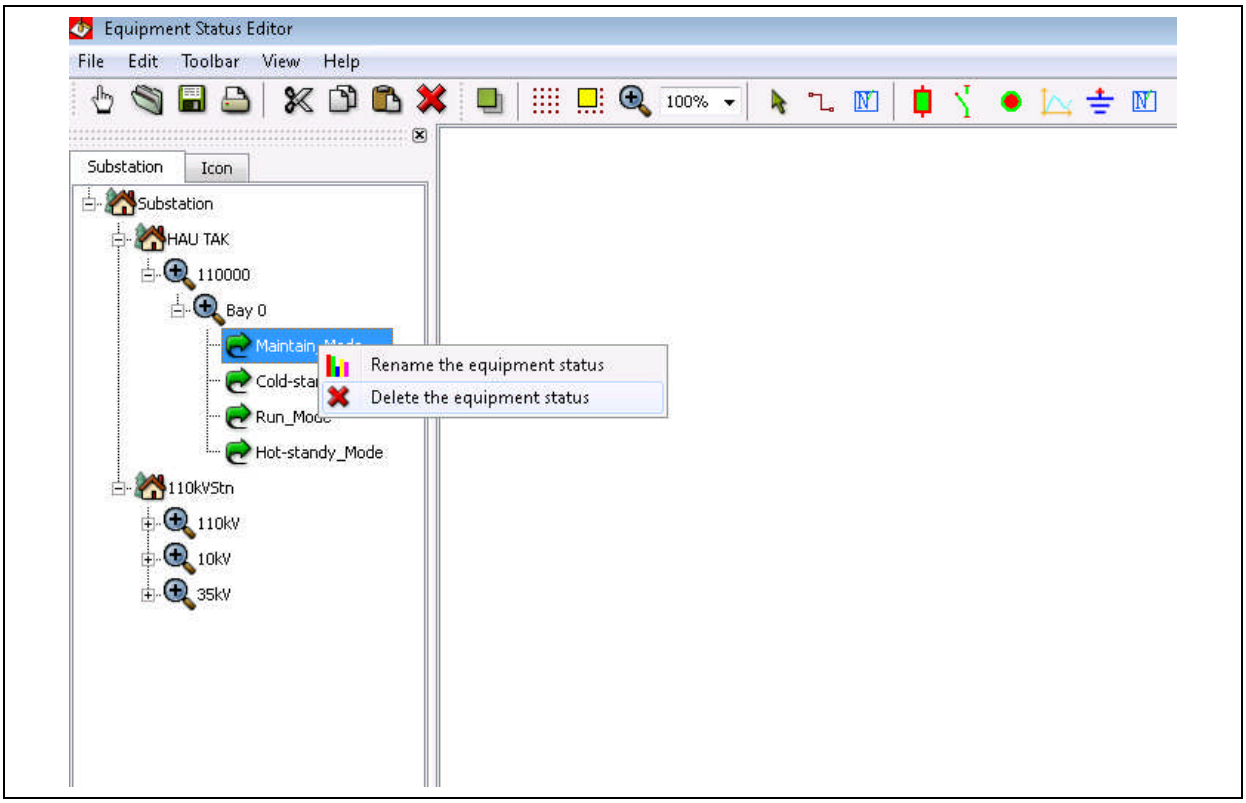


Figure 9.3-16 Delete equipment status

Click “OK” to delete current equipment status. Click “Cancel” button to cancel current deletion operation.

4) Rename equipment status

Select an equipment status and right click mouse. From the shortcut menu popped up, select “Rename equipment status”.

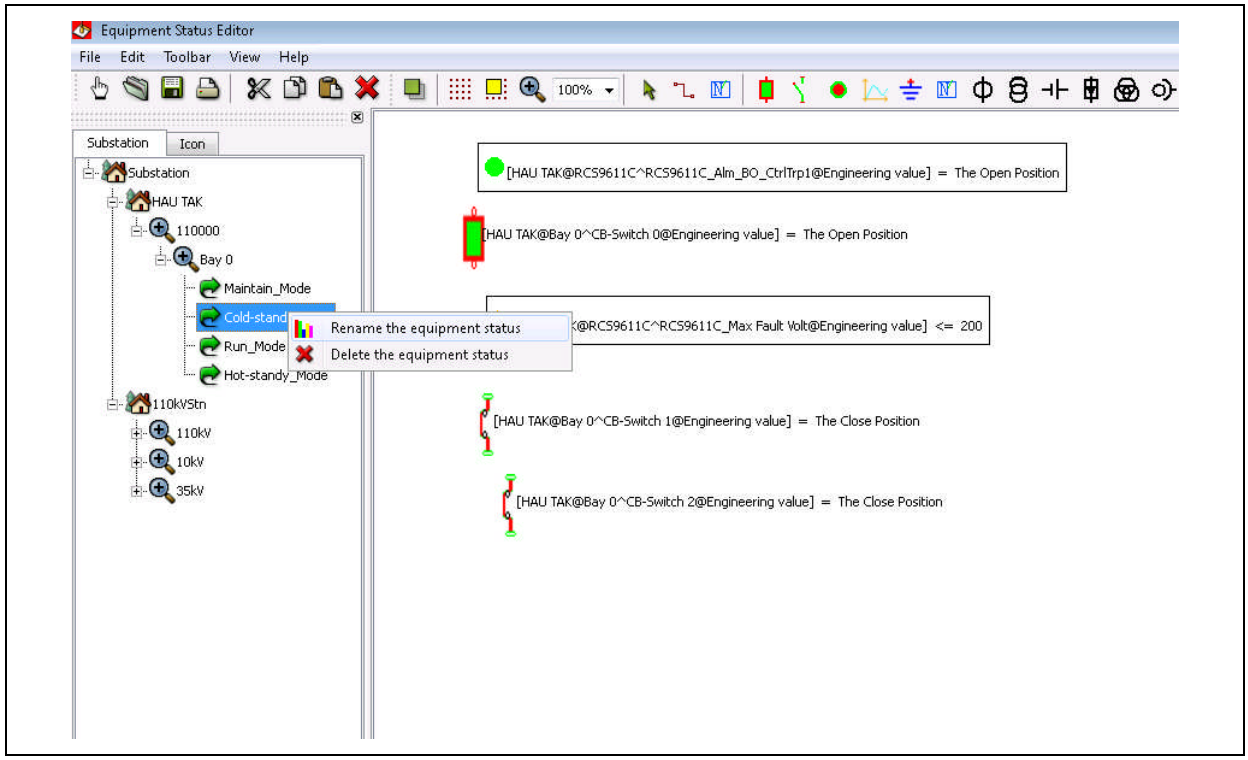


Figure 9.3-17 Rename equipment status

“Rename equipment status“ dialog box will pop up:

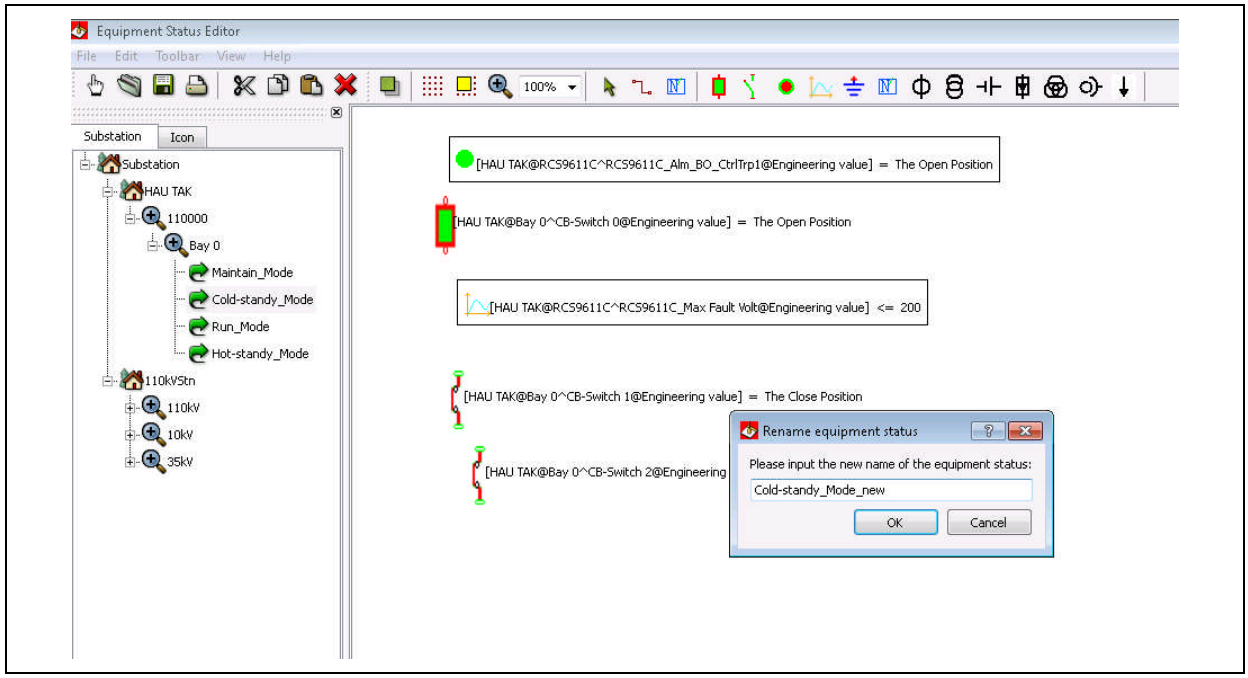


Figure 9.3-18 Rename equipment status

User can enter new equipment name in the editing box and click “OK”. Equipment status group can be renamed. Click “Cancel” button to cancel renaming operation.

5) Delete all equipment statuses of a bay

Select a bay and right click mouse. In the shortcut menu popped up, select “Delete all equipment statuses”.

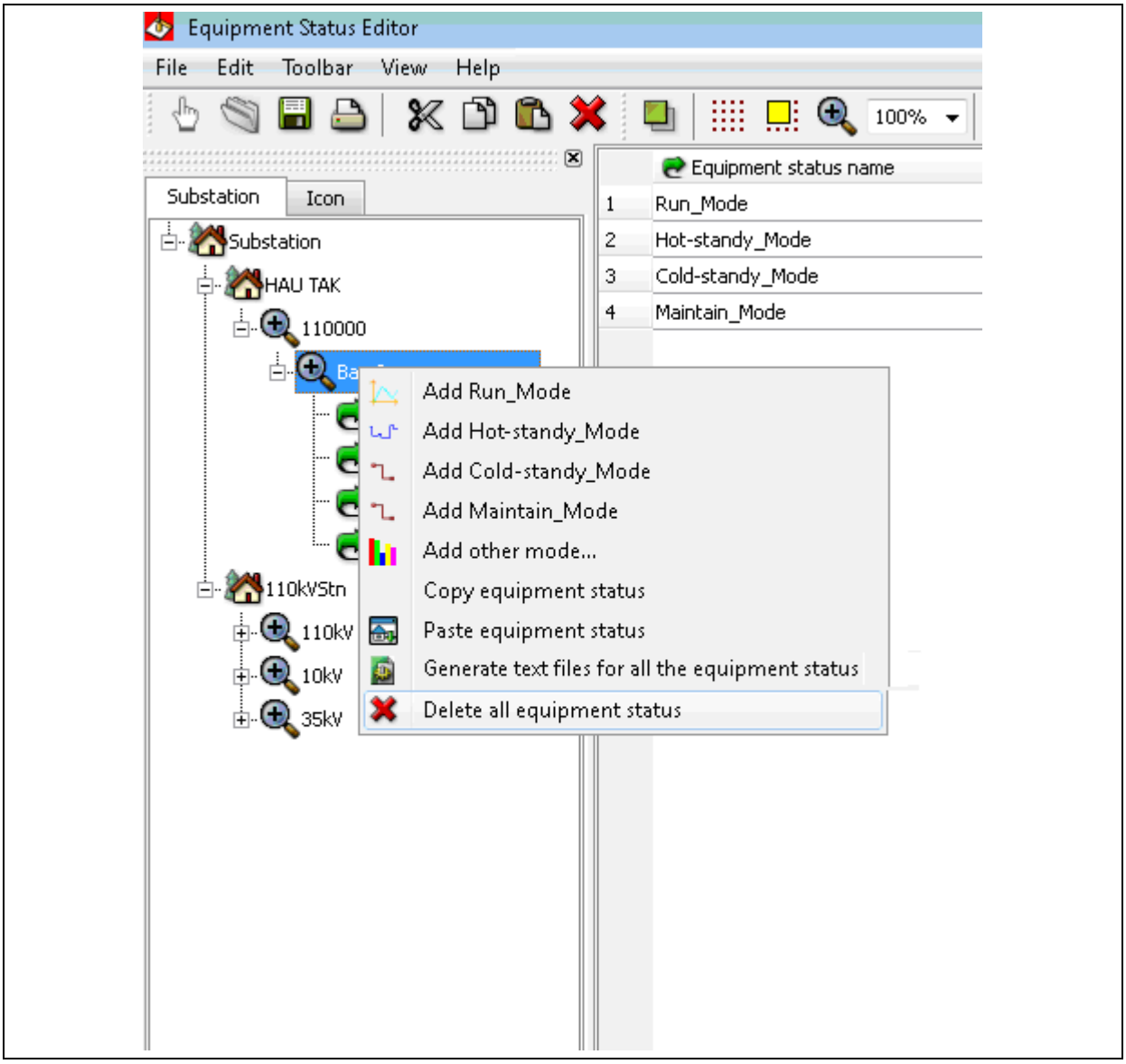


Figure 9.3-19 Delete all equipment statuses under a bay

6) Copy, paste all equipment statuses of a bay

Select a bay and right click mouse. In the shortcut menu popped up, select “Copy equipment status”.

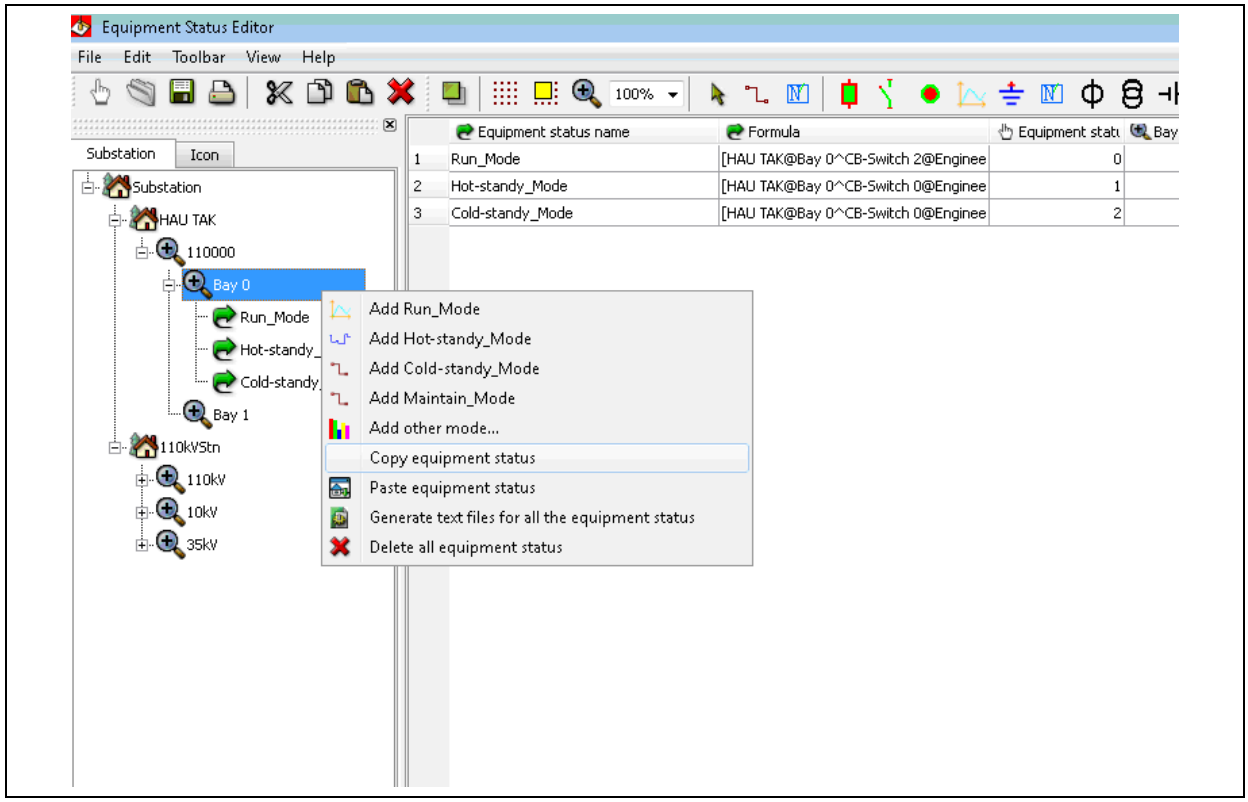


Figure 9.3-20 Copy all equipment statuses of a bay

Select a bay and right click mouse. From the shortcut menu popped up, select “Paste equipment status”.

“Replace target bay keyword by source bay keyword” dialog box will pop up:

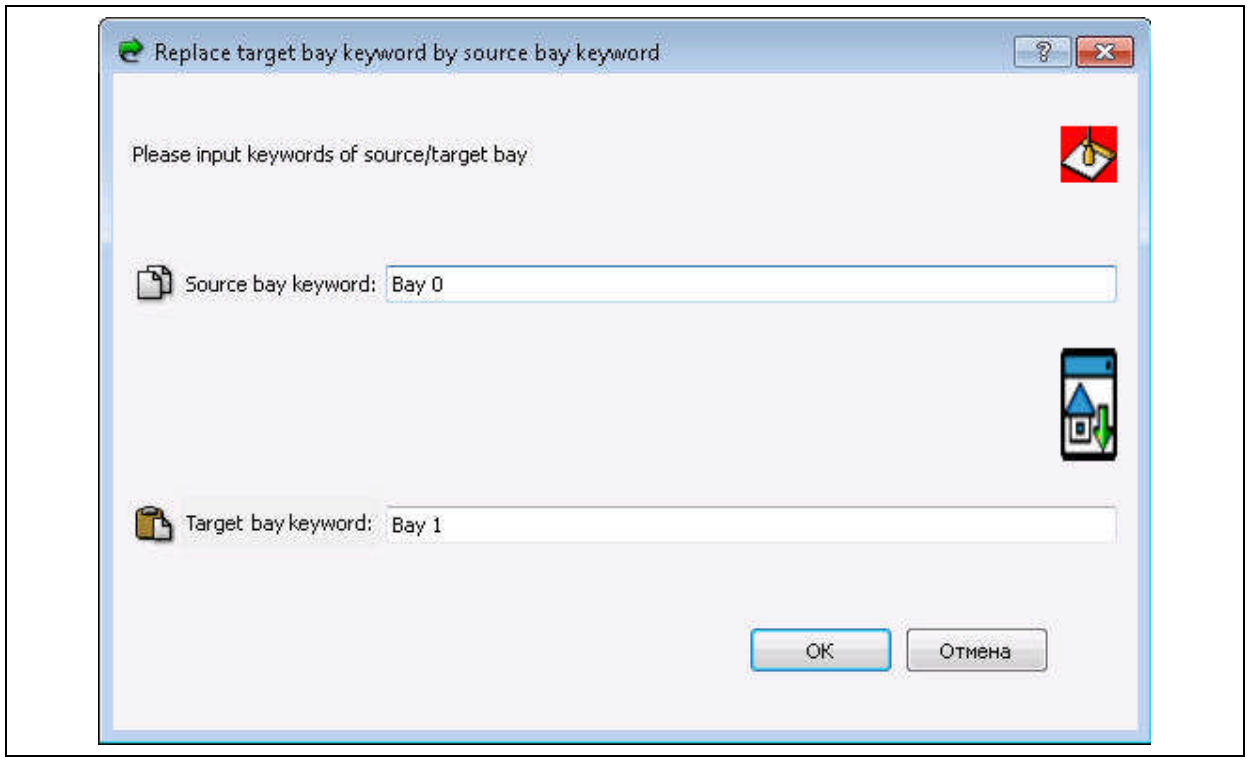


Figure 9.3-21 Replacement of bay when pasting all equipment statuses of bay

Click “OK” to generate all equipment statuses under target bay.

9.3.4.3 Operations of Substation Node Bay List

Operations of substation bay nodes allow user to view current bay attribute of association of equipment statuses, perform selective association of bay equipment status group, clear bay associated equipment status group, upload the bay equipment status defining file, download the bay equipment status defining file, and check the version of the equipment status defining file.

1) View substation node bay

In “Bay list”, information of all bays under this substation is displayed. Select a bay from this list. Upper half of the right view displays bay attributes, while lower half displays list of defined equipment statuses of current bay, as shown below.

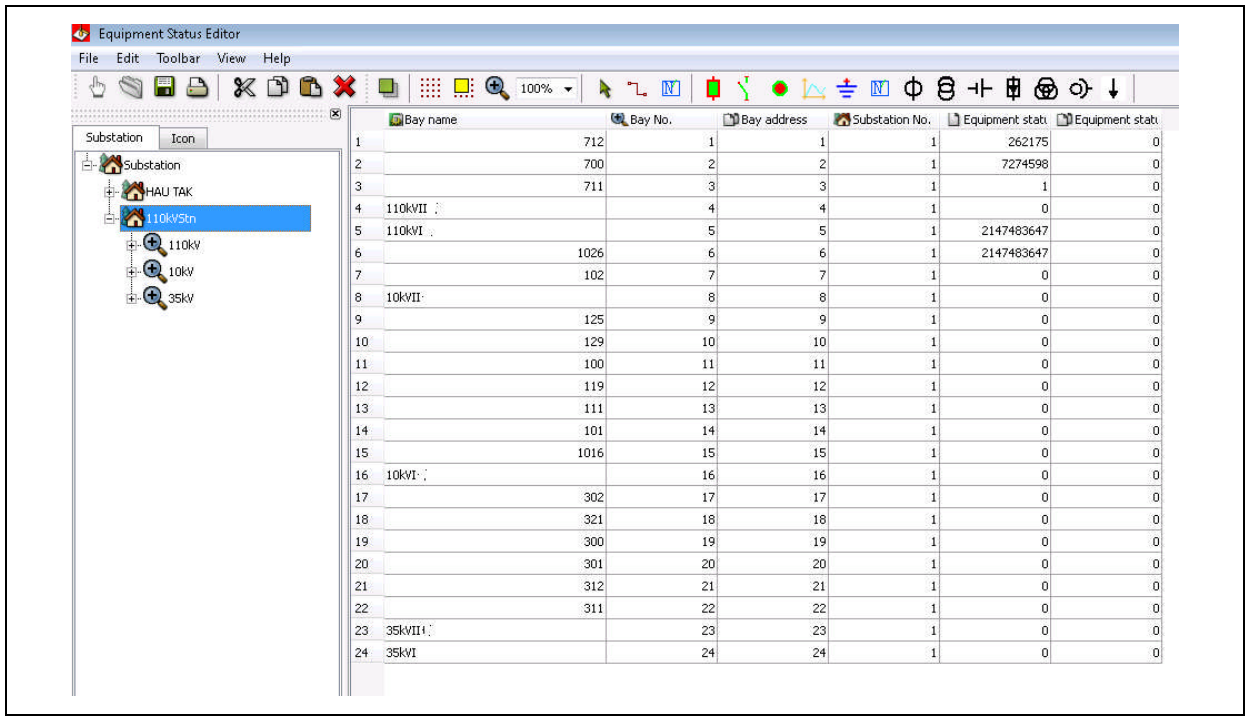


Figure 9.3-22 List of bays

2) Publish the sequential control database

Select Publish the sequential control database from File Menu, as shown below.

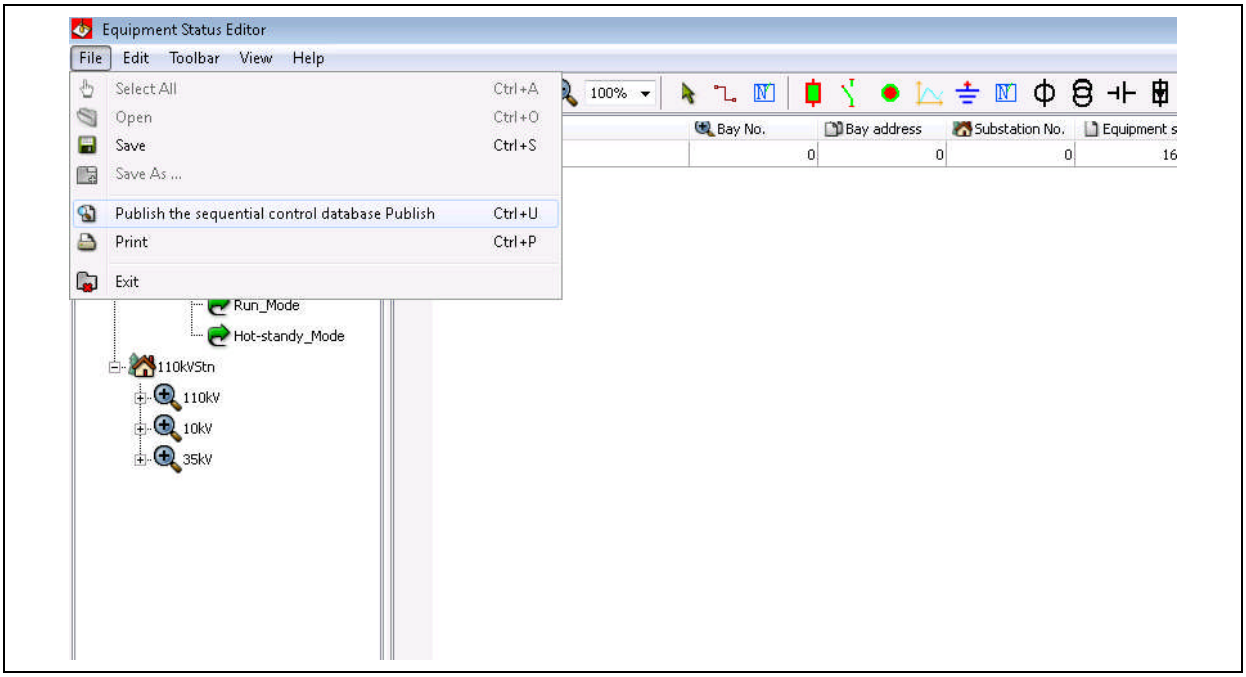


Figure 9.3-23 Publish the sequential control database

Publish sequential control database dialog box will pop up, as shown below.

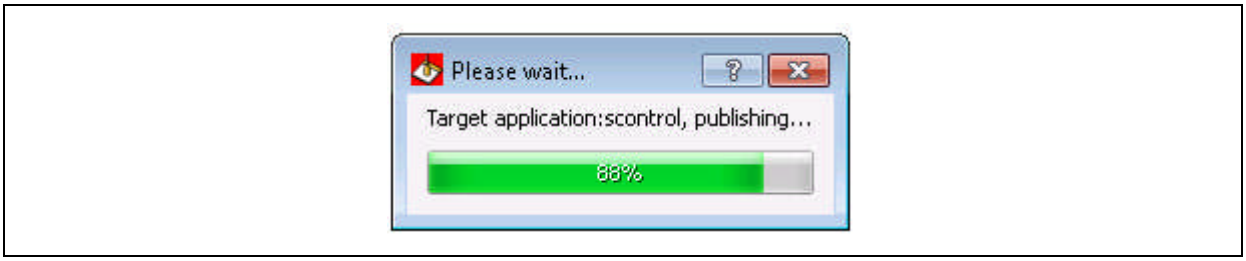


Figure 9.3-24 Publishing sequential control database

Final result will prompt user if publishing is successful. If not, cause of failure will be displayed, as shown below.

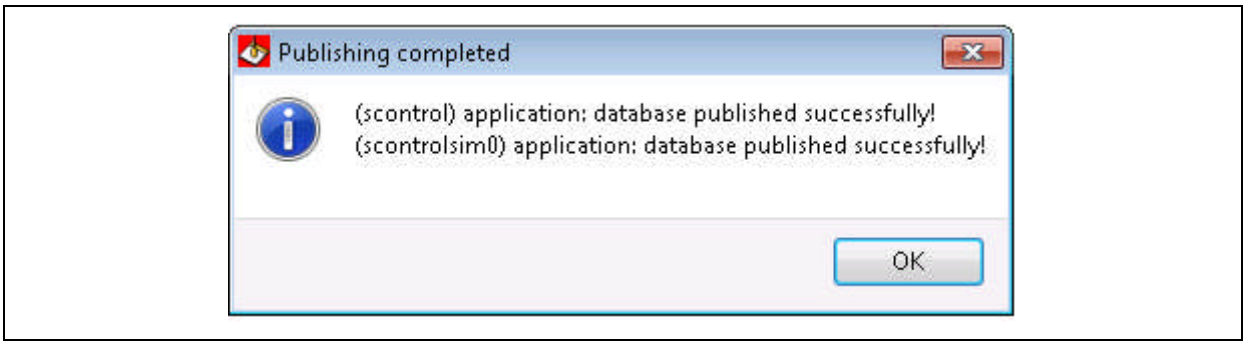


Figure 9.3-25 Successful publishing of sequential control database

If user publishing fails, the cause will be displayed, as shown below.

Figure 9.3-26 Failed publishing of sequential control database

9.3.5 Possible Problems and Operation Skills

9.3.5.1 Busy Database Prompted During Saving of Equipment status

Possible problem is that the equipment status has just been saved and publishing of equipment status file is saving database, or saving of configuration is in progress. In such case, please wait for some time and then save equipment status.

9.3.5.2 Make Use of Existing Graphs to Increase Work Efficiency

During definition of equipment status, we can reference or directly copy primary system wiring diagram drawn by tools, in particular bay equipment diagram. This can greatly save repetitive labor and accelerate definition of equipment statuses (drawing).

According to definition of equipment status, corresponding object primitive can be replaced by equipment status definition measuring point primitive or equipment object primitive, or new equipment status primitive object can be added in the graph. Double click the primitive to perform relevant setup of its attributes.

Primitives that do not need replacement can be omitted. In this way, repetitive definition on the graph can be reduced as much as possible, completed achievements can be made full use of, and graph definition of bay equipment statuses can be completed fast.

9.4 Sequential control flow definition

9.4.1 Brief Introduction

9.4.1.1 The Concept of Sequential Control Flow Definition

The sequential control editor establishes model of bay equipment in substation system according to equipment status definitions. Through definition of automatic conversion among bay equipment statuses, operations relevant to bay equipment can be realized automatically and reliably.

For conversion of bay equipment statuses, relevant telecontrol operations, prompts, setting of setting group No., viewing, and VEBI operations are realized by the sequential control editor. All operations are defined in operation sheet files and downloaded to sequential control execution device, to facilitate reliable realization of sequential control flow definition operations by the background monitoring system, and fully automatic realization of sequential control tasks defined in operation sheets. Device corresponding to bay equipment realizes the function of bay

equipment sequential control through operation sheet files. In this way, both configuration requirements by new generation comprehensive automation discipline are met, and effect of interconnection of devices of different manufacturers in new generation 61850 substation is achieved.

9.4.1.2 Generation of Operation sheets and Definition of Sequential Control Flow Tasks

The sequential control editor main performs the following work:

- Generate new primary or secondary operation sheets
- Define tasks of generated operation sheets (or sequential control process)
- Download and upload operation sheet files, and check version and contents of local operation sheet files and device operation sheet files.

Main types of tasks of sequential control editor include telecontrol, prompt, setting group setup, check of setting group, switching of VEBI, and telecontrol of other device.

9.4.1.3 Generation of Operation sheets and Relevant Operations

Operation sheets generated by sequential control editor are mainly used to realize the following functions:

- Define primary or secondary operation sheet that realizes conversion of bay equipment statuses
- Upload and download operation sheet files
- Check version and contents of bay operation sheet files
- View, add, delete, or modify definition of sequential control flow tasks of each operation sheet under the bay.

9.4.1.4 Start Sequential Control Editor

There are two methods to start this editor.

Method 1: under executable program directory, directly run program SControlEditor.

Method 2: start PCS console program and then select “Start”→“Program”→ “Maintenance”→ “SControlEditor”. User login dialog will pop up. User need to enter a password. If there is no authority or incorrect password is entered, the system will refuse login.

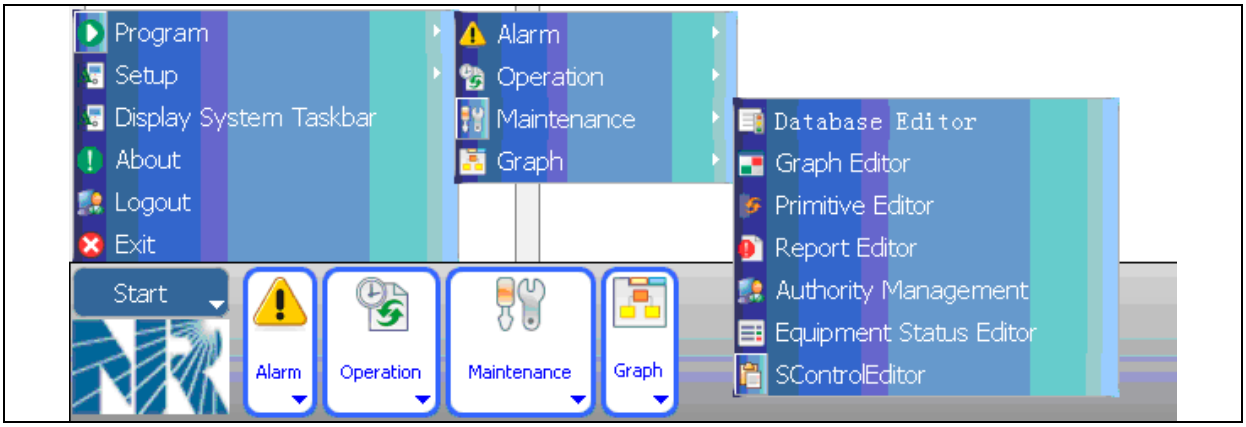


Figure 9.4-1 Start sequential control editor (method 2)

After successful login, main interface of sequential control editor will be displayed as follows.

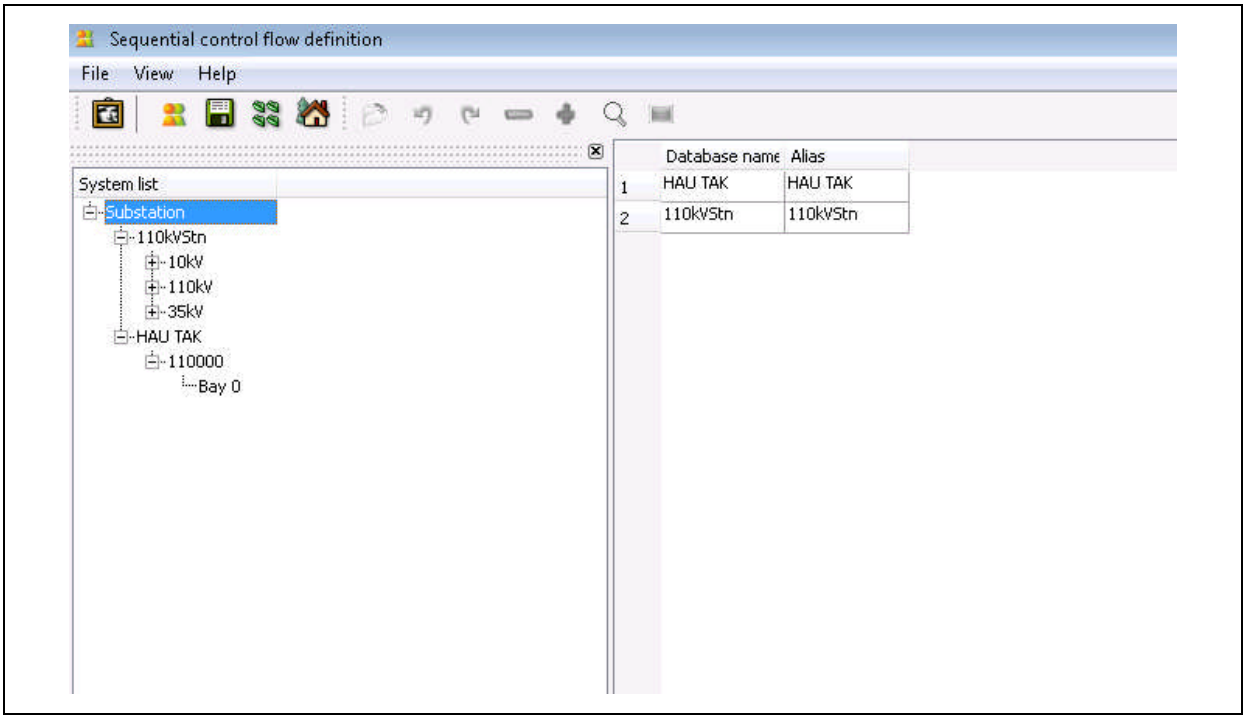


Figure 9.4-2 Main interface

Title bar: located at uppermost of the window and displays name of the sequential control editor.

Status bar: located at bottom of the window and displays various status messages.

Menu bar: located below the title bar and displays main menu of the sequential control editor.

Tools bar: normally located below the menu bar or above the status bar. The tools bar contains some commonly used tools. Without using menu commands, user can directly click tool buttons on the tools bar to execute corresponding operations, e.g. upload file, download file, add new task, delete record of a step of task, and save etc.

Tree type list: operation sheets are displayed according to bays. User can click a bay in the bay list to display each operation sheet under this bay. Through viewing and context menu, user can add, delete, upload, and download operation sheets, and add, delete, modify, and copy bay

sequential control flow definition operation sheets.

9.4.2 Operations of Tools Bars

9.4.2.1 System Basic Tools Bar

The basic tools bar provides flow definition shortcuts. Some tools in this tools bar have corresponding menu items, through which the same functions can be realized. However, use of tools bar can accelerate operations, as shown below.

Figure 9.4-3 Basic tools bar

Table 9.4-1 Description of functions of the basic tools bar

Icon	Function	Description
	Browse graph	Click Browse Graph button to pop up list of graphs
	Publish the sequential control flow	Publish sequential control flow
	Save	Save data to database

9.4.2.2 View Attributes of Operation sheet

The operation sheet attributes window is used to view attribute parameters of sequential control flow definition operation sheets. Double click current operation sheet to pop up attributes window of current operation sheet, as shown below. User can modify operation sheet task flow as required for him, as shown below.

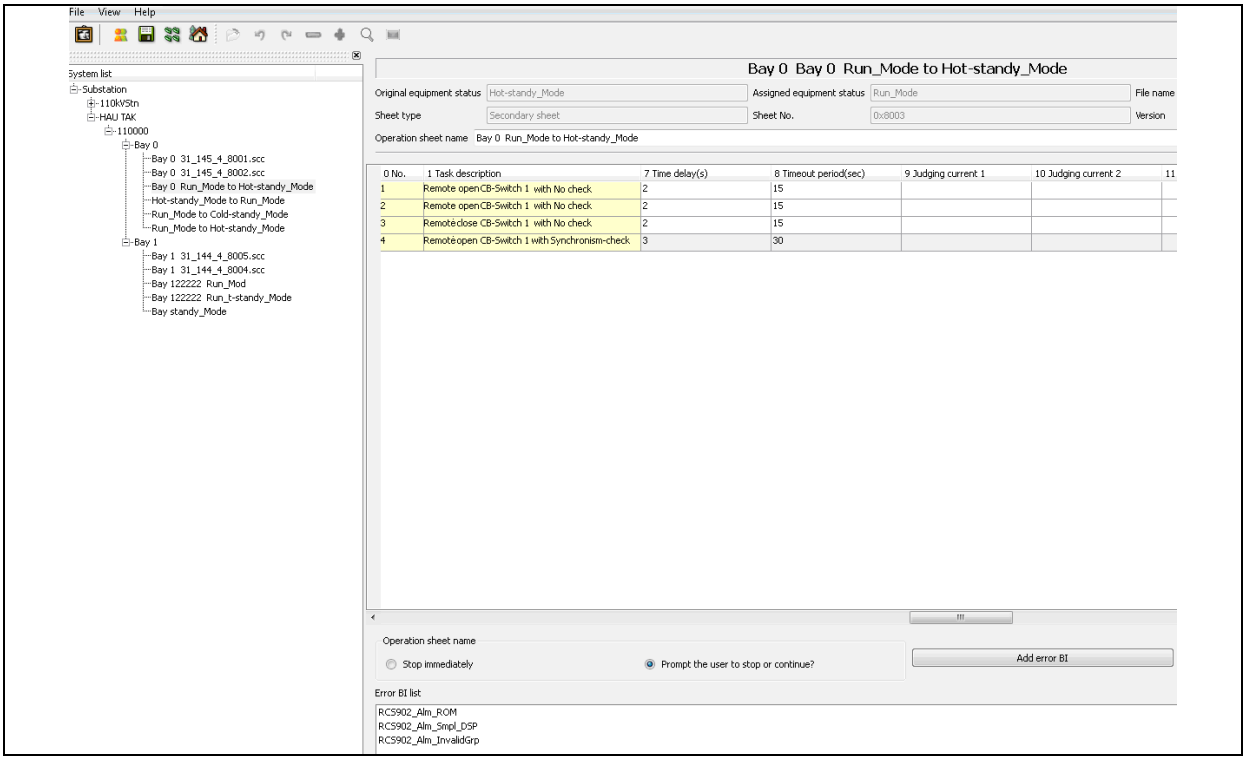


Figure 9.4-4 Operation sheet attributes window

9.4.2.3 Display, Add, Delete, and Modify Bay Operation Sheet Definition

The bay operation sheet attributes window of tree type structure at the left is used to display and modify operation sheet definition, and realize upload, download, and check of version of bay operation sheets. To set an operation sheet, right click the bay to pop up a shortcut menu to add, modify, edit, delete, and display an operation sheet, copy all operation sheets of the bay, and paste bay operation sheets, as shown below.

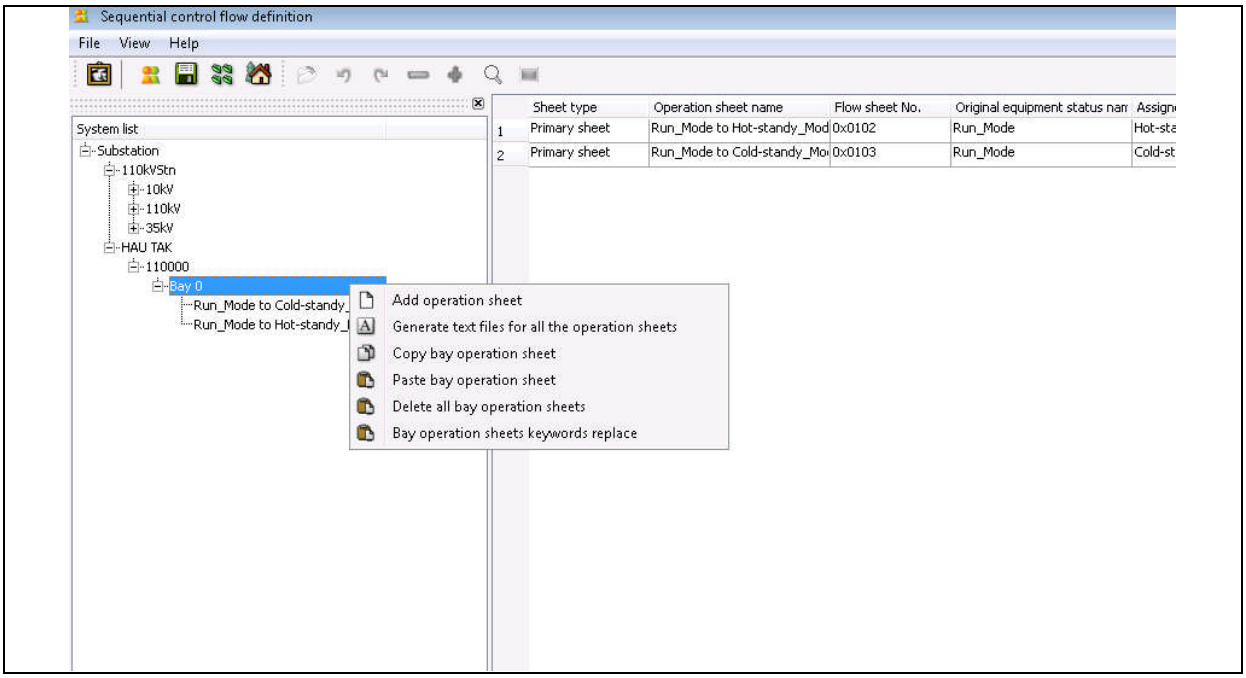


Figure 9.4-5 Bay context menu

9.4.3 System Menu Operations

In addition to menus, this chapter also introduces method to use shortcut keys. Some menu items have corresponding shortcut keys, the use of which can avoid 2-step operation of opening a menu and selecting a menu item. Instead, one key stroke on the keyboard can complete the operation. This accelerates drawing. Many menu functions are the same as those of buttons on tools bar, and the description is not repeated here.

9.4.3.1 File Menu

File menu of sequential control flow definition is shown below.

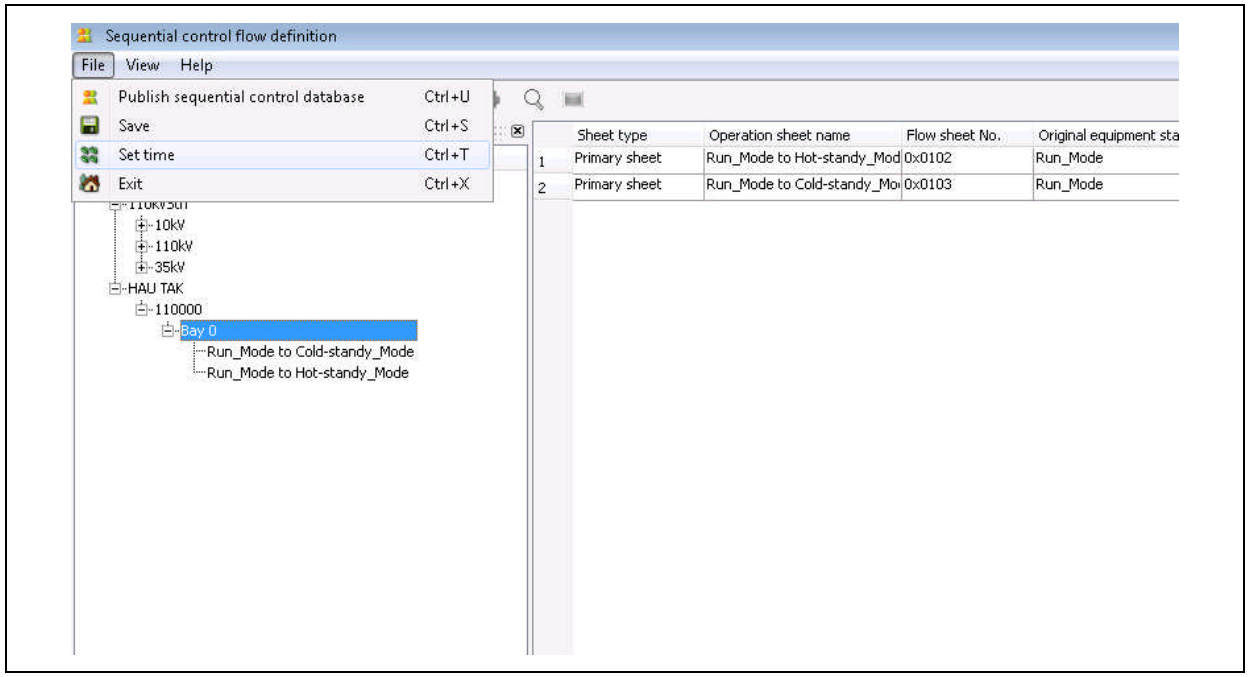


Figure 9.4-6 File menu

Table 9.4-2 Description of File menu items

Menu item	Description
Publish sequential control database	Publish the sequential control database. The system will pop up a prompt dialog box to prompt user result of publishing.
Save	After modification, user can save modified data.
Set time	Set default time delay and timeout period of sequential control task.
Exit	Exit the system. If user has not saved modified data at this point, the system will pop up a prompt dialog box: “Sequential control flow definition has modified some data! Save modification?”

9.4.3.2 View Menu

The View menu of sequential control flow definition is shown as below.

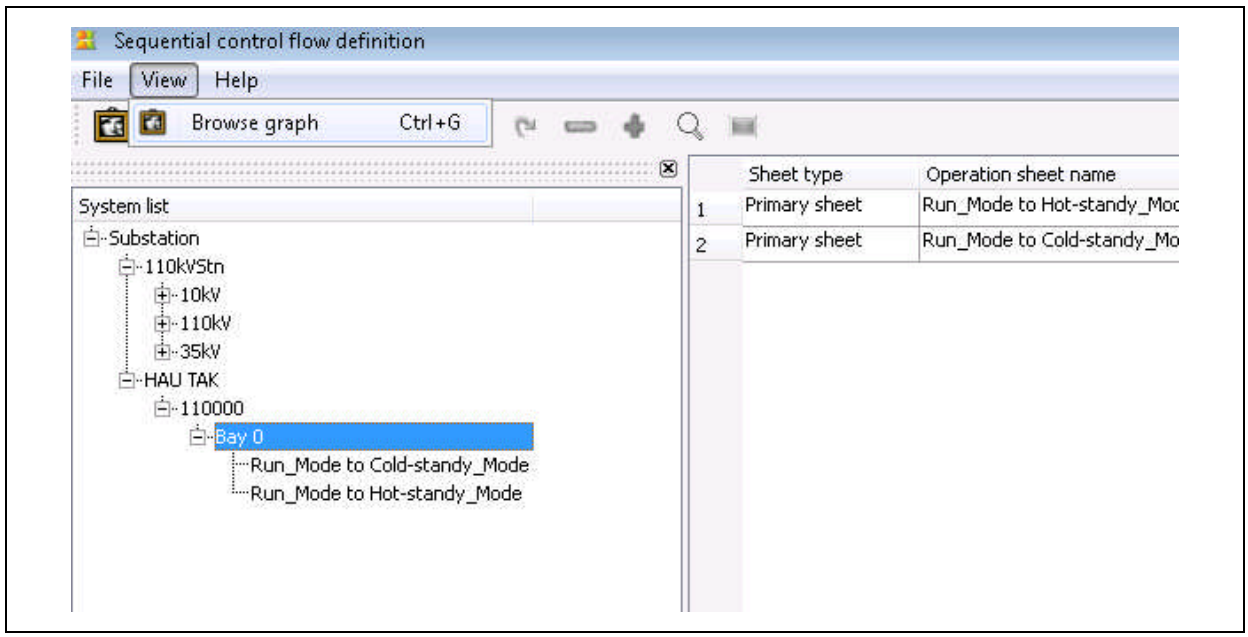


Figure 9.4-7 View menu

Table 9.4-3 Description of View menu item

Menu item	Description
Browse graph	Display/hide list of graphs; displayed in default

9.4.3.3 Help Menu

The Help menu of sequential control flow definition is shown as below.

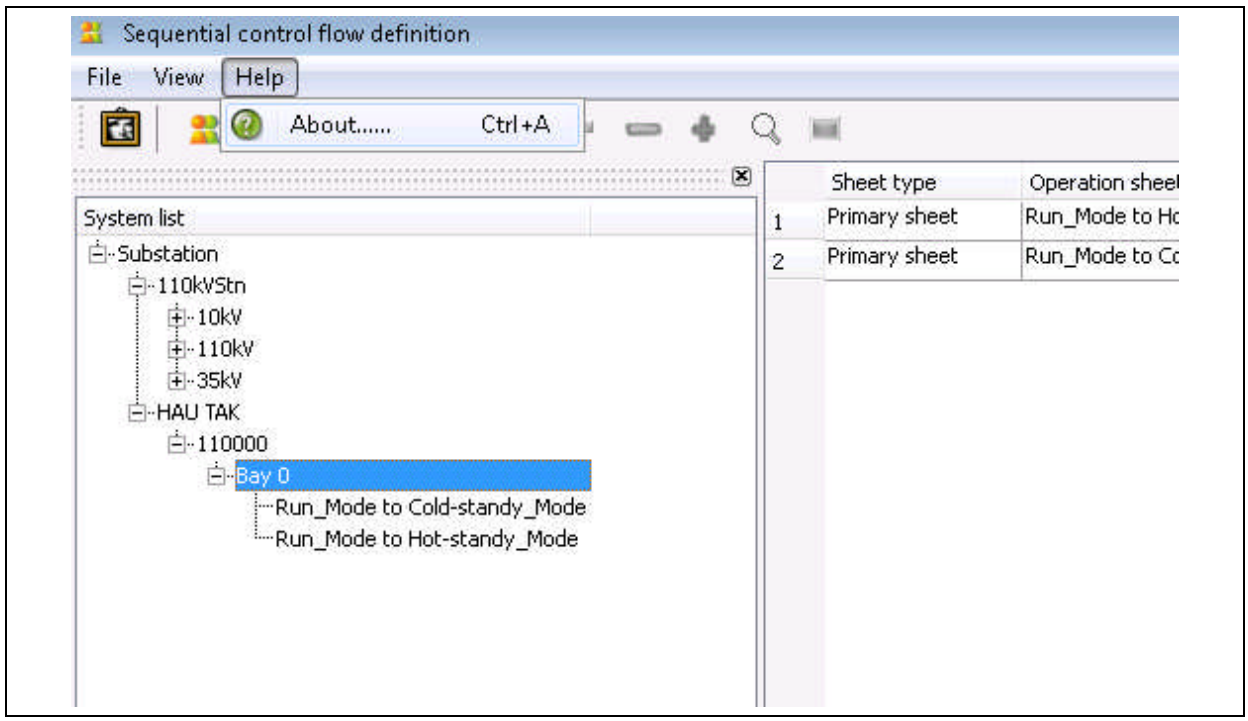


Figure 9.4-8 Help menu

Table 9.4-4 Description of Help menu item

Menu item	Description
About…	Display version and copyright etc. of sequential control flow definition

9.4.4 Tree Type List

9.4.4.1 Tree Type List Model of Substation

The tree type list of substation is mainly used to manage bay operation sheets, as shown below.

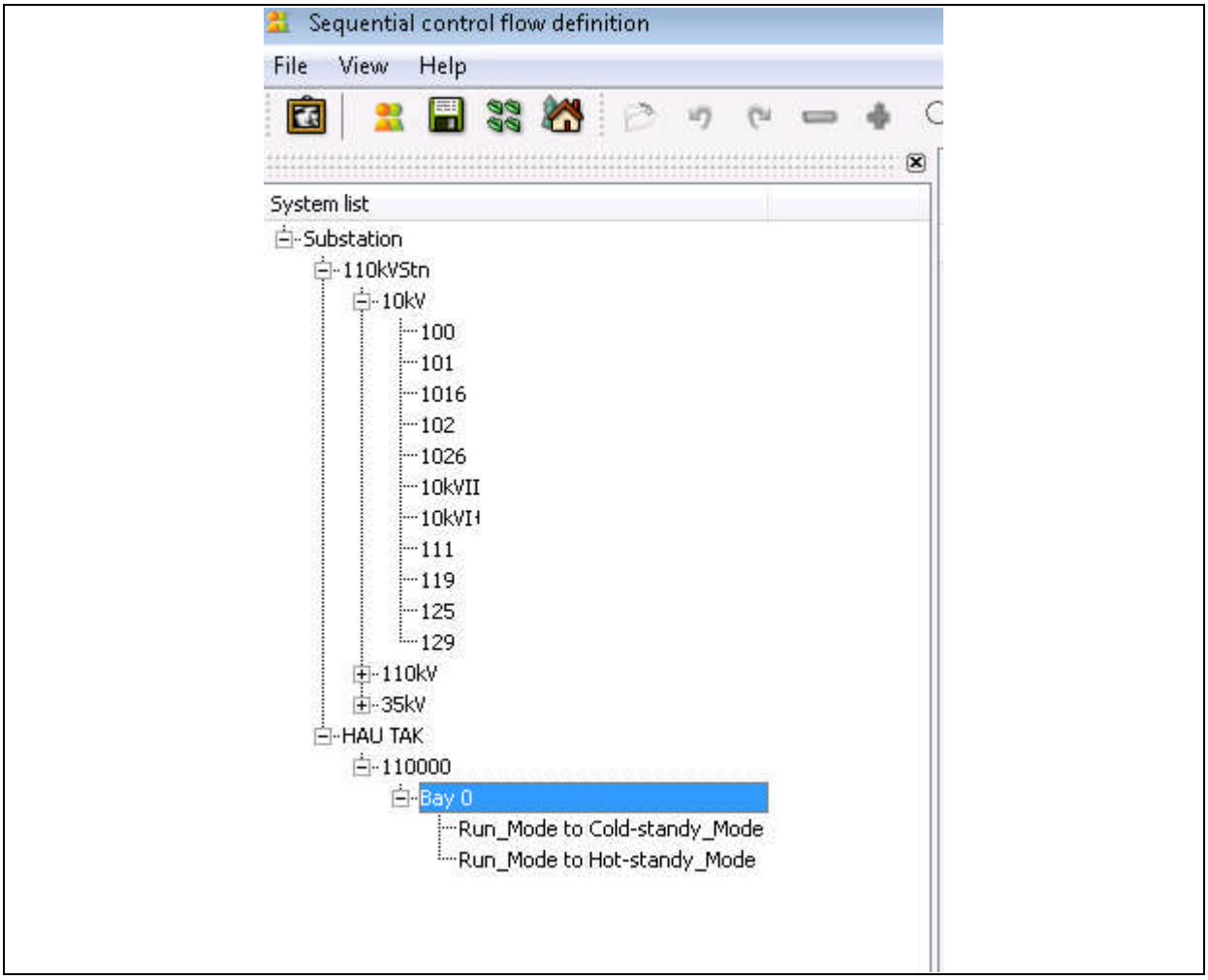


Figure 9.4-9 Tree type list of substation

When the sequential control editor is in Edit bay operation sheet status, click “+/-” before a node can expand or fold display of sub-nodes. Double click a node to open corresponding sequential control operation sheet definition attributes list.

9.4.4.2 Menu and Operations Relevant to Bay Node

The bay node context menu mainly includes the following operations, as shown below.

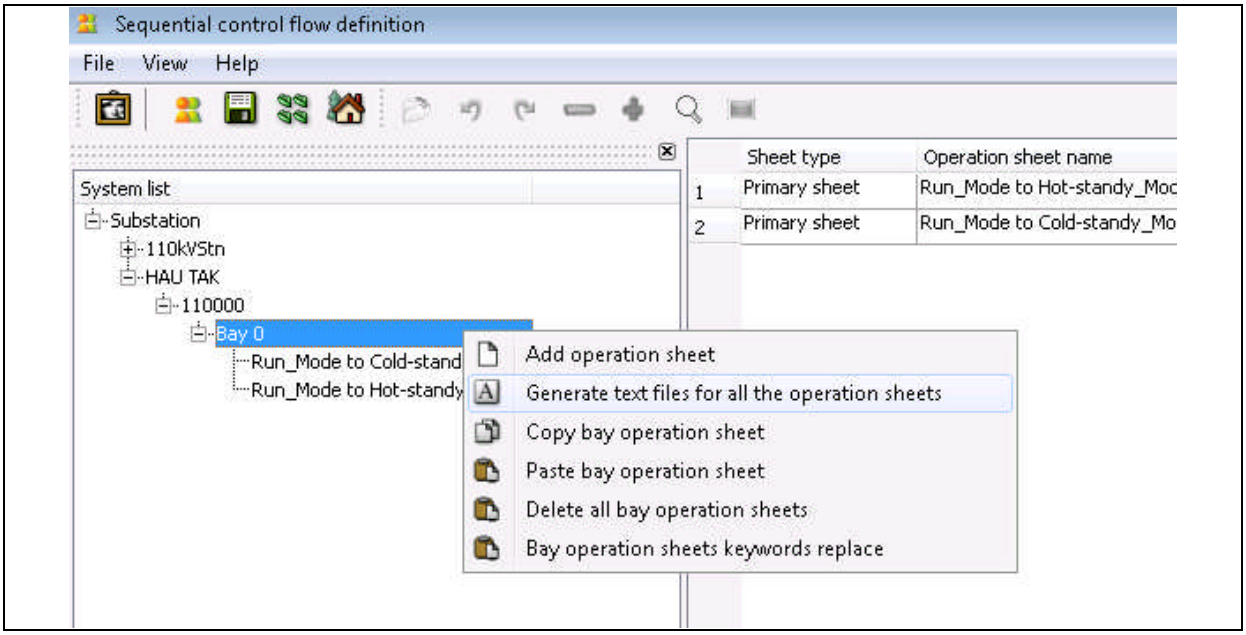


Figure 9.4-10 Bay node context menu

1) Add operation sheet

Select a bay node and right click mouse. From the shortcut menu popped up, select “Add operation sheet”. The system will pop up an Add operation sheet definition dialog box as shown below.

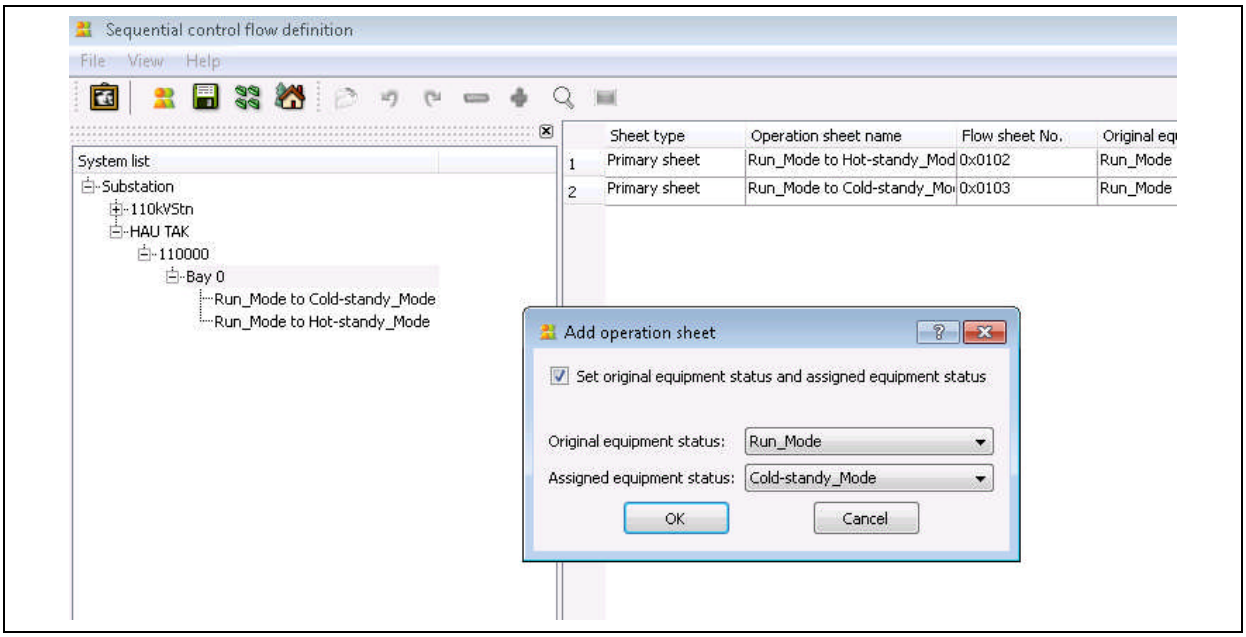


Figure 9.4-11 Add operation sheet to a bay

If primary sheet is selected, user needs to set current bay “original equipment status” and “assigned equipment status”. Click button “OK” to generate the operation sheet as shown below.

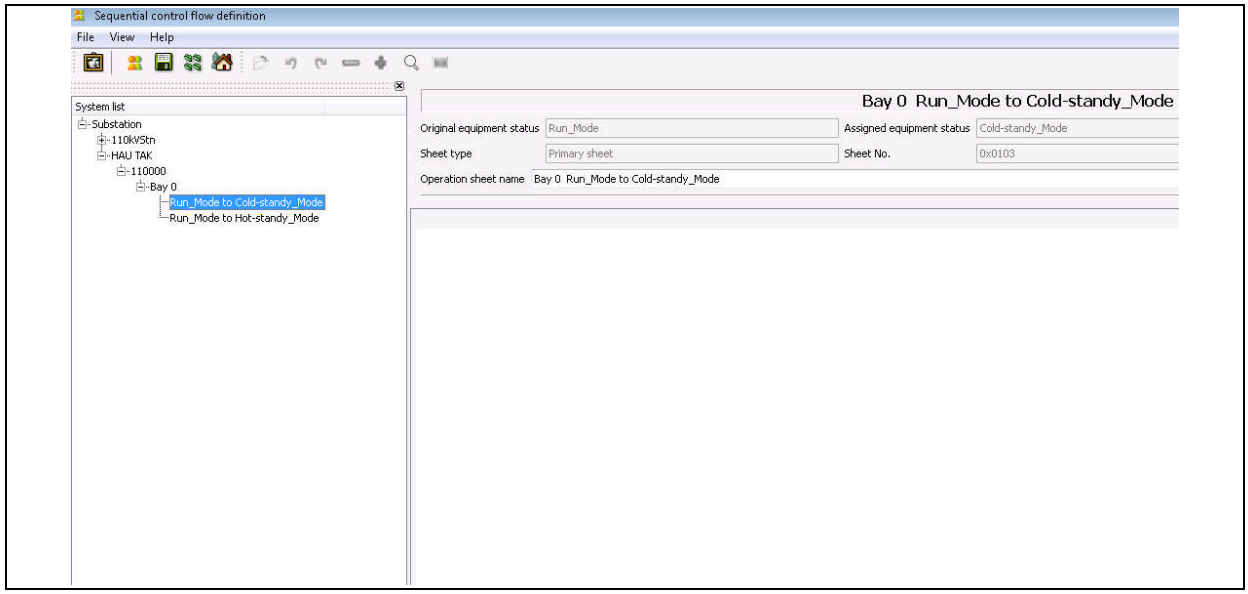


Figure 9.4-12 Generation of primary operation sheet

If secondary sheet is selected, user needs not select original equipment status or assigned equipment status of current bay, as show below.

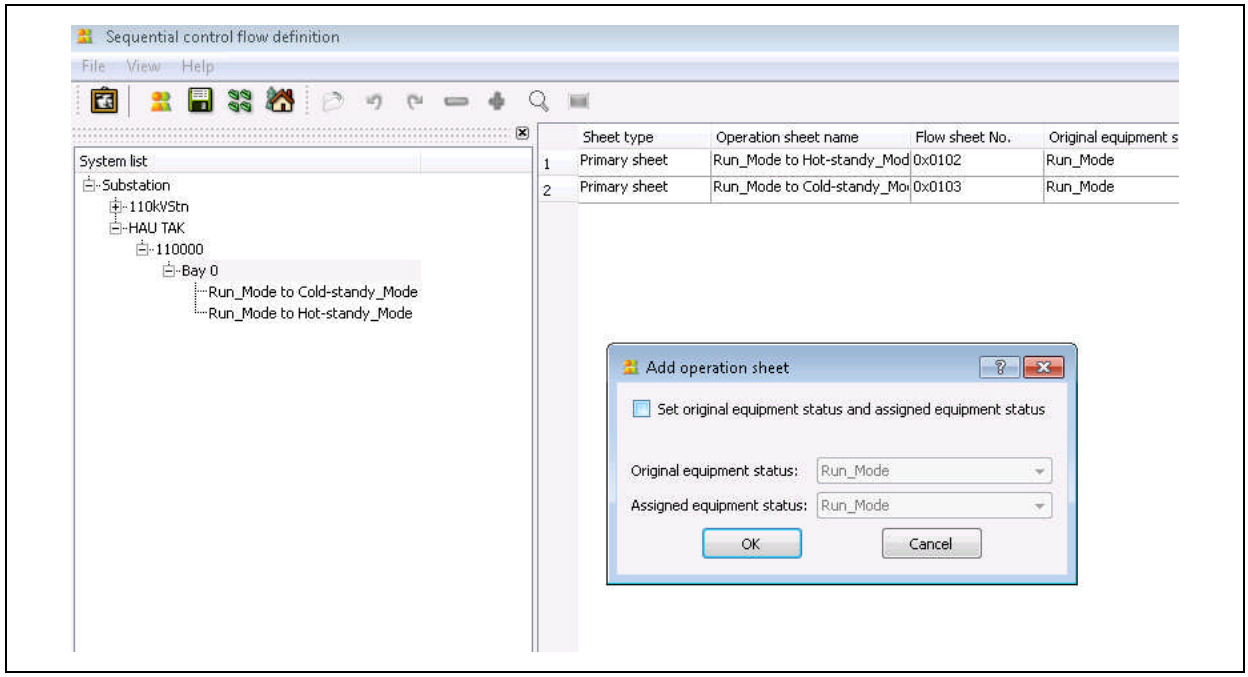


Figure 9.4-13 Add secondary operation sheet dialog box

Click button “OK” to generate the operation sheet shown below.

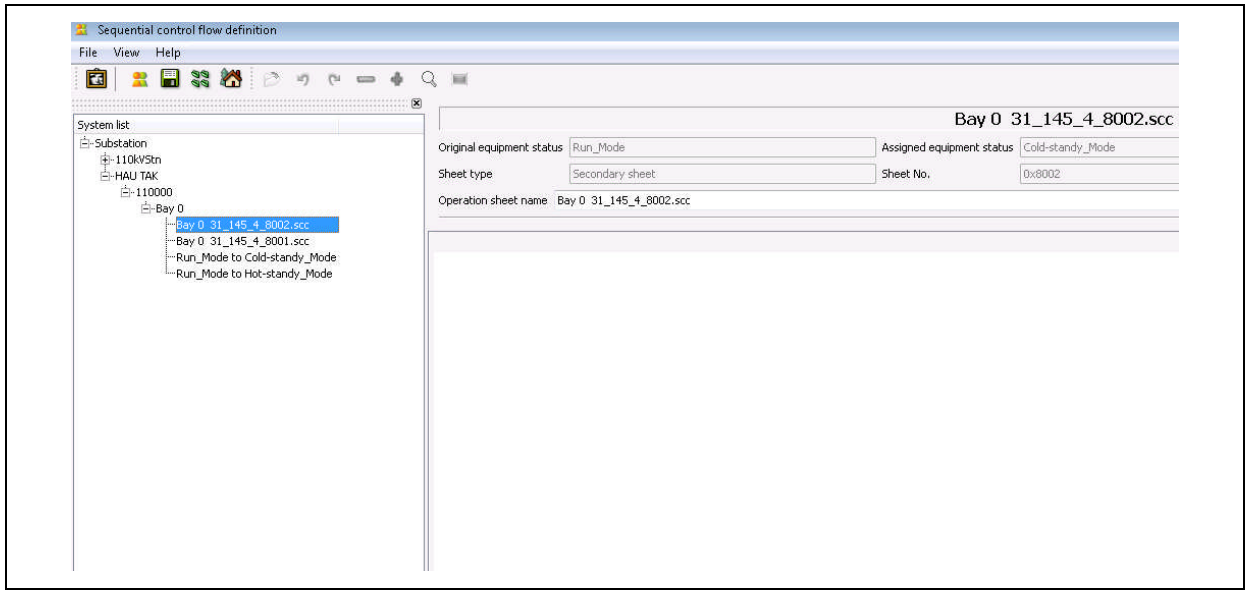


Figure 9.4-14 Generation of secondary operation sheet

At this time, name of secondary operation sheet can be edited and modified in the Attributes editing box at right side, i.e. renaming the sheet.

2) Delete operation sheet

Select a “Bay” node; information of all operation sheets under this bay will appear in the view list at right side. Select an operation sheet and right click mouse. From the shortcut menu popped up, select “Delete operation sheet”. The selected operation sheet will be deleted, as shown below.

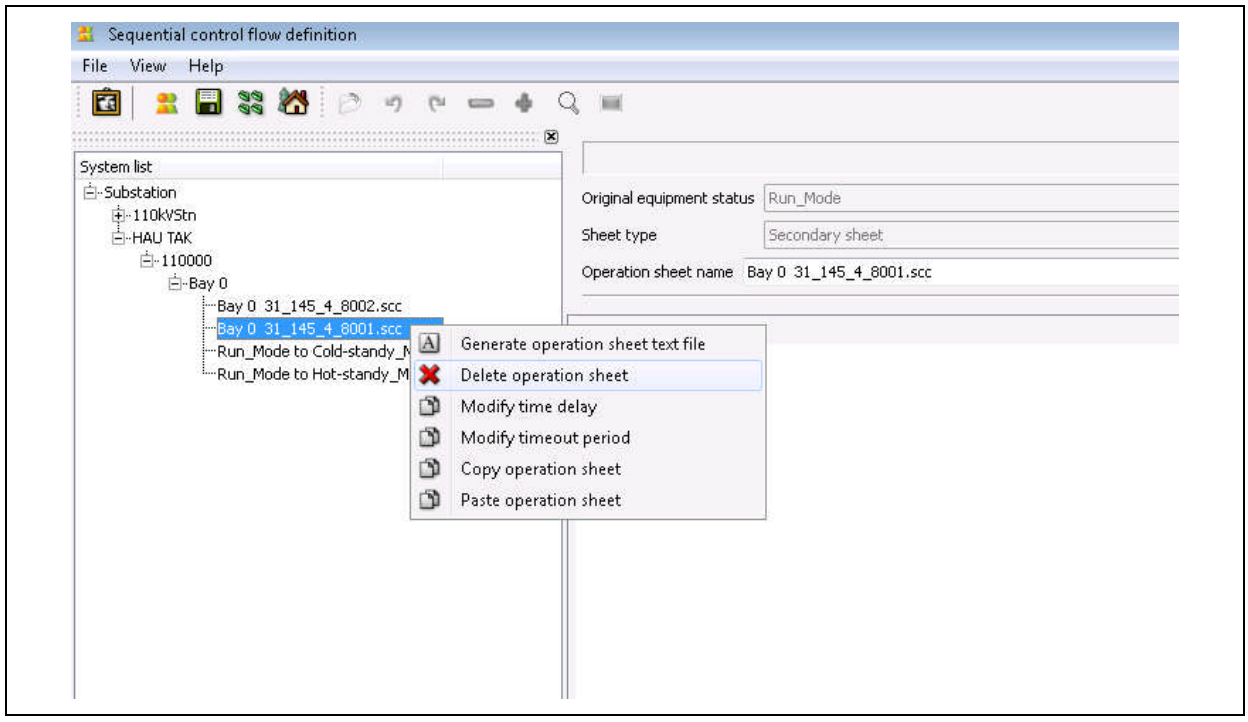


Figure 9.4-15 Delete an operation sheet

3) Copy operation sheet

From the tree type list, select a bay node, or right click mouse on View Attributes view at right side of the operation sheet and select “Copy operation sheet” from the shortcut menu popped up, to copy all operation sheets under this bay, as shown below.

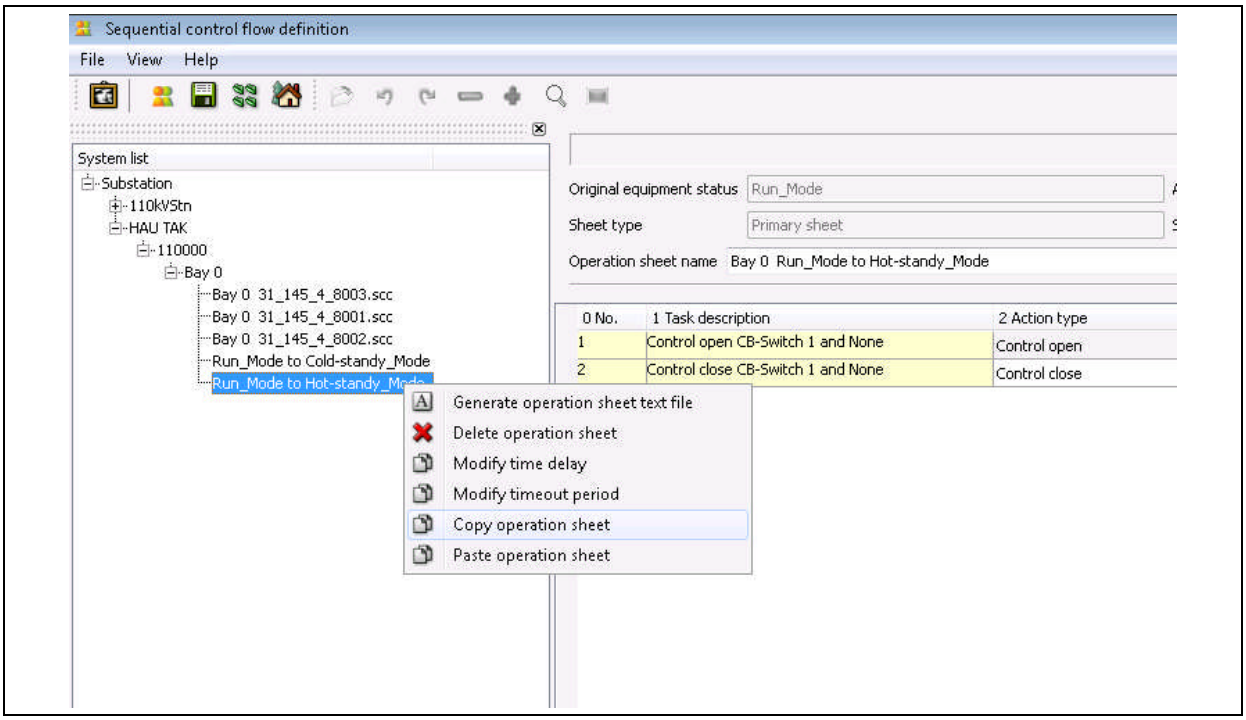


Figure 9.4-16 Copy operation sheet

4) Paste operation sheet

From the tree type list, select a bay node, or right click mouse on View Attributes view at right side of the operation sheet and select “Paste operation sheet” from the shortcut menu popped up, as shown below.

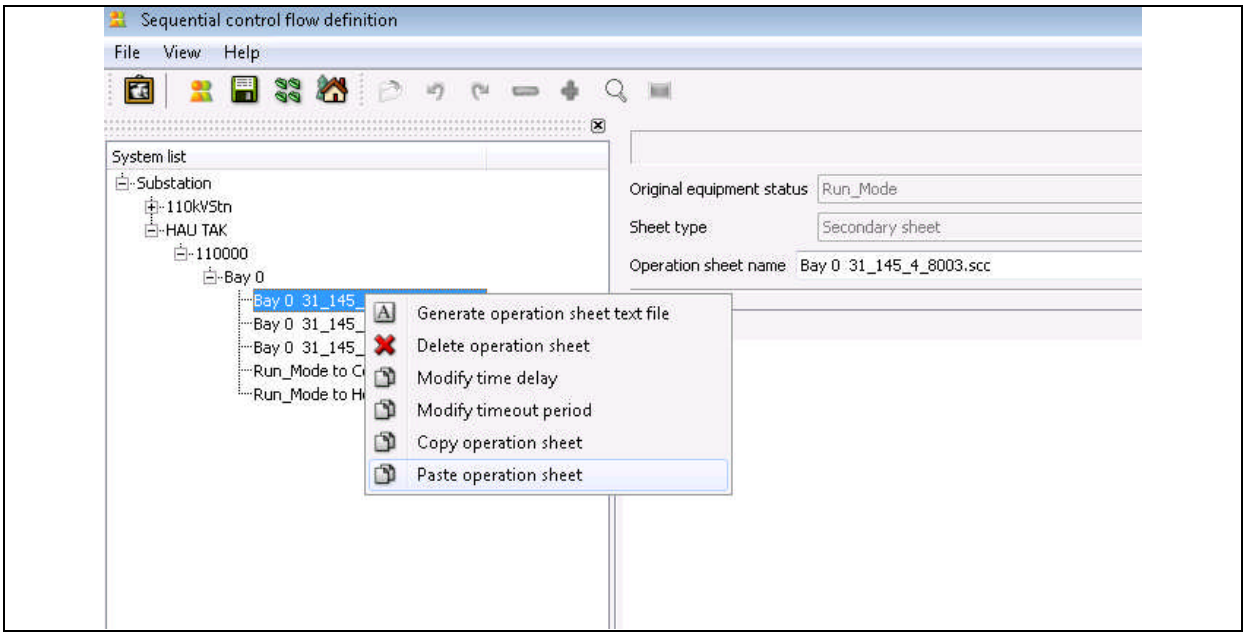


Figure 9.4-17 Paste operation sheet

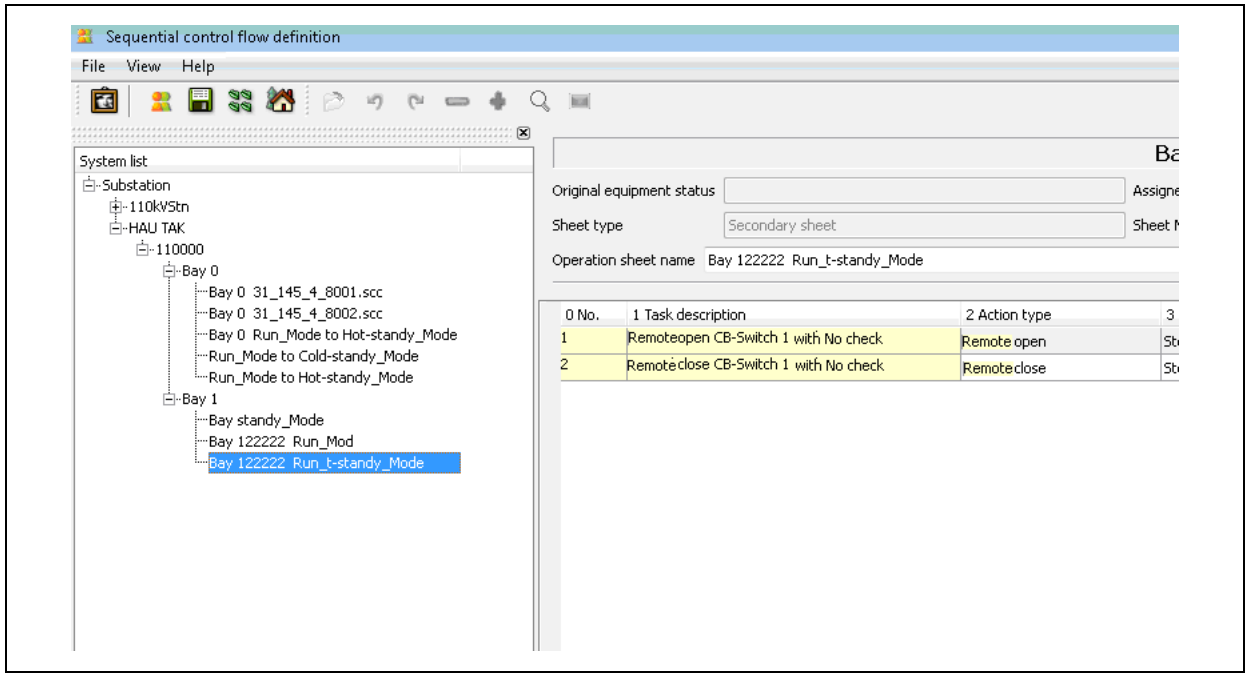


Figure 9.4-18 Schematic of results of pasting of operation sheet

5) Copy all operation sheets of a bay

From the tree type list, select a bay node, or right click mouse on View Attributes view at right side of the operation sheet and select “Copy bay operation sheet” from the shortcut menu popped up, as shown below.

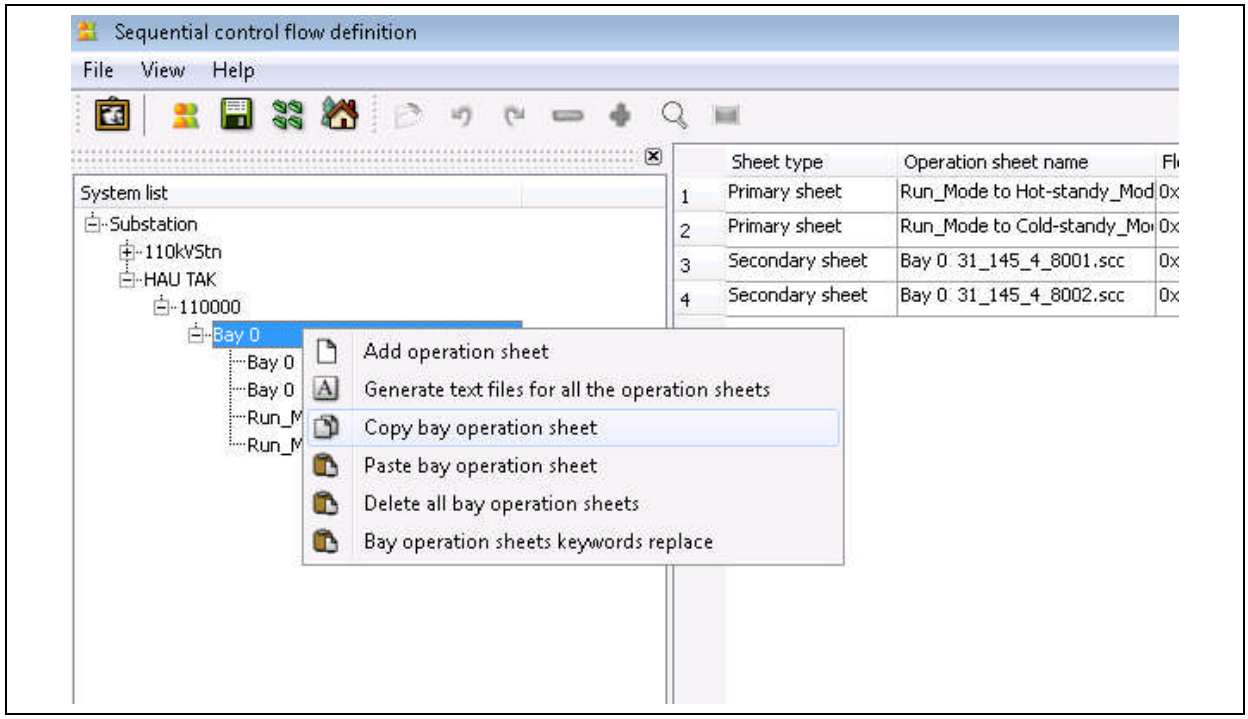


Figure 9.4-19 Copy operation sheets of a bay

6) Paste all operation sheets of a bay

From the tree type list, select a bay node, or right click mouse on View Attributes view at right side

of the operation sheet and select “Paste bay operation sheet” from the shortcut menu popped up, as shown below.

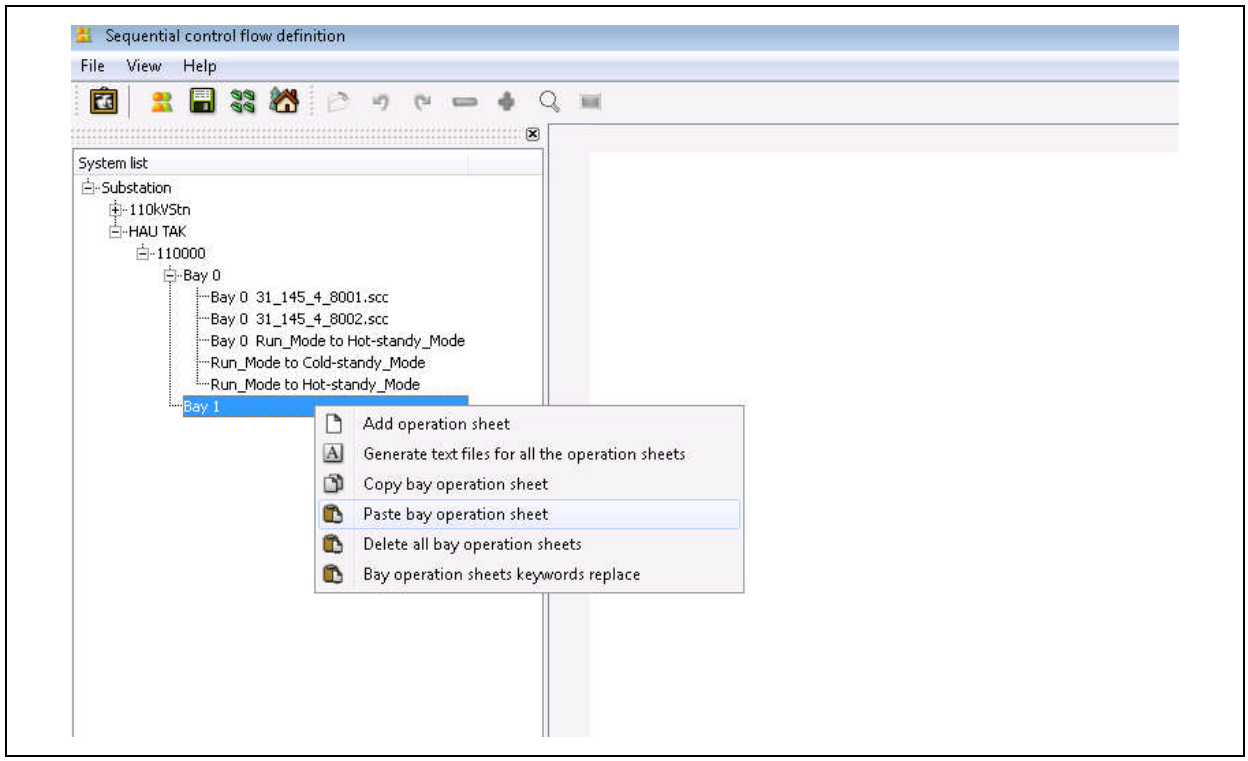


Figure 9.4-20 Paste bay operation sheets

During pasting of operation sheets of bay, a bay replacement dialog box will pop up, and results of pasting will be generated, as shown below.

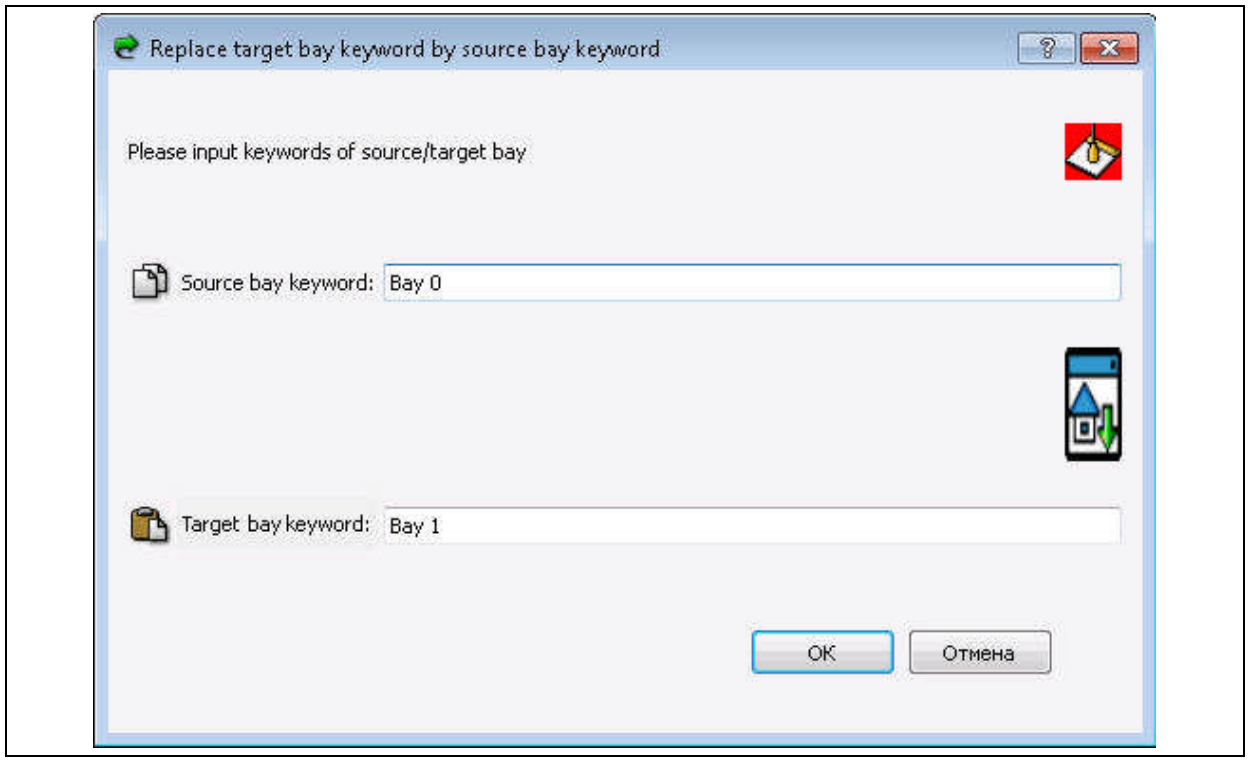


Figure 9.4-21 Bay replacement dialog box

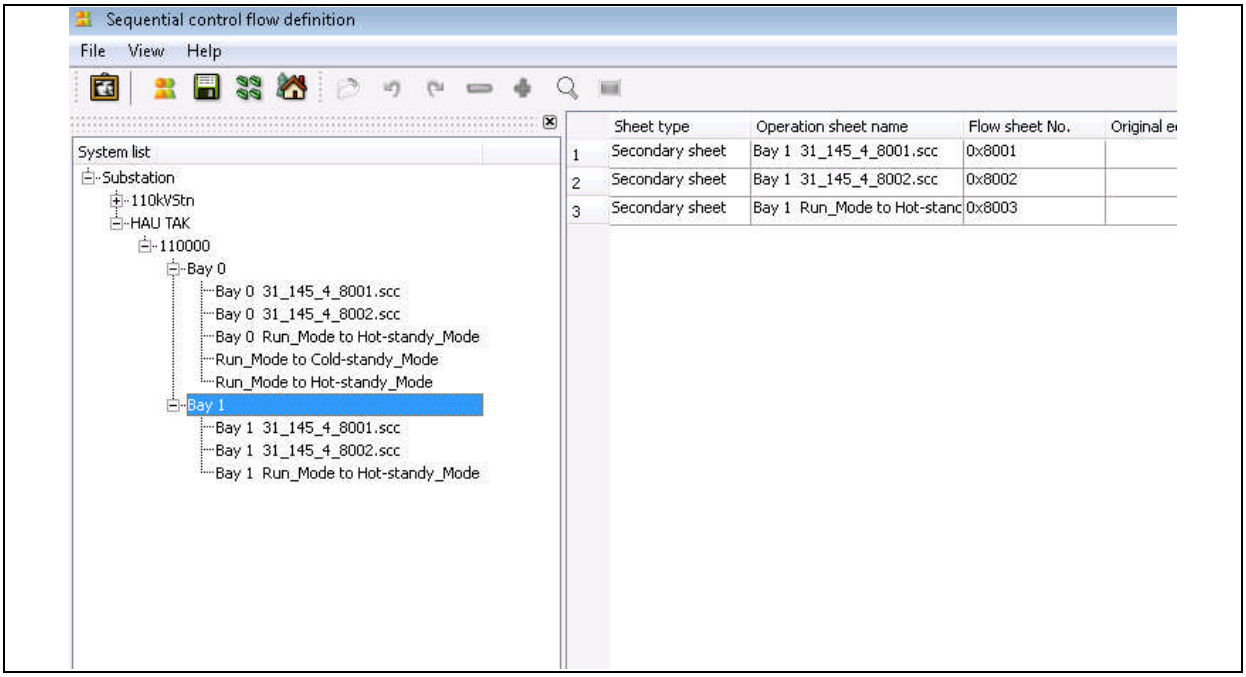


Figure 9.4-22 Results of pasting of bay operation sheets

7) Bay operation sheets keywords replacement

From the tree type list, select a bay node, or right click mouse on View Attributes view at right side of the operation sheet and select “Bay operation sheets keywords replace” from the shortcut menu popped up, as shown below.

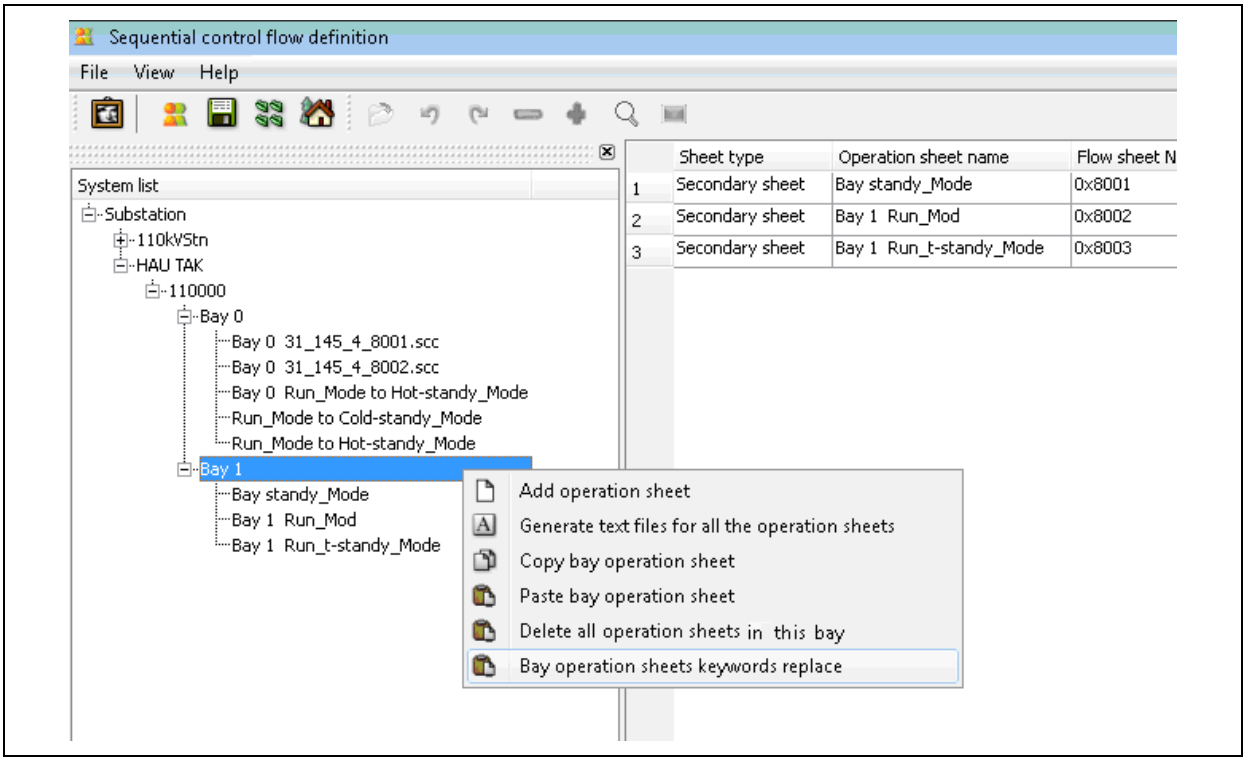


Figure 9.4-23 Bay operation sheets keywords replacement

For this replacement, a Replace Target Bay Keyword by Source Bay Keyword dialog box will pop

up and results of pasting will be generated, as shown below.

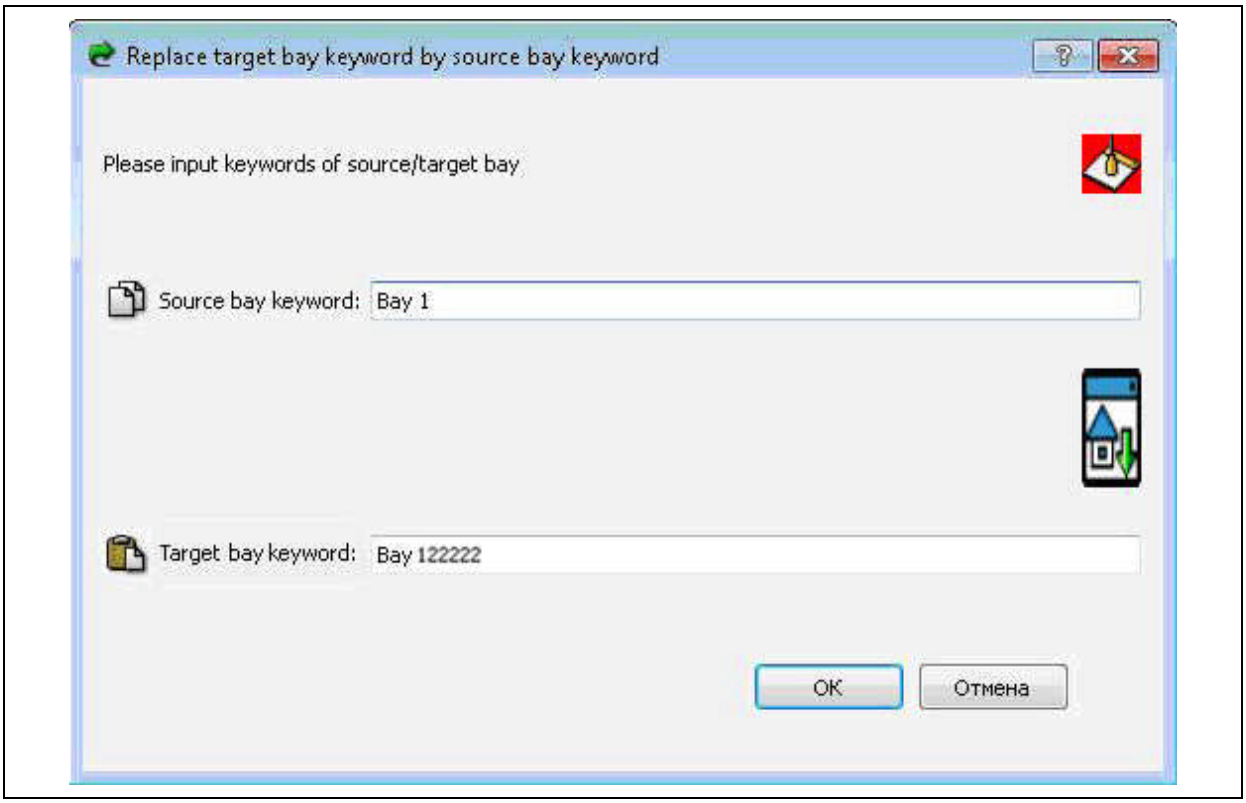


Figure 9.4-24 Bay replacement dialog box

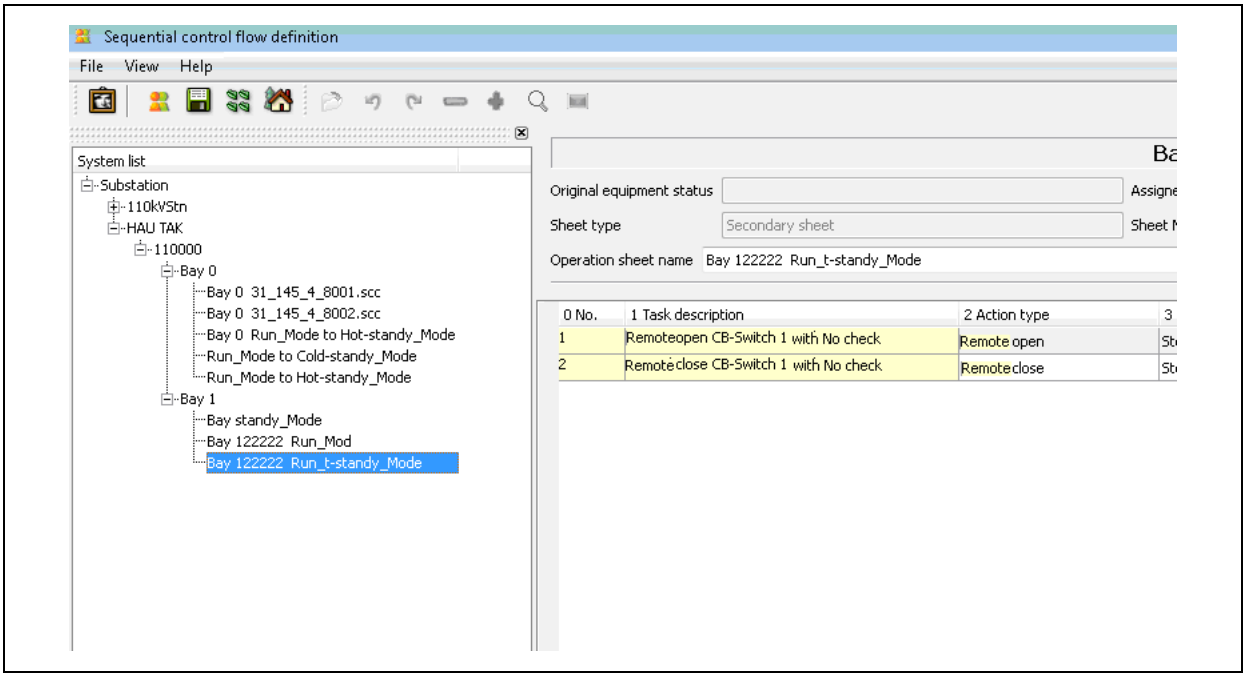


Figure 9.4-25 Results of bay operation sheets keywords replacement

8) Delete all operation sheets of a bay

From the tree type list, select a bay node, or right click mouse on View Attributes view at right side of the operation sheet and select “Delete all operation sheets of this bay” from the shortcut menu

popped up, as shown below.

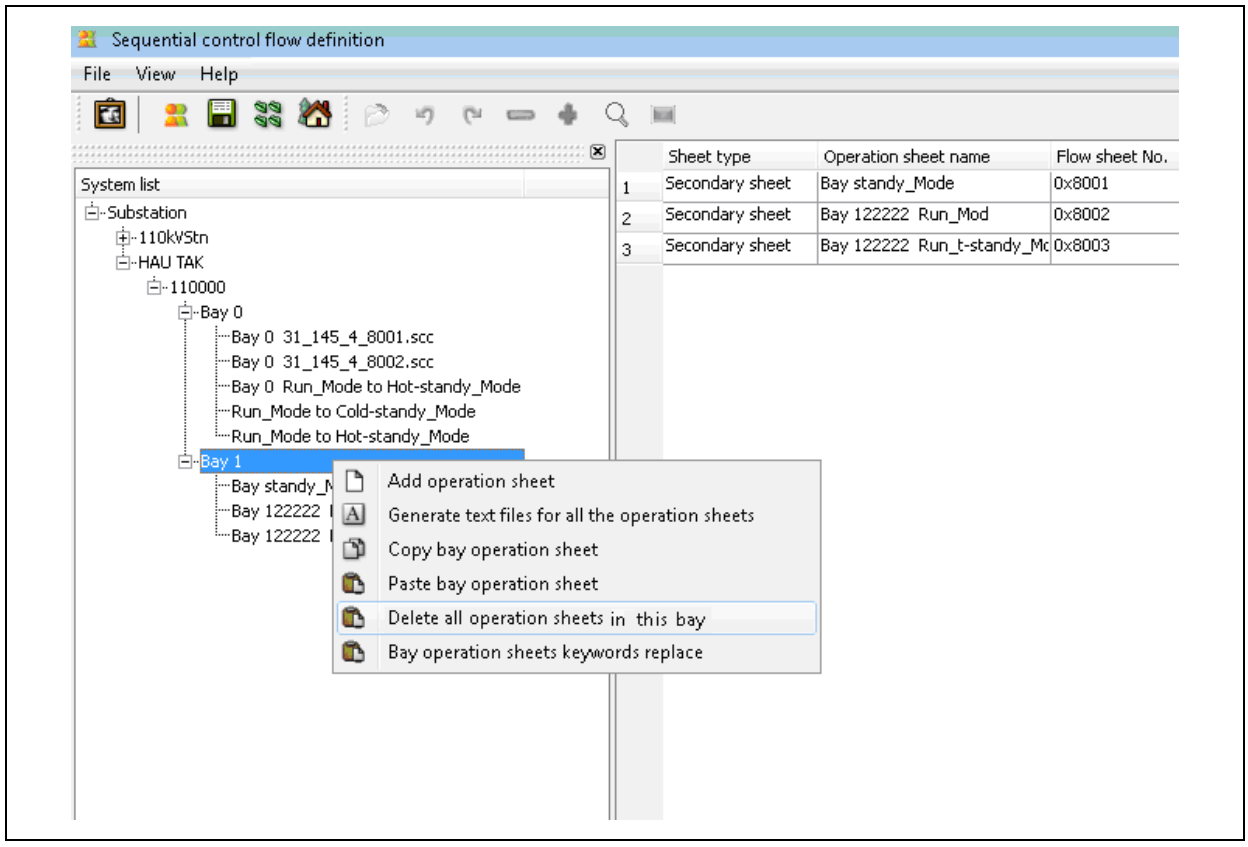


Figure 9.4-26 Delete all operation sheets of a bay

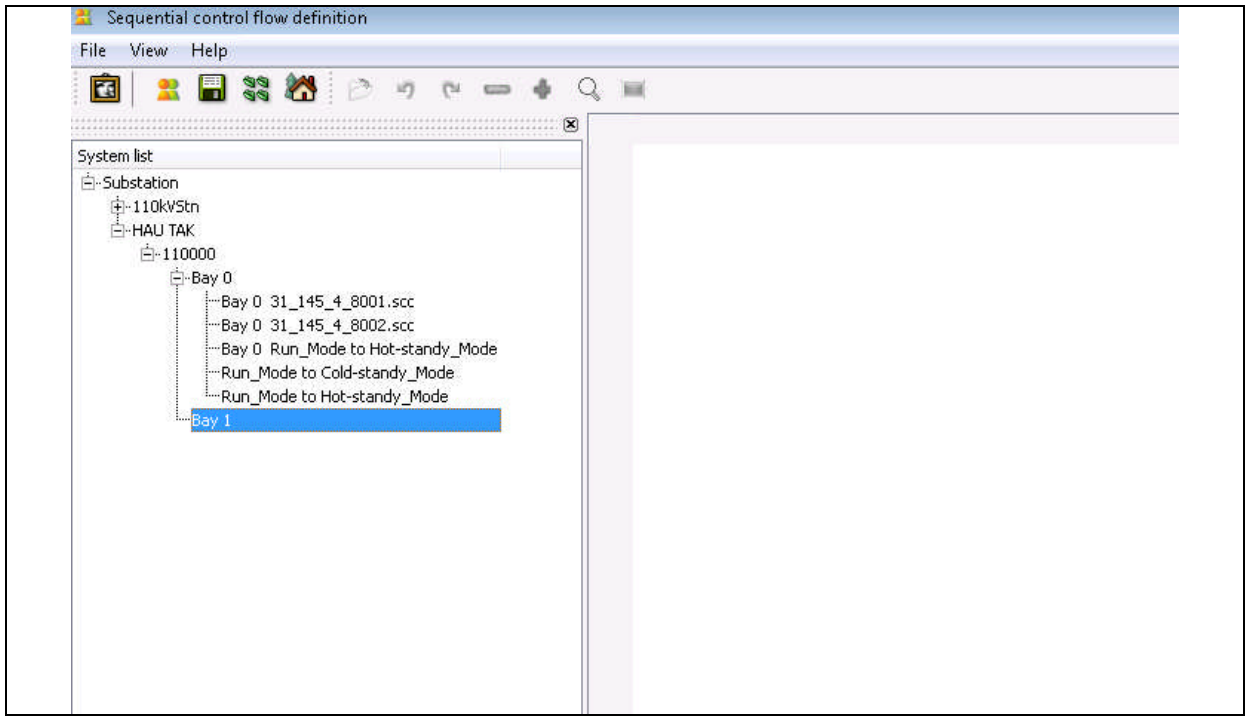


Figure 9.4-27 Schematic of results of deletion of all operation sheets of a bay

9.4.4.3 Operations Relevant to Operation Sheet Tasks

Operation sheet task attributes window is used to display and modify task operations defined for the operation sheet, i.e. operation sheet content parameters. To set definitions of task operations of an operation sheet, user can use the right mouse key for modification and editing, and addition, deletion, and modification of tasks, and define error BI list and error handling mode for current operation sheet, as shown below.

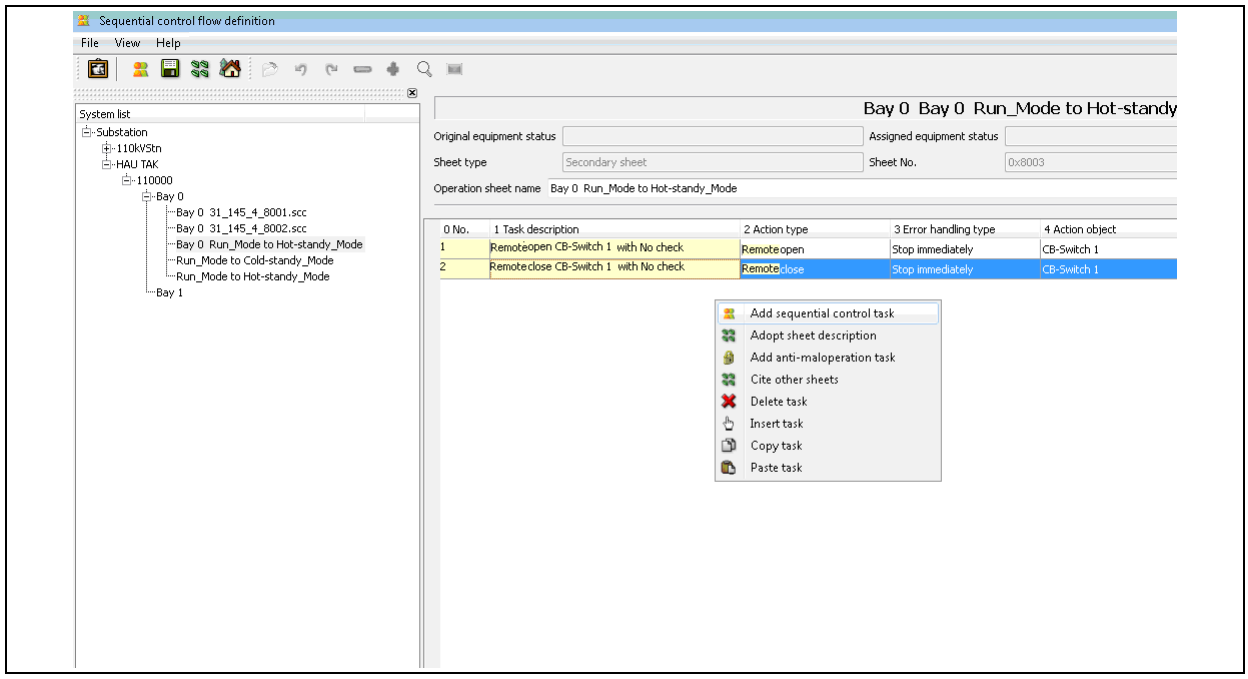


Figure 9.4-28 Operation sheet task attributes window

1） Add task

In “Operation flow” view, right click mouse and select “Add sequential control task” from the shortcut menu popped up, to add a new record in operation flow defined for an operation sheet, as shown below.

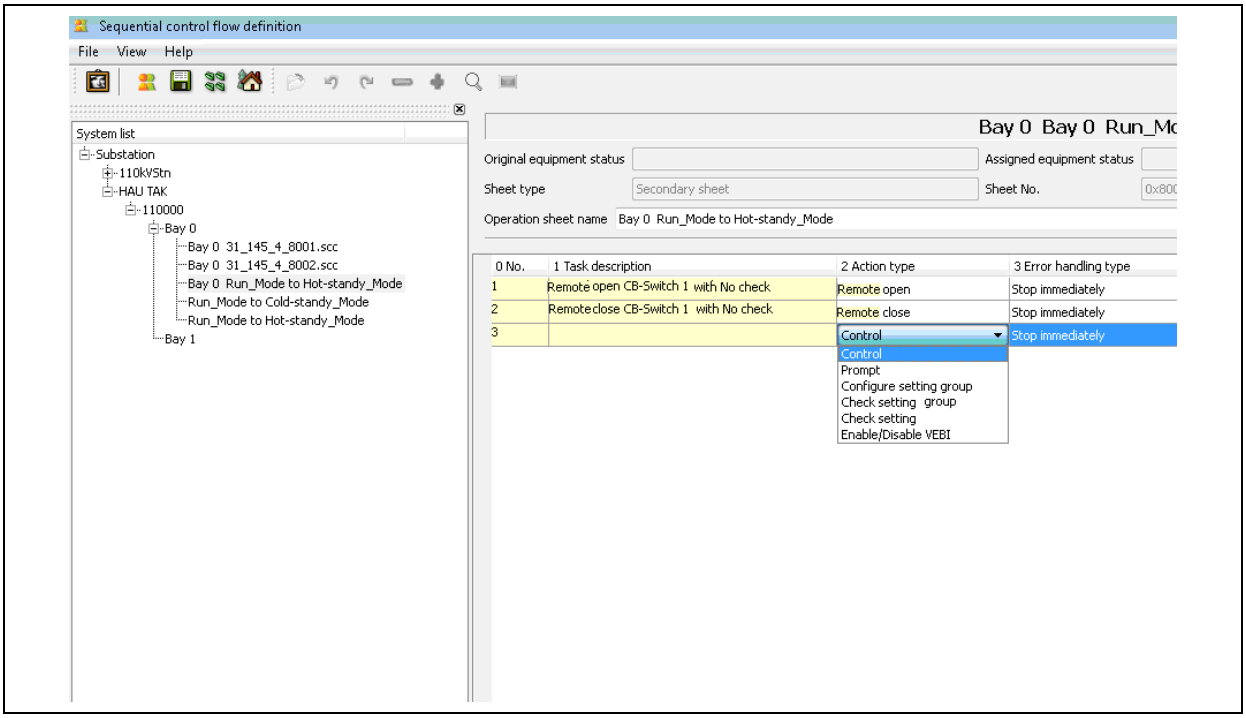


Figure 9.4-29 Add a task record

Later, click “Action type” to select defined type of action, as shown below.

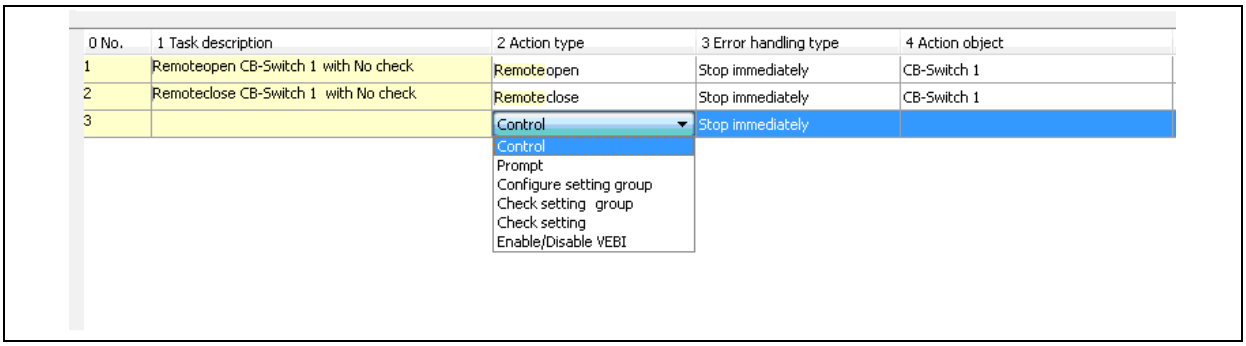


Figure 9.4-30 Select type of action defined

Later, click “operating object” to select defined operating object, as shown below.

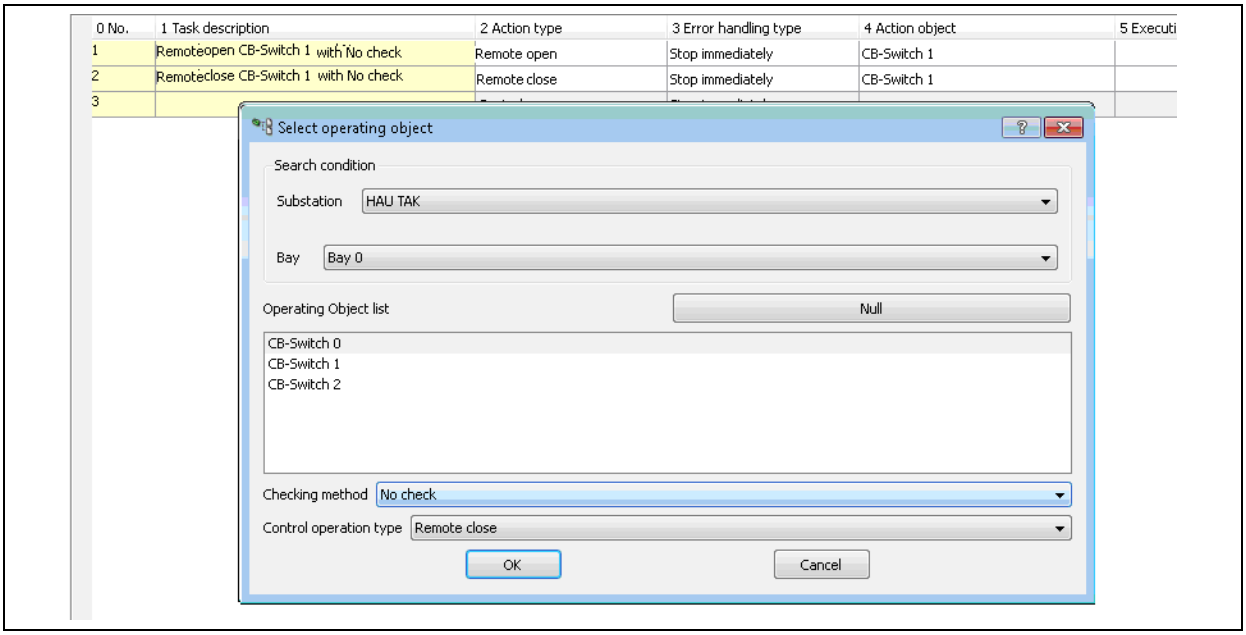


Figure 9.4-31 Select defined operating object

2） Delete task

Select a task to be deleted and right click mouse and select “Delete task” from the shortcut menu popped up, to delete current task of the operation sheet.

3） Insert task

Select a task and right click mouse and select “Insert task” from the shortcut menu popped up, to insert a new task before the selected task.

4） Copy task

Select a task to be copied and right click mouse, and select “Copy task” from the shortcut menu popped up, to copy all information of the selected task.

5） Paste task

In “Operation flow” view, right click mouse and select “Paste task” from the shortcut menu popped up, to paste a copied new task at end of the operation flow.

9.4.4.4 Examples of Process of Definition of Bay Operation sheet and Its Tasks

The sequential control flow operations defined by bay operation sheet and its task flow directly control telecontrol and regulation operations of relevant important equipment in the bay. Not a slight error is allowed in generation of operation sheets and definition of their sequential control flow tasks; otherwise serious production safety accident may occur.

The following describes process of definition of operation sheets and their tasks in details, as well as relevant notes and precautions.

1） Add operation sheet

For specified bay, right click mouse to pop up a shortcut menu, as shown below.

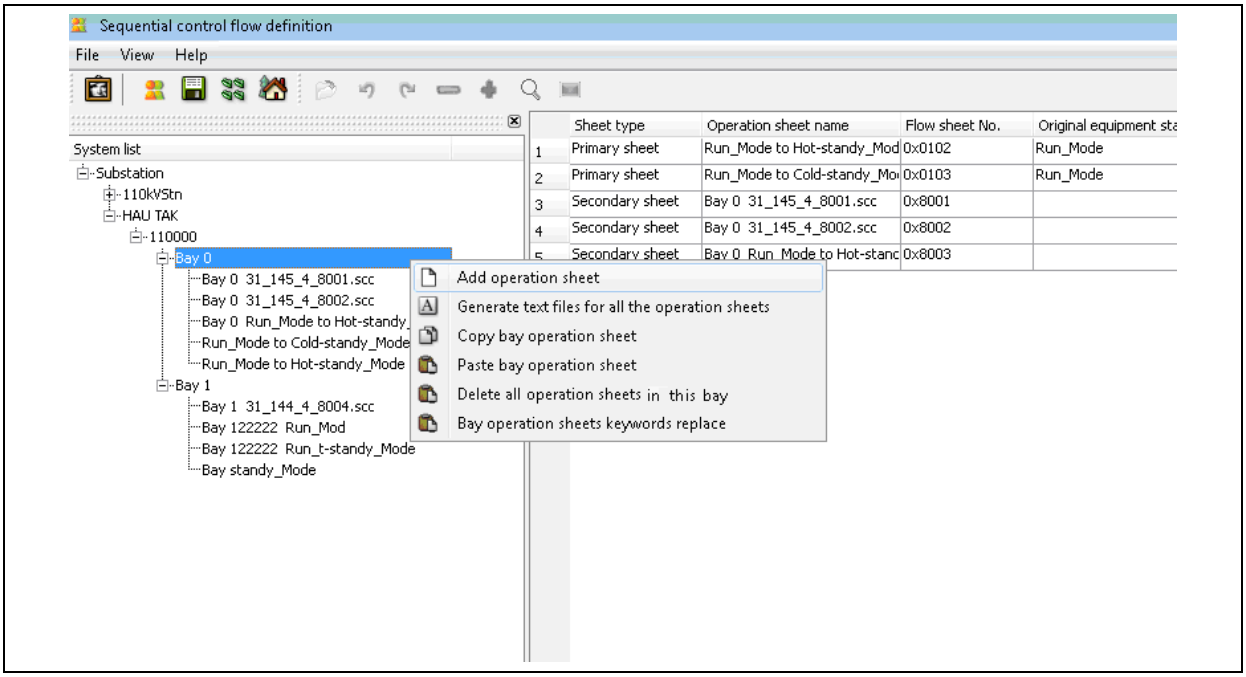


Figure 9.4-32 Shortcut menu

Click to select “Add operation sheet”. “Add operation sheet” dialog box will pop up, as shown below.

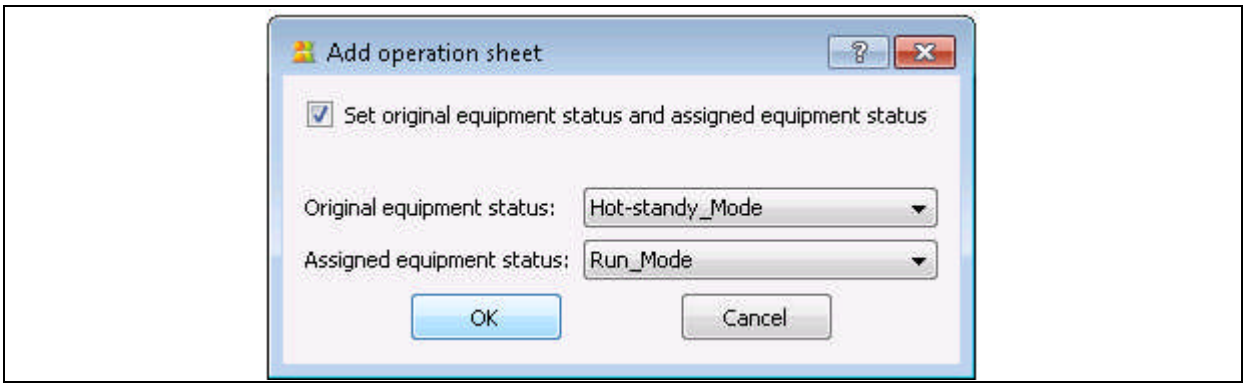


Figure 9.4-33 Add an operation sheet

If primary sheet is selected, user need to select original equipment status and assigned equipment status of current bay. After clicking OK, the operation sheet as shown below will be generated.

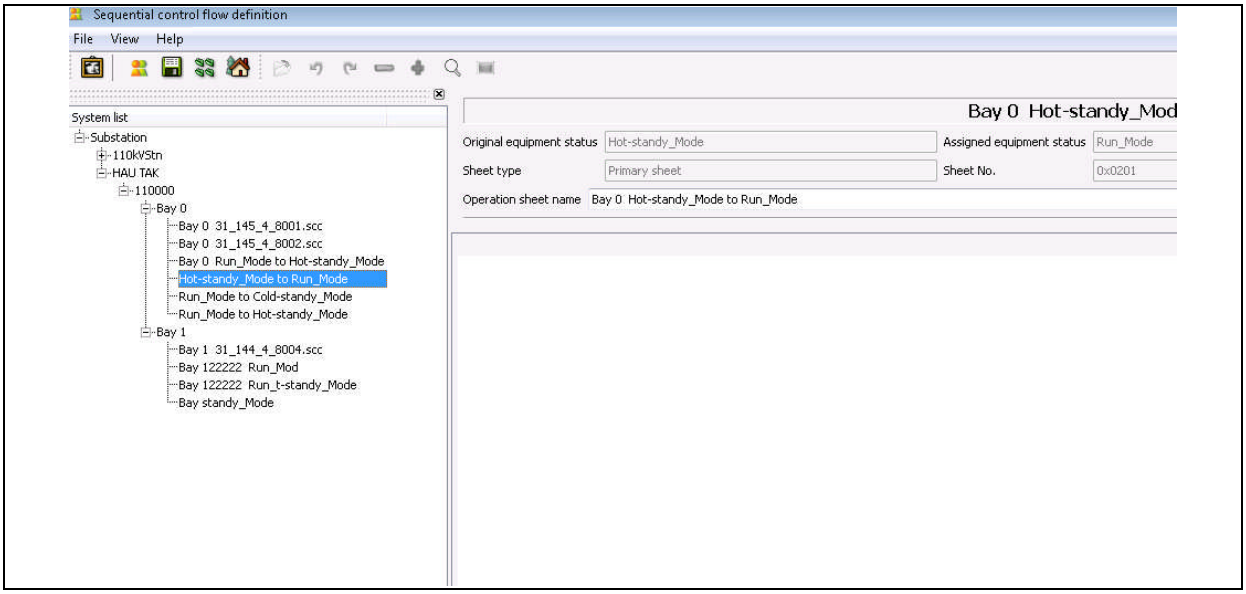


Figure 9.4-34 Generate primary operation sheet

If secondary sheet is selected, user need not select original equipment status or assigned equipment status of current bay, as shown below.

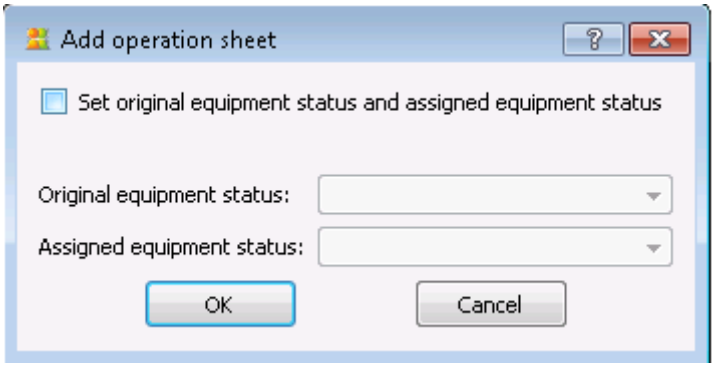


Figure 9.4-35 Add secondary operation sheet

After clicking “OK”, the operation sheet as shown below will be generated.

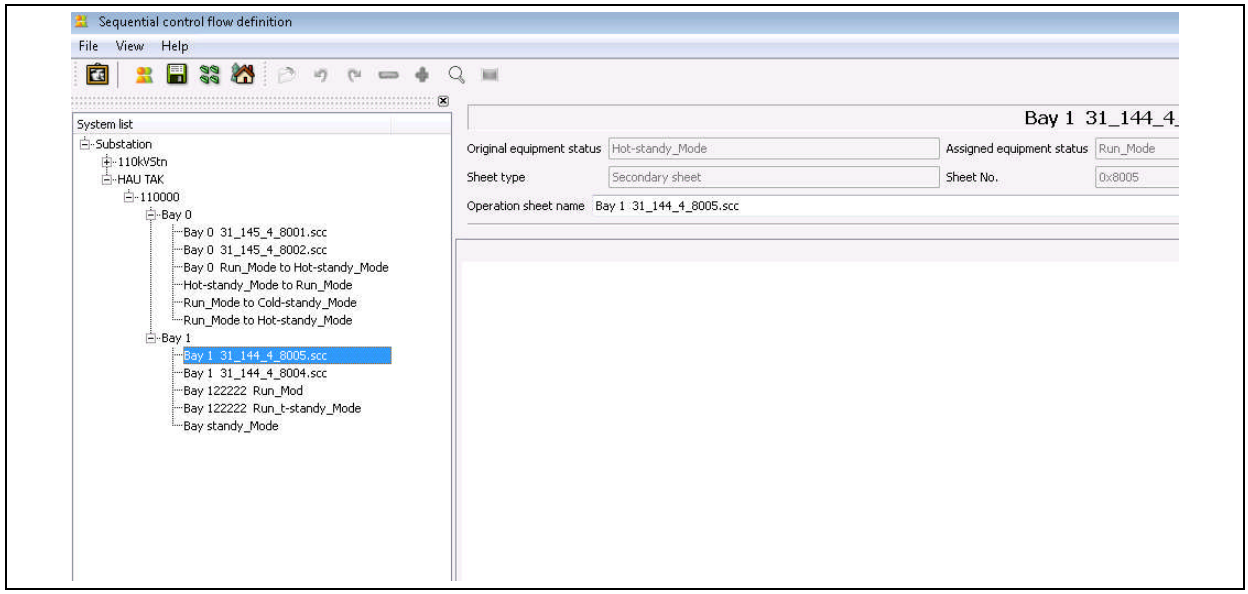


Figure 9.4-36 Generated secondary operation sheet

At this time, the name of secondary operation sheet and its task attributes can be edited (renamed) in the editing box, as shown below.

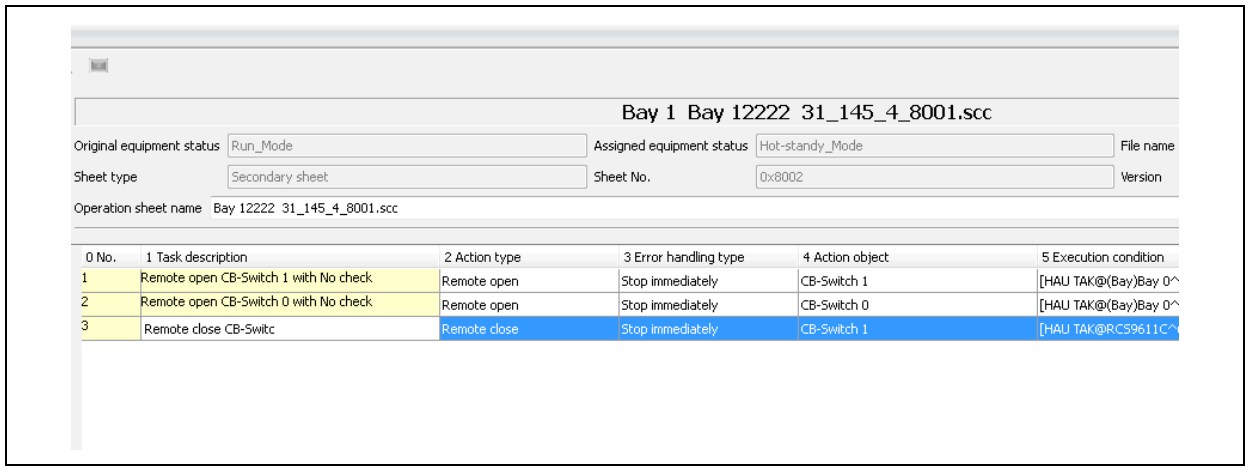


Figure 9.4-37 Editing and modification of operation sheet name and task attributes

2） Add task flow

For specified operation sheet, click to open task editing view of current operation sheet, as shown below.

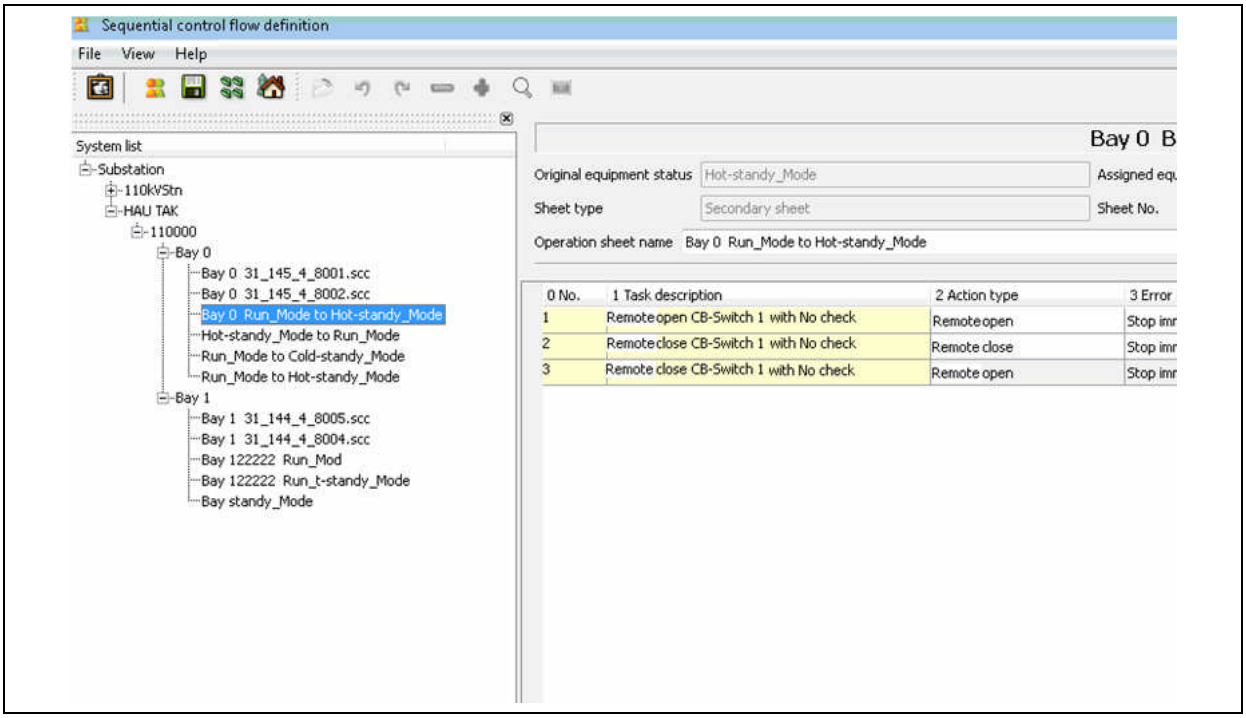


Figure 9.4-38 Operation sheet task editing view

In operation flow view, right click mouse to pop up a shortcut menu, to select Add flow task, as shown below.

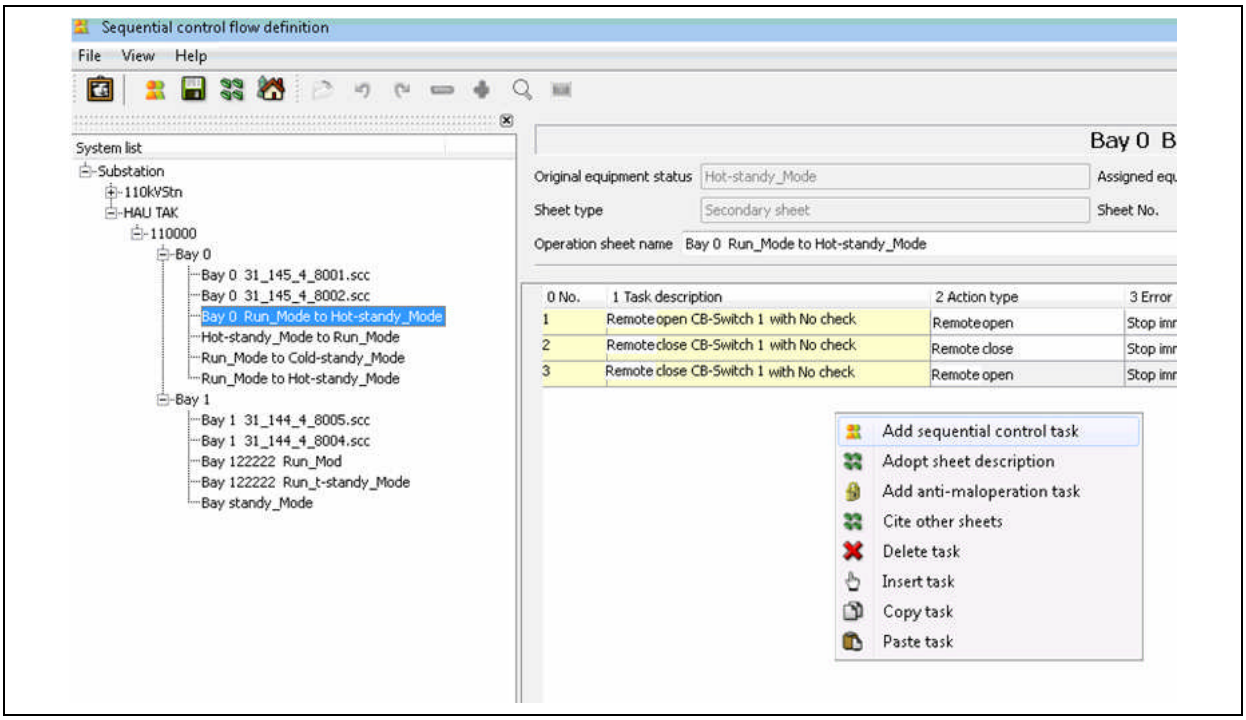


Figure 9.4-39 Add flow task

After adding a task, display of result is shown below. For current task record, some necessary values have been set in advance, e.g. time delay and timeout period etc., as shown below.

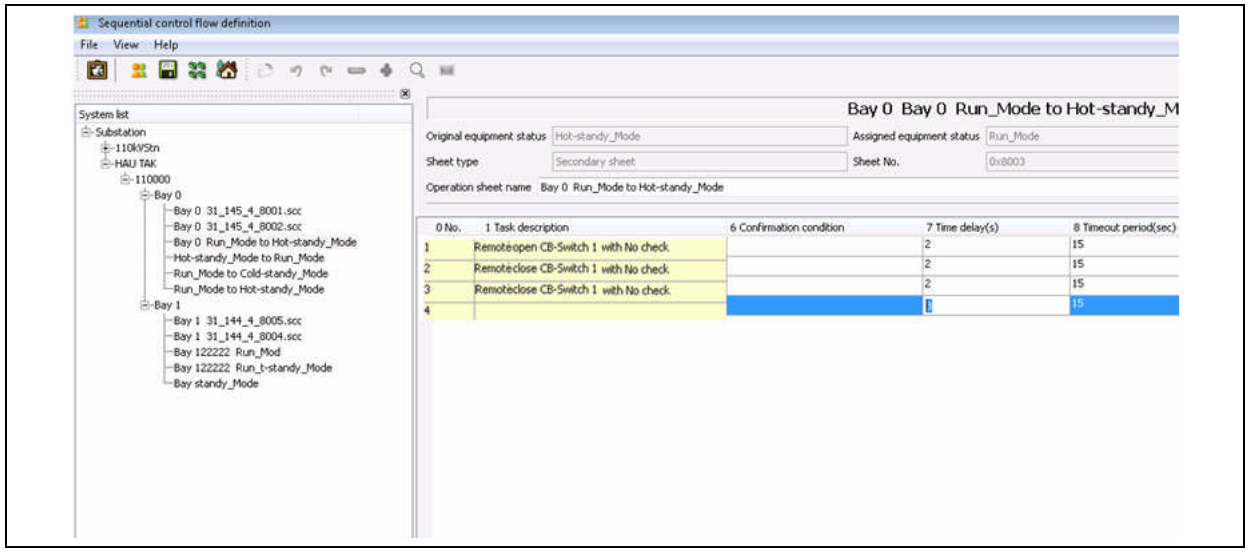


Figure 9.4-40 Set time delay and timeout period

At this time, user can select action type as required for current operation sheet. Take control as an example:

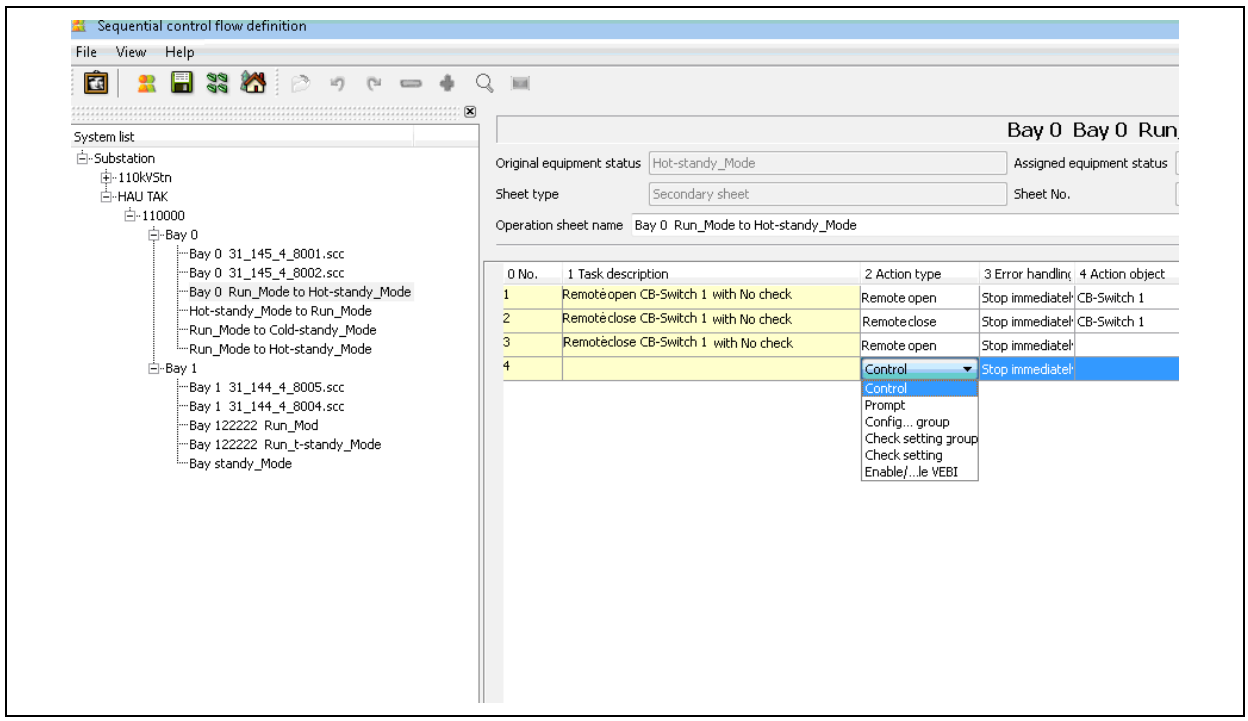


Figure 9.4-41 Modify selected action type to control

Click to select “operating object”, as shown below.

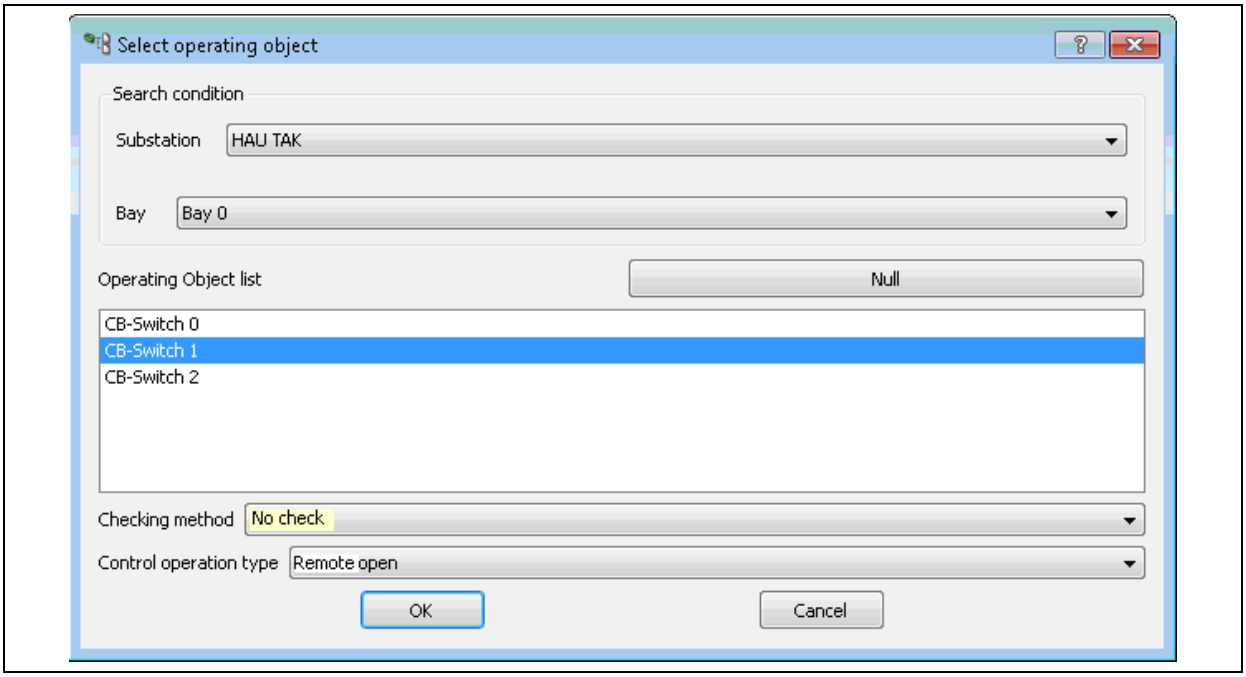


Figure 9.4-42 Select control operating object

"Checking Method" here indicates some interlock checks performed during execution of current control, e.g. "dead check" and "synchronism-check" etc., as shown below.

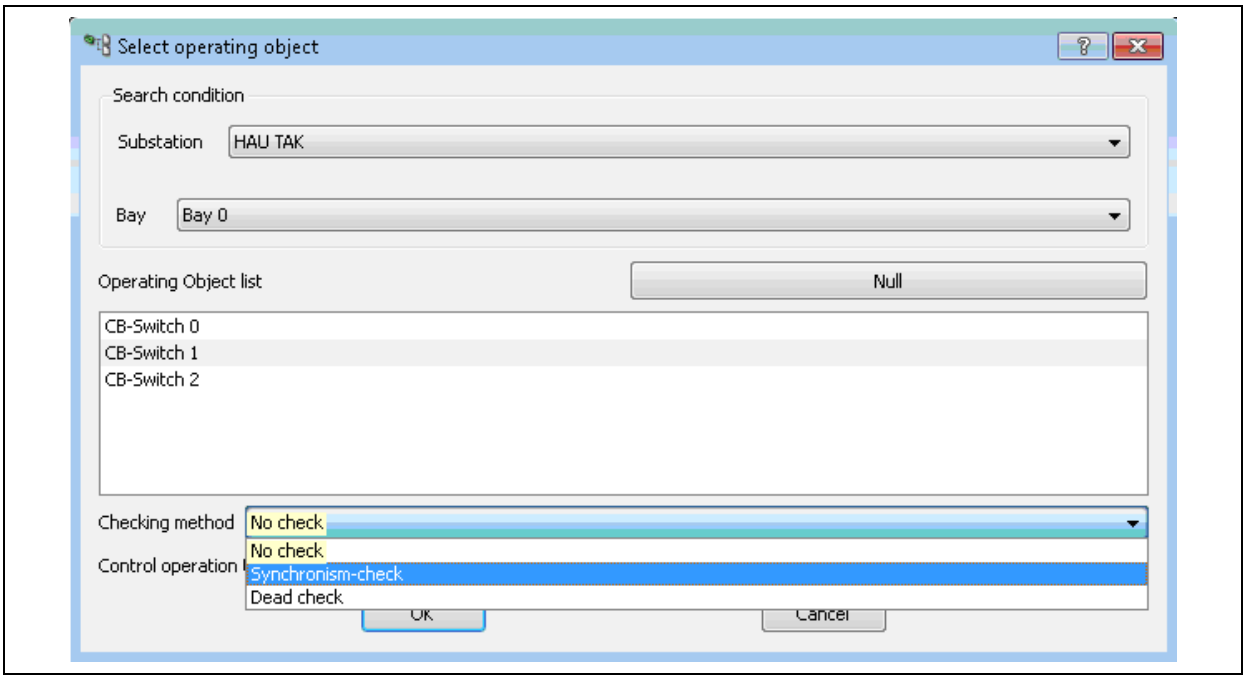


Figure 9.4-43 Dead check and synchronism-check

Control action type refers to current control operation, i.e. "remote open" or "remote close".

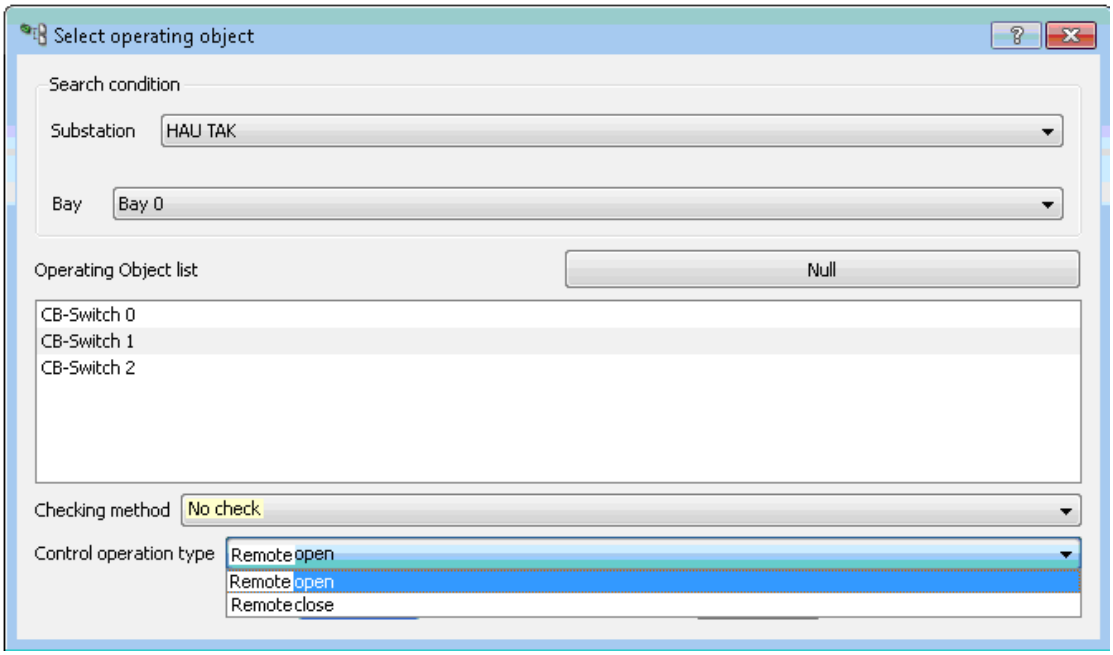


Figure 9.4-44 Control action type

Here, for checking mode, select “synchronism-check”, and for control action type, select “remote close”. Result is shown below.

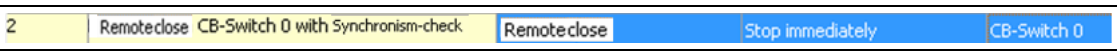


Figure 9.4-45 Result of control task setup

In case “Task description” field is empty, after selecting “operating object” and “action type”, description of this task will be automatically generated in “Task description”. User can modify this as required.

According to needs by current task operation, click “execution condition” field to set execution condition of closing by control, that is to say, circuit breaker status is the condition for closing. At the same time, if required, it is necessary to add suitable check of interlock conditions, e.g. earthing of earthing switch, as shown below.

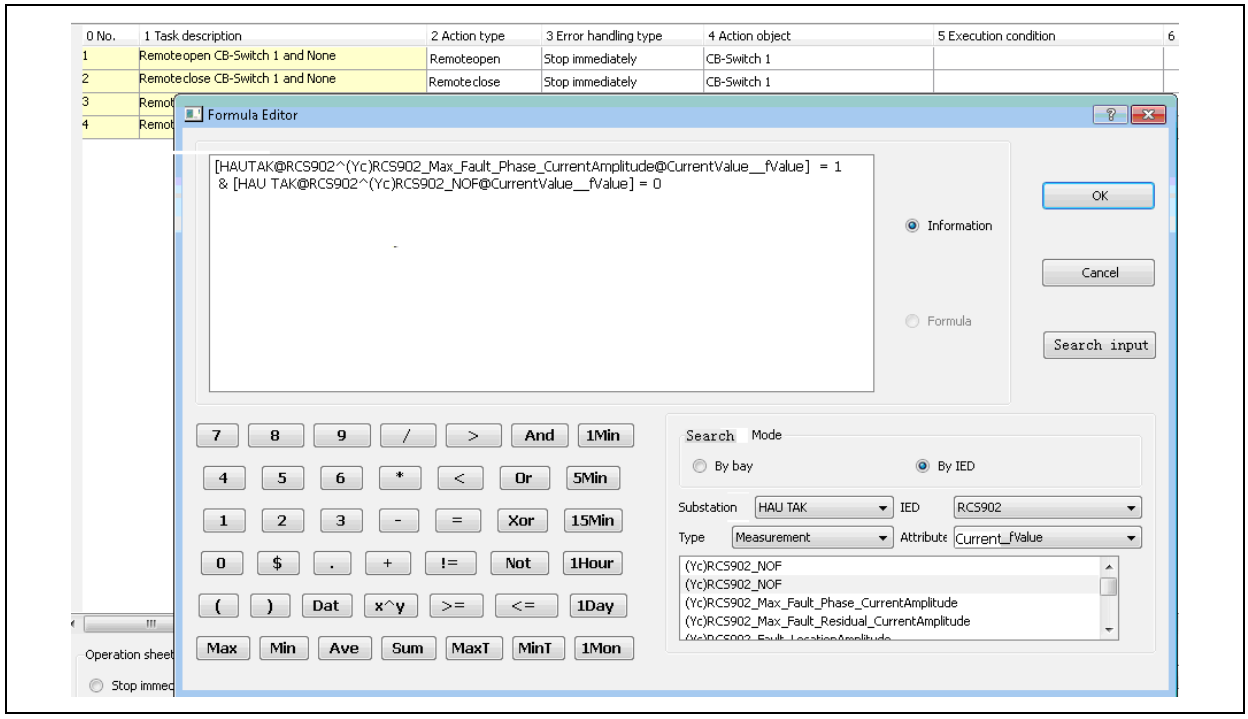


Figure 9.4-46 Control task execution condition

Similarly, set “confirmation condition” to tell success of operation, as shown below.

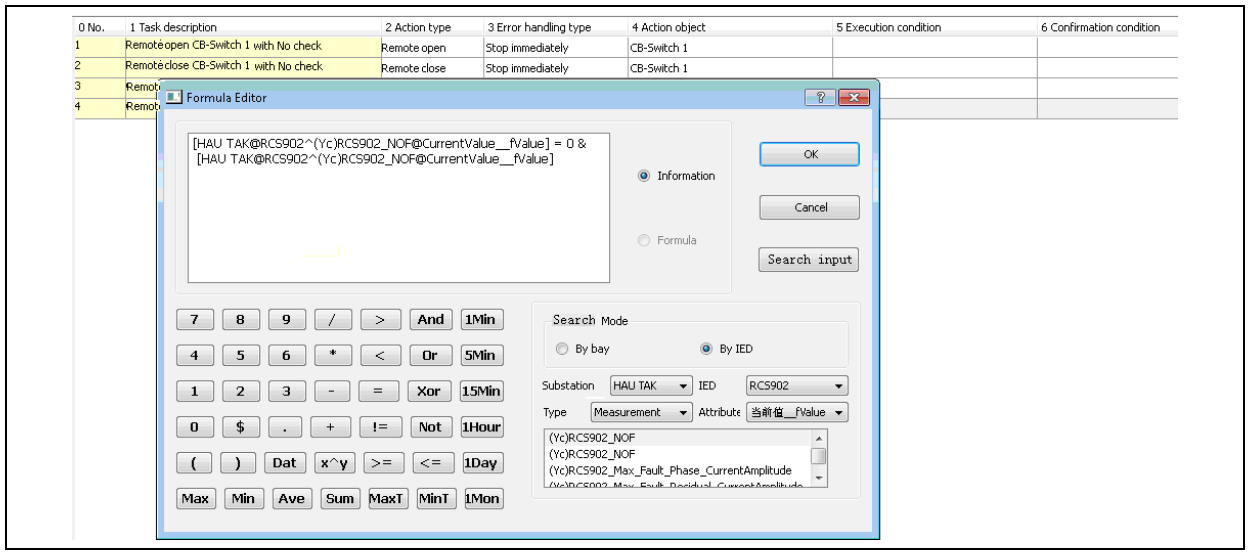


Figure 9.4-47 Control task confirmation condition

Next, user can modify time delay and timeout period of execution of current task according to requirement by current task, as shown below.

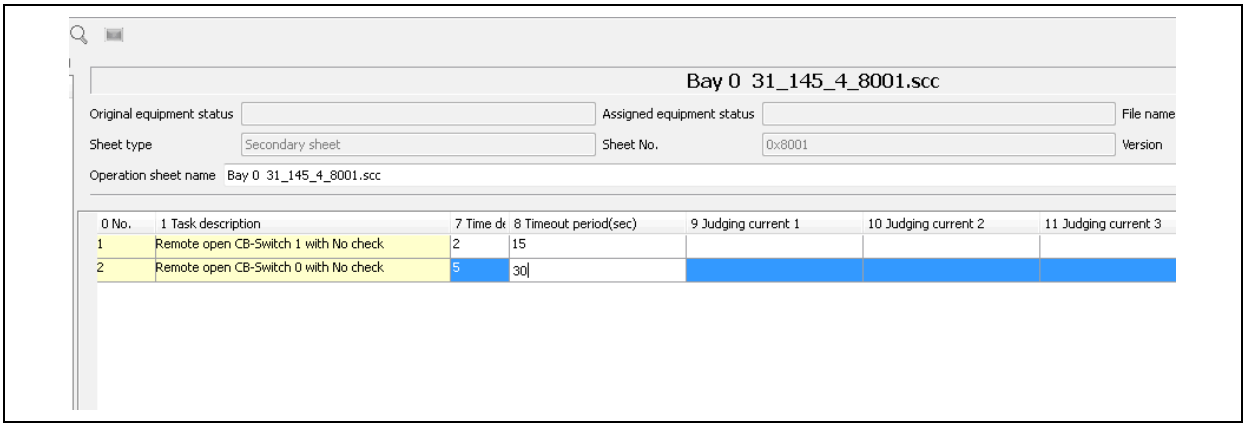


Figure 9.4-48 Time delay and timeout period of control task

Finally, determine if there is judging current after execution of current task. If yes, enter relevant judging current, as shown below.

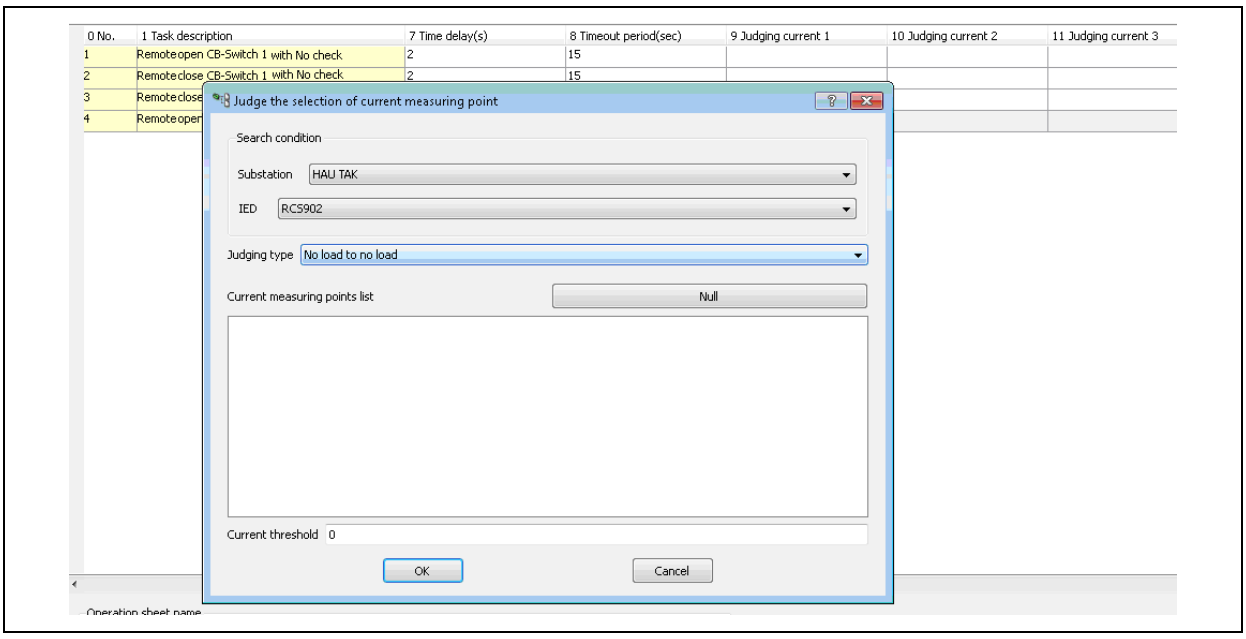


Figure 9.4-49 Control task judging current

Similarly, user can add other sequential control operation tasks.

Next, user can set error handling mode for current operation sheet in case of BI signal defined in “error BI list” during execution of current operation sheet as required: “stop immediately” or “prompt the user to stop or continue”, as shown below.

Figure 9.4-50 Error BI

Lastly, user can set error criterion during execution of current operation sheet: “Error BI list”. Click button “Add error BI”; the system will pop up “Error BI list” dialog box as shown below.

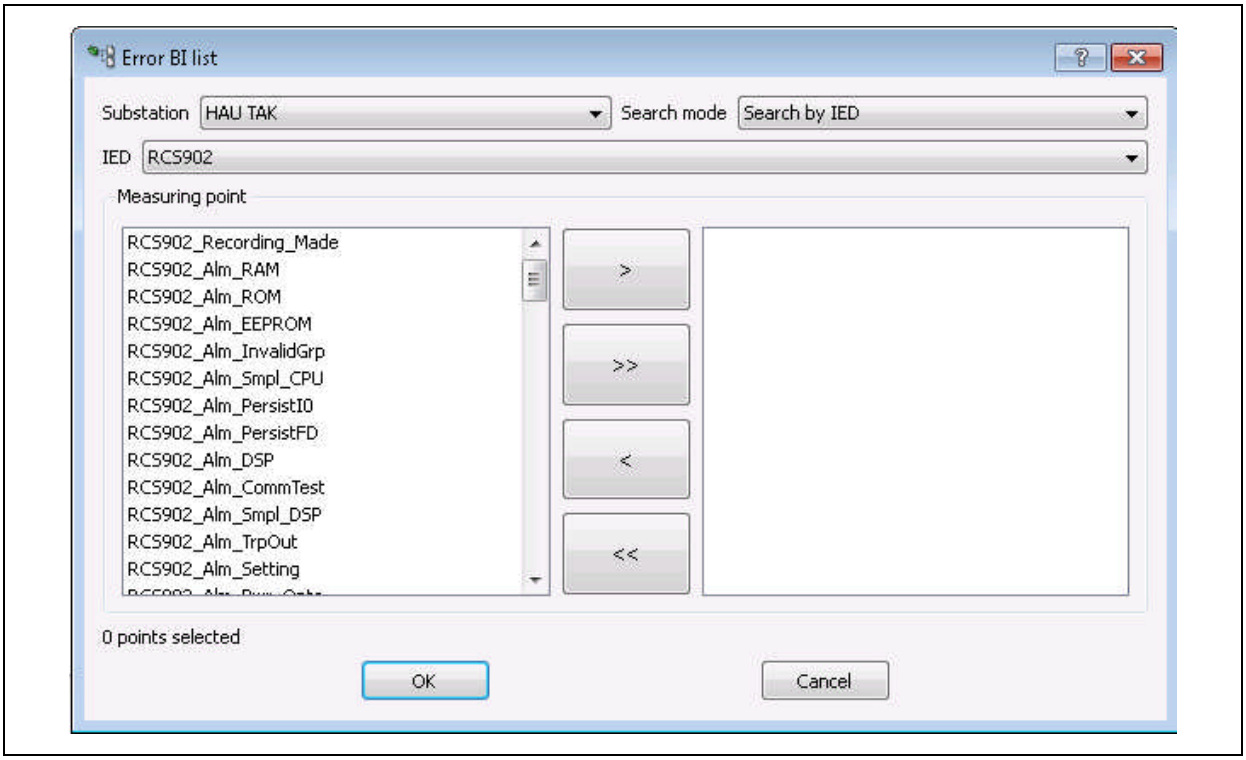


Figure 9.4-51 Error BI list

User can use “Substation”, “Search mode” (all measuring points, search by IED, search by bay) to find measuring point information.

Up to this point, an operation sheet is completed, as shown below.

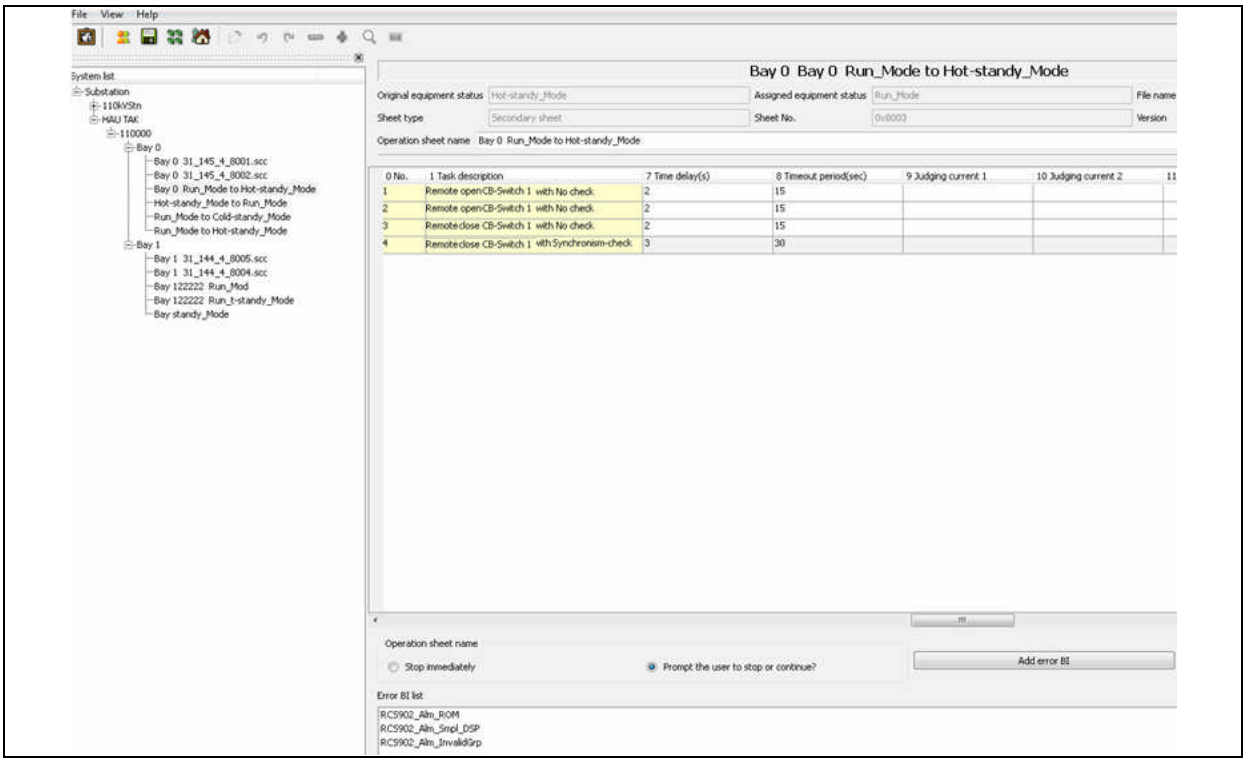


Figure 9.4-52 Completion of an operation sheet

9.4.5 Possible Problems and Operation Skills

9.4.5.1 Busy Database Prompted During Saving of Sequential Control Definition

Possible cause is that the sequential control flow definition is just saved, database is being saved during publishing of sequential control data, or saving of configuration is in progress. At this time, wait for a suitable period and then save sequential control flow definition again.

9.4.5.2 Using Defined Tasks

During definition of operation sheets by sequential control flow, defined sequential control tasks can be referenced or used, to accelerate generation of operation sheets by means of copying and pasting functions.

9.4.5.3 Consideration of Bay Operation Sheet Copying Function for Same Types of Bays

When defining equipment statuses, start to consider and prepare for use of bay operation sheet copying function for bays of the same type (e.g. lines of the same voltage level) when the same template group is referenced during sequential control flow definition, if the process of operation sheet definition is consistent, to accelerate generation of operation sheets and improve accuracy of operation sheet definition.

9.4.5.4 Bay Copying Function Requires Careful Checking

During sequential control flow definition, use of bay operation sheet copying and pasting functions for bays of the same type requires manual participation and checking to confirm that all operation sheet task flows generated after pasting are correct sequential control flows required for operation sheets of this bay. Also confirm if relevant task flow operations require careful checking and confirmation. Only download operation sheet definitions to the execution device after confirmation that such definitions are correct.

10 System Parameter Setup

10.1 General

System parameter setup shows common functions and configuration parameters of the system in a friendly interface, to facilitate user to adjust system operating status at any time. In addition, online adjustment of system parameters is supported, without the need of system reboot.

System configuration includes 3 main parts: graph setup, alarm setup, and SCADA setup.

10.2 Graph Setup

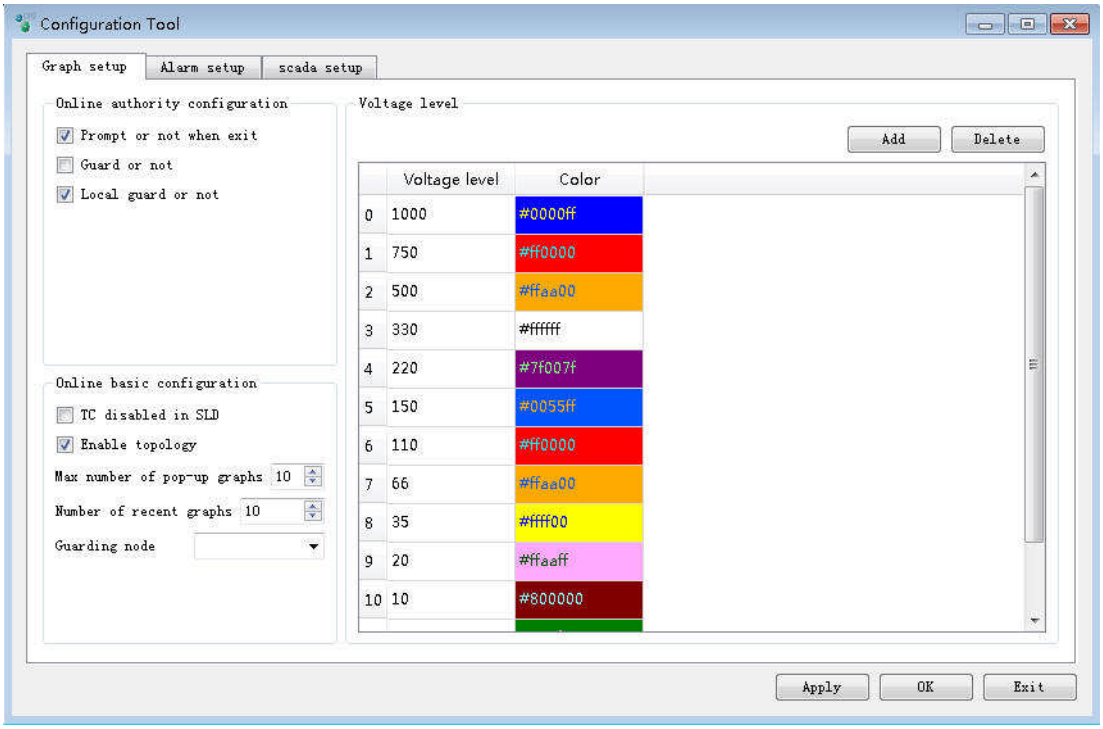


Figure 10.2-1 Graph setup

Table 10.2-1 Description of graph settings

Configuration item	Description	Data type	Unit
Prompt or not when exit	Click Close button Online without prompt box	BOOL	N/A
Guard or not	If telecontrol requires verification by guardian	BOOL	N/A
Local guard or not	When checked, guardianship is provided at the same node.	BOOL	
TC disabled in SLD	When checked, single line diagram will prohibit telecontrol. In graph editor, all graphs for which “Fill model” is checked	BOOL	N/A

Configuration item	Description	Data type	Unit
	are deemed SLD.		
Enable topology	When checked, topology will be enabled.	BOOL	N/A
Max. number of pop-up graphs	Max. number of windows that are allowed to pop up in case of alarm. When this number is exceeded, graph will be opened in the beginning window.	Integer	N/A
Number of recent graphs	Number of graphs recently opened and saved by Online history menu. When this number is exceeded, the beginning record will be overlaid.	Integer	N/A
Guarding node	The guarding node specified for remote guard	Character string	N/A
Voltage level	Set color displayed for each voltage level	Floating point	kV

10.3 Alarm Setup

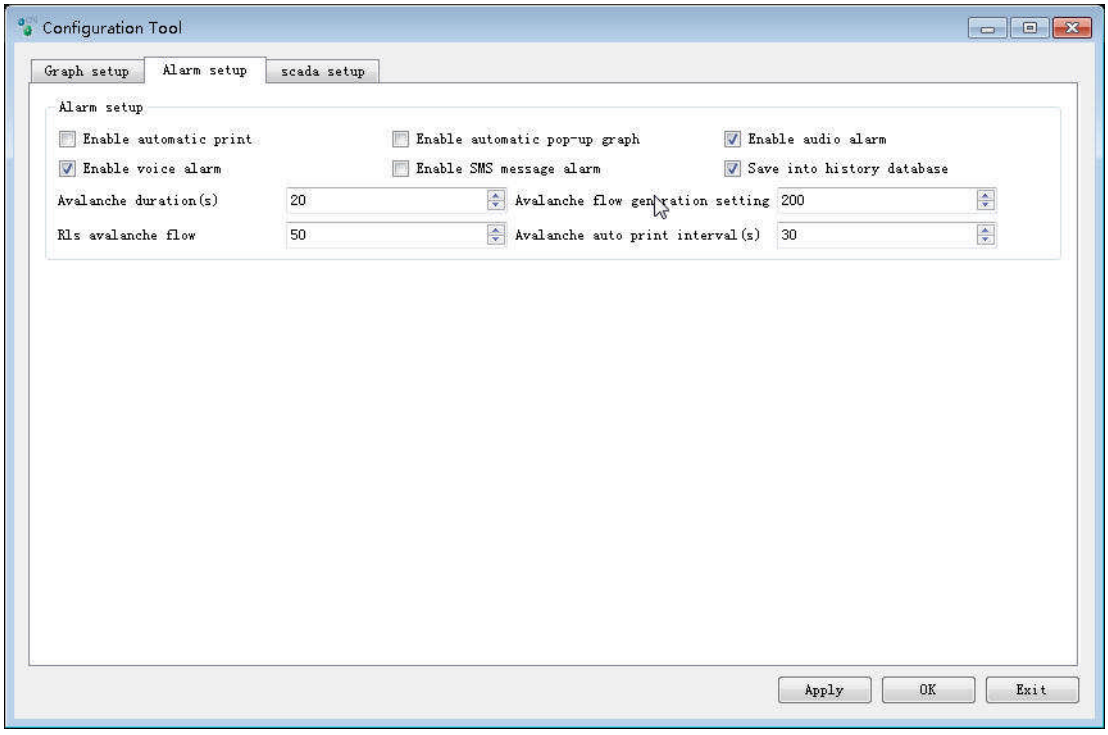


Figure 10.3-1 Alarm setup

Table 10.3-1 Description of alarm settings

Configuration item	Description	Data type	Unit
Enable automatic printing	Set system class: if automatic printing is enabled. An event will only be printed automatically if this option is selected and automatic printing in event alarm processing is set to True.	BOOL	N/A

Configuration item	Description	Data type	Unit
Enable automatic pop-up graph	Set system class: if automatic graph pop-up is enabled. The graph will only pop up automatically if this option is selected and automatic graph pop-up on alarm in event alarm processing is set to True.	BOOL	N/A
Enable audio alarm	Set system class: if audio function is enabled. Audio alarm will only be enabled if this option is selected and audio alarm in event alarm processing is set to True.	BOOL	N/A
Enable voice alarm	Set system class: if voice function is enabled. Voice alarm will only be enabled if this option is selected and voice alarm in event alarm processing is set to True.	BOOL	N/A
Enable SMS message alarm	Set system class: if SMS message function is enabled. SMS message alarm will only be generated if this option is selected and SMS message sending in event alarm processing is set to True.	BOOL	N/A
Save into history database	Set system class: if saving in history database function is enabled. Alarm event will only be saved into history database if this option is selected and Save into history database in event processing is set to True.	BOOL	N/A
Avalanche duration	Duration of judgment of avalanche; avalanche is deemed occurred if number of events in this duration exceeds the “avalanche flow generation setting”	Integer	s
Avalanche flow generation setting	In avalanche duration, number of events judged	Integer	item
Rls avalanche flow	If number of events is less than “release avalanche flow” during avalanche duration, avalanche status is deemed canceled	Integer	Item
Avalanche auto print interval	Automatic printing interval in case of avalanche	Integer	s

10.4 SCADA Setup

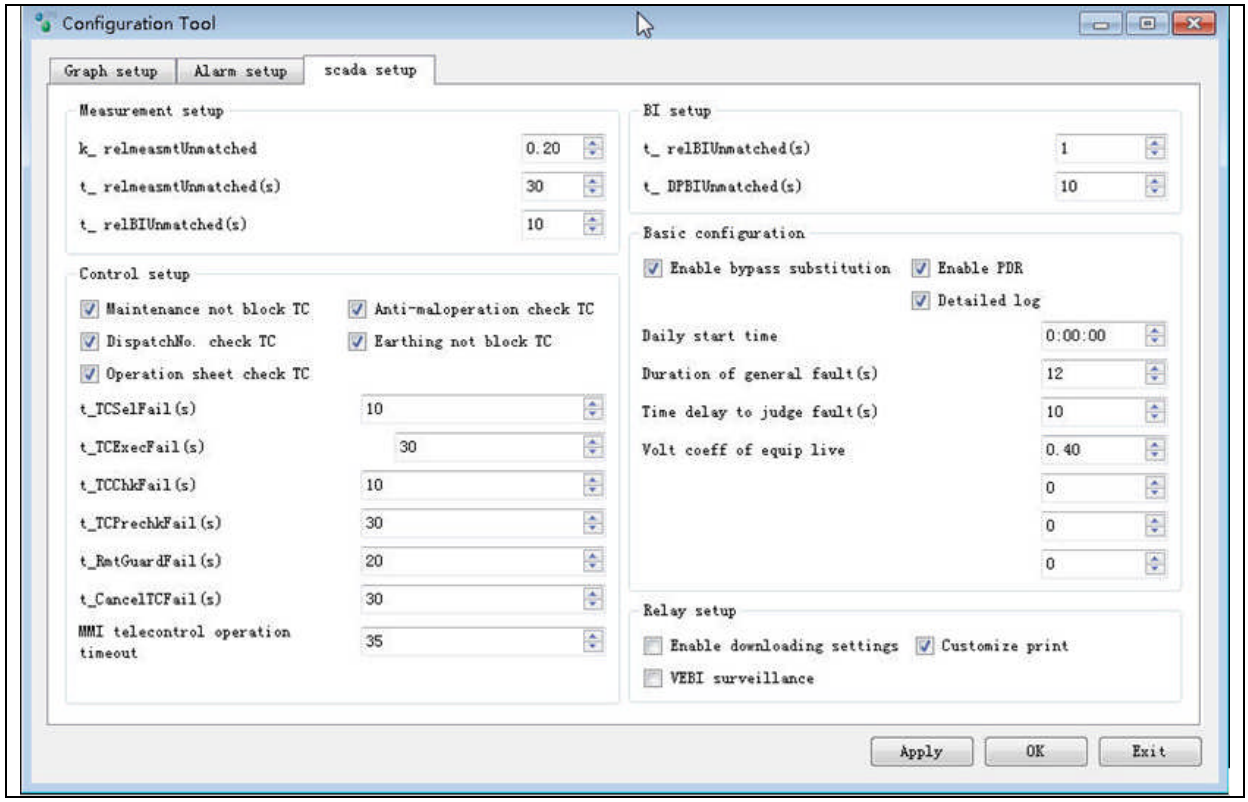


Figure 10.4-1 SCADA setup

- Measurement setup

Configuration item	Description	Data type	Unit
k_relmeasmtUnmatched (unmatched relevant measurement judging coefficient)	One of the conditions to judge unmatched relevant measurement of a measurement quantity. This is only judged if difference between this measurement quantity and its relevant measurement quantity exceeds current setting and this condition is satisfied for a period longer than "t_relmeasmtUnmatched".	Floating point	N/A
t_relmeasmtUnmatched (s) (unmatched relevant measurement judging time)	One of the conditions to judge unmatched relevant measurement of a measurement quantity. This is only judged if difference between this measurement quantity and its relevant measurement quantity exceeds "k_relmeasmtUnmatched" for duration longer than set time in current parameter.	Integer	s
t_relBIUnmatched (s) (unmatched relevant BI judging time)	Unmatched relevant BI is judged if current measurement quantity is not 0, relevant BI quantity is 0, and duration of these conditions exceeds this setting.	Integer	s

- Control setup

Configuration item	Description	Data type	Unit
Maintenance not block TC	Switch setting on permission of control when relevant substation, bay, or equipment to be controlled is in maintenance state.	BOOL	N/A
Anti-maloperation check TC	Set if check of anti-maloperation is required for control	BOOL	N/A
Dispatch No. check TC	Set if check of dispatch No. is required for control	BOOL	N/A
Earthing not block TC	Set if control is permitted when relevant substation, bay, or equipment is earthed.	BOOL	N/A
Operation sheet check TC	Set if check of operation sheet is required for control	BOOL	N/A
t_TCSelFail (s) (telecontrol selection failure time)	Time delay to judge SCADA control selection timeout	Integer	s
t_TCExecFail (s) (telecontrol execution failure time)	Time delay to judge SCADA control execution timeout	Integer	s
t_TCChkFail (s) (telecontrol check failure time)	Time delay to judge SCADA control check (mainly check of anti-maloperation)	Integer	s
t_TCPrechkFail (s) (telecontrol pre-check failure time)	Graph waiting timeout period for pre-check of control point information	Integer	s
t_RmtGuardFail (s) (remote guard failure time)	Timeout period of waiting for return of result of remote guard during control operation on graph (if remote guard is adopted)	Integer	s
t_CancelTCFail (s) (cancel telecontrol failure time)	Timeout period of waiting for return of operation result after control on graph is canceled	Integer	s
MMI telecontrol operation timeout (s)	After successful control selection, this control needs to be executed within a set time; otherwise SCADA will deem timeout and cancel this control operation.	Integer	s

- BI setup

Configuration item	Description	Data type	Unit
t_relBIUnmatched (s) (time to judge unmatched relevant BI)	Unmatched relevant BI of current BI quantity is judged if value of current BI quantity is unmatched with value of relevant BI quantity (current BI is open, relevant BI is close; or vice versa) for a period longer than this setting	Integer	s
t_DPBIUnmatched (s) (time to judge unmatched double position BI)	Unmatched double position BI of current BI quantity is judged in case of double position abnormity of value of current BI quantity with value of double position BI quantity (both current BI and double position BI are open or close) for a period longer than this setting.	Integer	s

- Basic configuration

Configuration item	Description	Data type	Unit
Enable bypass substitution	Switch setting to determine if SCADA enables bypass substitution function	BOOL	N/A
Enable PDR	Switch setting to determine if SCADA enables PDR data saving function	BOOL	N/A
Daily start time	Set start time of a day for statistic calculations of SCADA	time	N/A
Duration of general fault (s)	In case of general fault of substation (bay), all CB-switch tripping related to this substation (bay) during the hold time will be judged as accident tripping of this substation (bay)	Integer	s
Time delay to judge fault (s)	In case of tripping of CB-switch, if general fault occurs in corresponding substation (bay) within this time delay, this tripping will also be judged as accident tripping of this substation (bay).	Integer	s
Detailed log	If SCADA records detailed log of system; when this value is True, detailed log recording will be enabled.	BOOL	N/A
Volt coeff of equip live	Threshold coefficient used by SCADA to judge if equipment is live	Floating point	N/A

- Relay setup

Configuration item	Description	Data type	Unit
Enable download settings	Enable settings download operation in relay management software	BOOL	N/A
Customize print	Print according to user defined format	BOOL	N/A
VEBI surveillance		BOOL	N/A

11 Authority Management

11.1 General

Authorities have the following objects:

1） Authority domain

The authority domain is a comparatively flexible concept and its granularity can be defined at will. Normally, we can define a group of correlated authorities as one authority domain and the system will set a group of authorities defined according to application in default. An authority domain includes a group of function points and user roles defined on such function points.

2） Function point

A particular authority check point is referred to as a function point.

3） Role

A defined user group under a domain who has authorities of this domain. For example, under domain sysman, roles of system administrator and system maintenance personnel etc. are defined. A role can be associated with function points under the domain. Normally, the system administrator can be associated to all function points under the domain, that is to say, possess all authorities, while other roles can be customized at will and as required.

4） User

Personnel who operate the system. Particular authorities of a user are defined by association with roles under each domain. Each user can play different roles under different domains, or play a number of roles under one domain. This makes the authority system very flexible.

5） User operation node

Nodes that can be operated by different users vary. Nodes that may be operated by a user cab be defined. In default, users can operate all nodes.

11.2 Description of Operation

Figure 11.2-1 Login

Enter priv_manager at command line or click “Maintenance→Authority management tool” on the console to activate authority management tool. If only user password needs to be changed, this can be done directly without log-in the authority management tool.

Figure 11.2-2 Modify password

Authority management main interface is shown in the following figure.

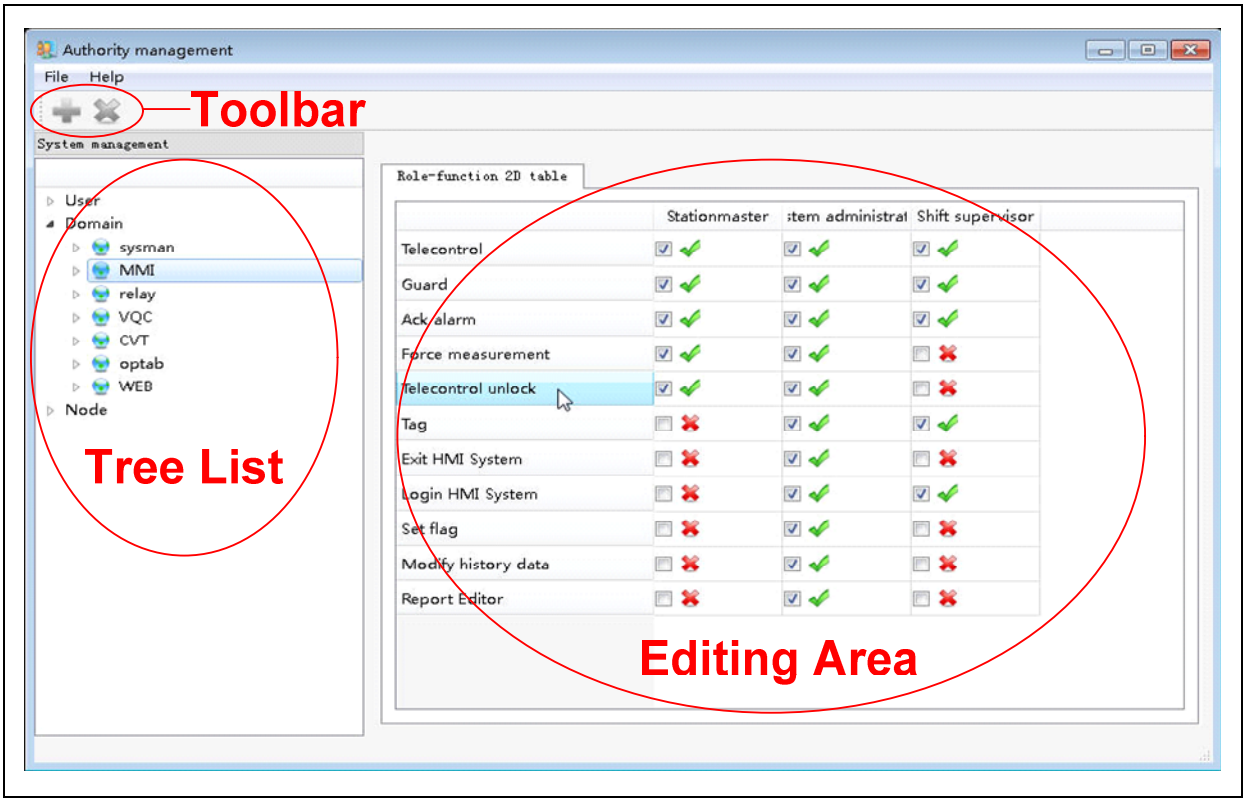


Figure 11.2-3 Main interface

11.2.1 Basic Operation Method

- Delete object: Object to be operated can be selected in the list zone. Right click an object and select Delete or click Delete button on the Tools bar.

Example: delete user

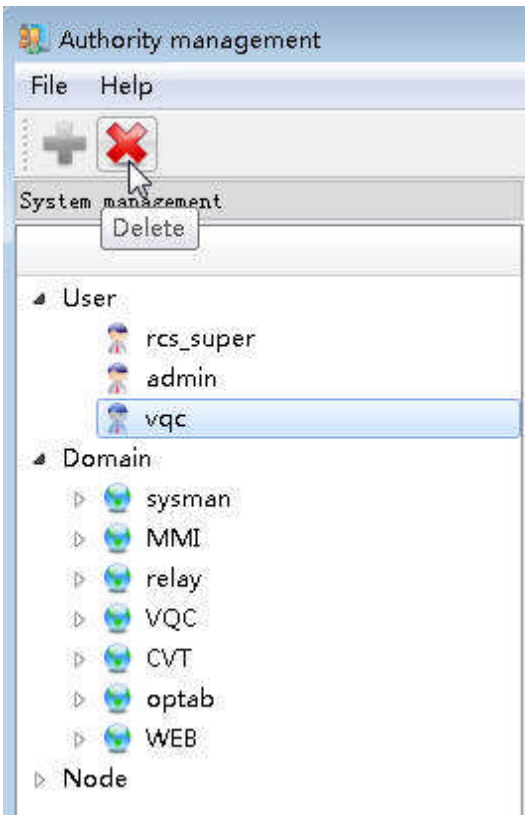


Figure 11.2-4 Example 1 of deletion

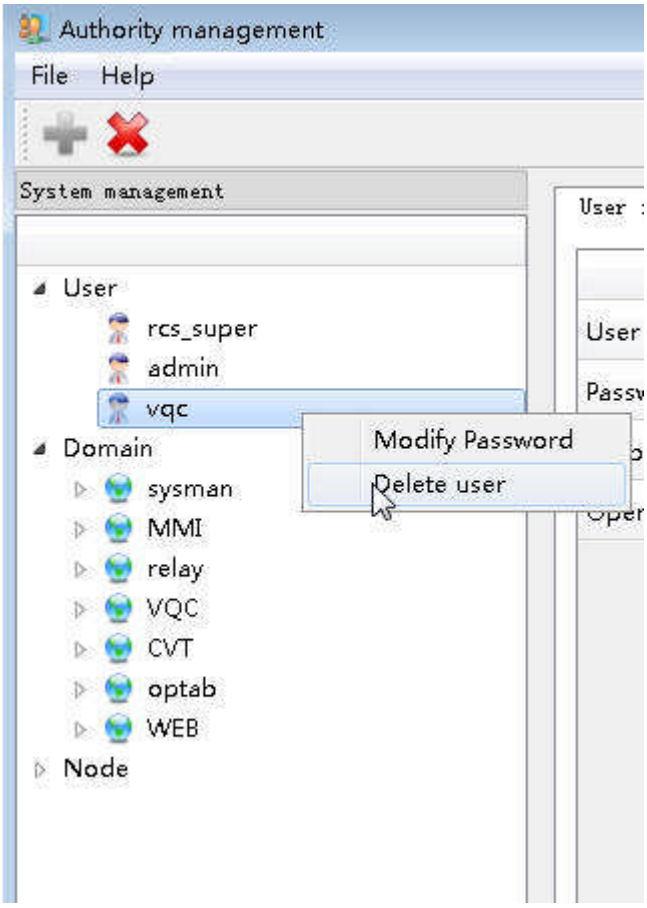


Figure 11.2-5 Example 2 of deletion

- Add object: In list zone, select upper layer object of the object to be added, and then right click and select Add or click Add button on the Tools bar.

Example: add user

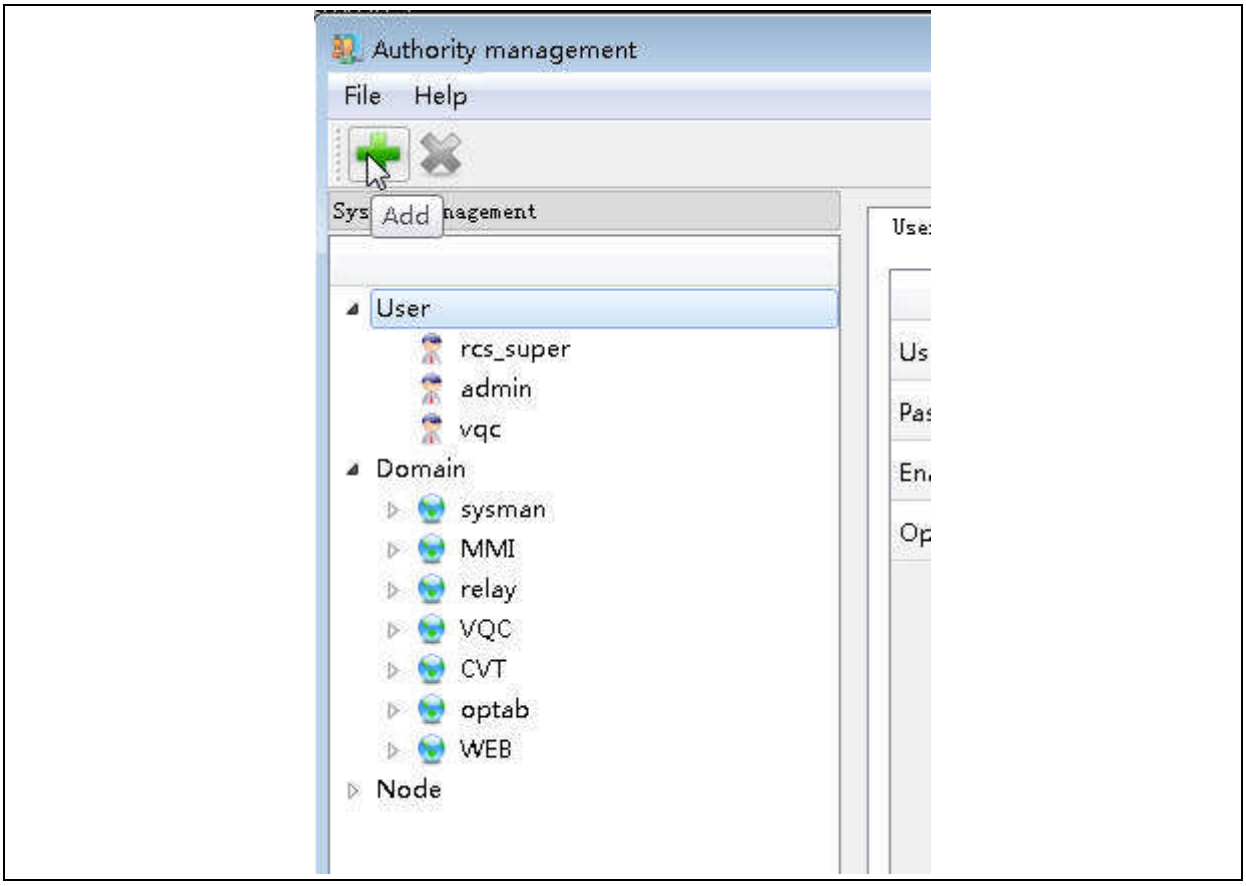


Figure 11.2-6 Example 1 of addition of user

Or

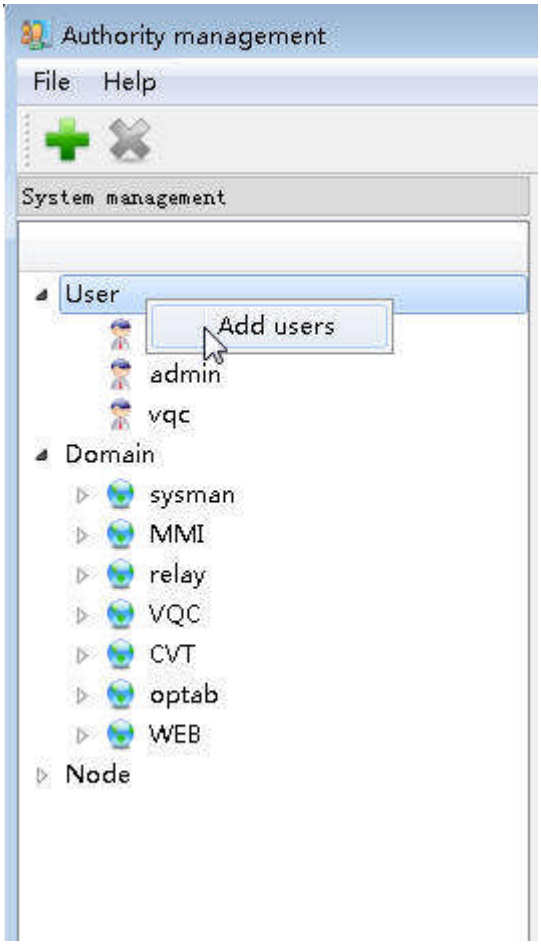


Figure 11.2-7 Example 2 of addition of user

11.2.2 Association of Domain Role with Domain Functions

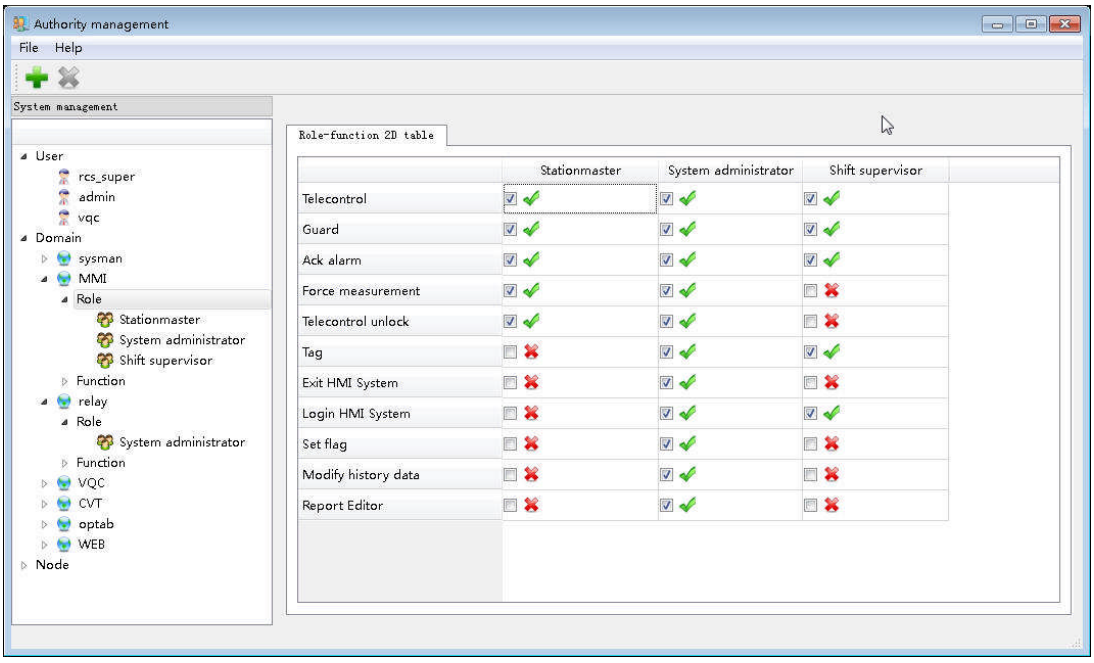


Figure 11.2-8 Association of role with functions

After selecting a domain, functional association between roles and functions in this domain can be performed. Different roles have different functions in a domain.

11.2.3 Association of Users with Domain Functional Roles

Each user is associated with different roles under a domain, representing authorities of each user in different domains. When mouse is moved to a role, authorities of this role will be prompted. Each user can be associated to a number of roles under a domain.

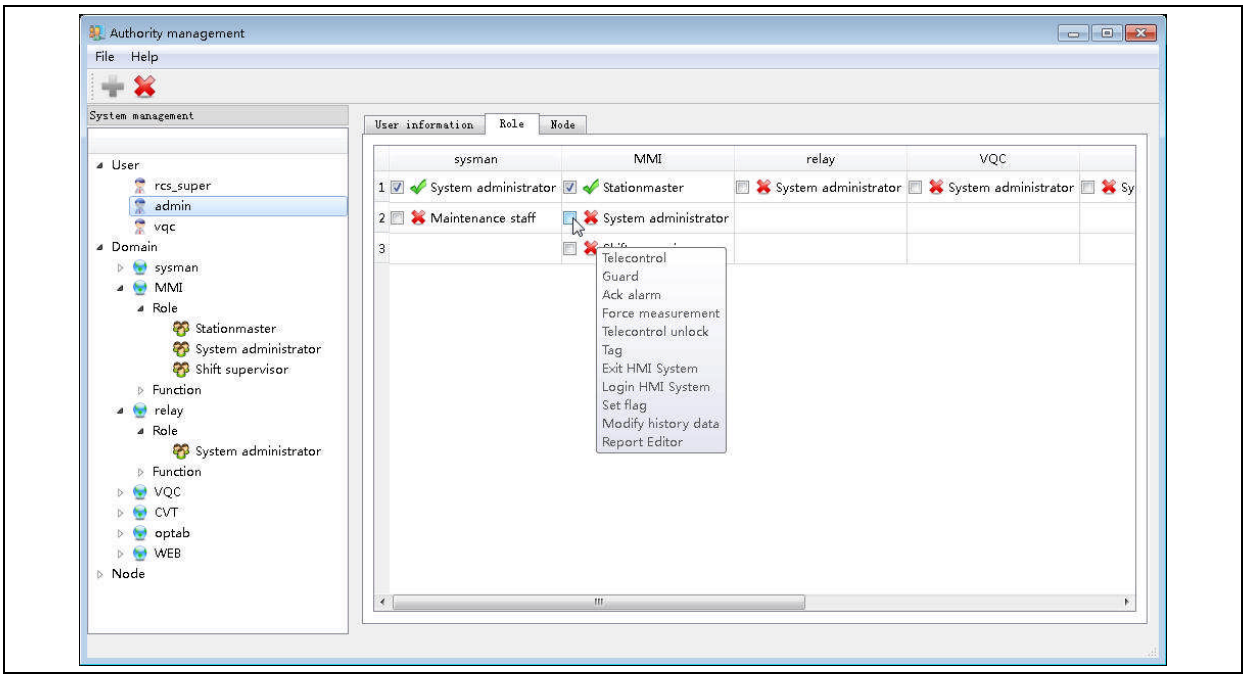


Figure 11.2-9 Association of a user with roles

11.3 Table of Comparison of Authority Functions

The following is an authorities comparison table used by all applications of PCS-9700, for your reference.

Table 11.3-1 Authority functions comparison

Domain	Functional point	Process/application used
sysman	System configuration	configmain
	Authority management	priv_manager
	Database maintenance	pcsdbdef
	Graph editor	Drawgraph, icon
	Switch applications	sm_console
	PDR	pdr
MMI	Telecontrol	online
	Guard	online

Domain	Functional point	Process/application used
	Ack alarm	online alarm
	Report editor	report
	Modify history data	report
	Force measurement	online
	Telecontrol unlock	online
	Tag	online
	Exit HMI system	online pcscon
	Login HMI system	online pcscon
	Set flag	online
RelayMMI	Modify settings	RelayMMI
	Switch setting group No.	
	Modify VEBI	
	Reset relay	
VQC	Run VQC	VQC
	Maintain VQC	
	VQC system configuration	
CVT	Run CVT	CVT
	Maintain CVT	
	CVT system configuration	
optab	Login operation sheet system	optab
	Logout operation sheet system	
	Open wiring diagram	
	Set default wiring diagram	
	Force measurement	
	Maintain typical sheet	
	Edit operation sheet	
	Save prepared sheet	
	Delete operation sheet	
	Execute operation sheet	
	Invalidate operation sheet	
	Abandon operation sheet	
	Guard operation sheet	
	Skip 1 step in prepared sheet	
	Maintain operation sheet	
	Database configuration	

Domain	Functional point	Process/application used
	Database browser	
	System configuration of operation sheet	

12 Database Editor

12.1 General

The purpose of development of PCS-9700 database editor(**PCS-9700 Database Configuration Tool**) is to provide user with a convenient interface tool for editing of models (including associations among objects) in the environment of complete designed functions of SCADA model and relatively complicated model association relations.

PCS-9700 Database Configuration Tool is an important module of PCS-9700 HMI system. It mainly realizes substation system configuration, alarm-related configuration, front end transpond database configuration, and configuration of anti-maloperation points etc. under SCADA application, as well as setup of various types of relations among objects, to support normal operation of other applications. Main interface of this tool is shown below:

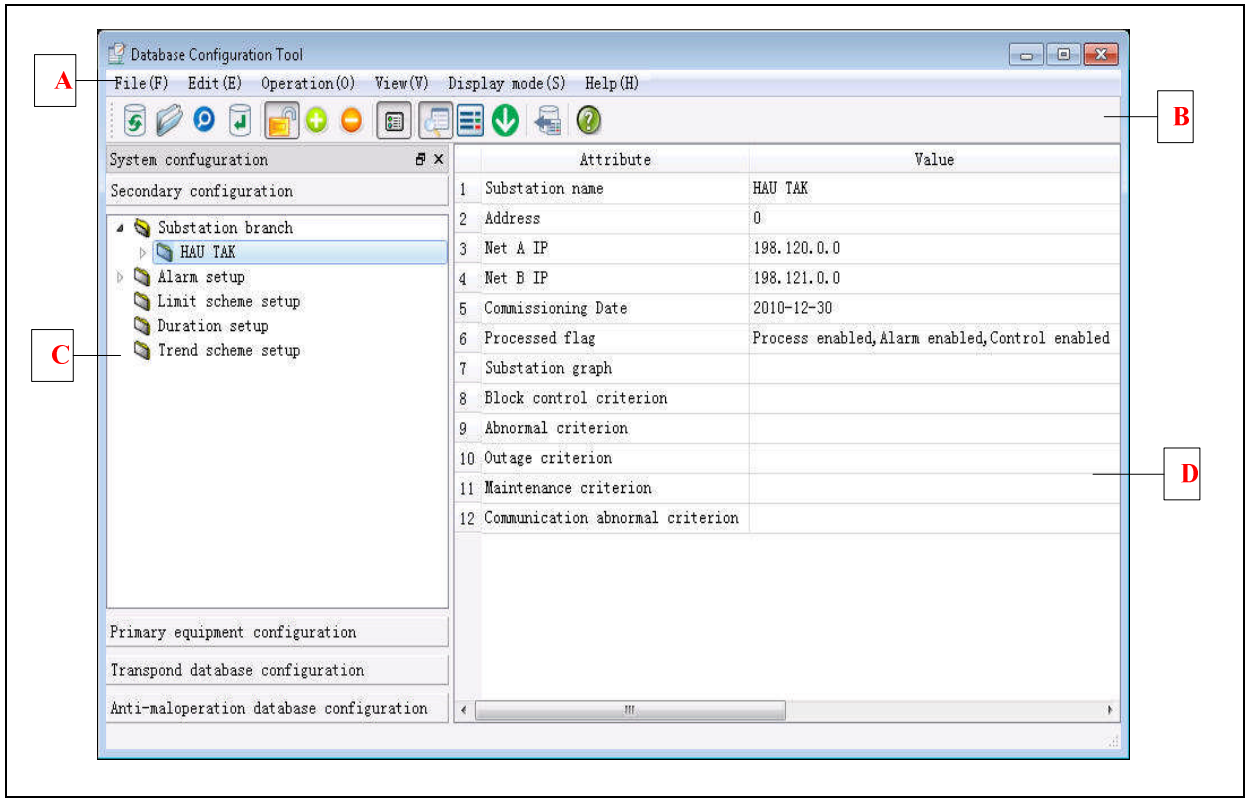


Figure 12.1-1 Main interface

Table 12.1-1 Description of main interface

No.	Description
A	Menu bar. Providing all operation functions and supporting corresponding shortcut key operations.
B	Tools bar. Providing common operation buttons

C	Dock window. Displays data objects in hierarchy and according to different functions.
D	List window. Displays attributes or sub-object list of data objects selected in the dock window.

12.2 Functional Features

This configuration tool adopts single window interface. Hierarchical relation of each application data object is displayed in a different page. After selecting an object in this hierarchical window, the main window will display attributes or sub-list information of this object. This makes operations easier and display more legible.

The configuration tool provides the function to hide attributes list. A measuring object has many attributes. For data configuration, some attributes of no interest can be temporarily hidden, to reduce contents displayed in the main window. For editing of bit fields, a control similar to Combox is adopted so that a number of items can be selected in a pull-down list. The function of batch modification of a number of items is provided. For configuration of measuring point attributes, attribute values configured for a number of items are often the same (e.g. type of measuring point). In such case, user can select a number of items and modify them to the same attribute value in a unified manner. Relatively large improvement has been made in browsing, display, search, editing, and association of database. Main features are as follows:

1） C/S mode is used to open database so that it can run on each node on site.

2） Maintenance functions covering each model of SCADA database and related applications are provided. Data modification directly enters logic database, so as to prevent loss of modified data due to omission of saving.

3） Database publishing function for a number of applications is provided.

4） 103 device and IEC61850 device configuration files can be imported respectively to generate device model.

5） Import of SCD file is supported. Friendly import wizard is provided so that configuration of substation based on IEC61850 protocol is more convenient.

6） IEC61850 measuring point information is extracted according to reference of data concentration, and the sequence is maintained consistent with sequence of data concentration.

7） When extracting FCDA object, object value attributes will be obtained also.

8） Hierarchical relations of SCADA data objects are provided.

9） The function of measurement point trend scheme setup is provided.

10） Limit scheme can be configured according to year, season, month, 10 days, and day.

11） For browsing of information of measuring points under device, such information can be displayed according to types of measuring points and groups of measuring points.

12） The function to hide measuring point attribute column is provided.

13） Modification of data object enable flag adopts the newly developed multi-selection list control, facilitating setup of enable flag.

14） Configuration file in xml format is provided for setup of minimum width of each attribute column of measuring point data, to adapt to different occasions and allow more complete and clearer display of contents.

15） When modifying data object attributes, entered values are verified to confirm correct and normalized values entered.

16） IEC61850 model transpond setup is supported.

17） When transpond data object is added or modified during configuration of the transpond database, the search window supports measuring point mode for SCADA application and ordinary mode for other applications, so that configuration of transpond database is more flexible.

18） If a data object in the transpond database does not exist in database of corresponding application, this object will be displayed in red font to clearly prompt the situation.

19） Before publishing of database, such database will be verified and non-conformity items and errors in this database will be prompted.

12.3 Menu Bar and Tools Bars

12.3.1 Menu Bar

The menu bar provides all operation functions and supports corresponding shortcut key operations, as shown below:

Figure 12.3-1 Menu bar

NOTE: The “Anti-maloperation definition” menu item is only displayed when switched to configuration of the anti-maloperation database.

12.3.1.1 File Menu

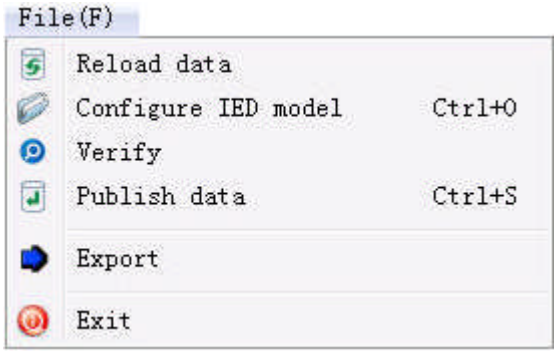


Figure 12.3-2 File menu items

Table 12.3-1 Description of File menu items

File menu	Description
Reload data	Again read data from the logic database to update interface display
Configure IED model	Open IED model configuration window to add, delete, or modify IED model
Verify	Complete database configuration and prompt non-conformity items and errors in database
Publish data	First verify database. Only proceed when passing this verification. Update modified contents in the logic database to the physical database. Modification of the logic database can be automatically detected.
Export	Export contents of device list or anti-maloperation transpond list to txt file or csv file
Exit	Exit configuration tool

NOTE: “Configure IED model” and “Publish data” menu items are only effective when switched to editing mode.

12.3.1.2 Edit Menu

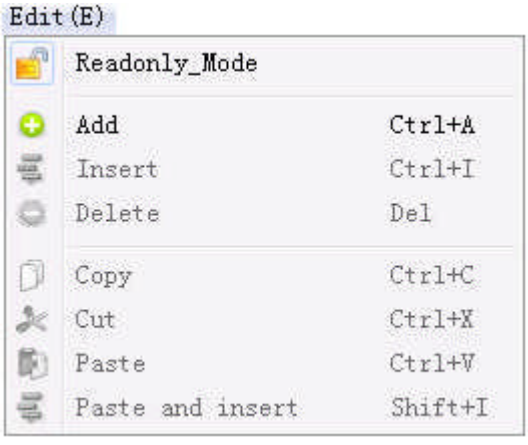


Figure 12.3-3 Edit menu items

Table 12.3-2 Description of Edit menu items

Edit menu	Description
Read-only_Mode	Switch between Read-only_Mode and editing mode. To switch from Read-only_Mode to editing mode, a password needs to be entered.
Add	Add a data object of the same type in the list that can be edited.
Insert	Insert a data object of the same type before selected object in the list that can be edited.
Delete	Delete selected data object
Copy	Copy selected data object
Cut	Cut selected data object
Paste	Paste copied object attributes to currently selected data object
Paste and insert	Before selected object, insert a data object of the same type and perform paste

NOTE: With the exception of “Read-only_Mode”, all other menu items are only effective when switched to the editing mode. Menu items “Paste” and “Paste and insert” are only effective after successful Copy operation.

12.3.1.3 Operation Menu

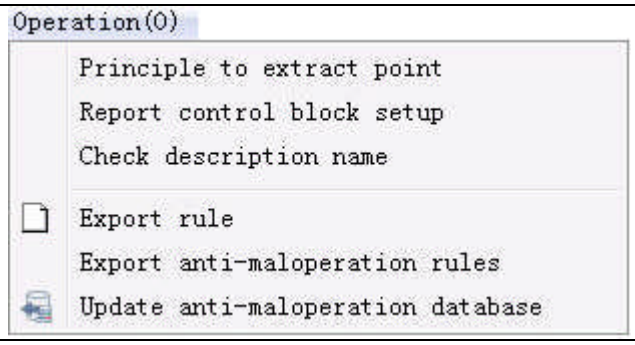


Figure 12.3-4 Operation menu items

Table 12.3-3 Description of Operation menu items

Operation menu	Description
Principle to extract point	Set principle of extraction of measuring points and their descriptive names. This principle will be adopted to obtain measuring points and their descriptive names when extracting measuring point objects during import of IEC61850 configuration file.
Report control block setup	Set attributes of report control block under device in batches
Check description name	Check of uniqueness of descriptive names of measuring points under all devices. Numbers are added at end of identical names for differentiation.
Export rule	Export open and close rules of control points under substation into a .txt file
Export anti-maloperation rules	Export open and close rules of anti-maloperation BI points under substation into a .txt file
Update anti-maloperation	Read defined data related to anti-maloperation from SCADA database and update

Operation menu	Description
database	them to the anti-maloperation database

NOTE: With the exception of “Export rule” and “Export anti-maloperation rules”, all other menu items are only effective when switched to the editing mode.

12.3.1.4 View Menu

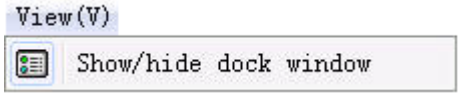


Figure 12.3-5 View menu item

Table 12.3-4 Description of View menu item

View	
Show/hide dock window	Show or hide data hierarchical relation dock window

12.3.1.5 Display Mode Menu

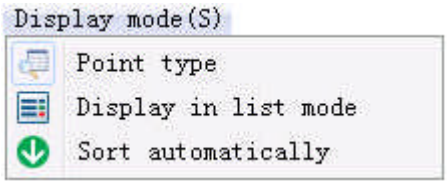


Figure 12.3-6 Display mode menu items

Table 12.3-5 Description of display mode menu items

Display mode menu	Description
Point type	Display list of measuring points under device according to types of measuring points or measuring point groups
Display in list mode	Select display of device or substation attributes in list form when a substation object is selected
Sort automatically	Enable or disable sorting function

12.3.1.6 Anti-Maloperation Definition Menu

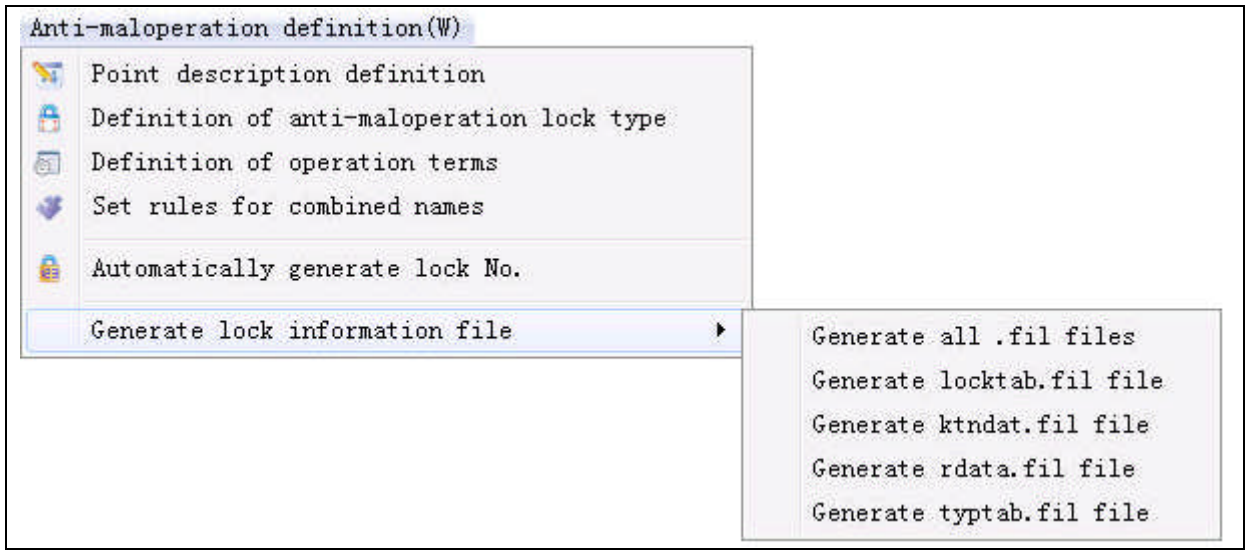


Figure 12.3-7 Anti-maloperation definition menu items

Table 12.3-6 Description of anti-maloperation definition menu items

Anti-maloperation definition menu	Description
Point description definition	Open anti-maloperation measuring points description definition dialog box
Definition of anti-maloperation lock type	Open anti-maloperation lock type definition dialog box
Definition of operation terms	Open anti-maloperation operation terms dialog box
Set rules for combined names	Open anti-maloperation BI measuring point combined names naming rules definition dialog box
Automatically generate lock No.	Automatically generate anti-maloperation BI point lock No. according to setup of anti-maloperation points
Generate lock information file	According to sub-menu operation, generate corresponding fil file for use by anti-maloperation lock

NOTE: With the exception of “Generate lock information file” menu item and its sub-menu items, all other menu items are only effective when switched to the editing mode.

12.3.1.7 Help Menu

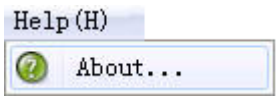


Figure 12.3-8 Help menu item

Table 12.3-7 Description of Help menu item

Help	
About	Displays configuration tool icon and version information

12.3.2 Tools Bars

The Tools bars provide common operation functions and include Ordinary operation tools bar and Anti-maloperation related tools bar. The anti-maloperation related tools bar is only displayed when switched to configuration of anti-maloperation database, as shown below:

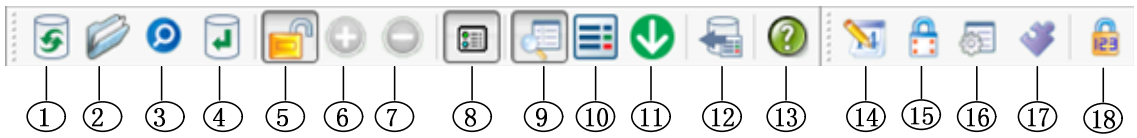


Figure 12.3-9 Tools bars

Table 12.3-8 Description of functions of tools bars

No.	Description
1	Reload data. Again read data from the logic database to update interface display.
2	Configure IED model. Open device model configuration window to add, delete, or modify device model.
3	Verify. Complete database configuration and prompt non-conformity items and errors in database.
4	Publish data. First verify database. Only proceed when passing this verification. Publish contents in the logic database to the physical database.
5	Switch between Read-only_Mode and editing mode. To switch from Read-only_Mode to editing mode, username and password need to be entered.
6	Add. Add a sub-object under current object, or a new object in the list.
7	Delete. Delete currently selected object or all selected items in the list.
8	Show or hide dock window.
9	Switch display of measuring points under device according to types of measuring points and according to measuring point groups.
10	Switch display of substation attributes and device list in the list window when a substation object is selected in the dock window.
11	Enable or disable list automatic sorting function
12	Update anti-maloperation database. Update data of anti-maloperation application logic database according to data configuration in SCADA database.
13	About. Display configuration tool icon and version information.
14	Point description definition. This functional key is displayed when the dock window is switched to configuration of anti-maloperation database (same below)
15	Definition of anti-maloperation lock type
16	Definition of operation terms
17	Set rules of combined names

No.	Description
18	Automatically generate lock No.

12.4 Operation Functions

12.4.1 Reload Data

As database configuration tool can be opened at a number of points of the same site, operation by a number of persons may result in non-correspondence between displayed data and the logic database. Therefore, the configuration tool provides reload data function to again read data object from the logic database, and update current display on the interface.

Select “Reload data” menu item in “File” menu or directly click button “Reload data” on the tools bar.

12.4.2 Switch to Editing Mode

When the database configuration tool starts, default status is Read-only_Mode, in which most menus and tools bar buttons are not usable. Select “Editing mode” menu item in menu “Edit” or directly click the editing mode/Read-only_Mode switching button on the Tools bar to pop up Authority check dialog box. Select username, enter correct password, and click “OK”. Database configuration tool will be switched to editing mode and in “Edit” menu, “Editing mode” will be changed to “Read-only_Mode”.

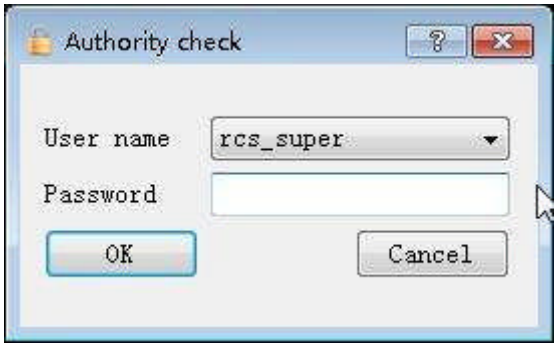


Figure 12.4-1 Authority check

NOTE: Database can only be modified when switched to Editing mode.

12.4.3 Principle to extract point

When importing 61850 configuration file, since definitions of data objects and object description names by each manufacturer vary, measuring point objects shall be flexibly extracted, and description names of such objects shall be read flexibly, according to actual condition of configuration text. Select “Principle to extract point” in menu “Operation”; the dialog box shown below will pop up.

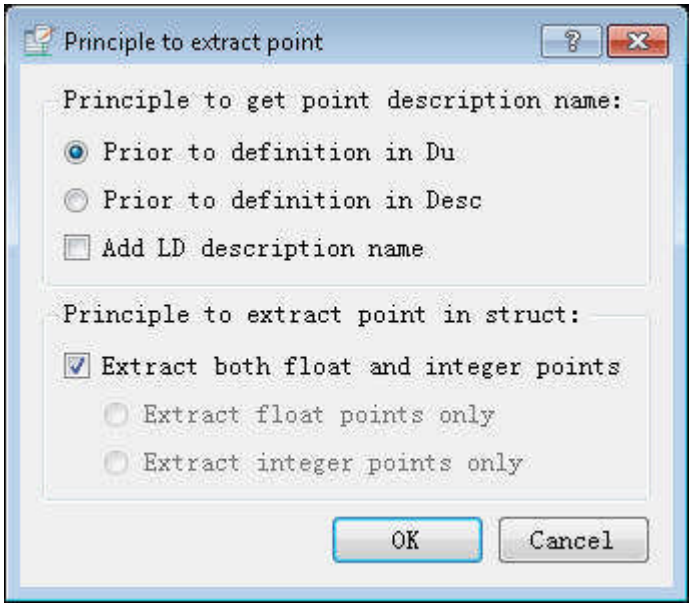


Figure 12.4-2 Principle to get point description name

According to actual condition of the IEC61850 configuration text to be imported, set corresponding extraction rule and click “OK” to validate and save the setting. After this operation, when importing IEC61850 configuration file, measuring points and their description names will be extracted according to this setting.

12.4.4 Check of Description Name

Since Graph Editor adopts description name of data as search path for association of icon with data point, it is required that description name of measuring point of the same type under device in the database shall be unique. However, in device configuration files, particularly configuration file of IEC61850 device, description name may not be unique. In such case, select “Check description name” menu item in “Operation” menu; the database configuration tool will check description name of each device. If there are measuring points of the same type with the same description name, corresponding sequence numbers will be added at end of such names for differentiation.

12.4.5 Verify Data

Perform this function to complete database configuration and check for correct database configuration. The display is shown as below:

Figure 12.4-3 Verify data

At end of verification, verification result will be given to prompt user if verification is passed (refer to *Figure 12.4-4* Verification result). In case of incorrect configuration of some objects in the

database, this will be prompted in the verification result. If such objects do not affect normal operation of system, they will be prompted as non-conformity items. If these affect system safe operation, they will be prompted as errors. The verification cannot pass in case of error.

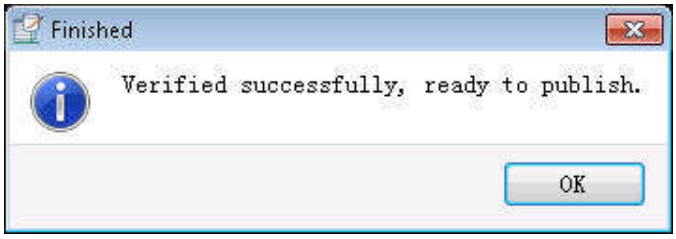


Figure 12.4-4 Verification result

12.4.6 Publish Data

After modification, to put the database into operation, select “Publish data” menu item in menu “File” or directly click button “Publish data” on the tools bar to pop up the dialog box as shown below.

Figure 12.4-5 Prompt for publishing

Click button “Yes”. First, the database will be verified. In case of configuration error, the configuration tool will prompt to prohibit publishing of the database; otherwise the verification is passed, and the dialog box as shown in

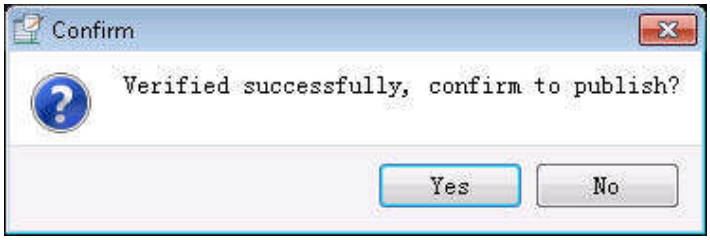


Figure 12.4-6 Confirm publishing will appear. Click button “Yes” to start publishing of data. The progress bar will display publishing process of each application. Applications for which database configuration tool executes publishing include: SCADA application, alarm application, front end application, historical application, anti-maloperation application, and applications that select a logic database under one of these applications as their main logic database loaded. In case data publishing by an application fails, the configuration tool will pop up a prompt box to indicate cause of such failure. Only after confirmation of the failure cause can user continue execution of data publishing. For databases not modified, the database configuration tool will not execute publishing, and will only prompt final result.

Figure 12.4-6 Confirm publishing

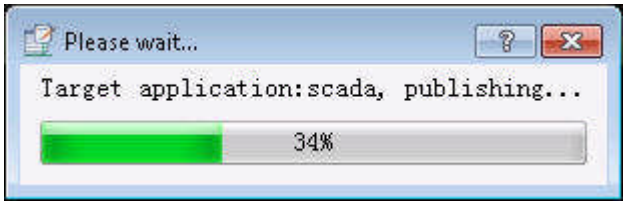


Figure 12.4-7 Progress of publishing

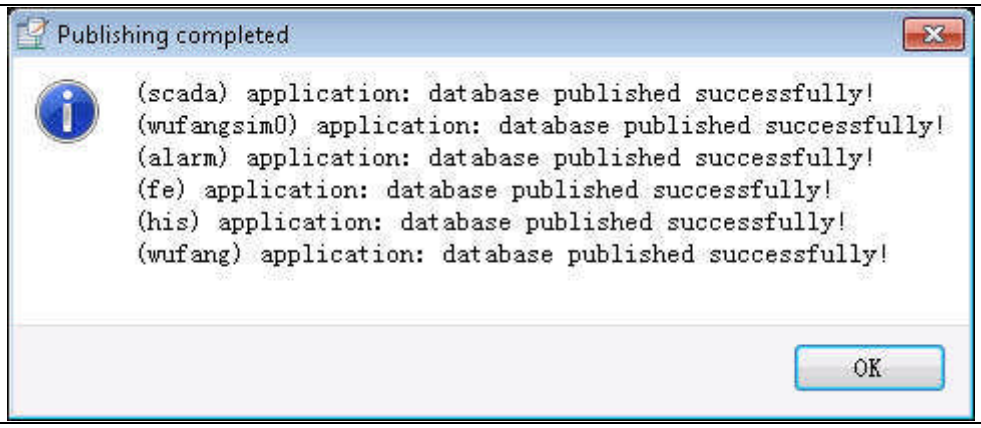


Figure 12.4-8 Results of publishing

12.4.7 Version Information

Select “About” menu item in menu “Help” or directly click button “About” on the tools bar to pop up a dialog box of related information. This window will display version information of the database configuration tool, as shown below:

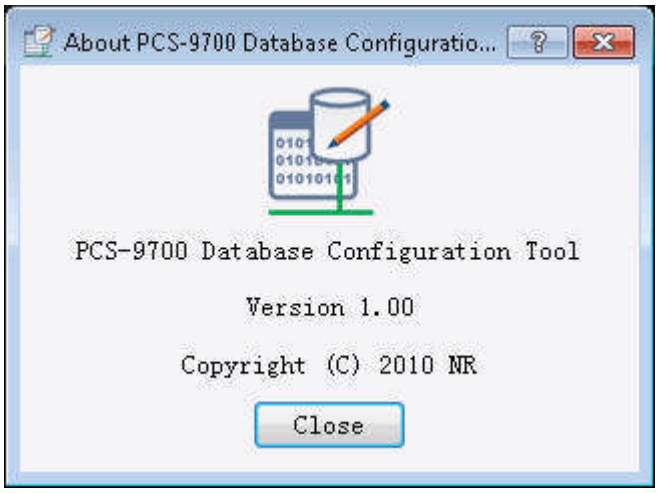


Figure 12.4-9 Version information

12.5 Configuration of SCADA Database

Configuration of SCADA database includes configuration of secondary models and primary models. Secondary models are also acquisition models and refer to IEC61850 models under each device object under a substation and configuration of relevant measuring points. Particular description: add, delete, and attribute modification of substation; add, delete, and attribute modification of device; modification of related attributes of IEC61850 model; and modification of related attributes of various measuring points under device. Configuration of primary model can be described as: configuration of voltage level, configuration of bay, configuration of each item of equipment under the bay, and association of measuring points.

12.5.1 Secondary configuration

12.5.1.1 Configure IED Model

Select “Configure IED model” menu item in menu “File” or directly click button “Configure IED model” on the tools bar, to open Configure IED model dialog box. In this dialog box, user can import IED model, delete IED model, modify IED model, check measuring point description name, and edit measuring point attributes etc.

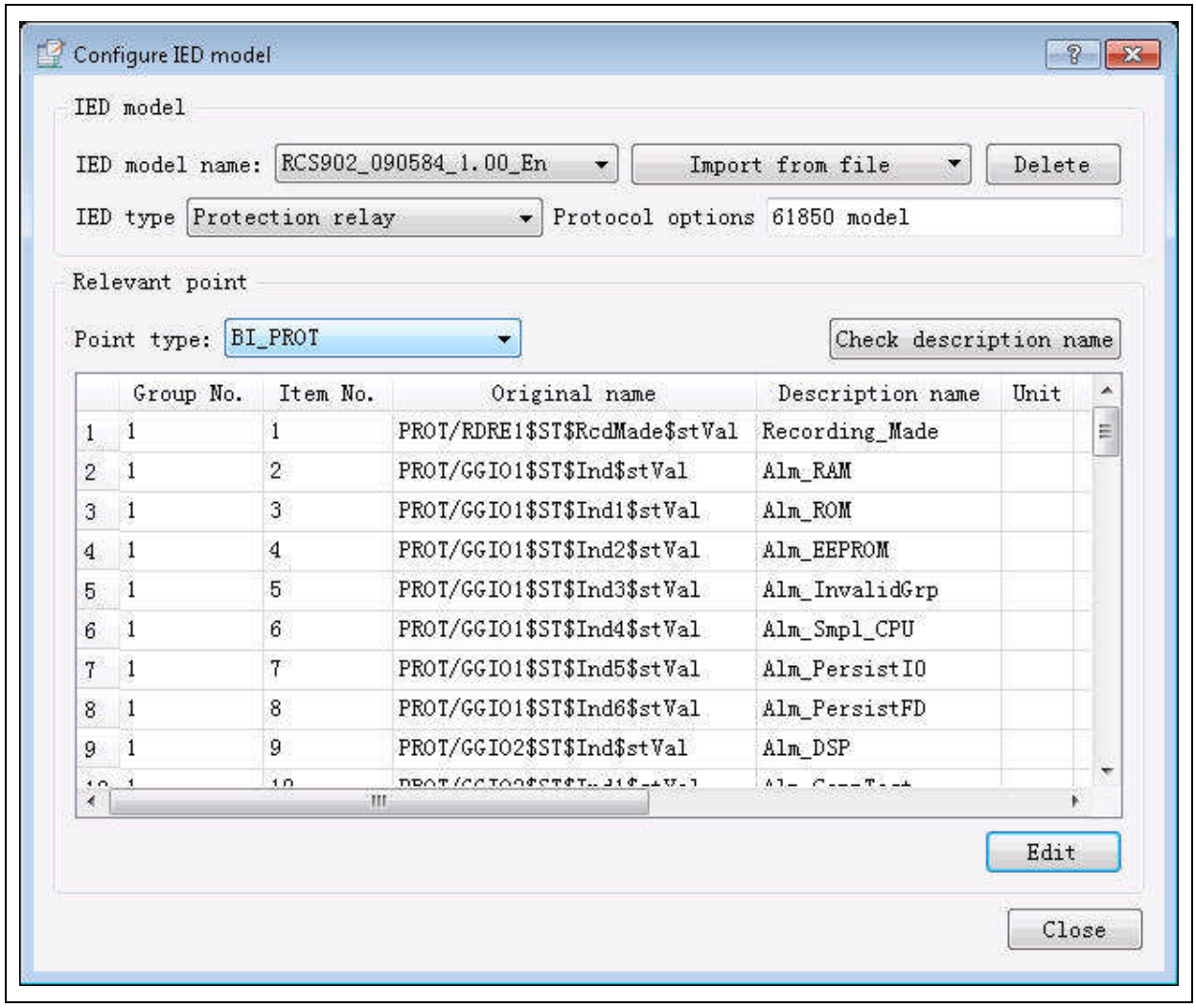


Figure 12.5-1 Configure IED model

- **Import IED model**

Click button “Import from file” to import 103 device standard configuration file, 9798 configuration file, and IEC61850 device ICD file respectively, and generate IED model. If the IED model to be imported already exists, the database configuration tool will give a prompt. File analysis will only occur after clicking button “Yes”, to update existing IED model.

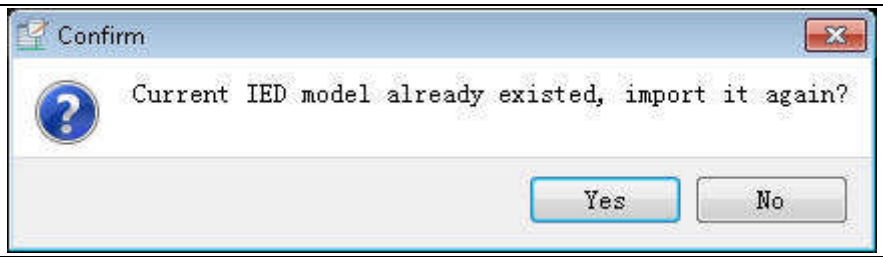


Figure 12.5-2 Re-import

After successful import of IED model, if this IED model already has an instance (or more), the database configuration tool will prompt updating of measuring point information under device of this model. After clicking button “Yes”, the database configuration tool will update measuring point

information and IEC61850 model under IEDs of this model configured under all substations.

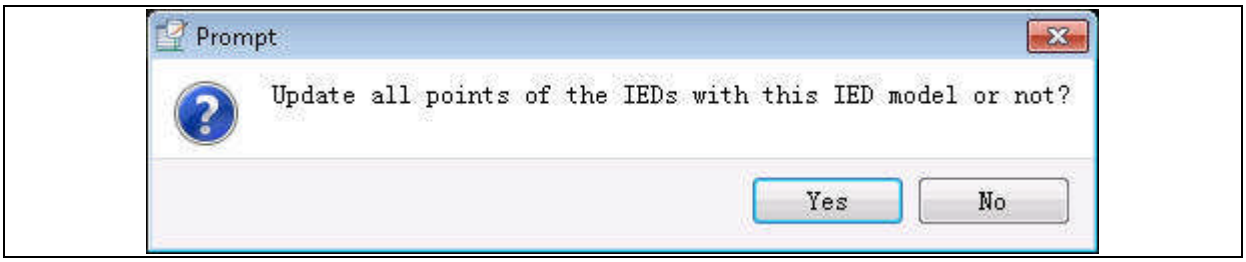


Figure 12.5-3 Update IEDs

- **Delete IED model**

After selecting the IED model to be deleted in the pull-down list of model names, click Delete button; the database configuration tool will prompt for confirmation of deletion of the selected IED model.

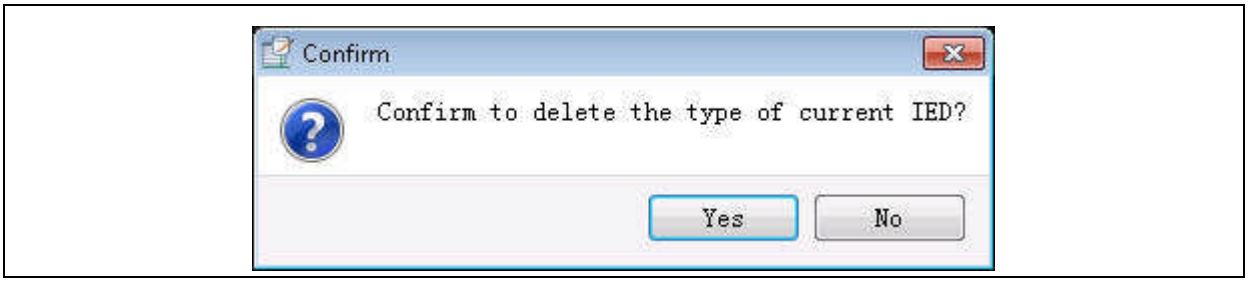


Figure 12.5-4 Delete model

After clicking button “Yes”, the database configuration tool will delete currently selected IED model. If this IED model already has an instance (or more) under the substation, the database configuration tool will not permit deletion of this IED model and will generate a prompt, as shown below:

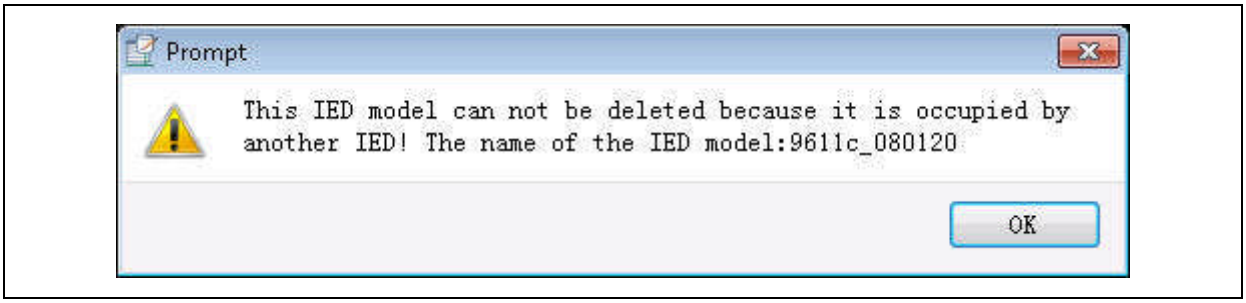


Figure 12.5-5 Prompt of failure of deletion

- **Modify IED type**

After selecting an IED model, select an item in the IED type pull-down list to modify type of this IED model. For example, change PCS9611 from type “Protection” to type “Protection, measuring, and control”. The database configuration tool will prompt for confirmation of such modification. After clicking button “Yes”, the database configuration tool will modify type of current IED model; otherwise it will not be modified.

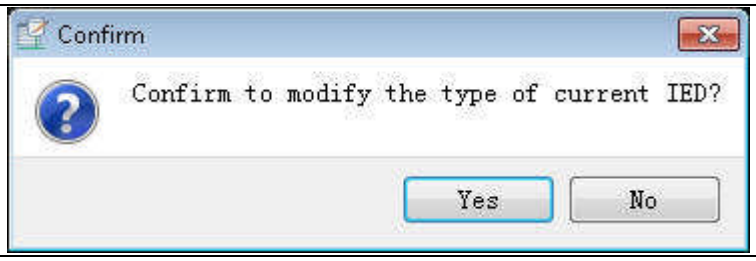


Figure 12.5-6 Modify type of IED

- **Check measuring point description name**

In configuration text imported, there may be the same description name used for different measuring points, in particular in configuration text corresponding to IEC61850 device. User can click button “Check description names” to check description names. The database configuration tool will add corresponding sequential numbers at end of same description names used for different measuring points of the same type for differentiation.

- **Modify measuring point attributes**

Select a measuring point object from the list and click button “Edit” to pop up measuring point attributes editing dialog box as shown below:

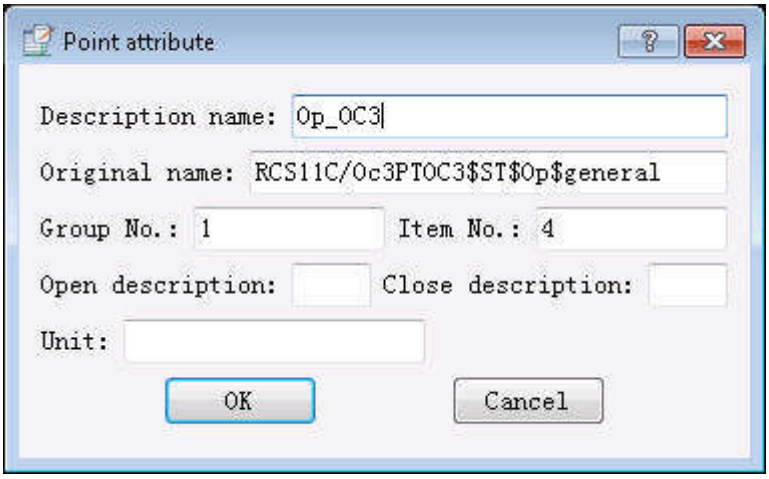


Figure 12.5-7 Modify point attributes

User can modify description name, open description, close description, and unit. Click button “OK”. After successful modification, contents displayed in the list will be updated. Or, user can double click the column corresponding to description name, open description, close description, or unit in the list, so that the cell becomes editable, to allow modification of corresponding attribute of the measuring point.

12.5.1.2 Configuration of substation

- **Add substation**

In the dock window, select “Substation branch” node; the list window will display all substations and their attributes, and the button “Add” on the tools bar will become usable. Click this “Add” button or select menu item “Add” under menu “Edit” to successfully add a substation object. In the

dock window, a new substation node will be added under “Substation branch” node, with the substation name as the node name. The list window will display default attributes corresponding to this substation.

- **Import SCD**

In the dock window, right click a substation node. In the menu popped out, select “Import SCD file” and select the SCD file to be imported. The database configuration tool will first extract relevant information of primary equipment and device in the SCD file. After such extraction, SCD file import wizard window will pop up to guide user through setup for SCD file import, as shown below:

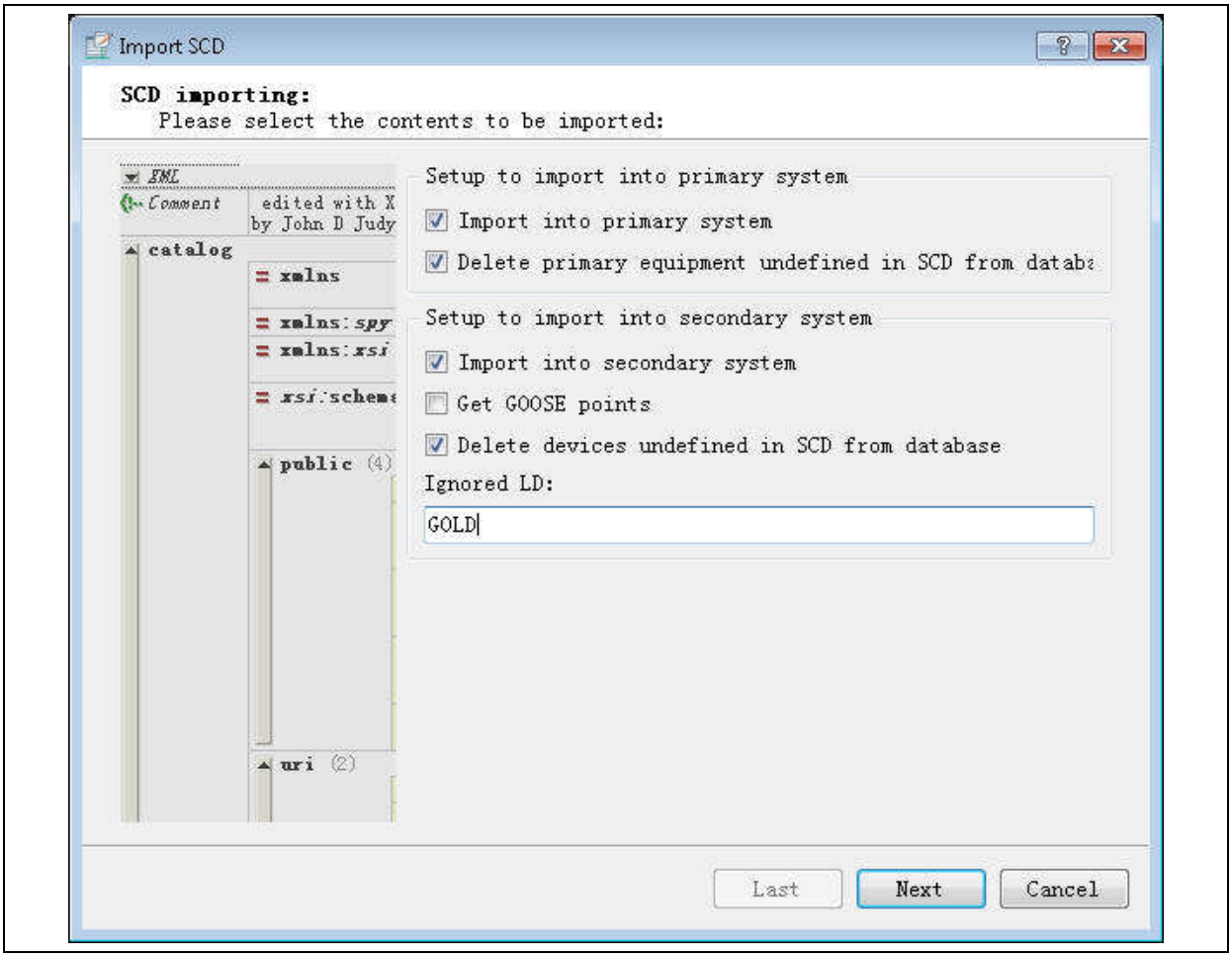


Figure 12.5-8 Import SCD step 1

In case in a model, some logic devices need no import, user can enter names of such logic devices in the Edit box corresponding to “Ignored LD”, or their common substring. If a number of substrings need to be entered, use “,” for separation. After this setup, click button “Next”.

NOTE: When the database configuration tool analyzes a logic device object, it will determine entered character strings in the name of the logic device. Therefore, the strings entered shall be as accurate as possible.

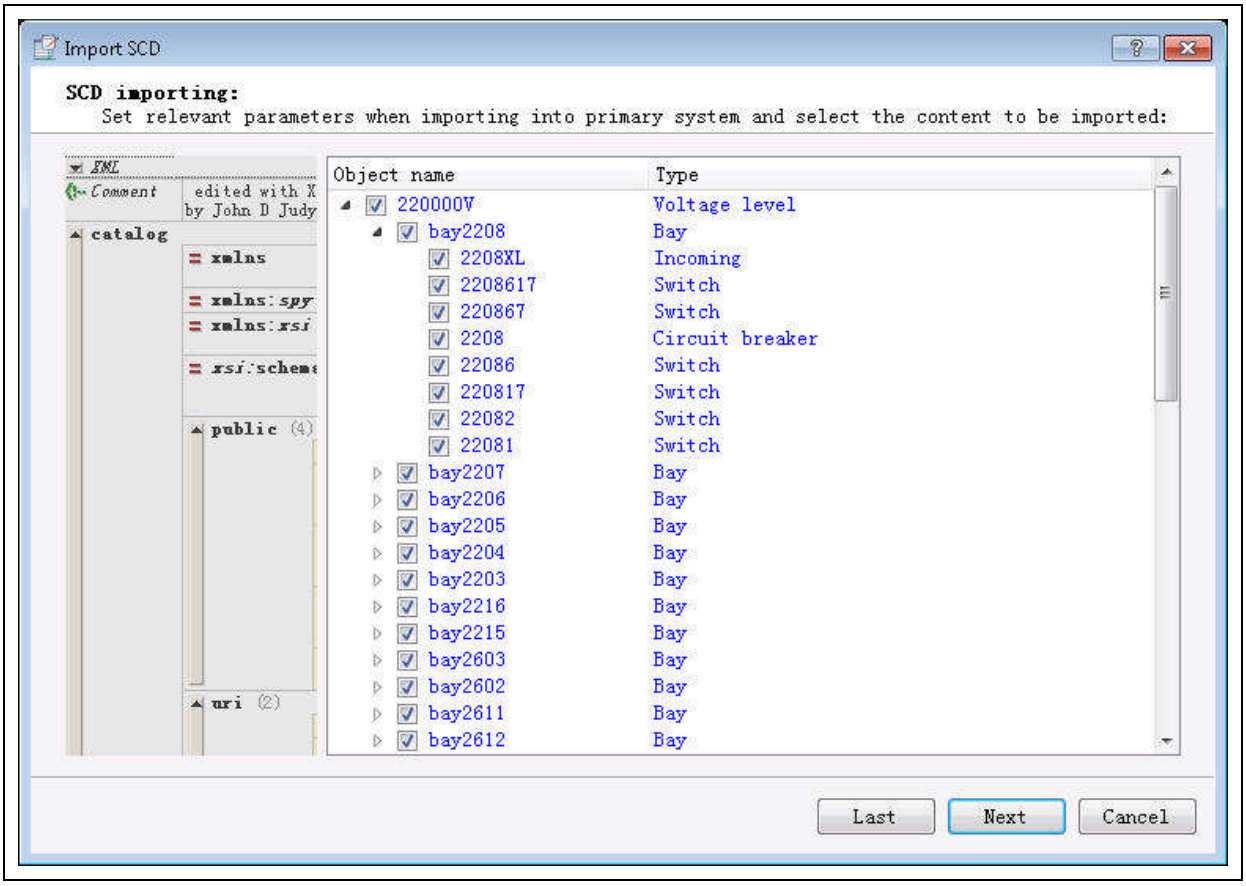


Figure 12.5-9 Import SCD step 2

The above graph shows information related to primary equipment in SCD file. The blue font indicates non-existence of corresponding equipment in the database, and the black font indicates that corresponding equipment exists in the database. Modify selection label (check) before the equipment to set primary equipment objects to be imported. After this setup, click button “Next”.

NOTE: If “Import into primary system” is not selected in Step 1, step 2 will be skipped.

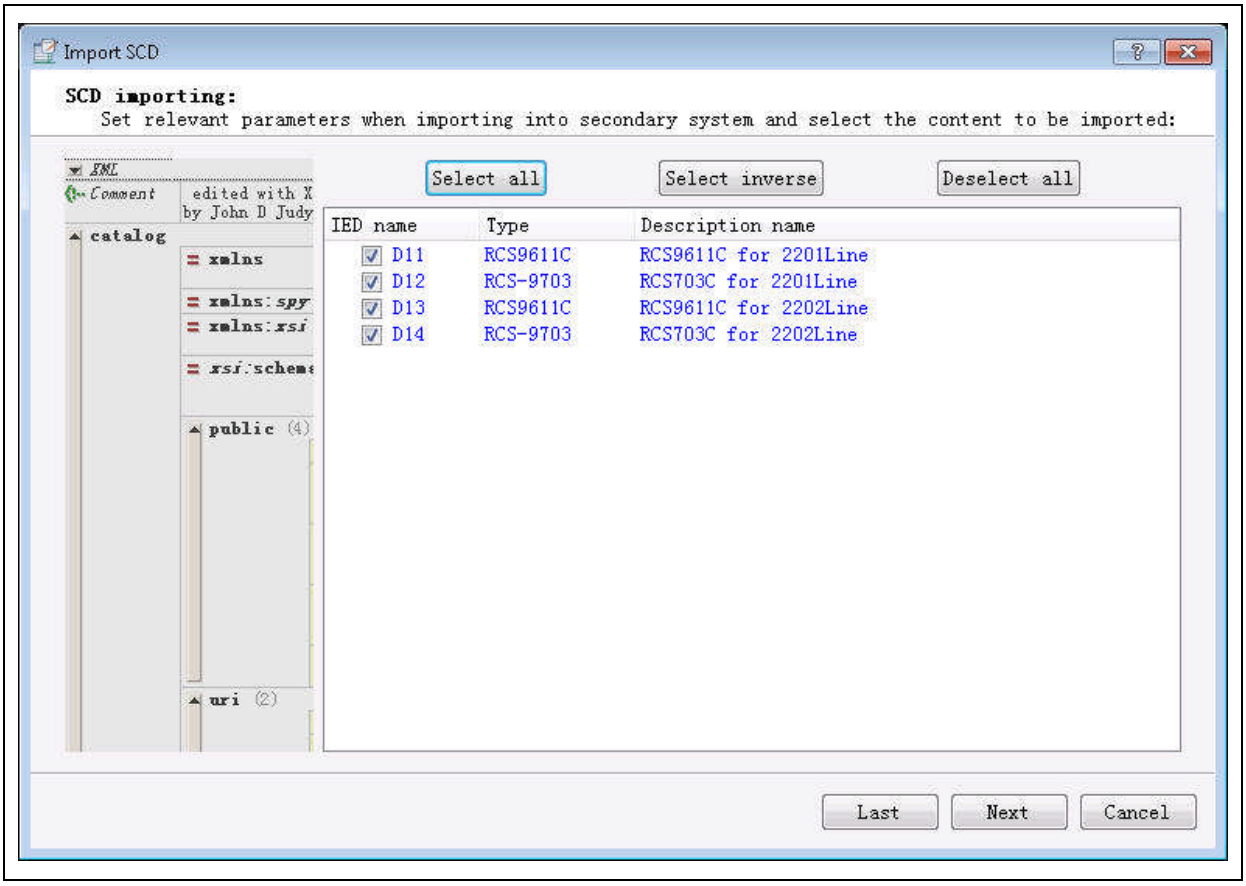


Figure 12.5-10 Import SCD step 3

The above graph shows information related to devices in SCD file. The blue font indicates non-existence of corresponding device in the database, and the black font indicates that corresponding device exists in the database. Modify selection label (check) before the device to set device objects to be imported. After this setup, click button “Next”.

NOTE: If “Import into secondary system” is not selected in Step 1, step 3 will be skipped.

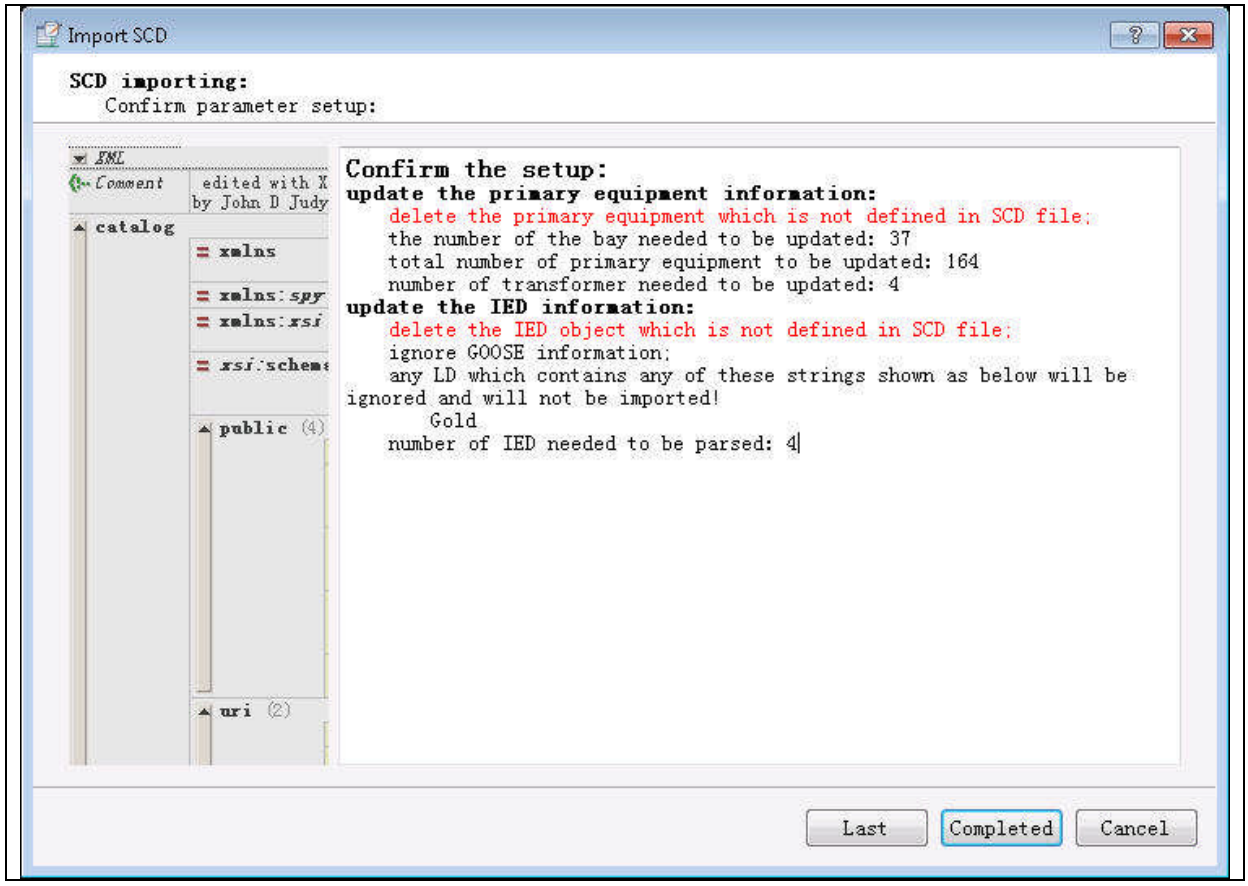


Figure 12.5-11 Import SCD step 4

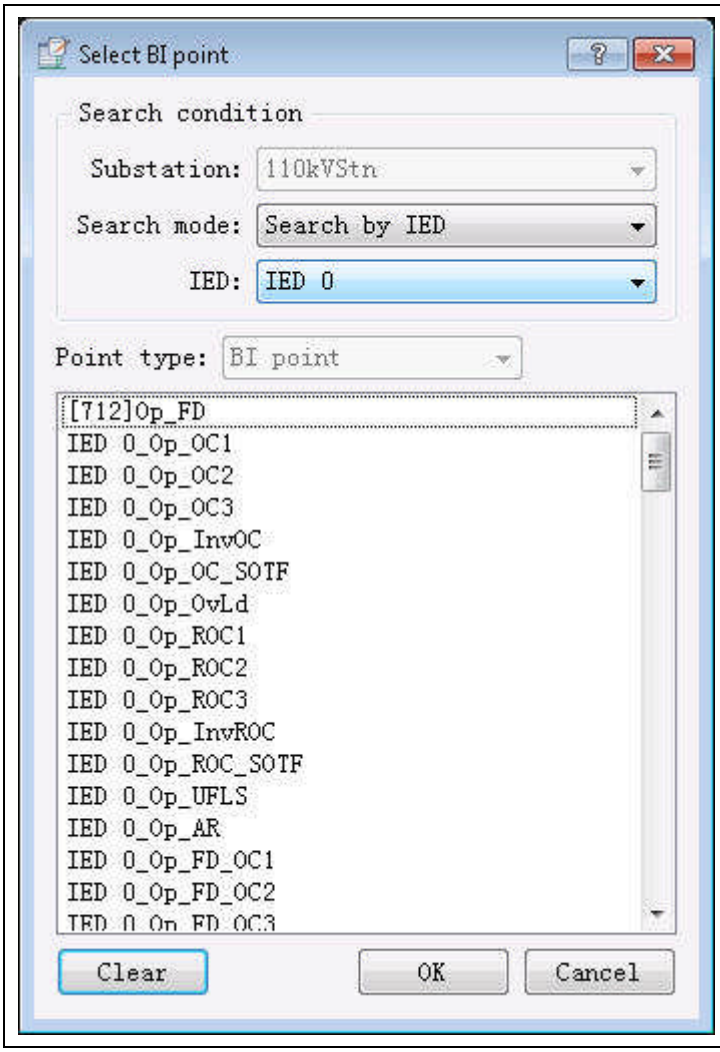
Finally, display all related setup for import of SCD. Red font indicates operations that delete database objects, please be prudent. In case of doubt on setup, user can click button “Last” to view and modify. After confirmation of no error, click button “Completed” to start analysis of SCD issue, extraction of IEC61850 model and measuring point information, and saving them in the logic database.

- **Modify substation attributes**

In the list window, user can modify substation name, substation address, commissioning date, Enable flag, substation graph, Block control criterion, abnormal criterion, outage criterion, maintenance criterion, and communication abnormal criterion. Relevant description is given below:

Table 12.5-1 Description of configuration of substation attributes

Name of attribute	Description
Substation name	Character string, not exceeding 128 English characters or 64 Chinese characters. Substation name must not be empty, repeated, or contain special characters such as “.” and “/” etc.
Address	Integer in the range of 0－65535. Address must not be repetitive.
Net A IP	IP address, reserved
Net B IP	IP address, reserved

Name of attribute	Description
Commissioning date	Year, month, day. User can directly enter numbers or open the Date editing window to select a date.
Enable flag	Select: process enabled, alarm enabled, telecontrol enabled; user can select a number of items in the pull-down list.
Substation graph	Name of graph; pop up Graph list window (*Figure 12.5-12*). Select corresponding substation graph and click “OK”, or double click a graph name to set substation graph. Click button “Clear” to clear currently set substation graph.
Block control criterion	BI point; pop up Select BI point dialog box ( **Figure 12.5-13**). Default searching mode is “Search according to device”. Corresponding device pull-down list will display all devices under this substation. Select a device; the list will display all BI points under this device. Switch search mode to “search according to bay”; corresponding bay pull-down list will display all bays under this substation. Select a bay; all BI points associated to primary equipment of this bay and under this bay will be displayed in the list. Select a BI point and click “OK”, or double click a BI point, to set block control criterion. Click button “Clear” to clear currently set block control criterion.
Abnormal criterion	Ditto

Name of attribute	Description
Outage criterion	Ditto
Maintenance criterion	Ditto
Communication abnormal criterion	Ditto

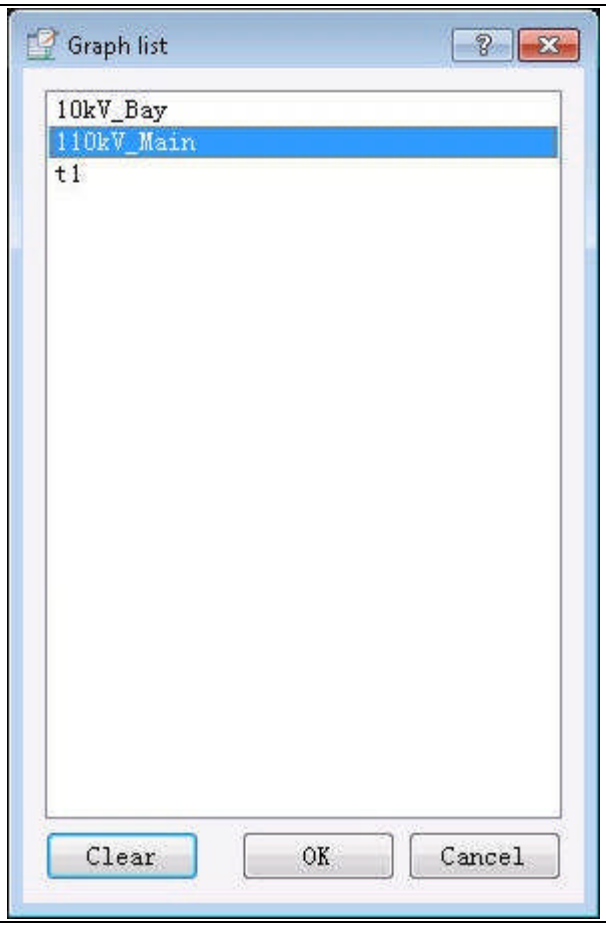


Figure 12.5-12 List of graph

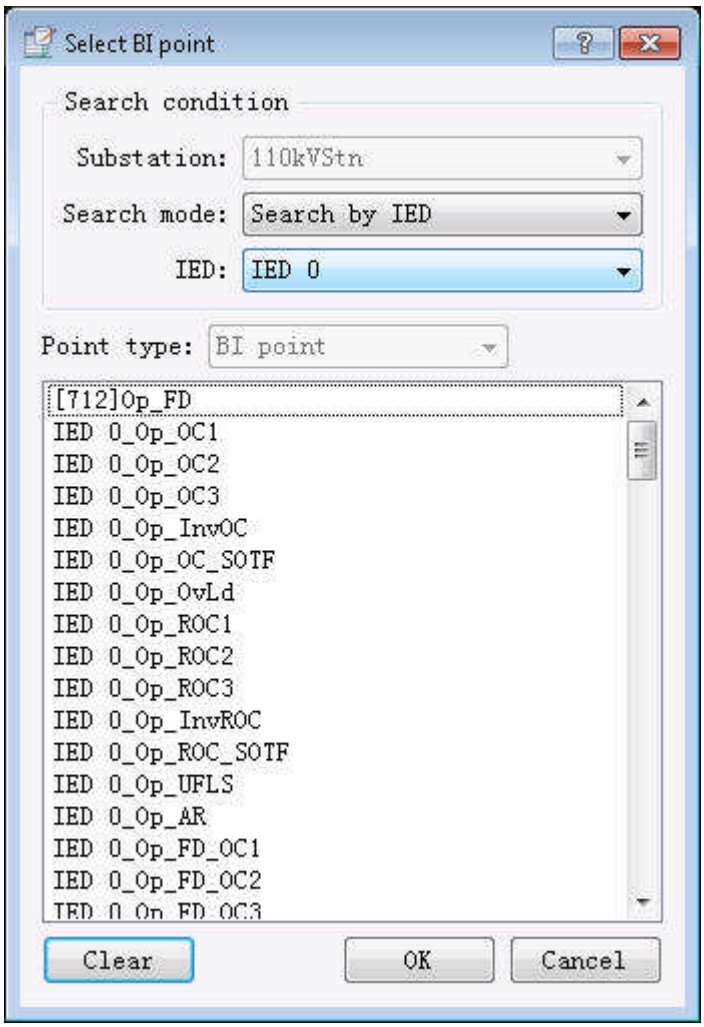


Figure 12.5-13 Selection of BI point

- **Delete substation**

Right click a substation node in the dock window, and select “Delete substation” in the menu popped up. A prompt window will pop up. Click OK to delete this substation object and all configurations under this substation from the database.

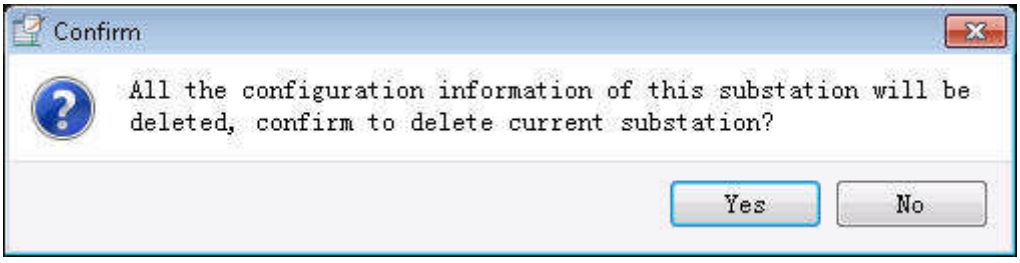


Figure 12.5-14 Delete substation

12.5.1.3 Configure IED

In default, there is a “synthetic information” virtual IED under each substation object, which has fixed address of 65040. This virtual IED cannot be deleted, and none of its attributes can be

modified.

- **Add IED**

In the dock window, right click a substation node and select “Add IED” in the menu popped up, or select a substation node and then click button “Add” on the tools bar, or select “Add” menu item under menu “Edit”, or use shortcut key “Ctrl+A”, to successfully add an IED object under this substation. In the dock window, a new IED node will be added under this substation node, with IED name as node name. If list mode is currently selected, right click the list window and select “Add” in the menu popped up, user can also add a new IED object, and the list window will display all IED objects under this substation.

- **Copy and paste IED**

Right click mouse on an IED in the dock window and select “Copy IED” in the menu popped up. Then, right click a substation node so that “Paste IED” menu item in the menu popped up is usable. Select “Paste IED” to pop up Paste IED dialog box.

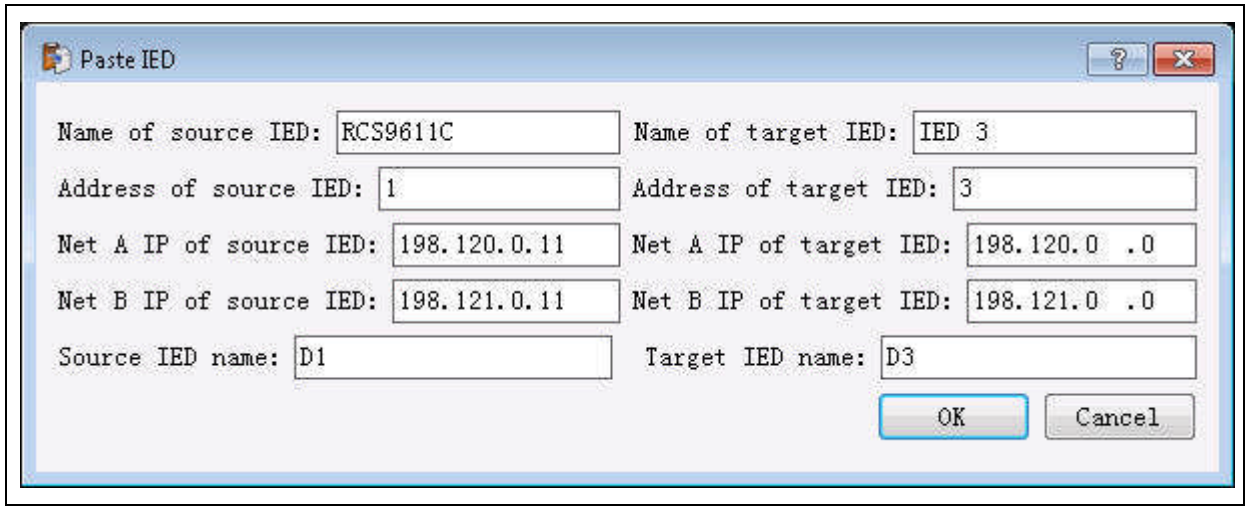


Figure 12.5-15 Paste IED

In this dialog box, user can set name of target IED, IED address, net A IP, net B IP, and IED ID. Among them, IED name, IED address, and IED ID shall be unique under the whole substation. After clicking button “OK”, a new IED object is added at end of the list of IED under the substation. Other attributes of this IED and model-related settings and measuring point attributes under this IED are consistent with those of source IED.

Right click an IED in the dock window; in the menu popped up, menu item “Paste and insert” is usable. Select “Paste and insert” to pop up Paste IED dialog box *(*

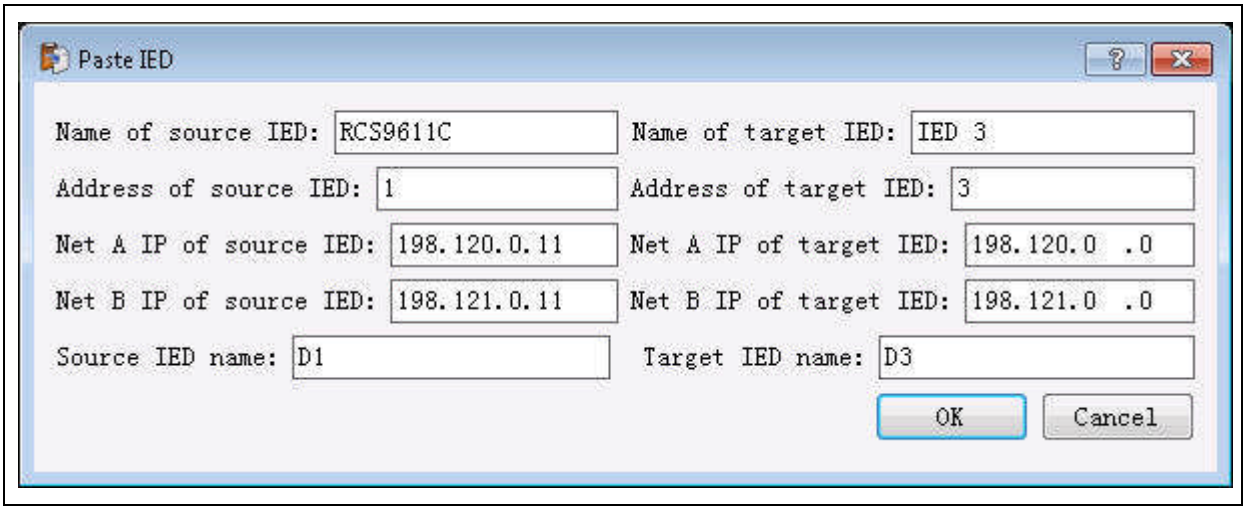


Figure 12.5-15). After setting, click “OK”; a new IED object will be added before this IED under the substation. Other attributes of this new IED and model-related settings and measuring point attributes under this IED are consistent with those of source IED.

Right click an IED in the dock window; if model of target IED is consistent with model of source IED, menu item “Paste IED” in the menu popped up is usable. Select “Paste and insert” menu item to pop up Paste IED dialog box (

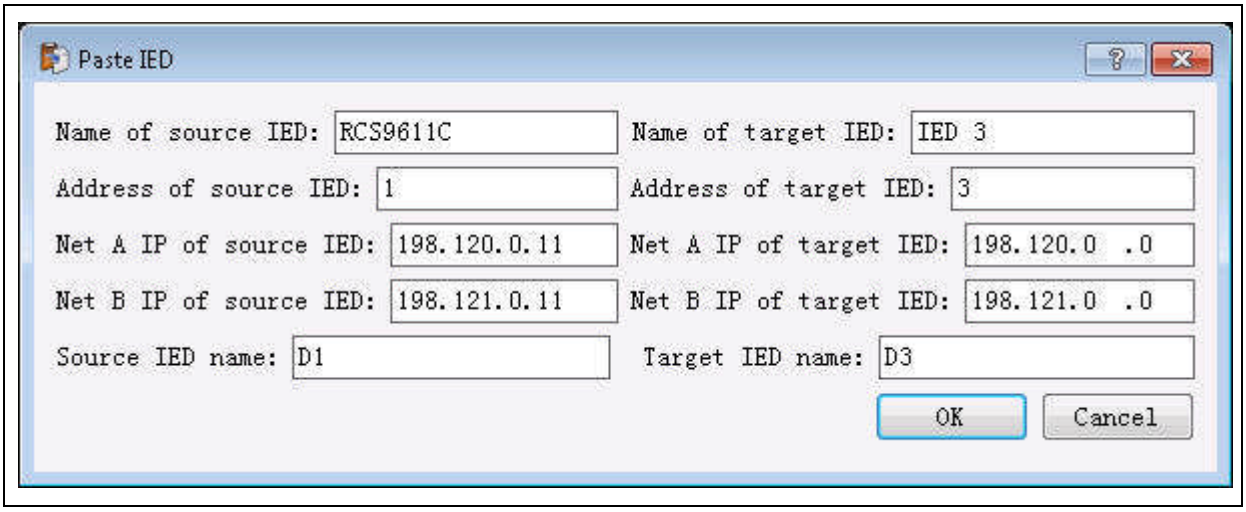


Figure 12.5-15). After setting, click “OK”. Other attributes of target IED and model-related settings and measuring point attributes under this IED are consistent with those of source IED.

- **Set Host/Standby_Mode**

Right click mouse on an IED in the dock window; if this IED is not set to Host/Standby_Mode, “Host/Standby_Mode” in the context menu will be effective.

Select this menu item to set current IED to the parent IED of Host/Standby_Mode, while generating 2 sub-IEDs, with these sub-IED nodes added under current IED node in the dock window. Or, if in list display status, select a substation so that all IEDs under this substation are displayed in the list window. Select two IED objects and right click mouse. If neither of these two IED objects is set to Host/Standby_Mode, menu item “Host/Standby_Mode” in the context menu will be effective. Select this menu item to set them as 2 sub-IEDs in the Host/Standby_Mode, while

generating a parent IED. In the dock window, these two IED nodes will be deleted, and a new parent IED node will be added, while setting these 2 IEDs to sub-nodes of this parent IED. If these 2 IEDs selected have inconsistent models, the database configuration tool will give a prompt, and operation can only continue after clicking button “Yes”. For 61850 device, measuring and control logic device is judged according to “Ctrl” character string contained in the logic device name, and the measuring and control part will be extracted to the parent IED, and set to Host/Standby_Mode.

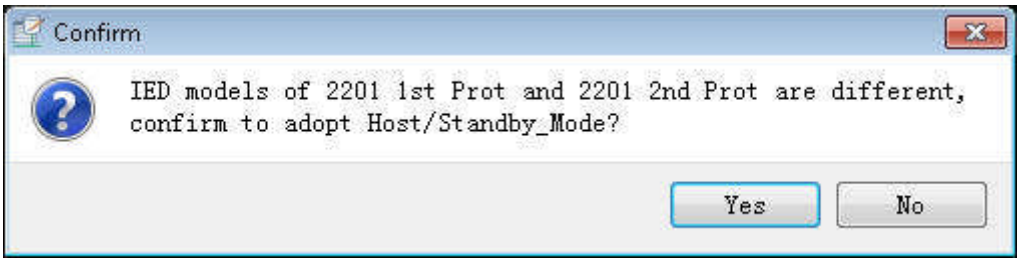


Figure 12.5-16 Set Host/Standby_Mode

NOTE: If user sets two IEDs of different measuring point sequence or model structure to Host/Standby_Mode, it may be impossible to realize setup of data attributes.

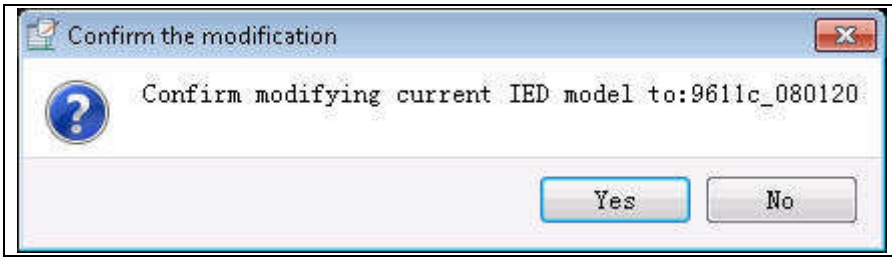
To cancel Host/Standby_Mode, right click parent IED node in the dock window and select “Cancel Host/Standby_Mode” menu item (if the selected IED is not parent IED, this menu item will be grey); the configuration tool will cancel Host/Standby_Mode and delete the parent IED. The two sub-IEDs will continue to exist as independent IED, with these two IED nodes added in the dock window. If user selects “Delete IED” menu item, the parent IED and its two sub-IEDs will be deleted. If user right clicks one sub-IED node and select “Delete IED” in the menu popped up, the configuration tool will delete currently selected sub-IED and the parent IED, while the other sub-IED will continue to exist as independent IED.

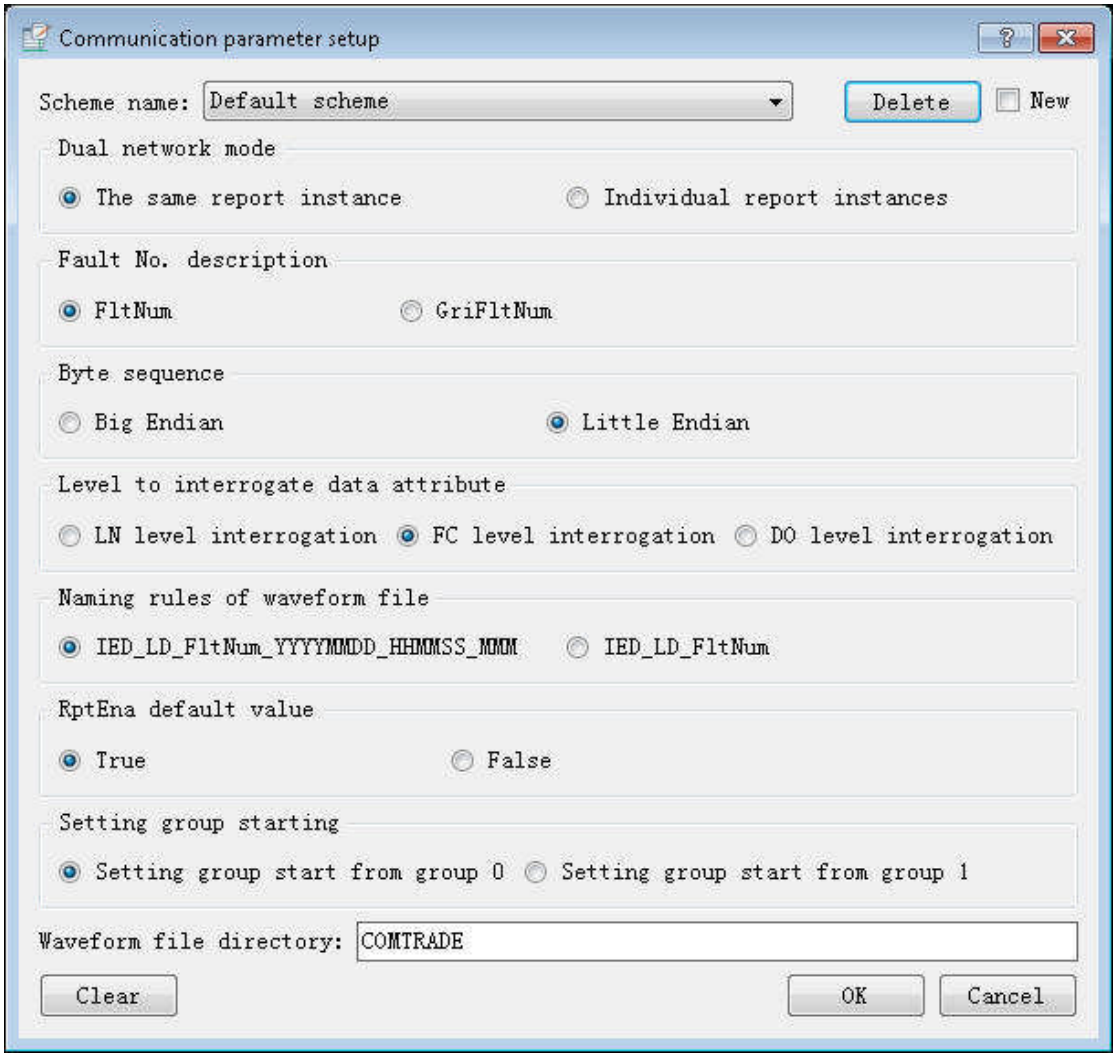
- **Modify IED attributes**

In the list window, user can modify IED name, IED address, IED model, IED type, IED ID, net A IP, net B IP, communication scheme, protection panel (switch cabinet) No., processed flag, manufacturer, commissioning date, abnormal criterion, outage criterion, maintenance criterion, earth criterion, and remark. Relevant description is provided below:

Table 12.5-2 Description of IED attributes configuration

Name of attribute	Description
IED name	Character string, not exceeding 128 English characters or 64 Chinese characters. Name of IED must not be empty, repeated (under the substation), or contain special characters such as “.”, “/”, and “_” etc.
IED address	Integer in the range 0—65535; unique under the substation.
IED model	Enumeration. The pull-down list will display all imported IED models. If IED model has been set for current IED, the database configuration tool will give a prompt (

Name of attribute	Description
	 **Figure 12.5-17** Modify IED model); after confirmation, the IED model can be modified, with model and measuring point information under this IED updated. If current IED has been generated by import of SCD file, this attribute cannot be modified. In Host/Standby_Mode mode, this attribute of sub-IED objects cannot be modified.
IED type	Select content: protection; protection, measuring, and control; measuring and control; fault recording; system information; and other. In Host/Standby_Mode, this attribute of sub-IED objects cannot be modified.
Model type	IEC61850 model or 103 model; cannot be modified; generated according to IED model
Device ID	Character string not exceeding 32 English characters; unique under the substation
Net A IP	Entered in IP address format
Net B IP	Entered in IP address format
Communication scheme	Name of communication scheme; pop up Communication scheme setup dialog box (

Name of attribute	Description
	 **Figure 12.5-18**). In this dialog box, user can add, modify, and delete communication scheme. After selecting a communication scheme, click “OK” to set it; click “Clear” to clear currently set communication scheme.
Protection panel (cabinet) No.	Character string not exceeding 64 English characters or 32 Chinese characters
Processed label	Content of selection: process enabled, alarm enabled. In the pull-down list, user can select a number of items. In Host/Standby_Mode, this attribute of sub-IED objects cannot be modified.
Manufacturer	Character string not exceeding 64 English characters or 32 Chinese characters
Commissioning date	Year, month, day. User can directly enter numbers or open Date editing box to select a date.
Abnormal criterion	BI point. The configuration method is the same as the attribute “Block control criterion” of the substation object.
Outage criterion	Ditto

Name of attribute	Description
Maintenance criterion	Ditto
Earth criterion	Ditto
Remark	Character string not exceed 128 English characters or 64 Chinese characters

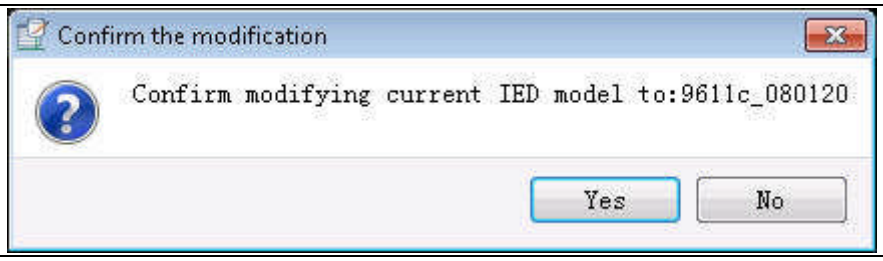


Figure 12.5-17 Modify IED model

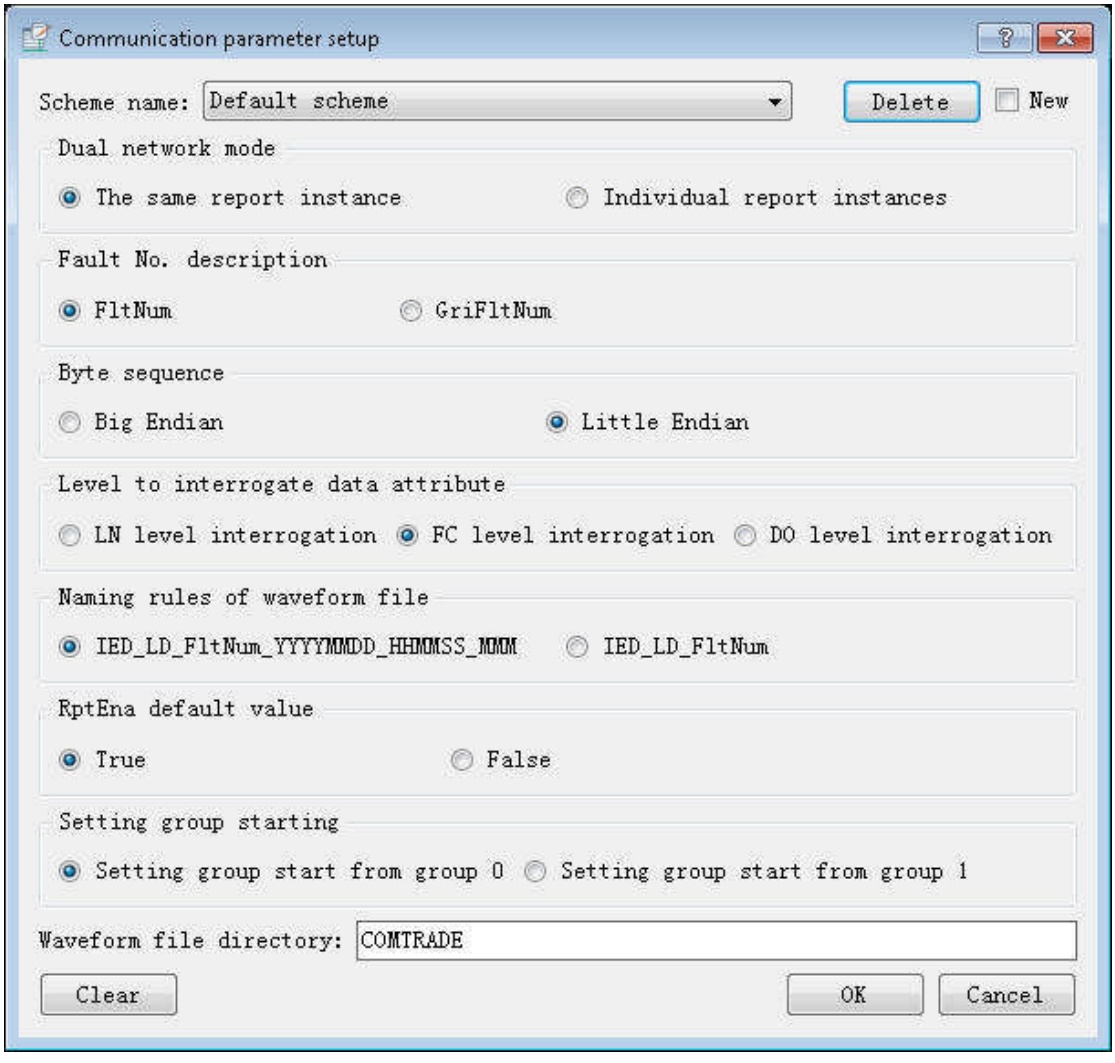


Figure 12.5-18 Setup of communication parameters

- **Delete IED**

In the dock window, select an IED node and click button “Delete” on the tools bar, or select “Delete” menu item under menu “Edit”, or directly press Delete key, or right click this IED node and select “Delete IED” in the menu popped up; the database configuration tool will prompt for confirmation. After clicking “Yes”, the database configuration tool will execute deletion operation. If current IED is the parent IED of Host/Standby_Mode, its two corresponding sub-IEDs will be deleted too.

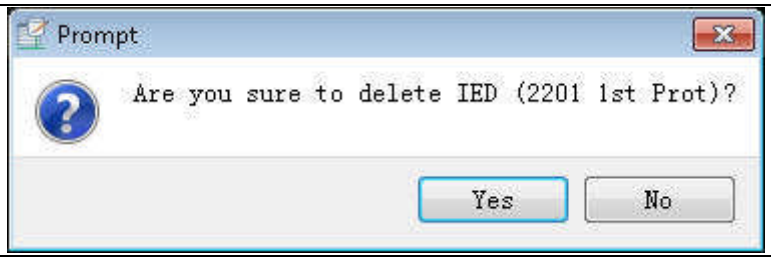


Figure 12.5-19 Delete IED

If currently in list display status, select a substation so that all IEDs under this substation will be displayed in the list window. Select IED object (or a number of IED objects) to be deleted and right click mouse. In the menu popped up, select “Delete” menu item, or click Delete button on tools bar, or select “Delete” menu item in menu “Edit”, or directly press Delete key; the database configuration tool will prompt deletion of all selected IEDs. If an IED object currently being deleted includes IED in Host/Standby_Mode, the database configuration tool will give a prompt for confirmation of deletion of IED in Host/Standby_Mode. If this operation continues, and currently selected IED includes a parent IED, this parent IED and its two sub-IEDs will be deleted along with. If currently selected IED includes a sub-IED of Host/Standby_Mode, this sub-IED and its parent IED will be deleted, while the other sub-IED of this parent IED will remain. If currently selected IED includes two sub-IEDs of Host/Standby_Mode, the parent IED and these two sub-IEDs will be deleted together.

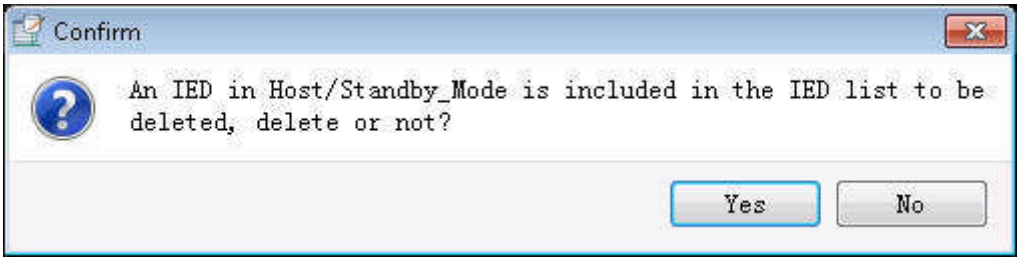


Figure 12.5-20 Delete IED in Host/Standby_Mode

12.5.1.4 Model Configuration

In the dock window, select an IED node. If this IED is 103 device, only one node “IED measuring point” exists under this node. If it is an IEC61850 device, two sub-nodes “IED model” and “IED measuring point” will exist under this node. Model configuration refers to configuration related to communication for IEC61850 model of the IED, and mainly includes setup of logic device loading function, setting of data set description name, and setup of the report control block.

- **Configuration of logic device**

In the dock window, select IED model node under an IED node. If current IED is IEC61850 device, the list window will display list of logic devices of this IED model. Names of logic devices in the logic device objects are extracted from configuration file and cannot be modified. User can modify description names and types of logic devices according to actual conditions. Relevant description is given below:

Table 12.5-3 Description of configuration of logic devices

Name of attribute	Description
Description name	Character string not exceeding 64 English characters or 32 Chinese characters
Type of logic device	Contents of selection: ordinary mode, dual measuring and control mode, and not loaded. In Host/Standby_Mode, this attribute of sub-IED objects cannot be modified. If change of logic device type to ordinary mode is confirmed, mode of all measuring points under this logic device will also be changed to ordinary mode.

NOTE: Type of logic device is the basis of data processing by the front end module. In default, in the database configuration tool, this type is ordinary mode.

- **Configuration of data set**

In the dock window, select an IEC61850 device node to open hierarchy of device model. Select “Date set” node under LN node; the list window will display all data sets under corresponding LN. All attributes displayed in data set objects are read from IED configuration files, but description names of data sets can be modified according to site demands to facilitate display and operations by other applications.

- **Configuration of report control block**

In the dock window, select an IEC61850 device node to open hierarchy of device model. Select a “Report control block” node under LN node; the list window will display all report control blocks under corresponding LN. After selection of a report control block node in the dock window, the list window will display attributes configuration interface of this report control block, as shown below:

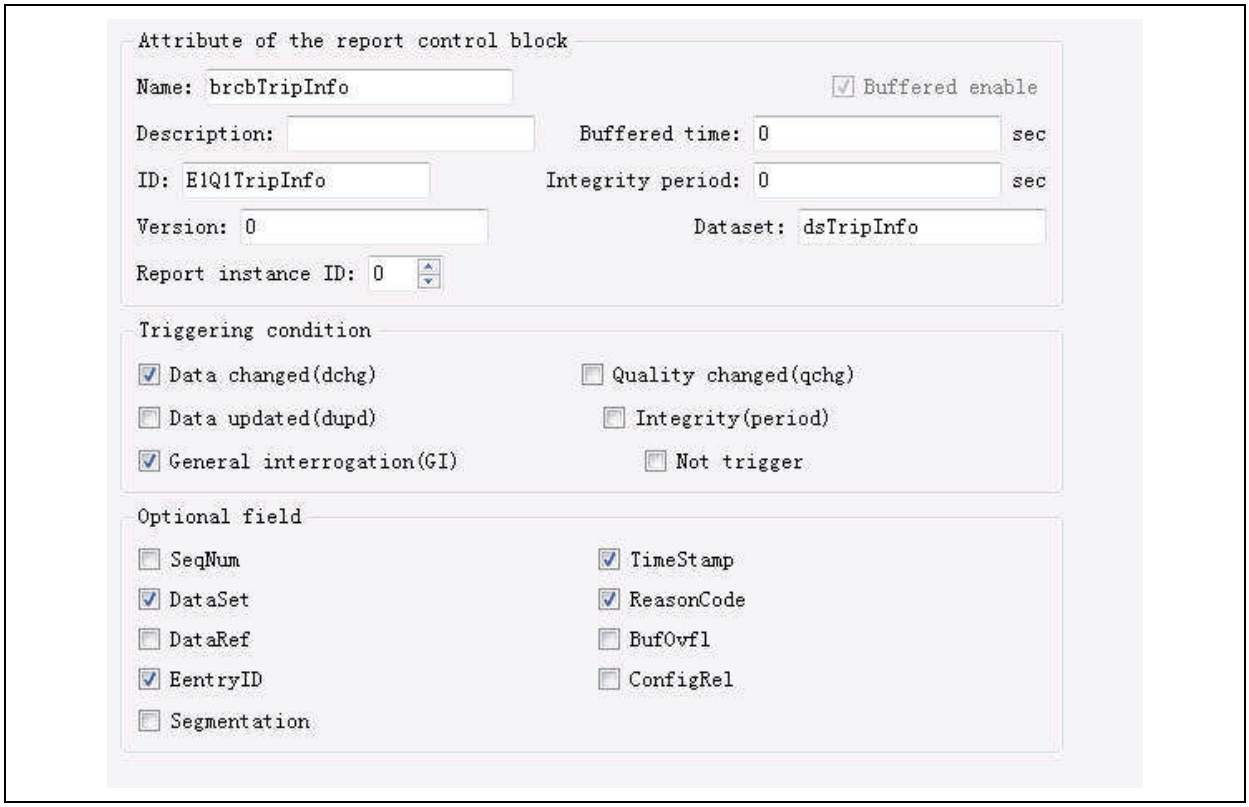


Figure 12.5-21 Configuration of report control block

Attributes, triggering conditions, and initial values of optional fields of a report control block are all read from IED configuration file. With the exception of report instant ID, it is not permitted to modify other attributes of the report control block. If the configuration file defines current report control block as single instance, default report instance ID will be 0 and cannot be modified. If it is defined as multi-instance, user can modify report instance ID according to site configuration, but not to exceed maximum value defined in the configuration file. Trigger conditions and relevant contents of optional fields can be modified according to site conditions, and the front end module will write report control block settings back to the IED.

Since setup of single report control block is complicated, the database configuration tool provides batch modification function for report control blocks. The batch modification can be carried out for 2 occasions: buffered report control block (BRCB) and unbuffered report control block (URCB). At the same time, IED can be flexibly selected for setup. Select “Set report control block” under menu “Operation” to open batch setup dialog box as shown below:

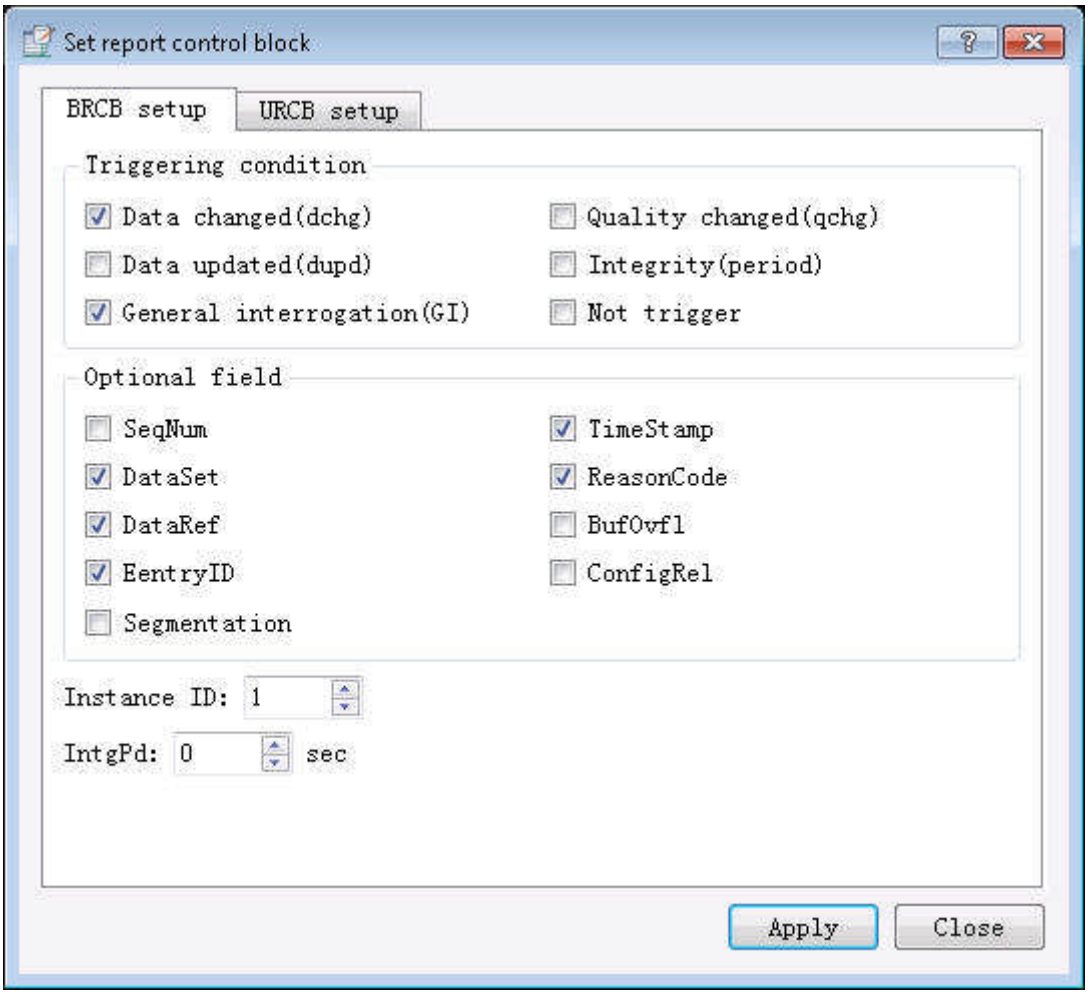


Figure 12.5-22 Batch configuration of report control blocks

After modification of attributes of BRCB or URCB, click button “Apply” to pop up an IED selection dialog box. User can select corresponding IED to set attributes of report control blocks.

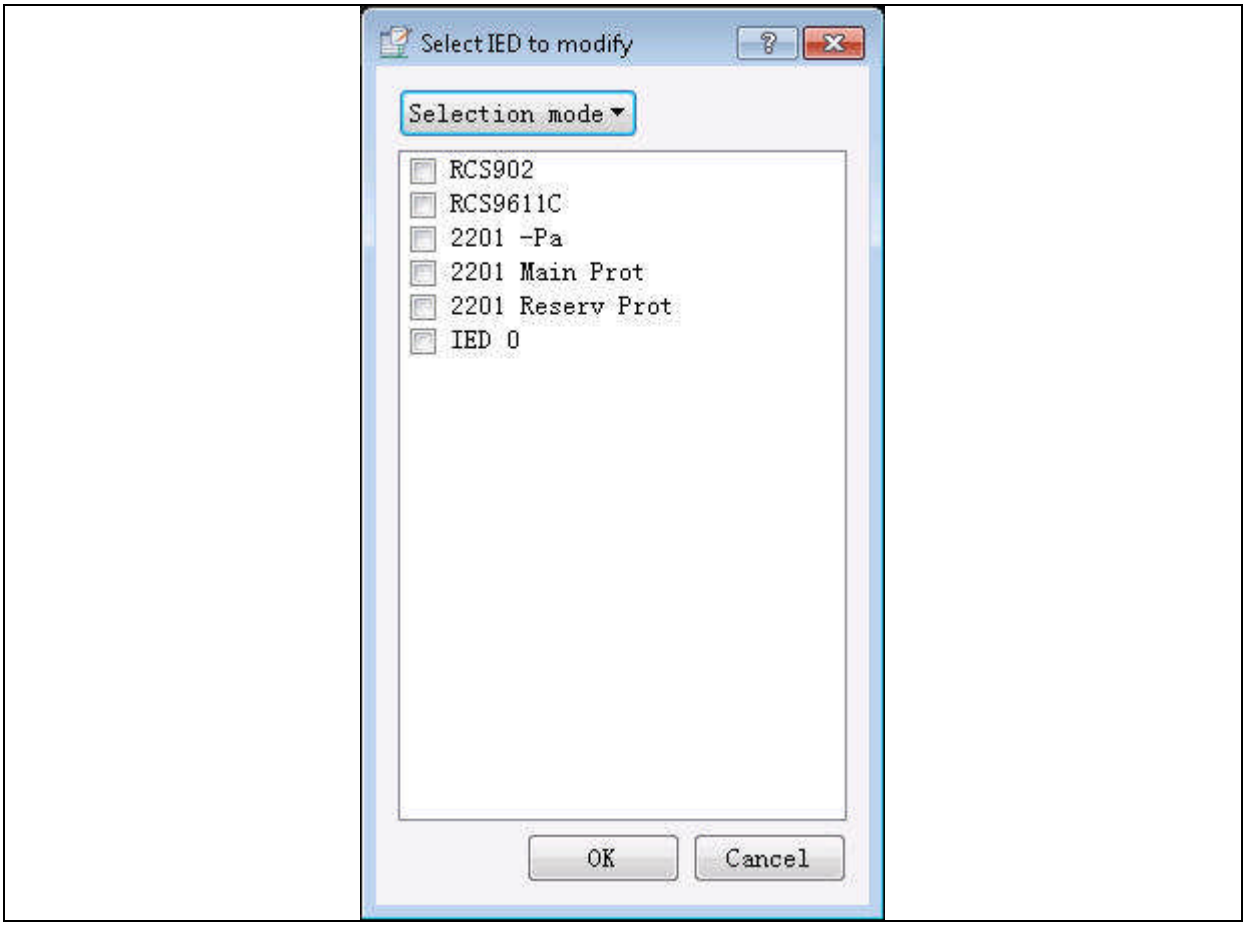


Figure 12.5-23 Select IED to modify

12.5.1.5 Configuration of Measuring Points

In the dock window, select and open “IED measuring point” sub-node under an IED node. The list window will display all measuring point groups of current IED, and provides the function to modify description of measuring point groups.

In the dock window, if current measuring point display scheme is displayed according to type, under the “IED measuring points” node, there will be 6 sub-nodes: “BI”, “Measurement”, “Control”, “Metering”, “TP”, and “Setting”. For display according to measuring point groups, sub-nodes under “IED measuring point” node will be IED measuring point group objects.

For ordinary 103 devices, measuring point groups and measuring point information are read from their configuration files (point tables), and can be classified into the following 6 types: BI, measurement, control, TP, metering, and settings. According to group titles, BI can be further classified into: general fault, circuit breaker, DS, operation element, device self-check, operation alarm, VEBI, EBI, special BI, earth alarm, and other; measurement can be further classified into: current, voltage, active power, reactive power, cycle, temperature, protection current, protection voltage, protection angle, and other; control can be further classified into: status control, value control, TP regulation sudden stop, sequential control, and other; metering can be further classified into: input energy and output energy; and settings can be further classified into: device settings and device parameters. For IEC61850 device, measuring point information is extracted from models according to relevant definitions in IEC61850-7-4 and IEC61850-7-3.

As there are many measuring point attributes, locating is not easy. The database configuration tool provides the function to hide and show attribute columns. When measuring point objects are displayed in the list, right click list head to pop up a menu, displaying hide/show status of each attribute column (the figure below is for BI attribute columns; other measuring points have similar arrangement). Attribute columns not marked are hidden. This can simplify configuration interface.

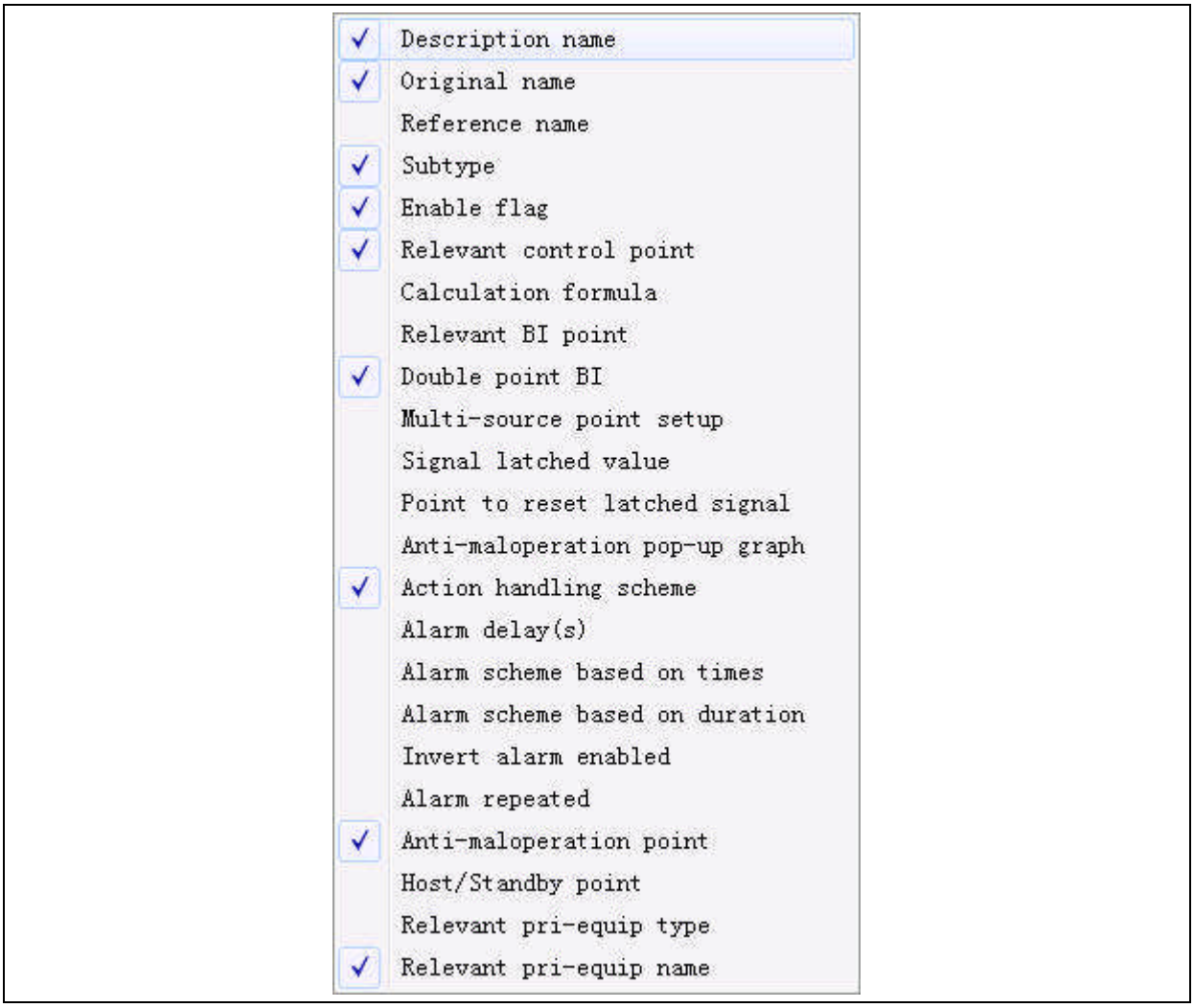


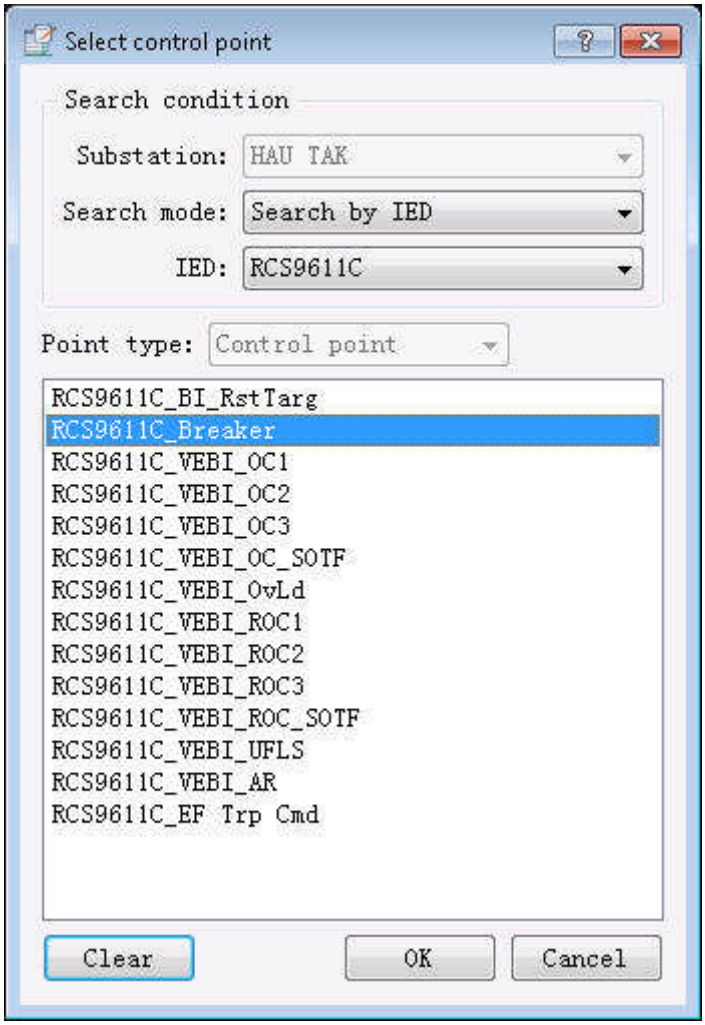
Figure 12.5-24 Hide/show BI attribute columns

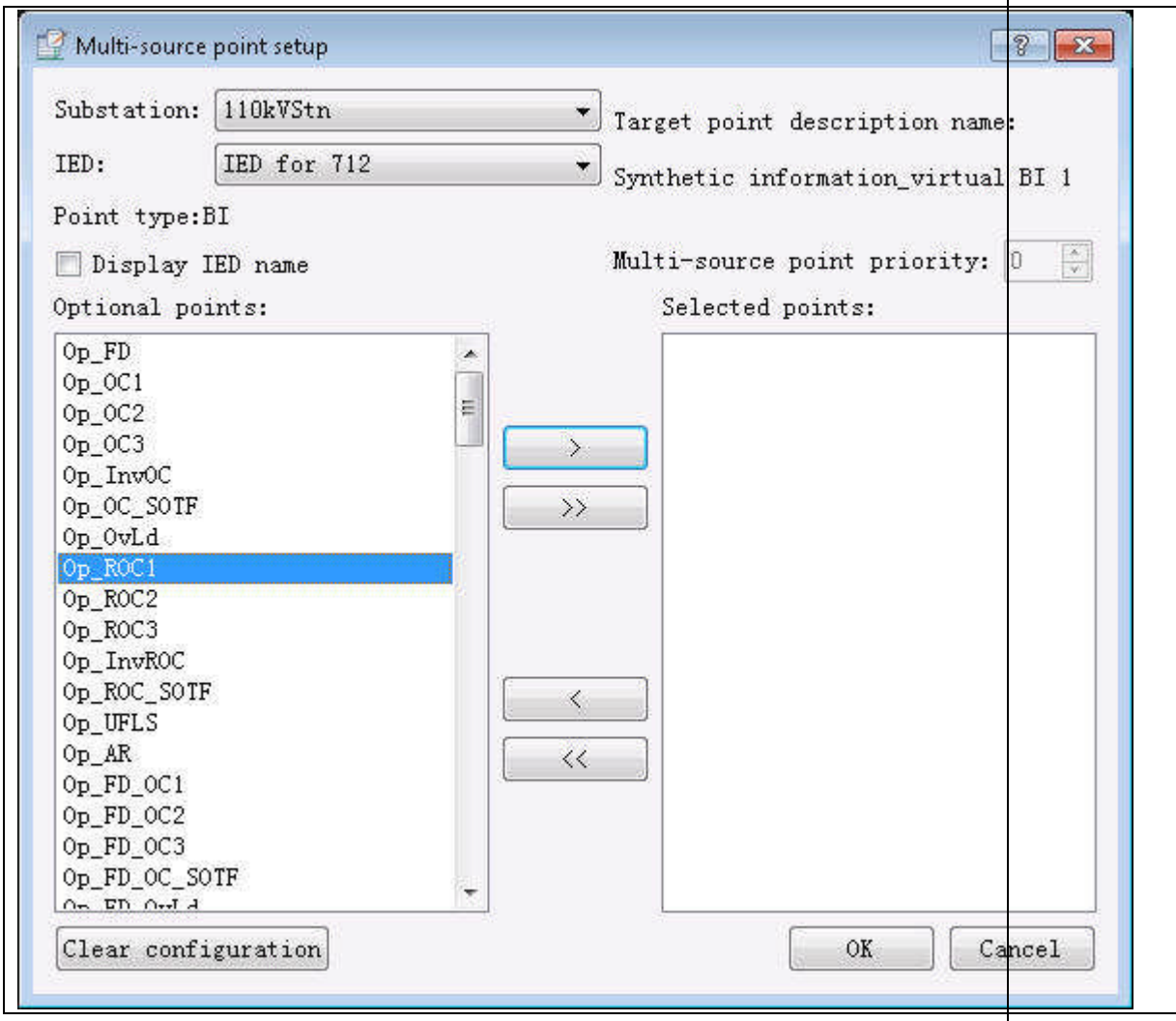
- **Configuration of BI points**

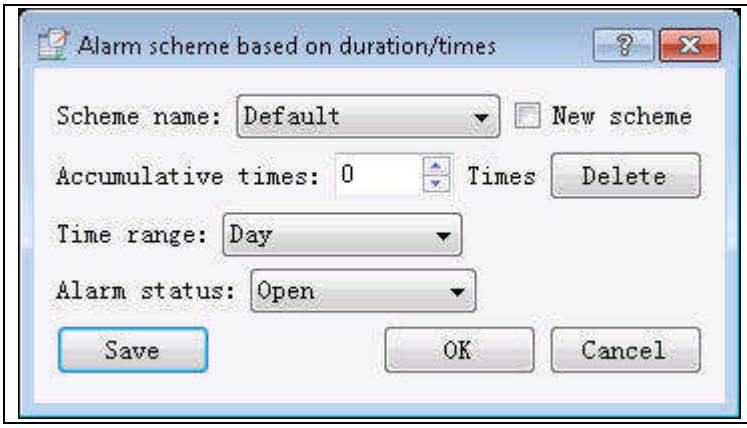
Attributes of BI point include: Description name, Original name, Reference name, Subtype, Enable flag, Relevant control point, Calculation formula, Relevant BI point, Double point BI, Multi-source point setup, Signal latched value, Point to reset latched signal, Anti-maloperation pop-up graph, Action handling scheme, Alarm delay, Alarm scheme based on times, Alarm scheme based on duration, Invert alarm enabled, Alarm repeated, Anti-maloperation point, Host-Standby point, Relevant pri-equip type, and Relevant pri-equip name. For particular description, refer to the table below:

Table 12.5-4 Description of configuration of BI points

Name of attribute	Description
Description name	Character string not exceeding 200 English characters or 100 Chinese characters; must not be empty or contain special characters such as “.” and “/”; to be as unique as possible under the device
Original name	Character string; measuring point name specified in device configuration file; cannot be modified.
Reference name	Character string; empty under 103 device; under 61850 device, path of measuring point in the model; cannot be modified.
Subtype	Enumeration. Subtypes include: circuit breaker, DS, truck, operation element, device self-check, operation alarm, VEBI, EBI, special BI, earth alarm, and other. In Host/Standby_Mode, for BI under sub-IED object, this attribute cannot be modified.
Enable flag	Contents of selection: process enabled, alarm enabled, invert enabled, calculation point, control enabled, post disturbance review enabled, latched signal, trigger general fault, and trigger general alarm. In the pull-down list, a number of items can be selected. Option “calculation point” is only selected for BI point under synthesized signal virtual device. In Host/Standby_Mode, this attribute of sub-IED objects cannot be modified.
Relevant control point	Control point. Click this attribute column to pop up control point selection dialog box (

Name of attribute	Description
	 **Figure 12.5-25**). If no relevant control point is set, in default, the device where current BI point is located is selected. If relevant control point has been set, in default, the device where the set control point is located is selected. At the same time, corresponding control point will be selected in the list. After selection of a control point, click “OK” to set relevant control point. At the same time, relevant status point of selected control will be set as current BI point. Click button “Clear” to clear set control point and association between current BI point and control point. If selected control point has been associated with other BI point, the database configuration tool cannot execute this operation and will give an error prompt. In Host/Standby_Mode, to set relevant control point for BI point under parent device, the database configuration tool will give a prompt for confirmation of the need of automatic setting of relevant control point of corresponding BI point under sub-IED. If the set control point is just the control point under this device, click “Yes” to automatically set relevant control point of corresponding BI point under the sub-IED.
Calculation formula	Edit formula. This attribute can only be edited if option “calculation point” is selected in Enable flag. Click this attribute column to pop up Edit formula dialog box. User can edit calculation formula

Name of attribute	Description
	corresponding to current virtual BI.
Relevant BI point	BI point; the process of setup is the same as that of attributes of substation object block control point.
Double point BI	BI point. The configuration method is the same as that of attributes of substation object block control point. This attribute is a one-to-one 2-way association relation. If selected BI point has established double point BI relation with other BI, the database configuration tool cannot continue this operation and will give an error prompt. In Host/Standby_Mode, to set double point BI for BI point under parent device, the database configuration tool will give a prompt for confirmation of the need of automatic setup of double point BI of corresponding BI point under the sub-IED. If the set double point BI is just the BI point under this device, click button "Yes" to automatically set double point BI of corresponding BI point under the sub-IED.
Multi-source point setup	Click this attribute column to pop up multi-source point setup dialog box ( **Figure 12.5-26**). In default, setup of multi-source point of current measuring point will be displayed. After selecting an item in the list of selected measuring points, multi-source point priority will be switched to a state that allows modification. User can set priority of the data object

Name of attribute	Description
	that has been selected as multi-source point. Select a device in the device list, and select measuring points from those to be selected and add them into the list of selected measuring points. After setup, click “OK” to set multi-source points of current BI point; click “Clear” to clear setup of multi-source points.
Signal latched value	A value; enter 0 or 1
Point to reset latched signal	BI point; process of its setup is the same as process of setup of attributes of substation object block control point.
Anti-maloperation pop-up graph	Name of graphic. The configuration method is the same as that of attributes of substation object substation graph.
Action handling scheme	Name of action handling scheme. Action handling schemes defined in the alarm database for selection. In Host/Standby_Mode, for BI under sub-IED, this attribute cannot be modified.
Alarm delay (s)	A value (integer) in seconds
Alarm scheme based on times	Name of alarm scheme based on times. Click this attribute column to pop up Alarm scheme based on duration/times setup dialog box ( **Figure 12.5-27**). User can add and delete alarm scheme based on duration/times, or modify selected alarm scheme based on duration/times.
Alarm scheme based on duration	Name of alarm scheme based on duration, setup of which is the same as for alarm scheme based on times.
Invert alarm enabled	A value; enter 0 or 1. Used to specify normal status value and alarm status value corresponding to this BI point.
Alarm repeated	“Yes” or “No”. In Host/Standby_Mode, for BI under sub-IED object, this attribute cannot be modified.
Anti-maloperation point	“Yes” or “No”. After this measuring point is associated to primary equipment, if this attribute is Yes, when updating anti-maloperation database, this BI object will be copied into the

Name of attribute	Description
	anti-maloperation database. In Host/Standby_Mode, for BI under sub-IED object, this attribute cannot be modified.
Host-standby point	“Yes” or “No”. This attribute can only be modified for parent device in Host/Standby_Mode. For ordinary device, this attribute is “No” in default. When setting host-standby device, for BI points of sub-type of “operation element”, “device self-check”, and “operation alarm”, this attribute is “No”; for other types, this attribute is “Yes”.
Relevant pri-equip type	Character string; type of primary equipment associated with current BI point; cannot be edited.
Relevant pri-equip name	Character string; Name of primary equipment associated with current BI point; cannot be edited.

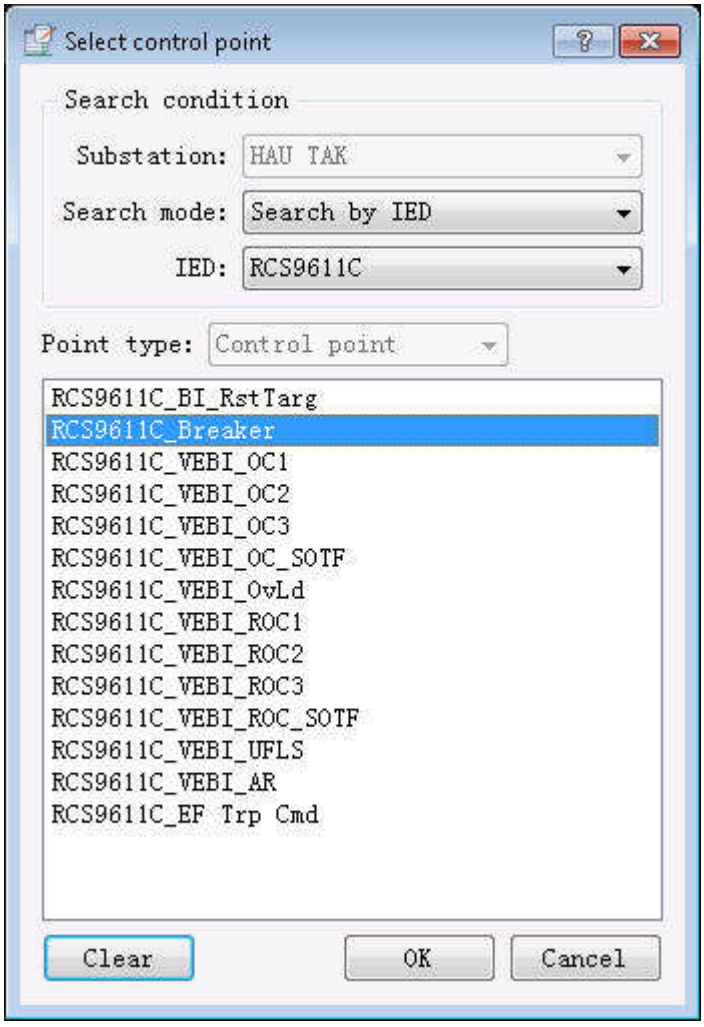


Figure 12.5-25 Select control point dialog box

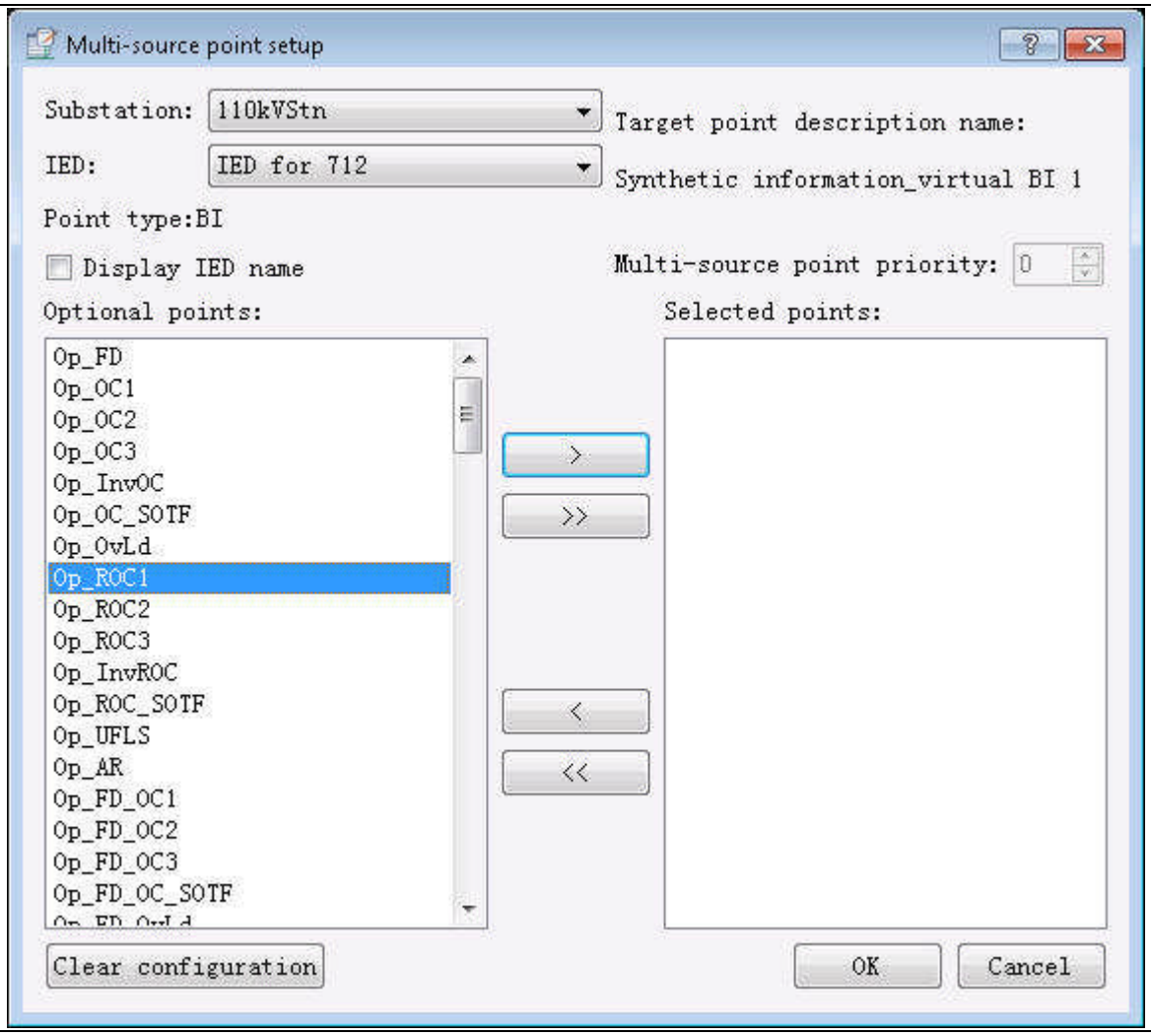


Figure 12.5-26 Multi-source point setup dialog box

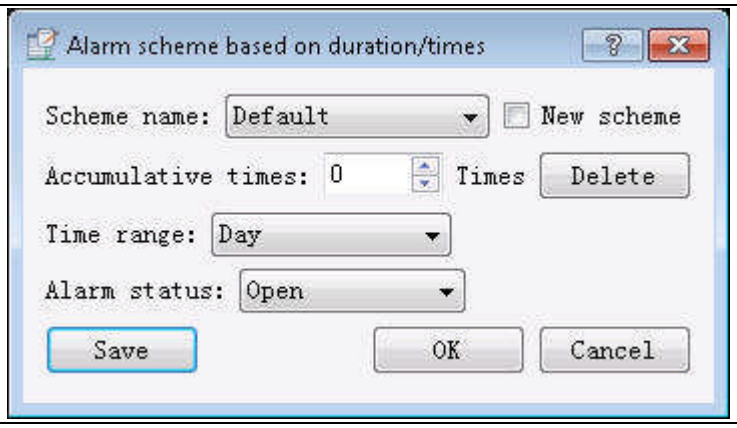


Figure 12.5-27 Alarm scheme based on duration/times dialog box

- **Configuration of measurement points**

Attributes of measurement point include: Description name, Original name, Reference name, Subtype, Unit, Coefficient, Offset, Residual, Dead zone, Enable flag, Sampling period, Calculation formula, Limit value table, Multi-source point setup, Relevant BI point, Relevant measurement point, Relevant P, Relevant Q, Relevant I, Relevant control point, Pop up graph?, Trend scheme,

Action handling scheme, Sudden change type, Sudden change threshold, Anti-maloperation point, Host-Standby point, Relevant pri-equip type, and Relevant pri-equip name. Particular description is given in the table below:

Table 12.5-5 Description of configuration of measurement points

Name of attribute	Description
Description name	Character string not exceeding 200 English characters or 100 Chinese characters. Must not be empty; must not contain special characters such as "." and "/" etc.; shall be as unique as possible under the device.
Original name	Character string; name of measuring point specified in IED configuration file; this name cannot be modified.
Reference name	Character string; empty under 103 device; under 61850 device, this is path of measuring point in the model; cannot be modified.
Subtype	Enumeration; sub-types include: current, voltage, active power, reactive power, cycle, temperature, protection current, protection voltage, protection angle, and other. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Unit	Character string; read from IED configuration file in default. For different sub-types, units for selection vary. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Coefficient	Floating point number; for multiplication with uploaded measuring point value. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Offset	Floating point number; after uploaded measuring point value is multiplied by the coefficient, the offset will be added to yield actual value. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Residual	Floating point number; in case absolute value of measuring point actual value is less than this value, actual value is set to 0. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Dead zone	Floating point number; if absolute value of the difference between two succeeding actual values before and after a measuring point is less than this value, value of the measurement point is deemed unchanged. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Enable flag	Contents of selection: process enabled, alarm enabled, absolute calculation enabled, invert enabled, save trend, calculated point, regulation enabled, post disturbance review enabled, and sudden change alarm enabled. In the pull-down list, user can select a number of items. The item "calculated point" is only selected for measurement point under synthesized signal virtual device. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Sampling period	Name of sampling period; sampling periods defined in historical database for selection
Calculation formula	Edit formula; this attribute can only be edited if "calculated point" is selected in Enable

Name of attribute	Description
	flag. Click this attribute column to pop up Edit formula dialog box; user can edit calculation formula corresponding to current virtual measurement.
Limit value table	Name of limit scheme; defined limit schemes are displayed in the pull-down list for selection
Multi-source point setup	The process of setup is the same as that of BI multi-source point.
Relevant BI point	BI point. The configuration method is the same as the attribute “Block control criterion” of the substation object.
Relevant measurement point	Measurement point. The configuration method is the same as above.
Relevant P	Measurement point. The configuration method is the same as above.
Relevant Q	Measurement point. The configuration method is the same as above.
Relevant I	Measurement point. The configuration method is the same as above.
Relevant control point	Control point; its process of setup is the same as that of attributes of control point related to BI object.
Popup graph?	Name of graph; its process of setup is the same as that of attributes of substation object substation graph.
Trend scheme	Name of scheme; all defined trend schemes for selection. This attribute can only be edited if “save trend” is selected as enable flag.
Action handling scheme	Name of action handling scheme. The configuration method is the same as for action handling scheme for BI object.
Sudden change type	Absolute value type or percentage type. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Sudden change threshold	Floating point number; used to judge sudden change of value of current measuring point object. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Alarm scheme based on duration	Name of alarm scheme based on duration; its setup is the same as for alarm scheme based on times.
Anti-maloperation point	“Yes” or “No”. In Host/Standby_Mode, for measurement under sub-IED object, this attribute cannot be modified.
Host-standby point	“Yes” or “No”. This attribute can only be modified for parent device in Host/Standby_Mode. For ordinary device, this attribute is “No” in default. When setting host-standby device, for measurement points of sub-type “protection current”, “protection voltage”, and “protection angle”, this attribute is “No”; for all other sub-types, this attribute is “Yes”.
Relevant pri-equip type	Character string; type of primary equipment associated with current measurement point; cannot be edited.
Relevant pri-equip	Character string; Name of primary equipment associated with current measurement

Name of attribute	Description
name	point; cannot be edited.

- **Configuration of control points**

Attributes of control point include: Description name, Original name, Reference name, Control point type, Dispatching No., Enable flag, Relevant status, Relevant position, Relevant measurement, Close rule, Open rule, Pop up graph?, Control mode, Host-Standby point, Relevant pri-equip type, and Relevant pri-equip name. Particular description is given in the table below:

Table 12.5-6 Description of configuration of control points

Name of attribute	Description
Description name	Character string not exceeding 200 English characters or 100 Chinese characters. Must not be empty; must not contain special characters such as "." and "/" etc.; shall be as unique as possible under the device.
Original name	Character string; name of measuring point specified in IED configuration file; this name cannot be modified.
Reference name	Character string; empty under 103 device; under 61850 device, this is path of measuring point in the model; cannot be modified.
Control point type	Enumeration; sub-types include: status control, value control, TP control, TP regulation sudden stop, and sequential control. In Host/Standby_Mode, for control under sub-IED object, this attribute cannot be modified.
Dispatching No.	Character string not exceeding 32 English characters or 16 Chinese characters. Used to confirm correct control object for control operation
Enable flag	Contents of selection: process enabled, telecontrol blocked. In the pull-down list, a number of items can be selected. In Host/Standby_Mode, for control under sub-IED object, this attribute cannot be modified.
Relevant status	BI point; can be edited if type of control point is status control, or TP regulation sudden stop or sequential control. The process of setup is the same as that of relevant control point of BI object.
Relevant position	TP point; can be edited if type of control point is TP control. Process of setup is the same as above.
Relevant measurement	Measurement point; can be edited if type of control point is value control. Process of setup is the same as above.
Close rule	Edit rule; click this attribute column to pop up Edit rule dialog box. User can set close rule corresponding to the control point. For telecontrol close operation, first, judge if this rule is met (calculation result is true).
Open rule	Edit rule; click this attribute column to pop up Edit rule dialog box. User can set open rule corresponding to the control point. For telecontrol open operation, first, judge if this rule is met (calculation result is true).
Pop up graph?	Name of graph. The configuration method is the same as that of attributes of substation object substation graph.

Name of attribute	Description
Control mode	Single selection; for measuring point under IEC61850 device. Default value is read from IEC61850 model and can be edited. Optional contents: direct control, selective control, enhanced direct control, and enhanced selective type control. In Host/Standby_Mode, for control under sub-IED object, this attribute cannot be modified.
Host-standby point	“Yes” or “No”. This attribute can only be modified for parent device in Host/Standby_Mode. In default, for ordinary device, this attribute is “No”; for host-standby device, this attribute is “No”
Relevant pri-equip type	Character string; type of primary equipment associated with current BI point; cannot be edited.
Relevant pri-equip name	Character string; Name of primary equipment associated with current BI point; cannot be edited.

- **Configuration of TP points**

Attributes of TP point include: Description name, Original name, Reference name, Enable flag, Relevant control point, Calculation formula, Host-Standby point, Relevant pri-equip type, and Relevant pri-equip name. Particular description is given in the table below:

Table 12.5-7 Description of configuration of TP points

Name of attribute	Description
Description name	Character string not exceeding 200 English characters or 100 Chinese characters. Must not be empty; must not contain special characters such as “.” and “/” etc.; shall be as unique as possible under the device.
Original name	Character string; name of measuring point specified in IED configuration file; this name cannot be modified.
Reference name	Character string; empty under 103 device; under 61850 device, this is path of measuring point in the model; cannot be modified.
Enable flag	Contents of selection: process enabled, alarm enabled, and calculated point. In the pull-down list, a number of items can be selected. Among them, item “calculated point” is only selected for TP point under synthesized signal virtual device. In Host/Standby_Mode, for TP under sub-IED object, this attribute cannot be modified.
Relevant control point	Control point. The configuration method is the same as that of attributes of control point related to BI object.
Calculation formula	Edit formula; this attribute can only be edited if “calculated point” is selected in Enable flag. Process of setup is the same as that of attributes of calculation formula of measurement object.
Host-standby point	“Yes” or “No”. This attribute can only be modified for parent device in Host/Standby_Mode. In default, for ordinary device, this attribute is “No”; for host-standby device, this attribute is “No”
Relevant pri-equip type	Character string; type of primary equipment associated with current BI point; cannot be edited.

Name of attribute	Description
Relevant pri-equip name	Character string; Name of primary equipment associated with current BI point; cannot be edited.

- **Configuration of metering points**

Attributes of metering point include: Description name, Original name, Reference name, Subtype, Unit, Coefficient (CC2), Offset (CC1), Transformation ratio, Full scale value, Enable flag, Sampling period, Calculation formula, Multi-source point setup, Limit value of peak energy, Limit value of daily energy, Limit value of monthly energy, Peak period, Valley period, Pop up graph?, Action handling scheme, Host-Standby point, Relevant pri-equip type, and Relevant pri-equip name. Particular description is given in the table below:

Table 12.5-8 Description of configuration of metering points

Name of attribute	Description
Description name	Character string not exceeding 200 English characters or 100 Chinese characters. Must not be empty; must not contain special characters such as "." and "/" etc.; shall be as unique as possible under the device.
Original name	Character string; name of measuring point specified in IED configuration file; this name cannot be modified.
Reference name	Character string; empty under 103 device; under 61850 device, this is path of measuring point in the model; cannot be modified.
Subtype	Enumeration; sub-types include: input energy, output energy, and other. In Host/Standby_Mode, for metering under sub-IED object, this attribute cannot be modified.
Unit	Character string; read from IED configuration file in default. Units that can be selected include: time, kWH, and kVH. In Host/Standby_Mode, for metering under sub-IED object, this attribute cannot be modified.
Coefficient (CC2)	Floating point number; after uploaded metering value is converted to primary value, it will be multiplied by this coefficient. In Host/Standby_Mode, for metering under sub-IED object, this attribute cannot be modified.
Offset (CC1)	Floating point number; after uploaded metering value is multiplied by the coefficient, add offset to become actual value. In Host/Standby_Mode, for metering under sub-IED object, this attribute cannot be modified.
Transformation ratio	Floating point number; uploaded metering value is multiplied by this ratio to yield primary value of metering. In Host/Standby_Mode, for metering under sub-IED object, this attribute cannot be modified.
Full scale value	Integer in the range of 0 to 65535; uploaded metering value will first be compared with the full scale value to calculate accumulated energy.
Enable flag	Contents of selection: process enabled, peak energy alarm enabled, daily energy alarm enabled, monthly energy alarm enabled, abnormal value check cancelled, and calculated point. In the pull-down list, user can select a number of items. Among them, item

Name of attribute	Description
	"calculated point" is only selected for metering point under synthesized signal virtual device. In Host/Standby_Mode, for metering under sub-IED object, this attribute cannot be modified.
Sampling period	Name of sampling period. Sampling periods defined in history database can be selected.
Calculation formula	Edit formula. This attribute can only be edited if "calculated point" is selected as enable flag. Click this attribute column to pop up Edit formula dialog box; user can edit calculation formula corresponding to current virtual metering.
Multi-source point setup	Process of setup is the same as that of BI multi-source point.
Limit value of peak energy	Integer in the range of 0 to 65535; compared with peak accumulated energy in SCADA statistics
Limit value of daily energy	Integer in the range of 0 to 65535; compared with daily accumulated energy in SCADA statistics
Limit value of monthly energy	Integer in the range of 0 to 65535; compared with monthly accumulated energy in SCADA statistics
Peak period	Name of time period; when edited, time periods defined in SCADA database will be displayed in the pull-down list for selection
Valley period	Process of setup is the same as above.
Popup graph	Name of graph. The configuration method is the same as that of attributes of substation object substation graph.
Action handling scheme	Name of action handling scheme. The configuration method is the same as that of action handling scheme of BI object.
Host-standby point	Process of setup is the same as that of "Host-Standby point" for TP object.
Relevant pri-equip type	Character string; type of primary equipment associated with current measurement point; cannot be edited.
Relevant pri-equip name	Character string; Name of primary equipment associated with current measurement point; cannot be edited.

- **Configuration of setting points**

Attributes of a setting include: Description name, Original name, Reference name, Subtype, Value type, Value type ID, Display mode, Unit, Min, Max, Step, Resolution, and Host-Standby point. Particular description is given in the table below:

Table 12.5-9 Description of configuration of setting points

Name of attribute	Description
Description name	Character string not exceeding 200 English characters or 100 Chinese characters. Must not be empty; must not contain special characters such as "." and "/" etc.; shall be as unique as possible under the device.
Original name	Character string; name of measuring point specified in IED configuration file; this name

Name of attribute	Description
	cannot be modified.
Reference name	Character string; empty under 103 device; under 61850 device, this is path of measuring point in the model; cannot be modified.
Subtype	Subtypes include: IED parameter, active settings, and edit settings. This attribute is acquired from configuration file and cannot be modified. This attribute is used by protection engineering module.
Value type	Acquired from device mode; cannot be edited.
Display mode	Contents of selection: Boolean type, integer, floating point type, enumerated type, hexadecimal, binary, IP address, VEBI/EBI, and character string. Used for protection engineer software interface display. Display mode can be customized according to value type.
Unit	Reserved
Min	Reserved
Max	Reserved
Step	Reserved
Resolution	Reserved
Host-standby point	Process of setup is the same as that of “Host-Standby point” for TP object.

NOTE: To set attributes after simultaneous selection of a number of objects in the list window, the database configuration tool can set attributes of all selected items in a unified manner.

12.5.1.6 Configuration of Virtual Device

In the dock window, there is always default node “synthetic information” under each substation node. Object corresponding to this node is the virtual device for synthetic information. Attributes of this virtual device cannot be modified. It has fixed address of 65040 and fixed type of model 103. Under this virtual device, there are 5 types of measuring points: BI, measurement, control, metering, and TP. Configuration of these measuring points is identical to configuration of ordinary device, only that functions of Add, Delete, Copy, Cut, Paste, and Generate formula are provided.

- **Add virtual measuring point**

In the dock window, select a measuring point type node under “Device measuring point” node; all virtual measuring points of this type will be displayed in the list window. Right click the list window and select “Add” in the context menu popped up, or select “Add” menu item in menu “Edit”, or directly click button “Add” on the tools bar, or directly press “Ctrl+A” shortcut; a new measuring point object will be added in current list. In default, “calculated point” will be selected in Enable flag.

- **Insert virtual measuring point**

In the list window, select a measuring point object, right click mouse, and select “Insert” in the

context menu, or select “Insert” in “Edit” menu, or directly press “Ctrl+I” shortcut; a new virtual measuring point will be inserted before the selected virtual measuring point. If there is no measuring point object selected in the list, menu item “Insert” in context menu and in “Edit” menu will be grey.

- **Delete virtual measuring point**

In the list window, select the measuring point object(s) to be deleted. Right click mouse and select “Delete” in the context menu, or select “Delete” in “Edit” menu, or directly click “Delete” button on the tools bar, or directly press “Delete” key; the database configuration tool will prompt deletion of all selected items. Click “Yes” to confirm deletion of virtual measuring points.

- **Copy virtual measuring point**

In the list window, select a measuring point object. Right click mouse and select “Copy” in the context menu, or select “Copy” in menu “Edit”, or directly press “Ctrl+C” shortcut, to copy attributes of current measuring point object. If no measuring point object is selected in the list, “Copy” in context menu and “Edit” menu will be grey. After successful “Copy” operation, “Paste” and “Paste and insert” in the context menu will become usable.

- **Cut virtual measuring point**

In the list window, select a measuring point object, right click mouse, and select “Cut” in the context menu, or select “Cut” in menu “Edit”, or directly press “Ctrl+X” shortcut. First, attributes of current measuring point object will be copied, and then this selected measuring point object will be deleted from the list. If no measuring point object is selected in the list, “Cut” in context menu and in “Edit” menu will be grey. After successful “Cut” operation, “Paste” and “Paste and insert” in the context menu will become usable.

- **Paste virtual measuring point**

In the list window, select a measuring point object, right click mouse, and select “Paste” in the context menu, or select “Paste” in menu “Edit”, or directly press “Ctrl+V” shortcut, to modify attributes of currently selected measuring point object using attributes of measuring point object copied earlier. If no measuring point object is selected at this time, a virtual measuring point will be added at end of the list, with its attributes consistent with those of the object copied earlier.

- **Paste and insert virtual measuring point**

In the list window, select a measuring point object, right click mouse, and select “Paste and insert” in the context menu, or select “Paste and insert” in menu “Edit”, or directly press “Ctrl+I” shortcut, to insert a new virtual measuring point before currently selected measuring point object, and modify its attributes to attributes of measuring point object copied earlier. If no measuring point object is selected at this time, a virtual measuring point will be added at end of the list, with its attributes consistent with those of the object copied earlier.

- **Generate formula**

This function can quickly generate a formula according to selected BI point.

If current list is BI list, in the list window, select BI objects for which formula needs to be generated.

Right click mouse and select “Generate formula”; the following dialog box will pop up. Select operator and target virtual BI to be used; contents of formula of target virtual BI can be automatically set.

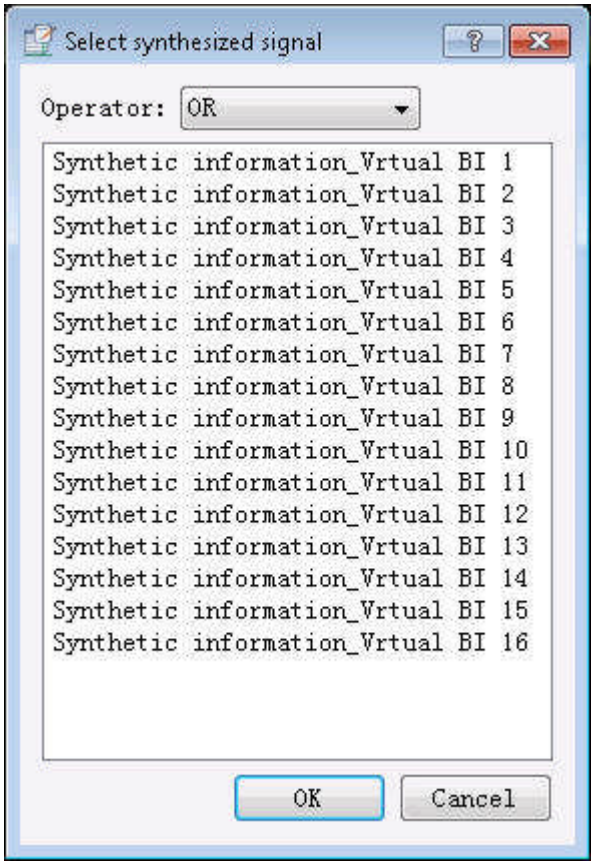


Figure 12.5-28 Select synthesized signal

12.5.1.7 Definition of Formula

The formula definition module mainly defines BI points in virtual device that require calculation. Therefore, calculation type of such BI points needs to be “calculate enabled”. Calculation formula can only be edited and defined for BI points the calculation type of which is “calculate enabled”.

If current list is virtual BI list, in this list window, user can select BI objects for which formula needs to be generated. Click Enable flag of virtual BI to pop up a pull-down combination list box. Select “calculate enabled” as enable flag of measuring point, as shown below:

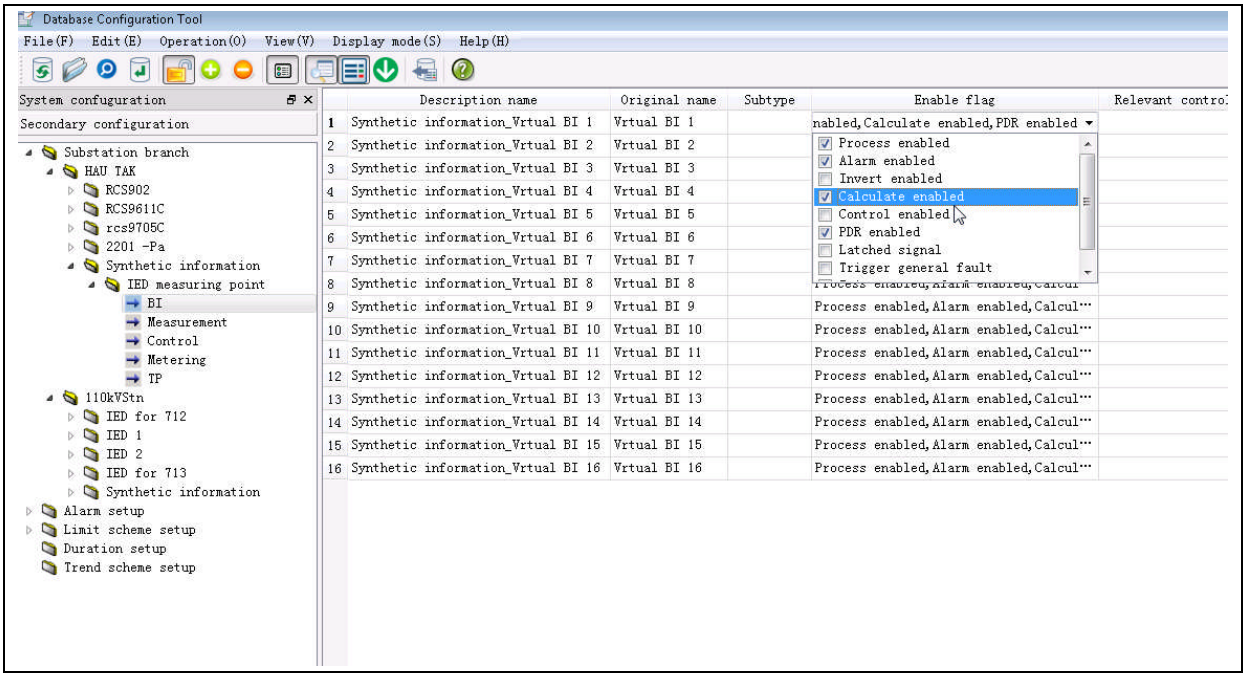


Figure 12.5-29 Select “calculate enabled” as enable flag

Select Calculation formula attribute of this BI point and left click mouse to pop up “Formula editor” dialog box as shown below. User can edit this BI synthetic definition formula:

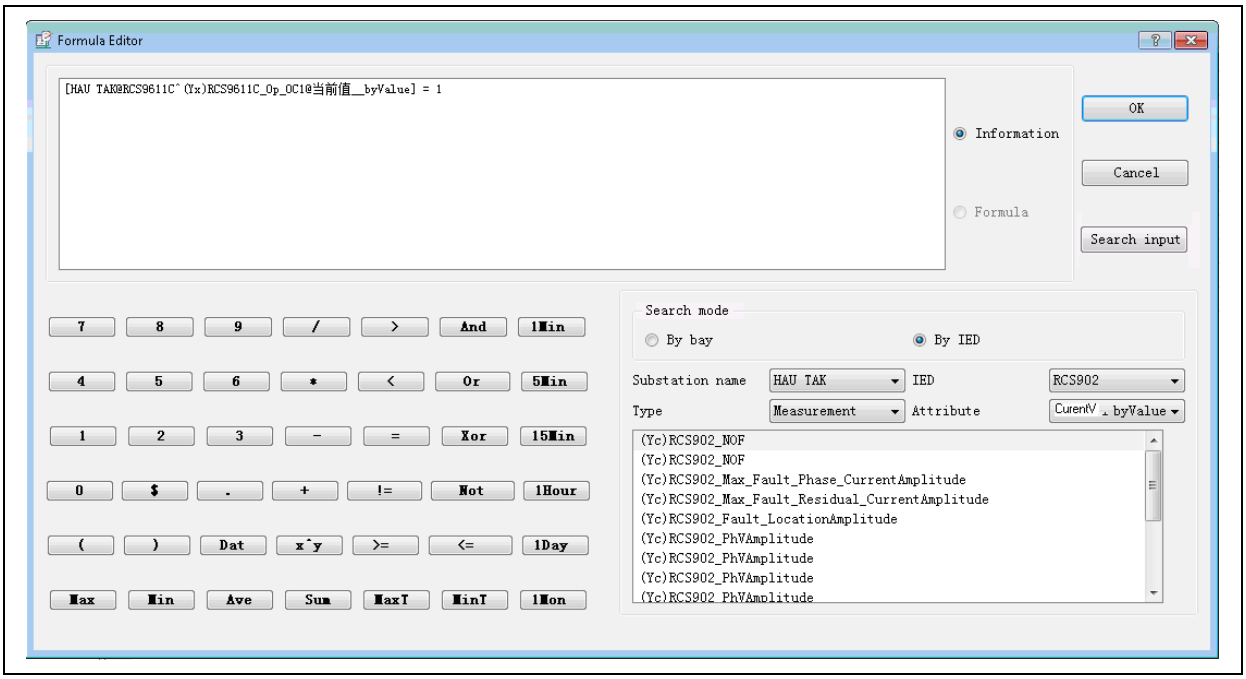


Figure 12.5-30 Formula editor dialog box

If search mode is By bay, user can select measuring points under relevant substation and bay, and edit this BI synthetic definition formula using “Formula editor” dialog box below:

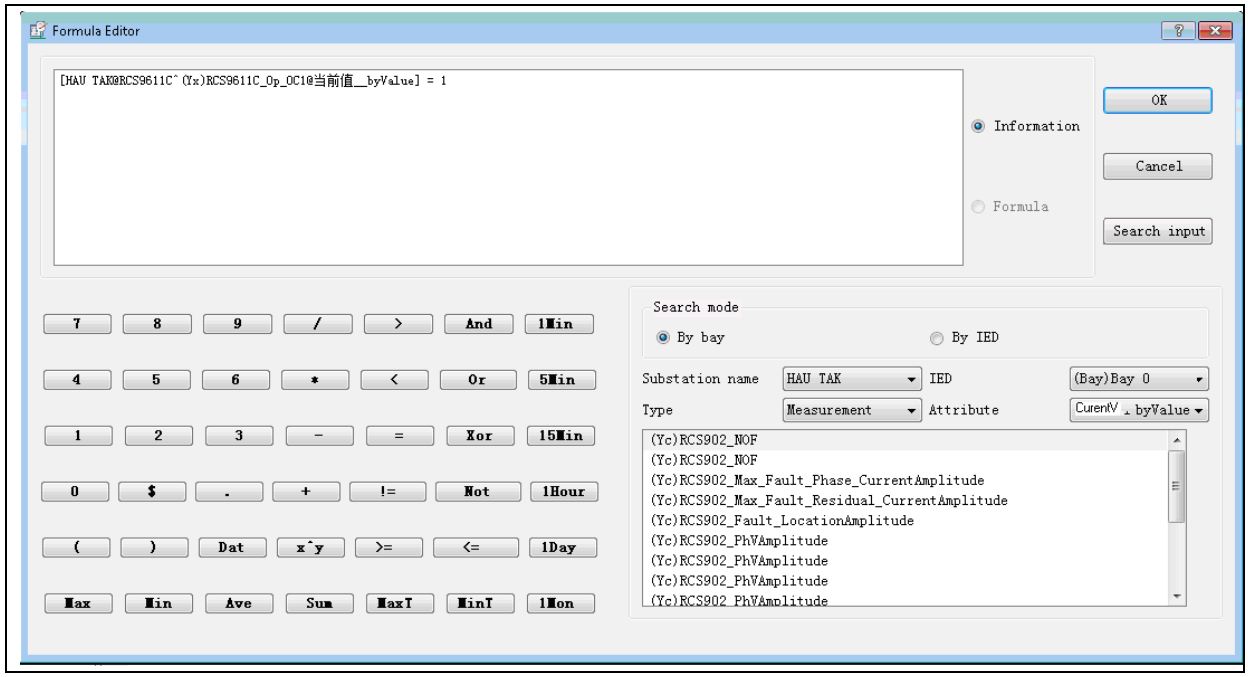


Figure 12.5-31 Define formula by bay dialog box

Search and editing mode can also be entered via Search input. Click button “Search input” to pop up a dialog box as shown below. User can edit and select measuring point application name, mode name, and operator of this synthetic definition calculation formula:

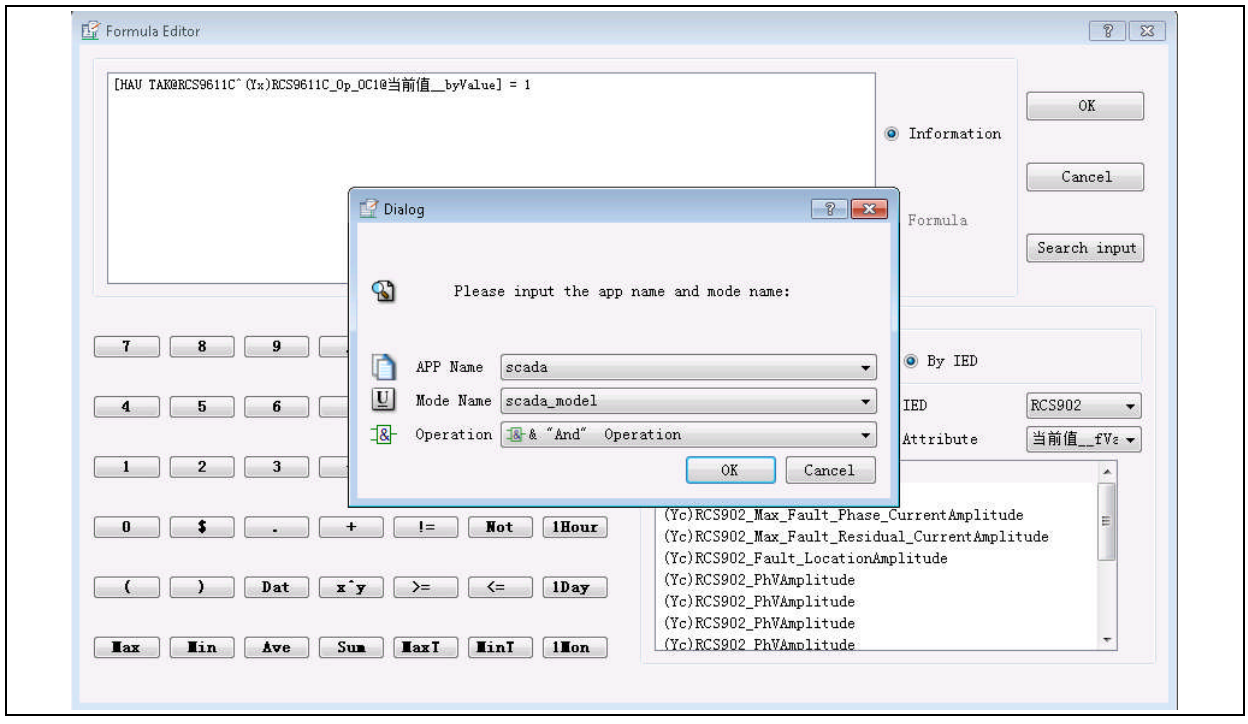


Figure 12.5-32 Select application name and mode name via Search input

Click “OK” on Search input dialog box above to pop up the Index dialog box as shown below. At this time, user can select to enter this BI synthetic definition formula by search and editing “according to measuring point model”; a number of measuring points can be selected at the same time:

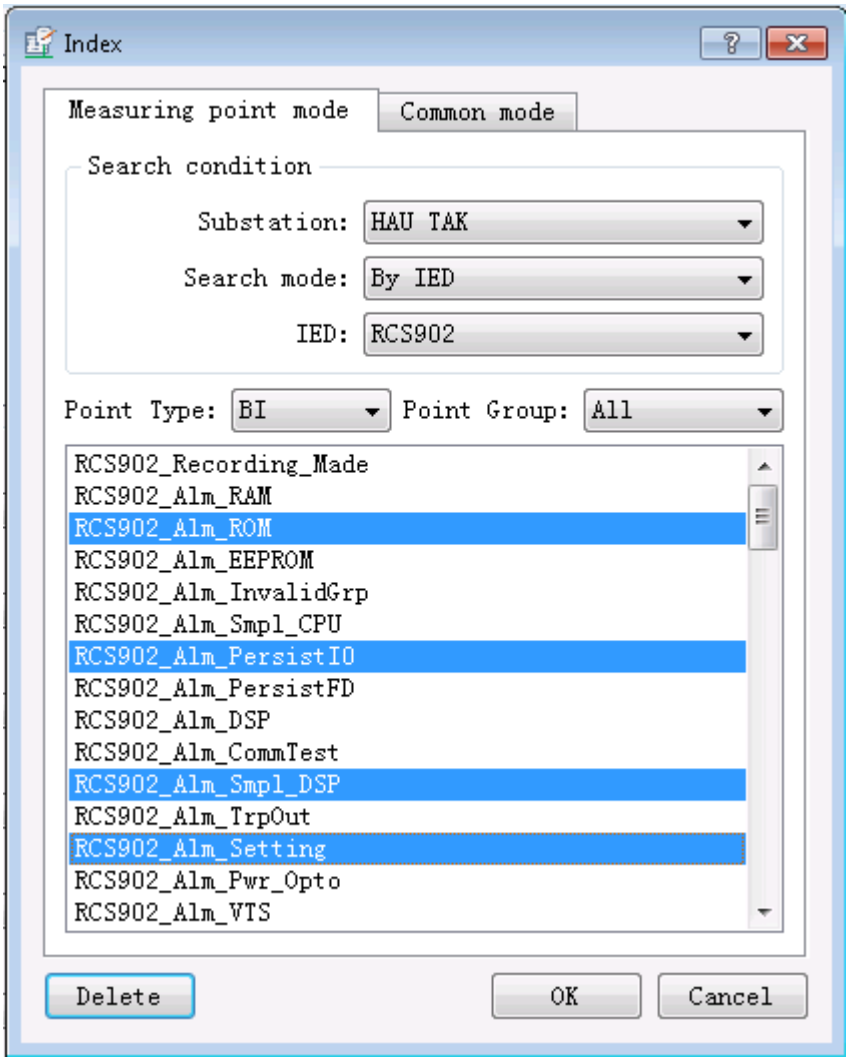


Figure 12.5-33 Select formula definition according to measuring point model

Click “OK” in the Index above; user can view expressions of defined formula already edited and input in the “Formula editor” dialog box:

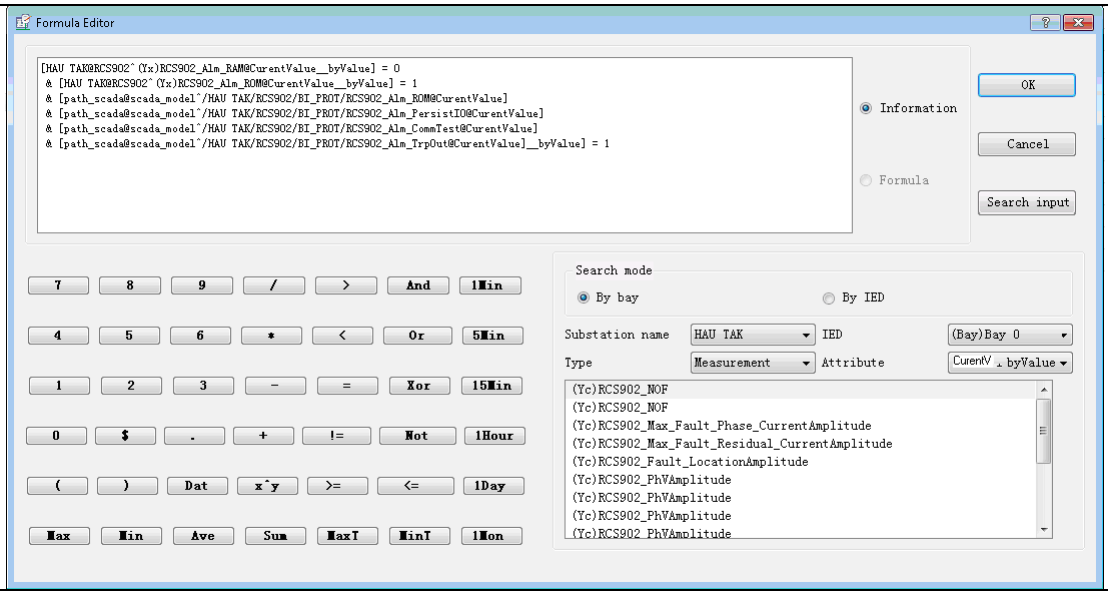


Figure 12.5-34 Input expressions of defined formula

When inputting formula from Index for editing, in the “Search mode” pull-down box, user can also select search, editing, and input of expressions of defined formula according to bay:

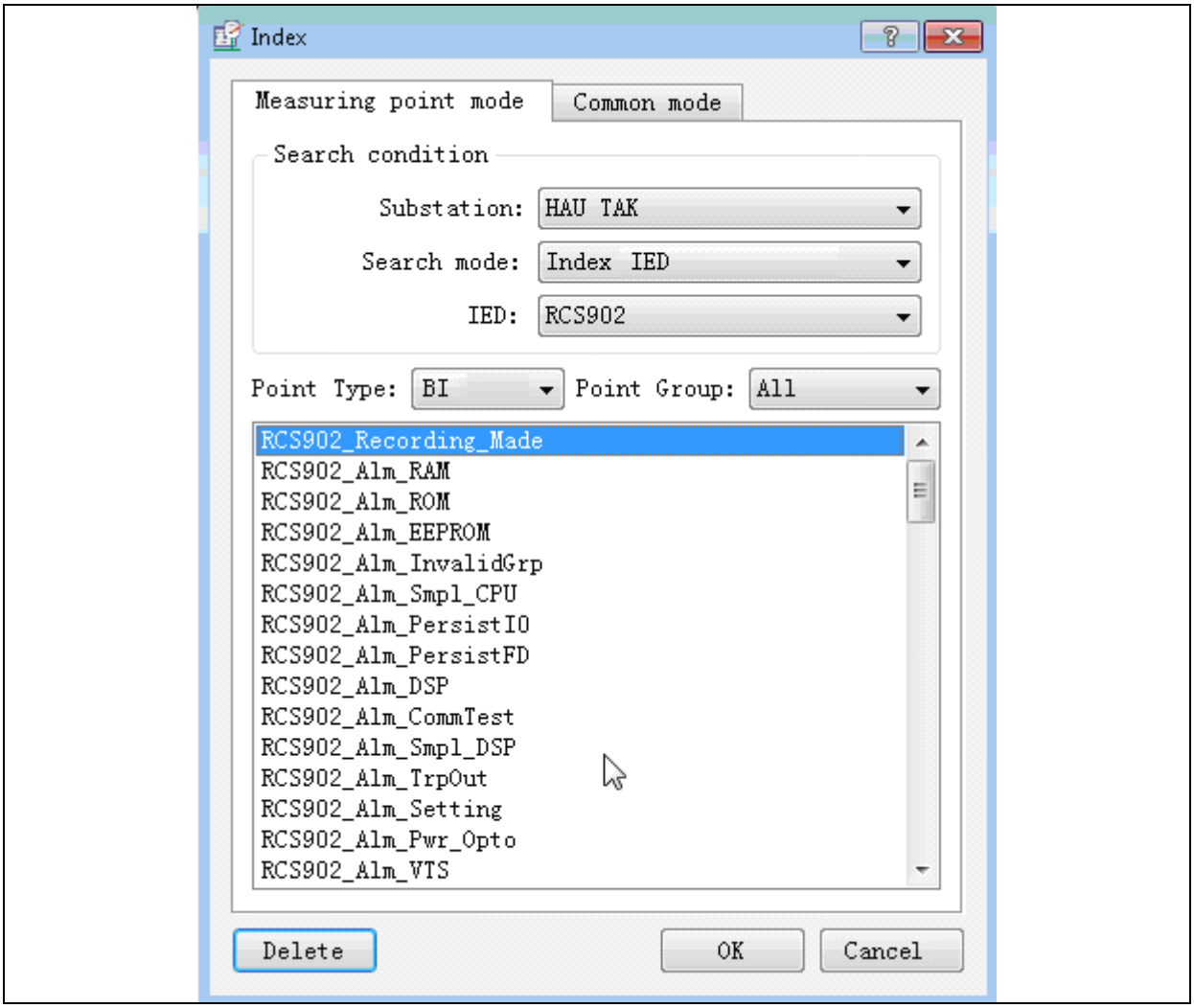


Figure 12.5-35 Define formula using search mode according to bay

For input of formula from Index for editing, in the “Measuring point type” pull-down box, user can select measurement as type of measuring point defined for input of defined formula:

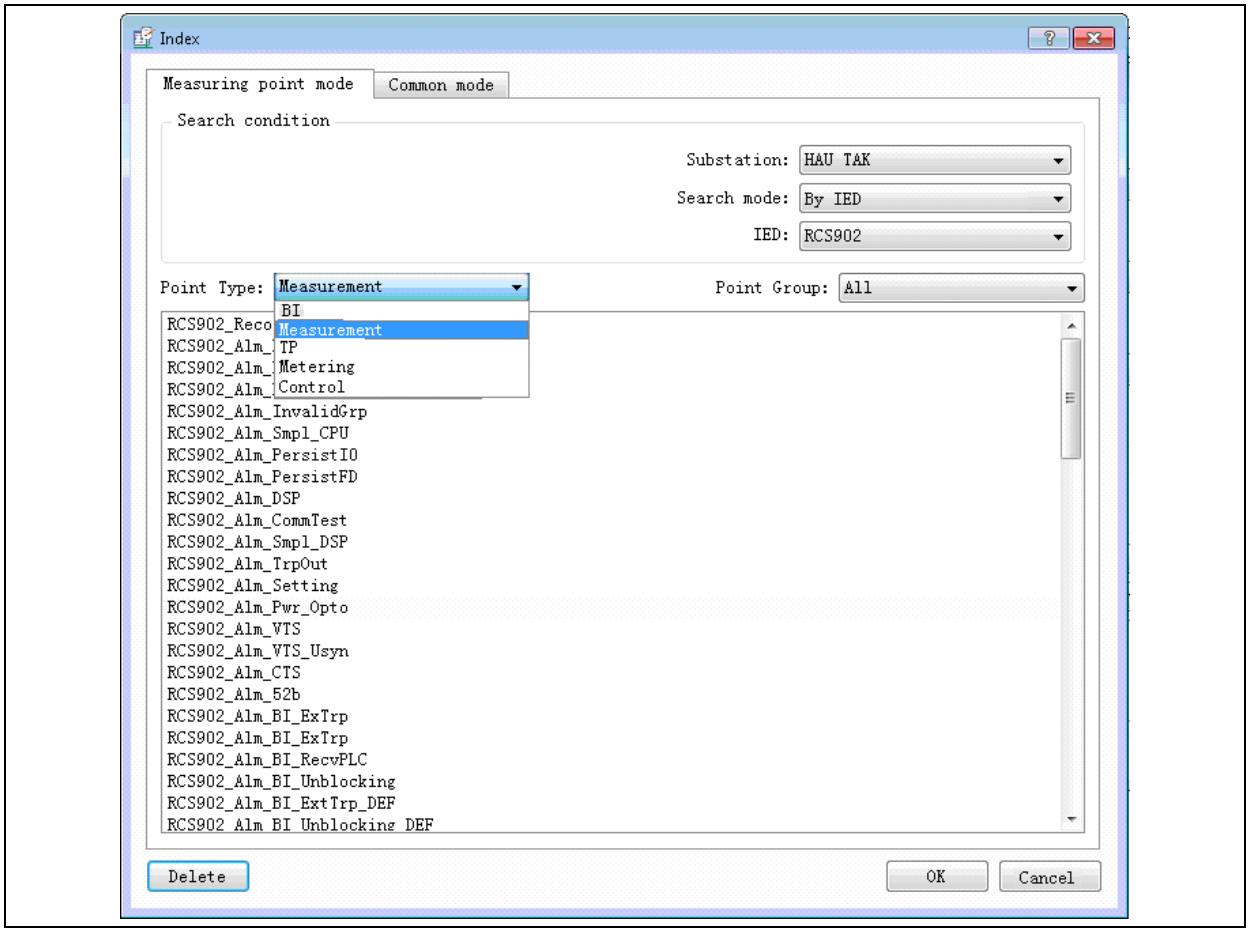


Figure 12.5-36 Select measurement as point type

For Index input, user can also select search and editing according to “common mode”, to edit and input synthetic definition formula of this virtual BI. A number of measuring points can be selected as the same time:

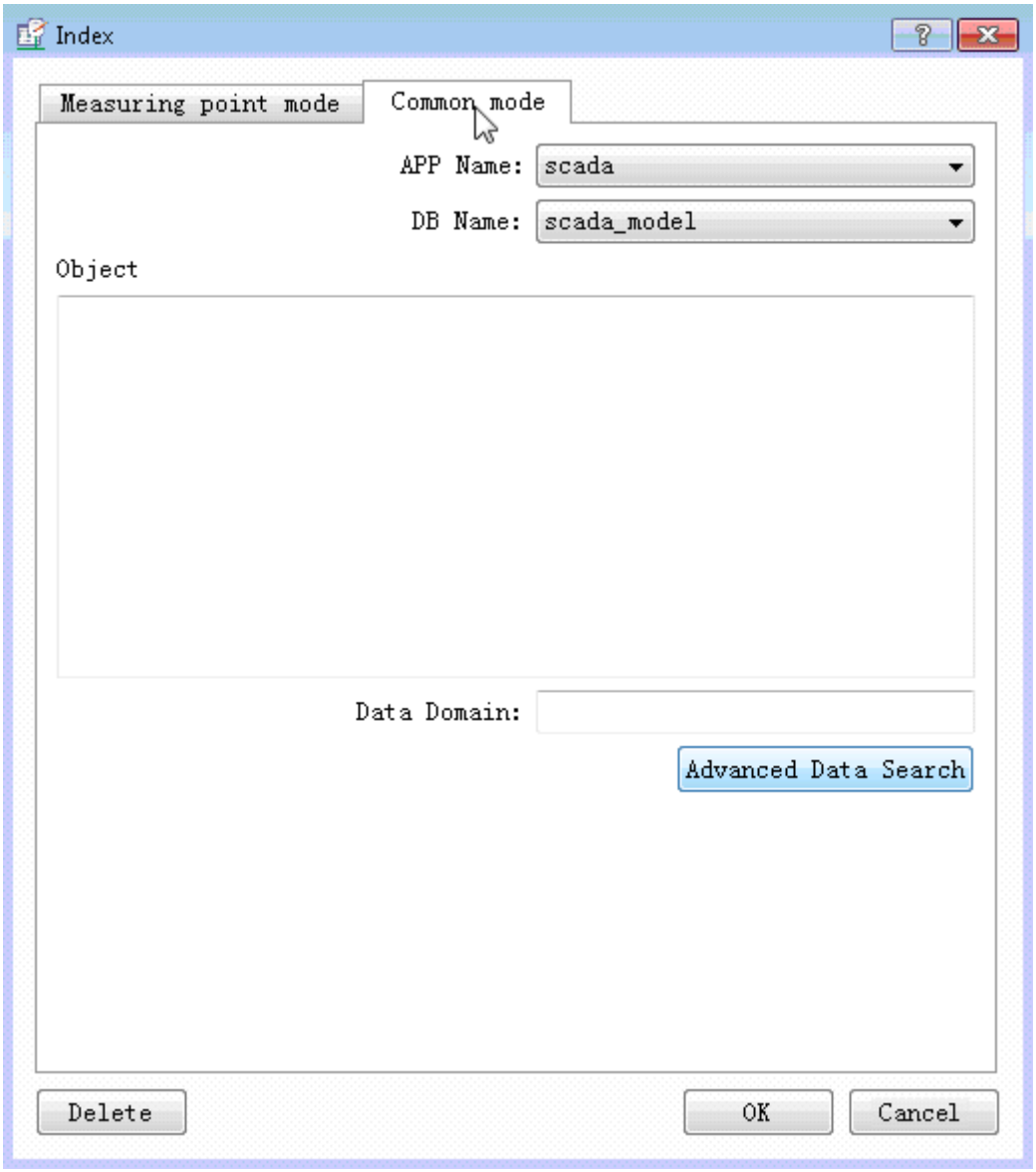


Figure 12.5-37 Common mode for formula definition

To input and edit formula using Index, name of application of input measuring point can be selected in the “APP Name” pull-down box:

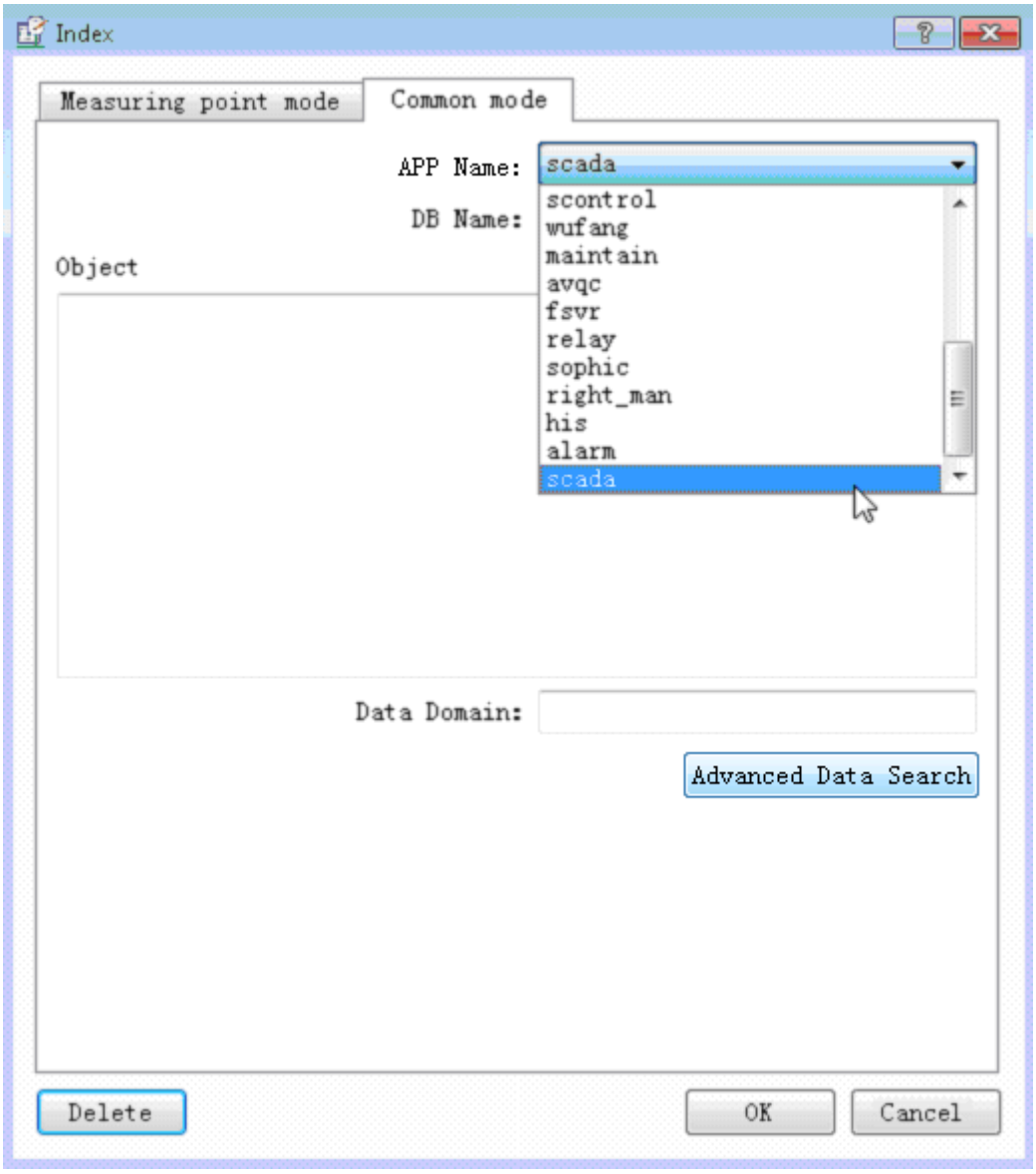


Figure 12.5-38 Select name of application dialog box

To input and edit formula using Index, name of database of input measuring point can be selected in the “DB Name” pull-down box:

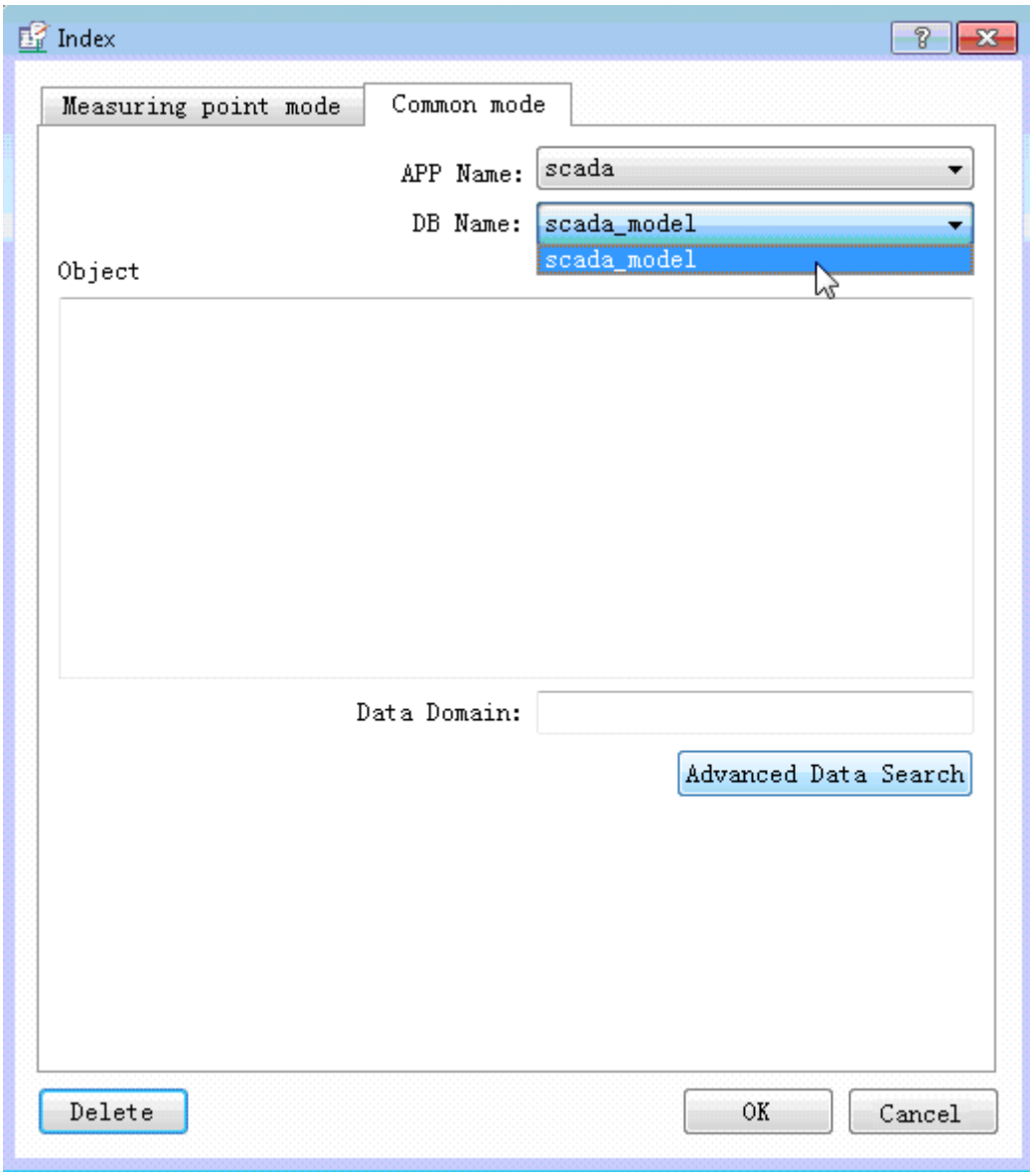


Figure 12.5-39 Select name of database of input measuring point

After selection of name of application and name of database in Index, user can click “Advanced data search” button:

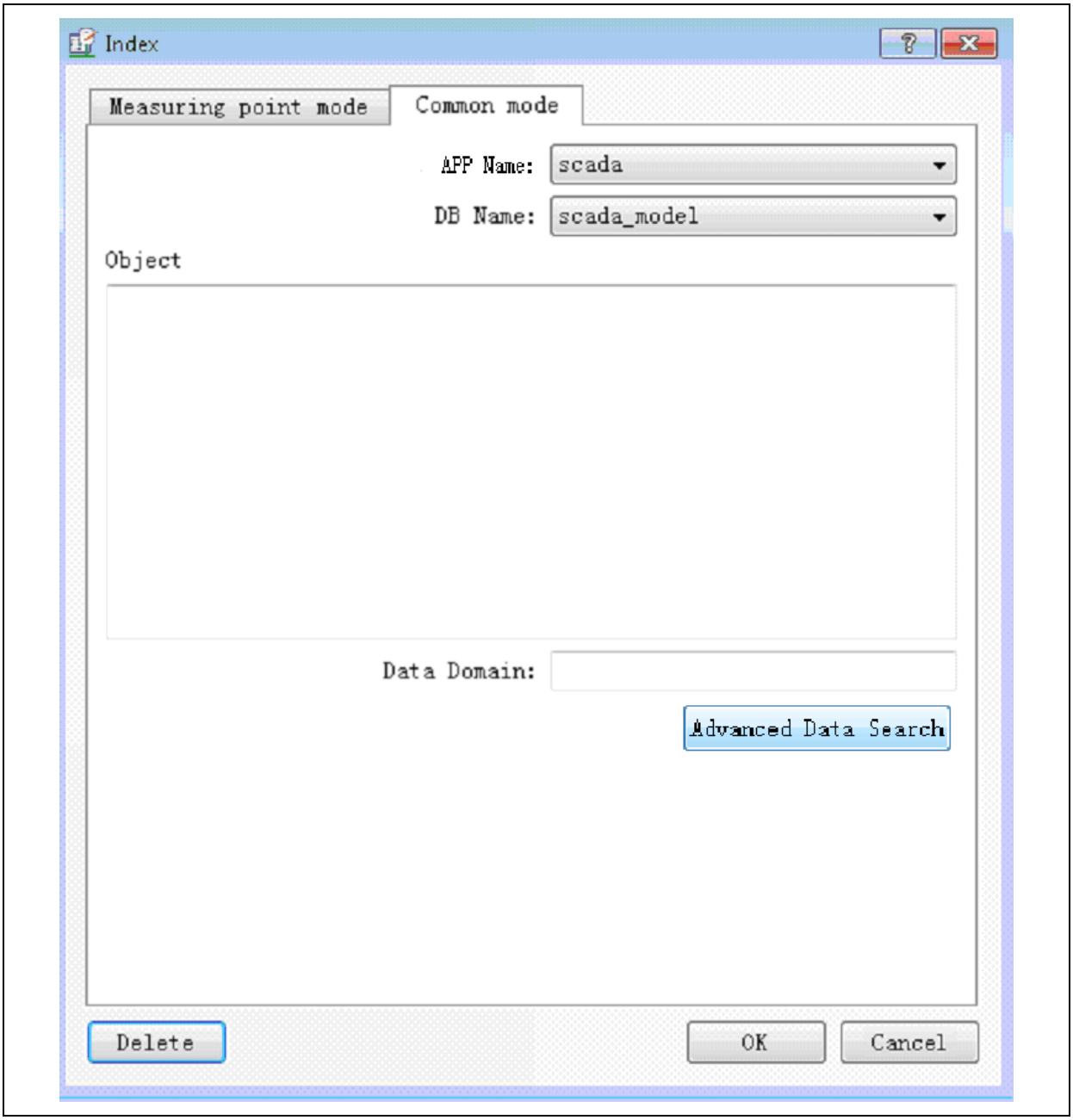


Figure 12.5-40 Advanced data search

At this time, the following index input dialog box will pop up. User can select Search type as “Level”:

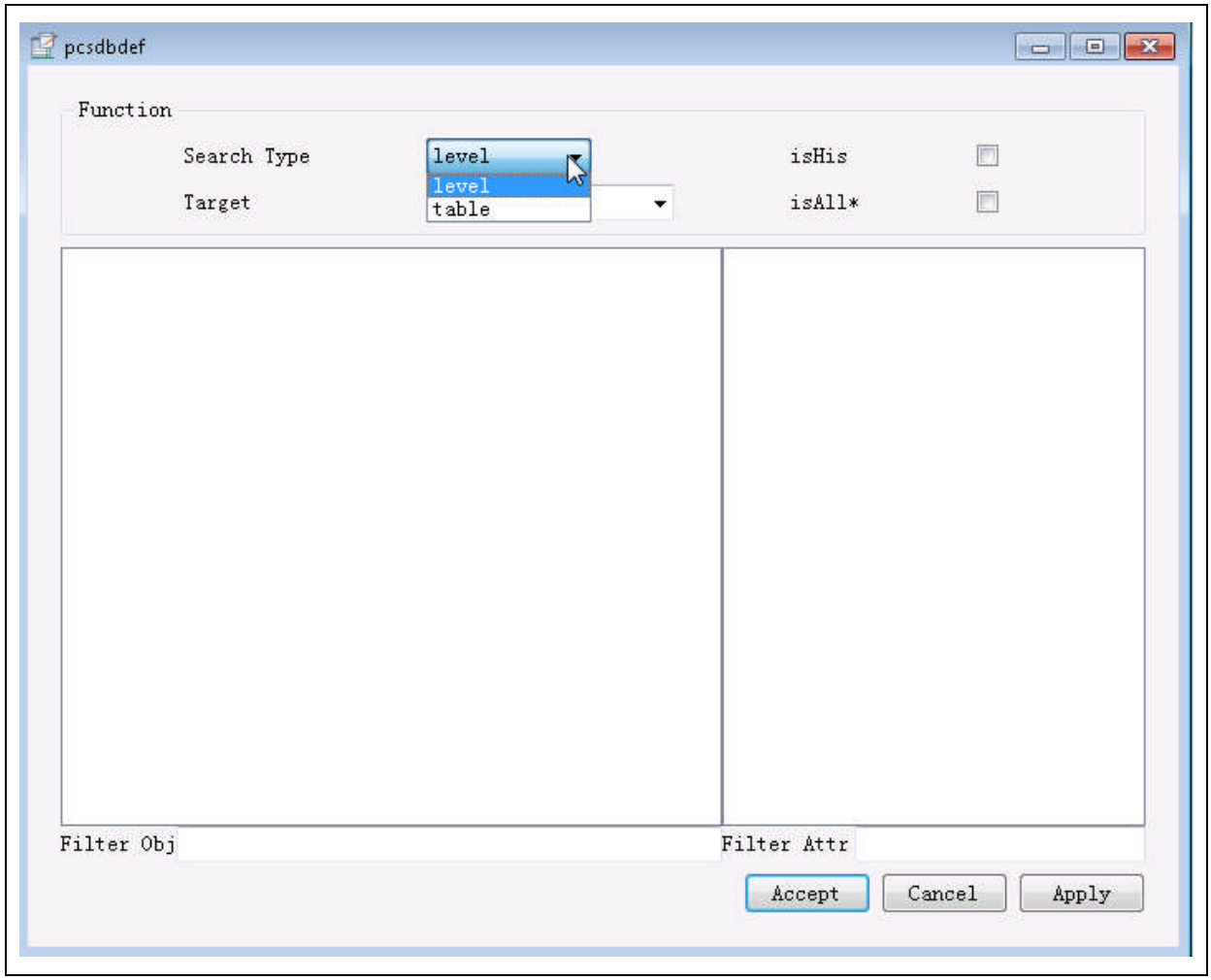


Figure 12.5-41 Select Level as search type

In the Target pull-down box of Index input, select “BI”:

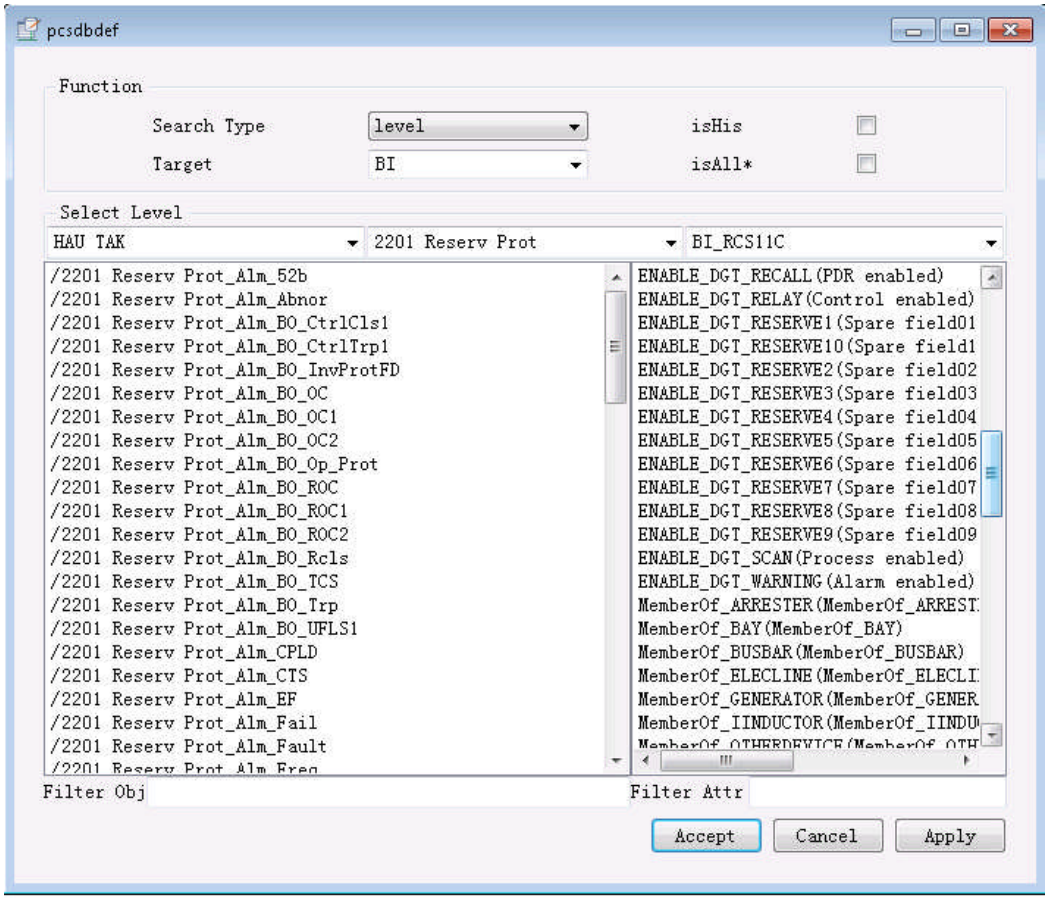


Figure 12.5-42 Select BI as Target

For search of input formula according to level, user can select formula definition measuring points and measuring point domain type under substation and device, as shown below:

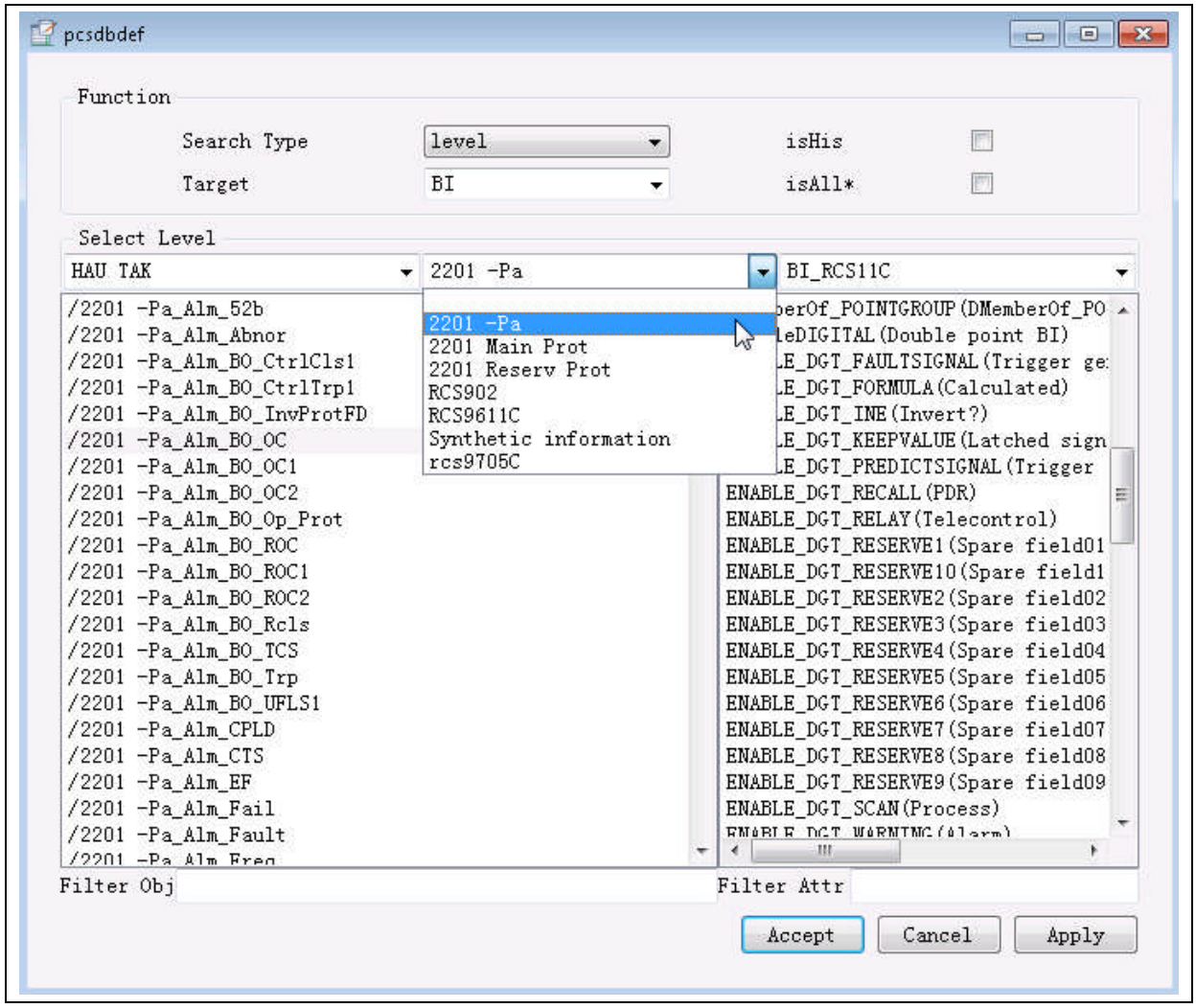


Figure 12.5-43 Select substation and device

To input and edit formula using the Index input, measuring point calculation data domain type is normally selected as current value, as shown below:

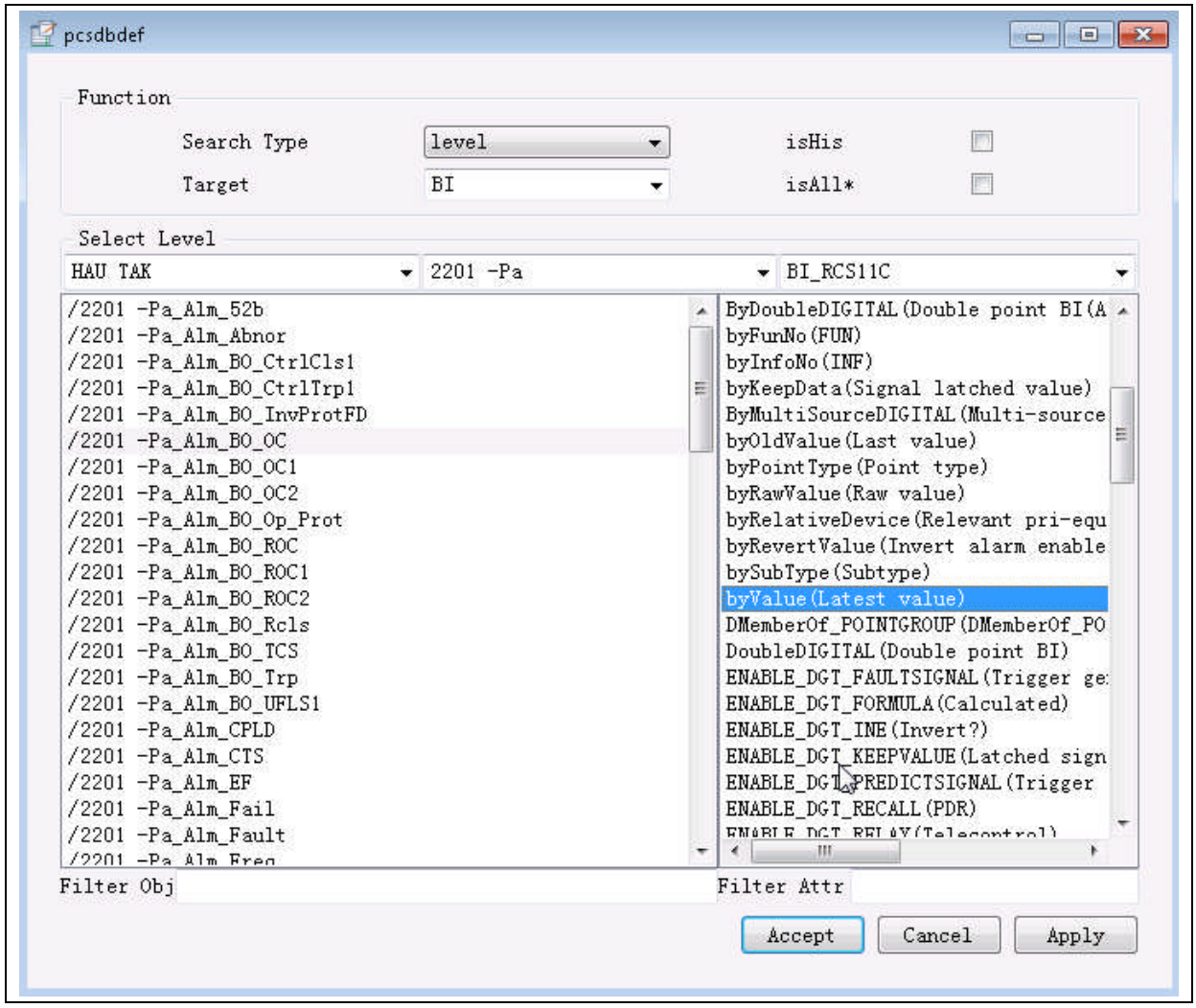


Figure 12.5-44 Select current value as measuring point data domain type

After selections are made in the Index input dialog box and “Accept” is pressed, the following dialog box will pop up and user can view selected measuring points participating in the calculation and data domain:

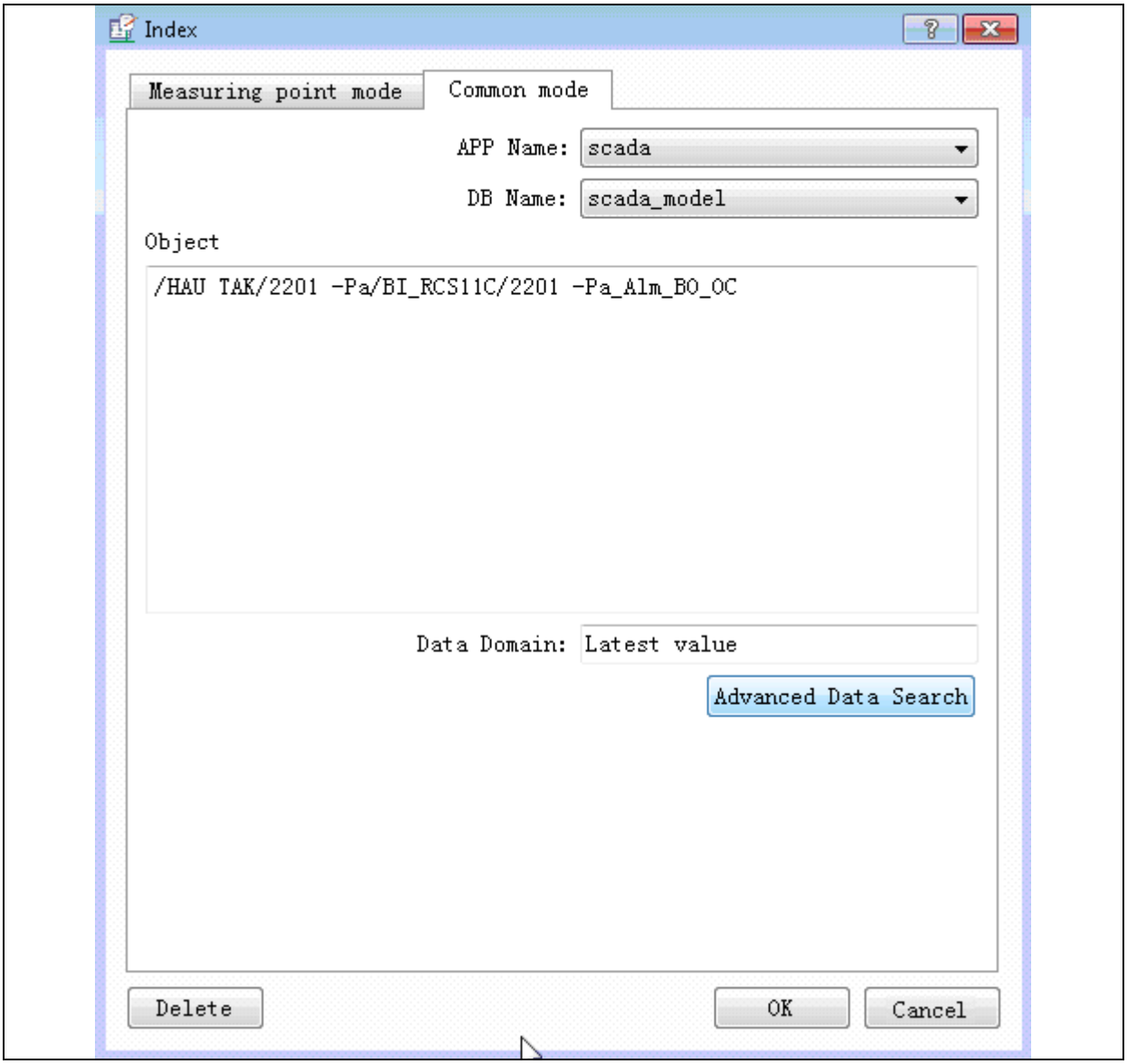


Figure 12.5-45 Selected measuring points and data domain

Click “OK” in the Search input formula editing dialog box to pop up the following generated formula expression:

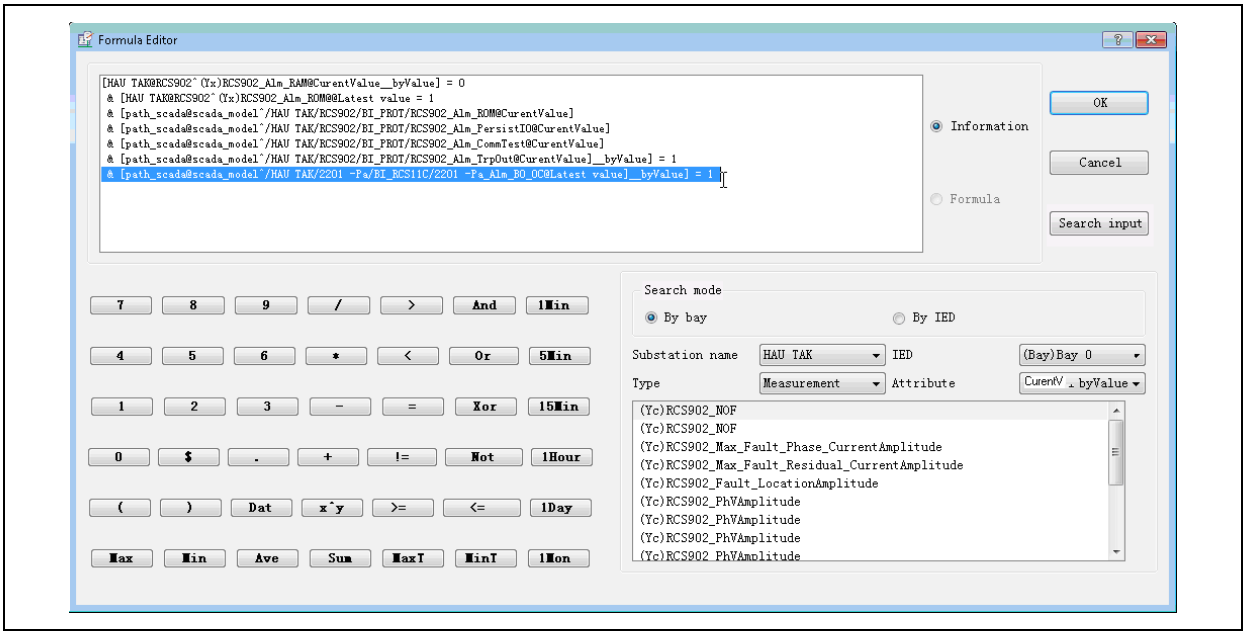


Figure 12.5-46 Generated formula expression

Click “OK” in the Formula editor dialog box to generate formula expression:

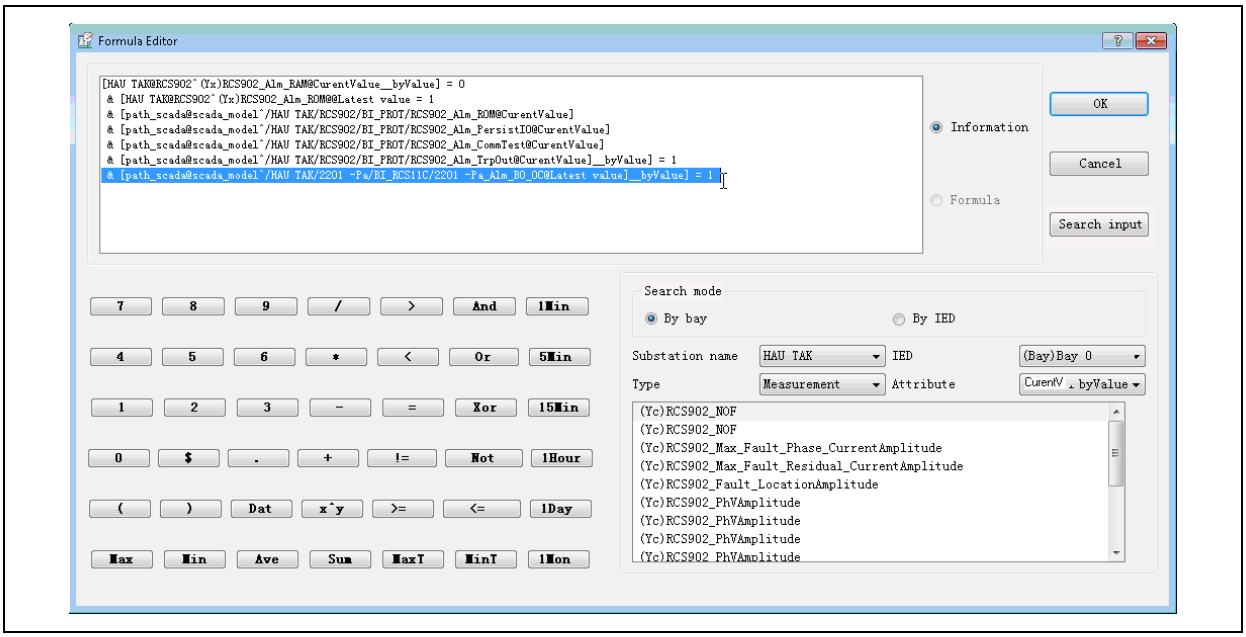


Figure 12.5-47 Confirmation after completion of formula definition

At this time, formula No. of the measuring point calculation formula defined can be generated:

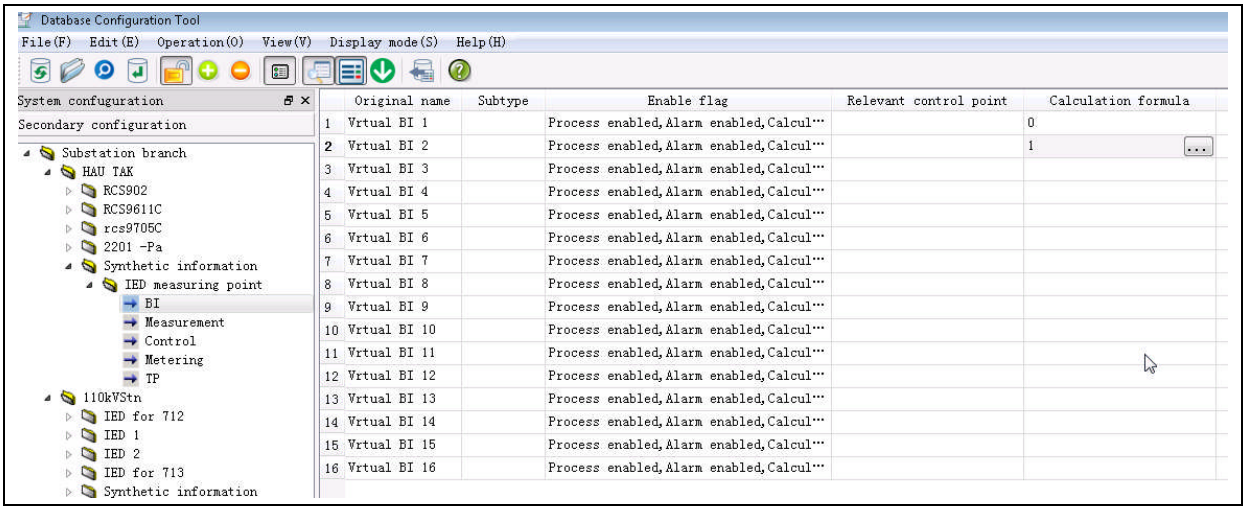


Figure 12.5-48 Formula No. of the generated formula

12.5.1.8 Rules Definition Module

This module mainly defines open and close rules for control points in BCU and anti-maloperation BI points in anti-maloperation configuration database.

Select IED measuring point under BCU, and select Control, to display list of control measuring point definitions. At this time, user can select a control measuring point entry for which rules definition is required, to define its open and close rules. Click to select close rule of the control measuring point entry:

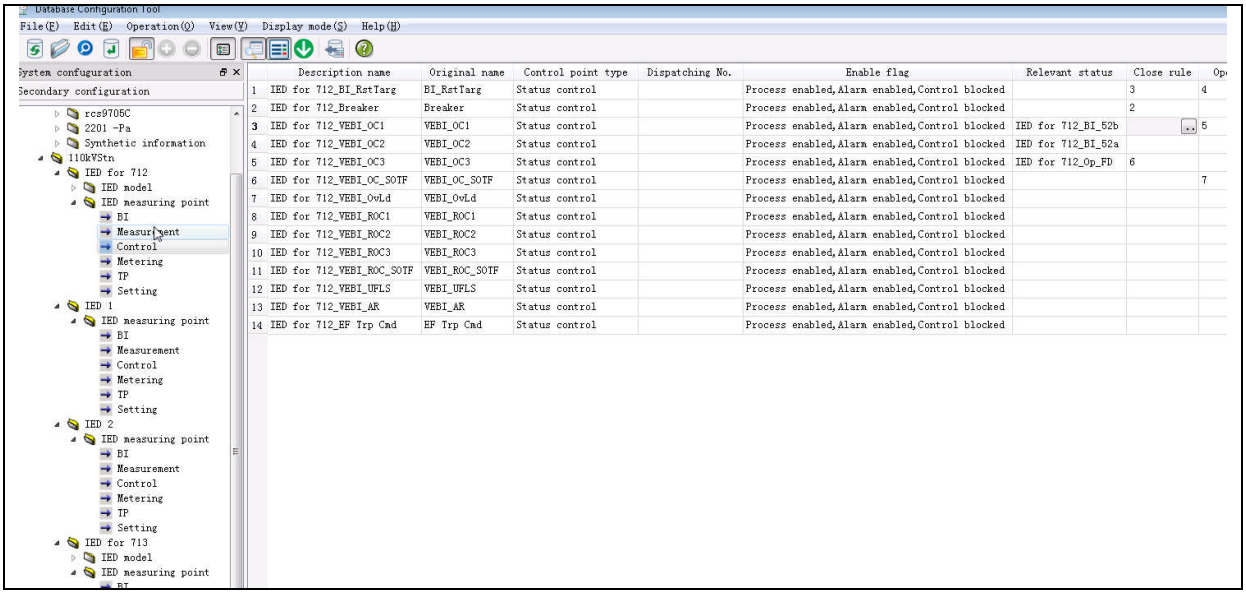


Figure 12.5-49 Select definition of close rule for control measuring point

"Close rule" definition dialog box (in Rule editor) will pop up; user can define measuring point close rule:

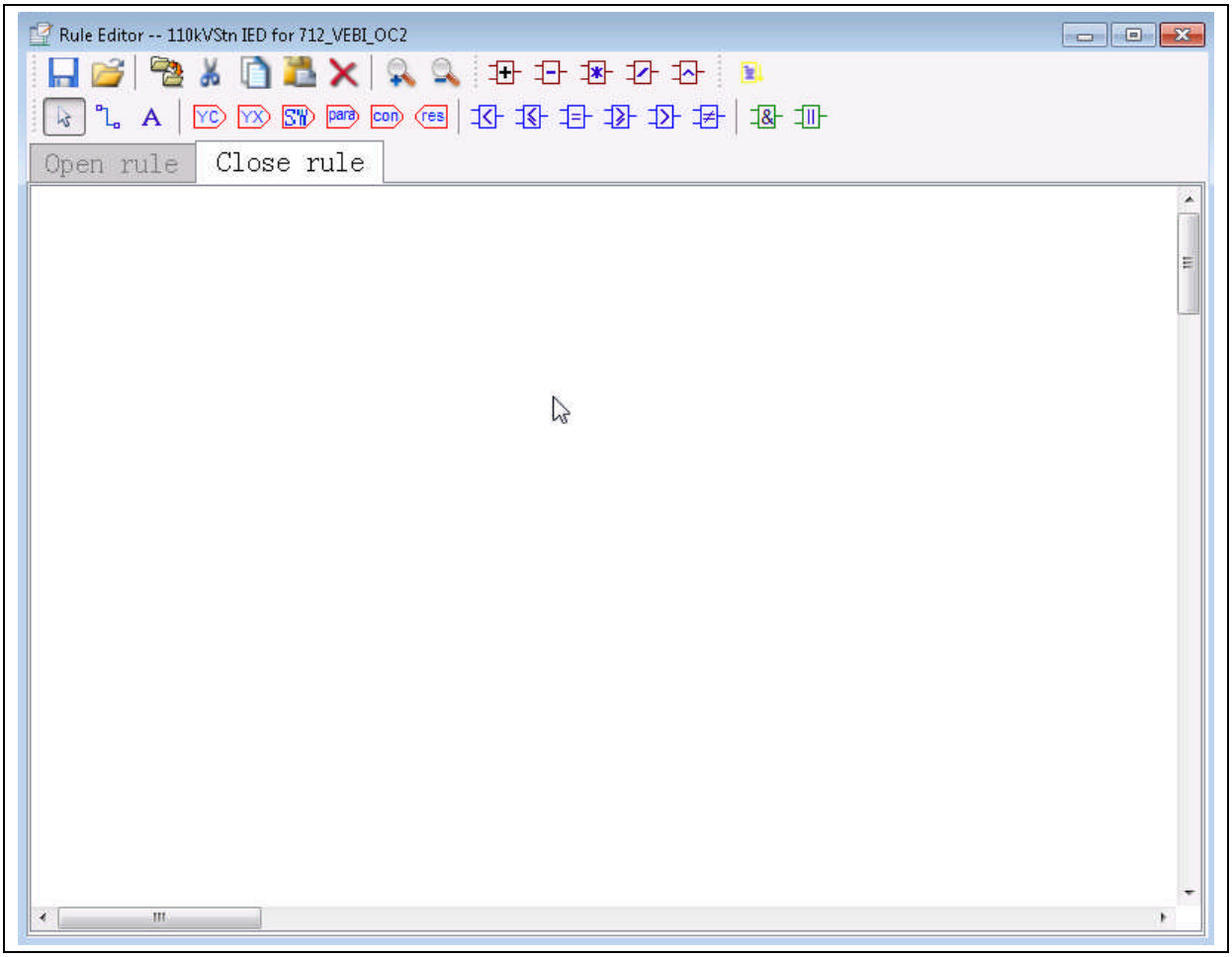


Figure 12.5-50 “Close rule” definition dialog box

To edit rule, click measurement type analog quantity button on the tools bar to select type of measuring point defined by input definition formula as measurement:

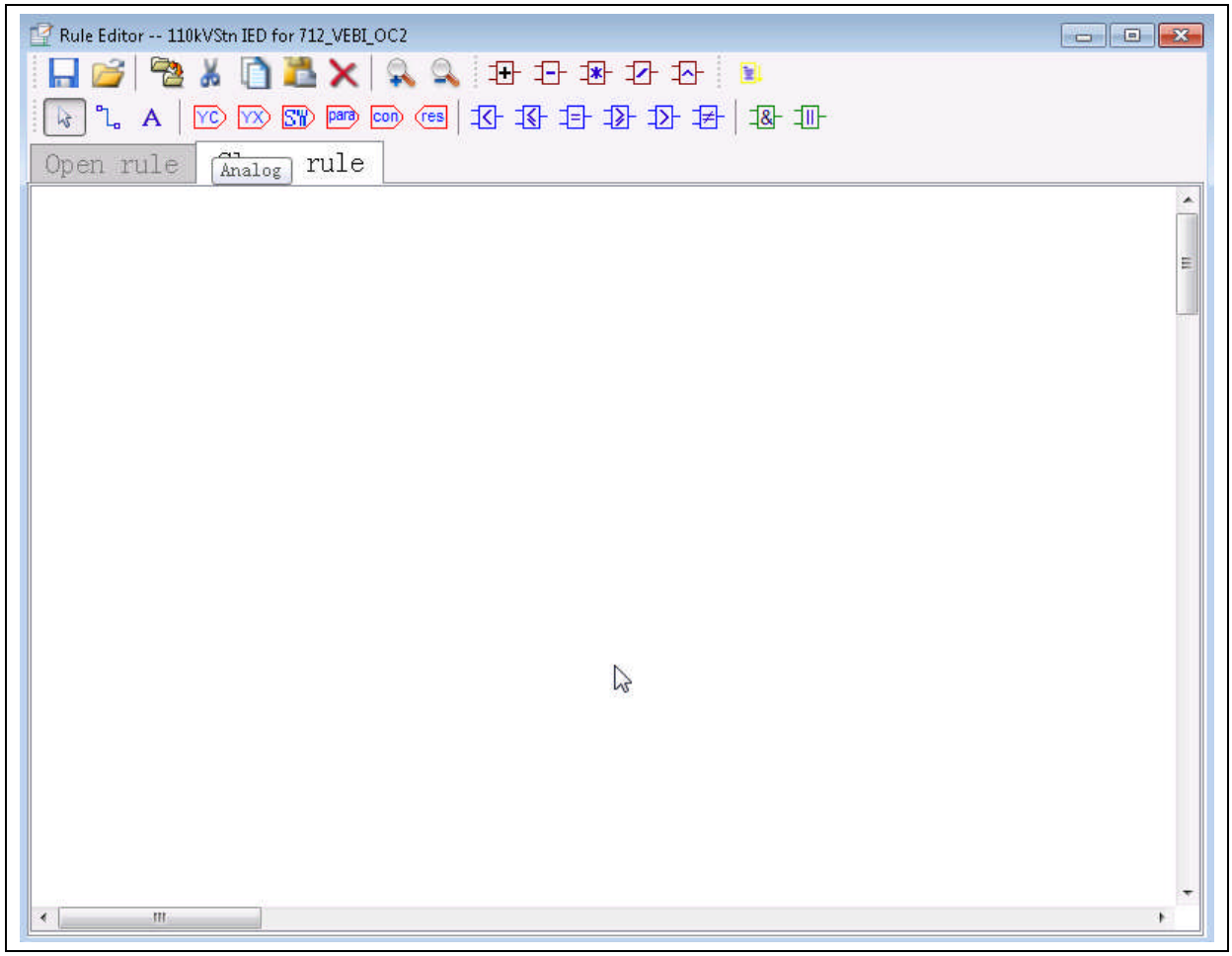


Figure 12.5-51 Select type of measuring point as measurement

Left click mouse to generate a measurement measuring point icon for formula definition measuring point:

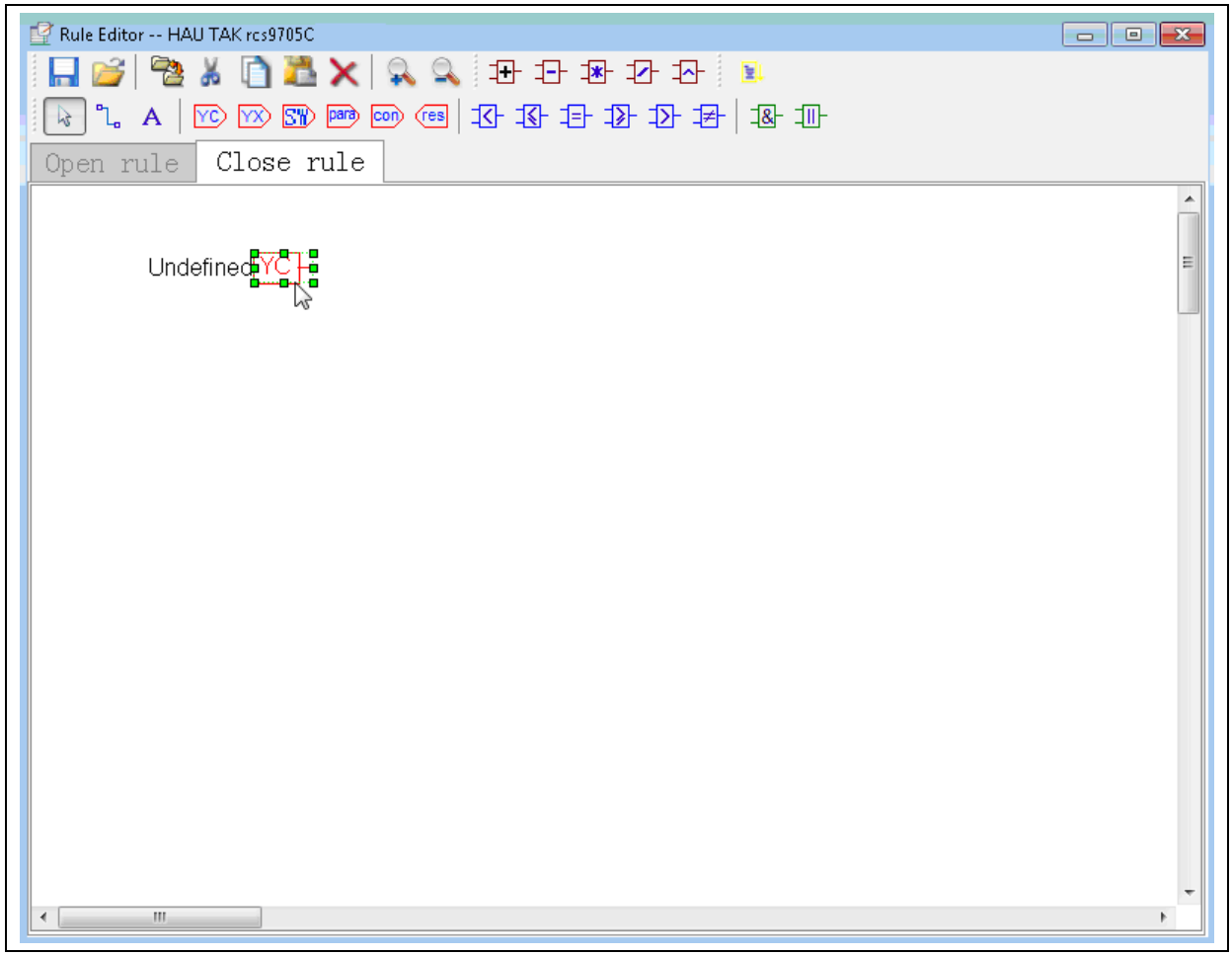


Figure 12.5-52 Generate measurement measuring point icon

Click this measurement measuring point icon to pop up analog quantity definition dialog box for this measurement point:

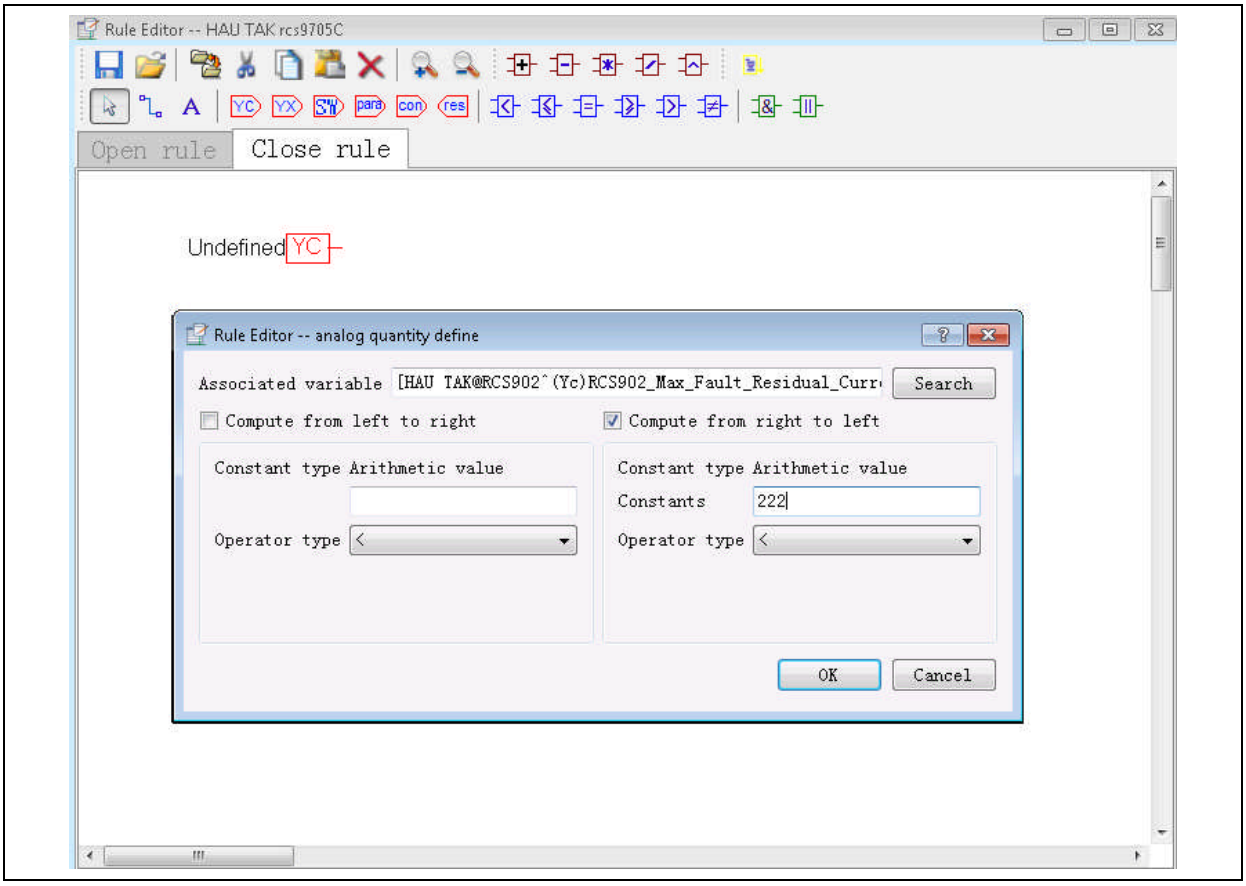


Figure 12.5-53 Analog quantity definition dialog box

Click “Search” button in this dialog box to pop up the (measurement) Point input dialog box:

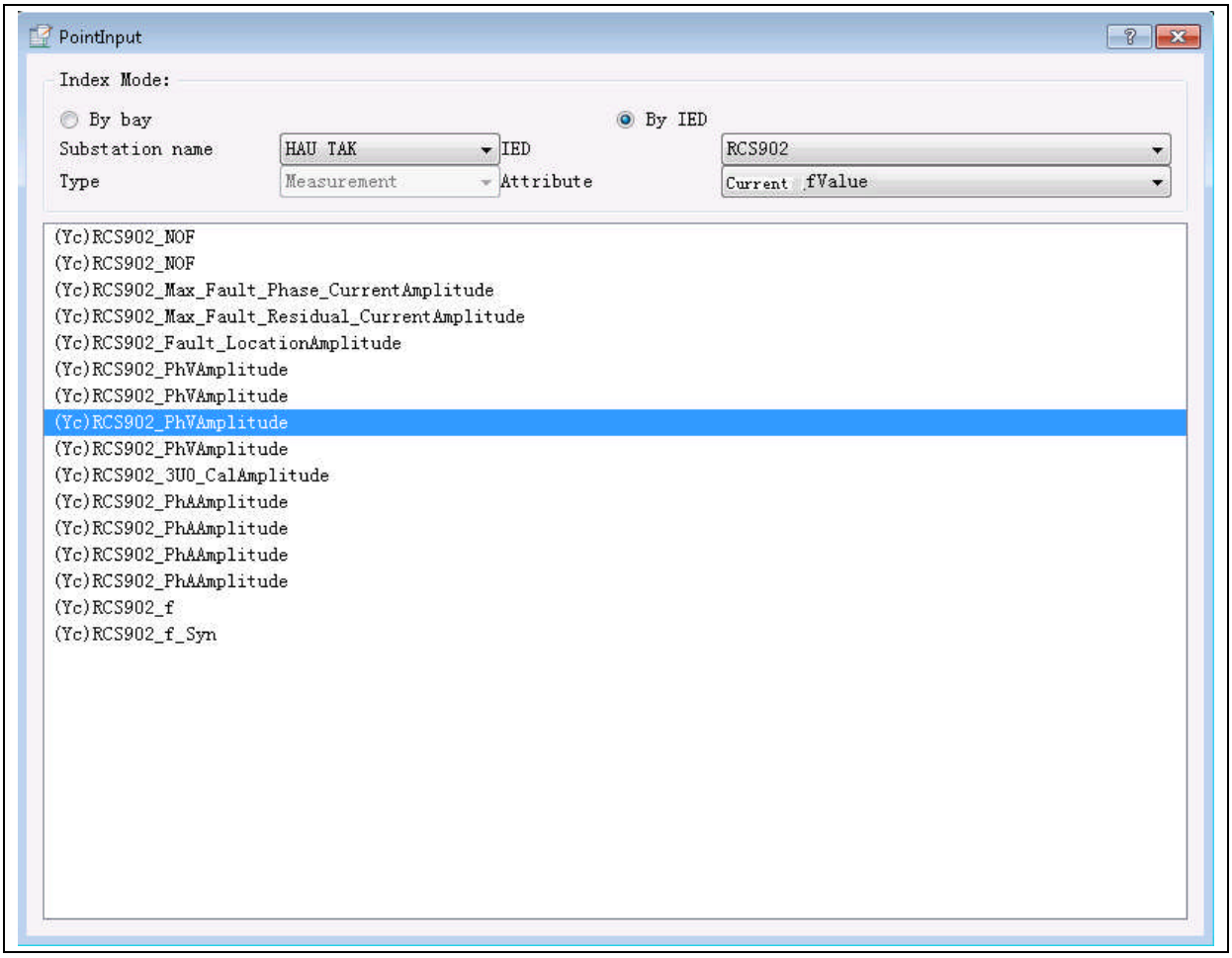


Figure 12.5-54 Measurement point input dialog box

In the measuring point list box, user can select input of measuring points under current IED:

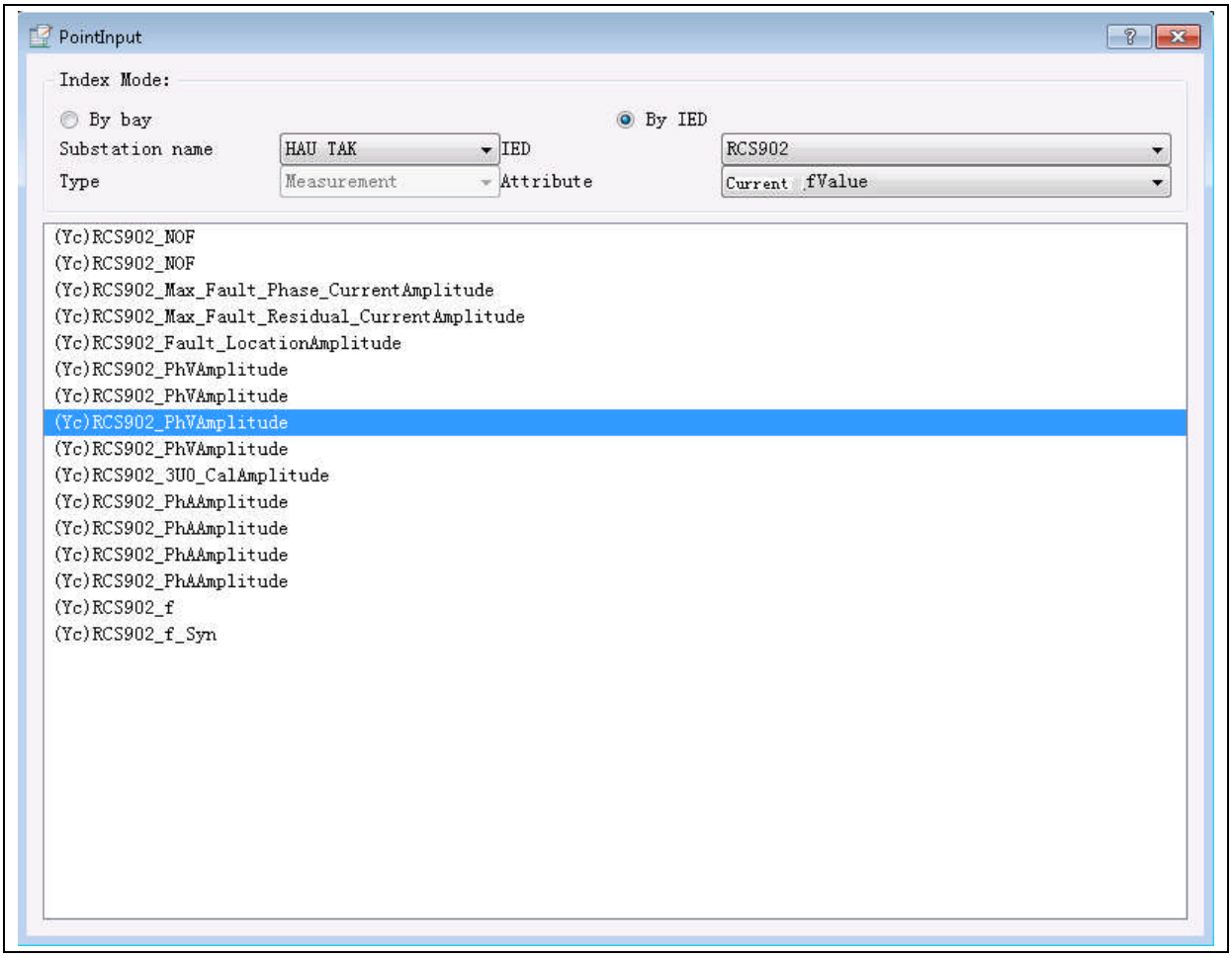


Figure 12.5-55 Select measurement measuring point

BI point can be similarly defined. Select required “measuring point” and double click to select object of rule definition:

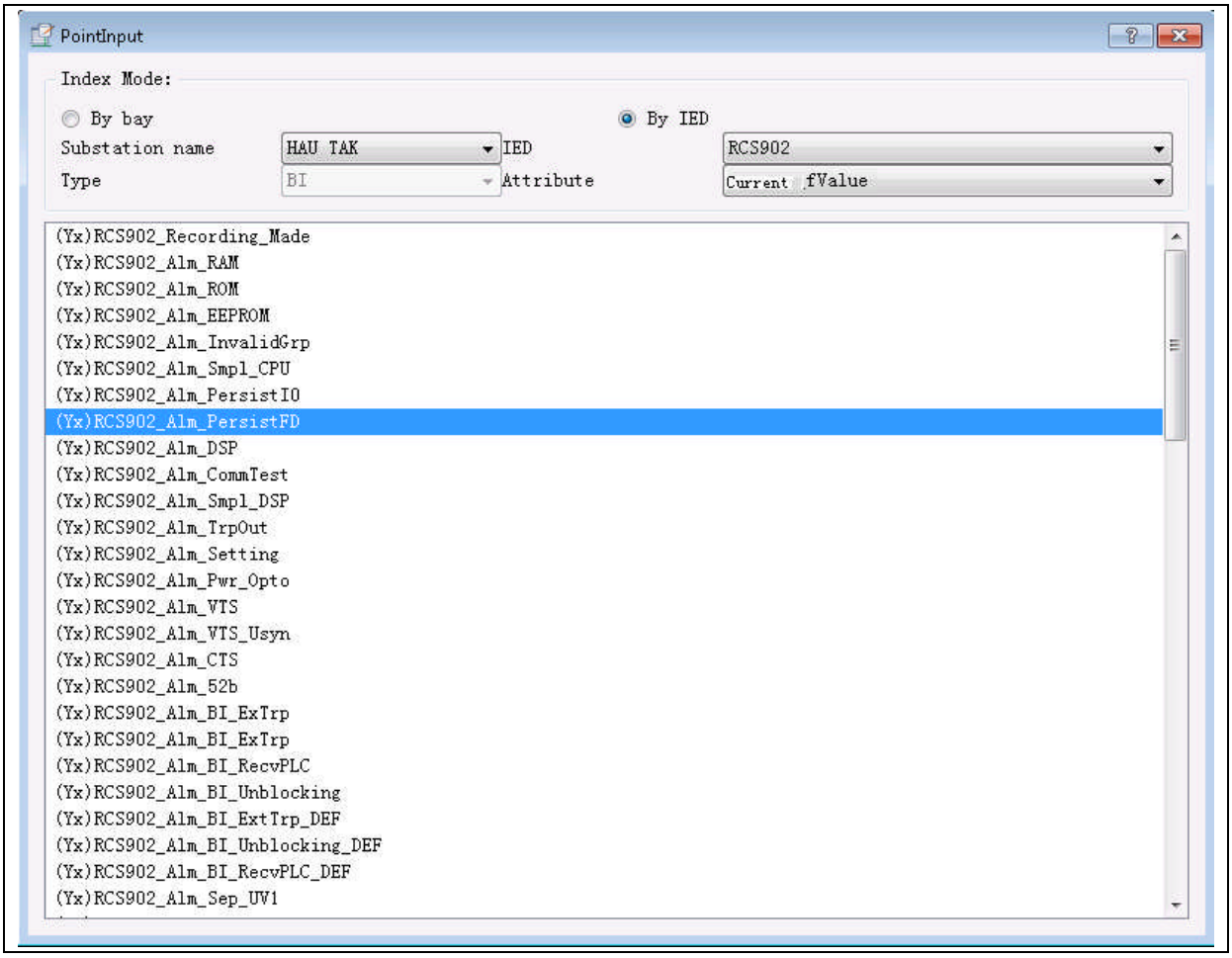


Figure 12.5-56 Select BI measuring point

In Edit BI rule dialog box, measuring point object of rule definition BI point and open position/close position defined will be displayed:

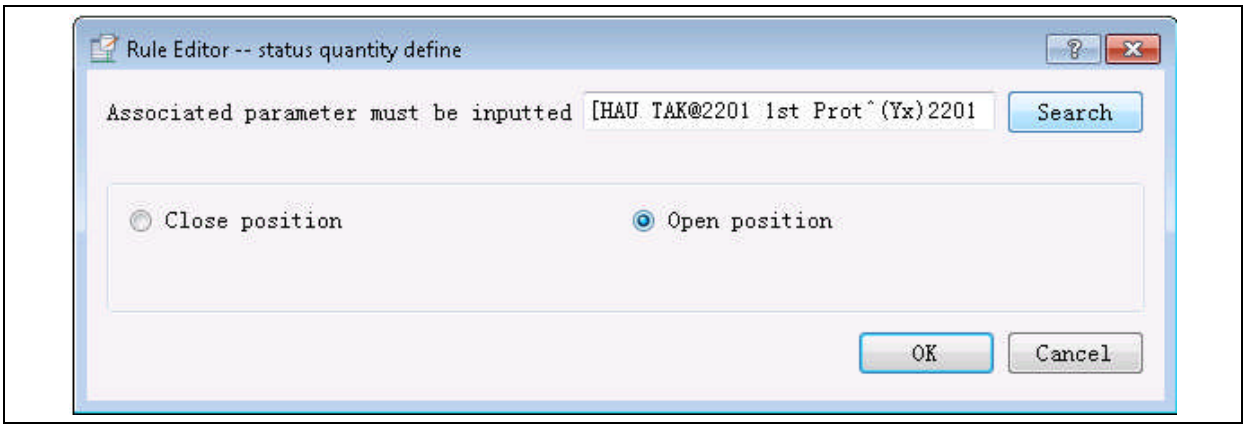


Figure 12.5-57 Measuring point object of BI point and open position/close position defined

After clicking OK, definition of objects of measurement point and BI point can be generated respectively, as shown below:

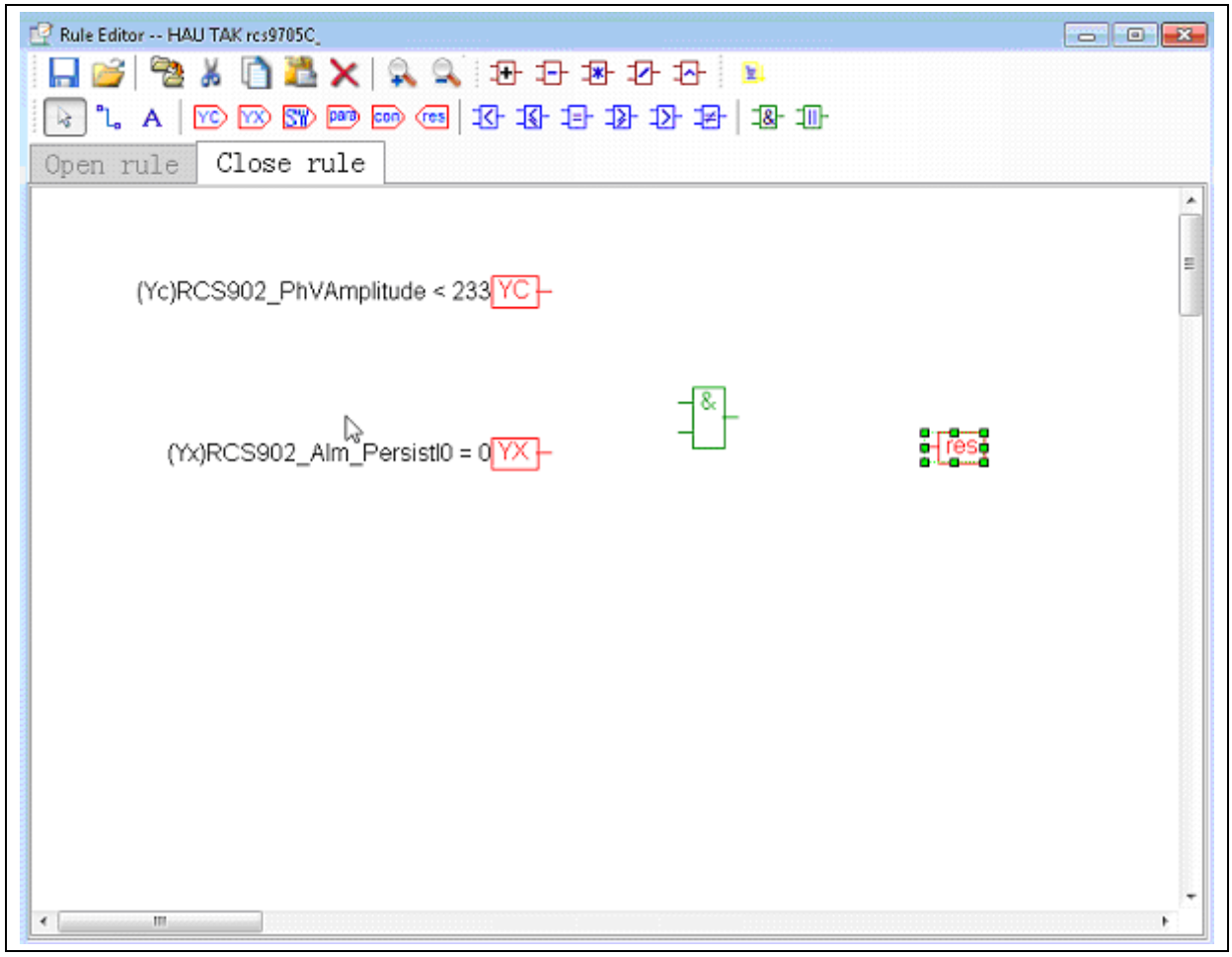


Figure 12.5-58 Generation of definition of objects of measurement point and BI point

After definition of measurement and BI data objects, editing of logic operator symbols, and editing of rule definition output icons, user can click to select Connection line button on the tools bar, as shown below:

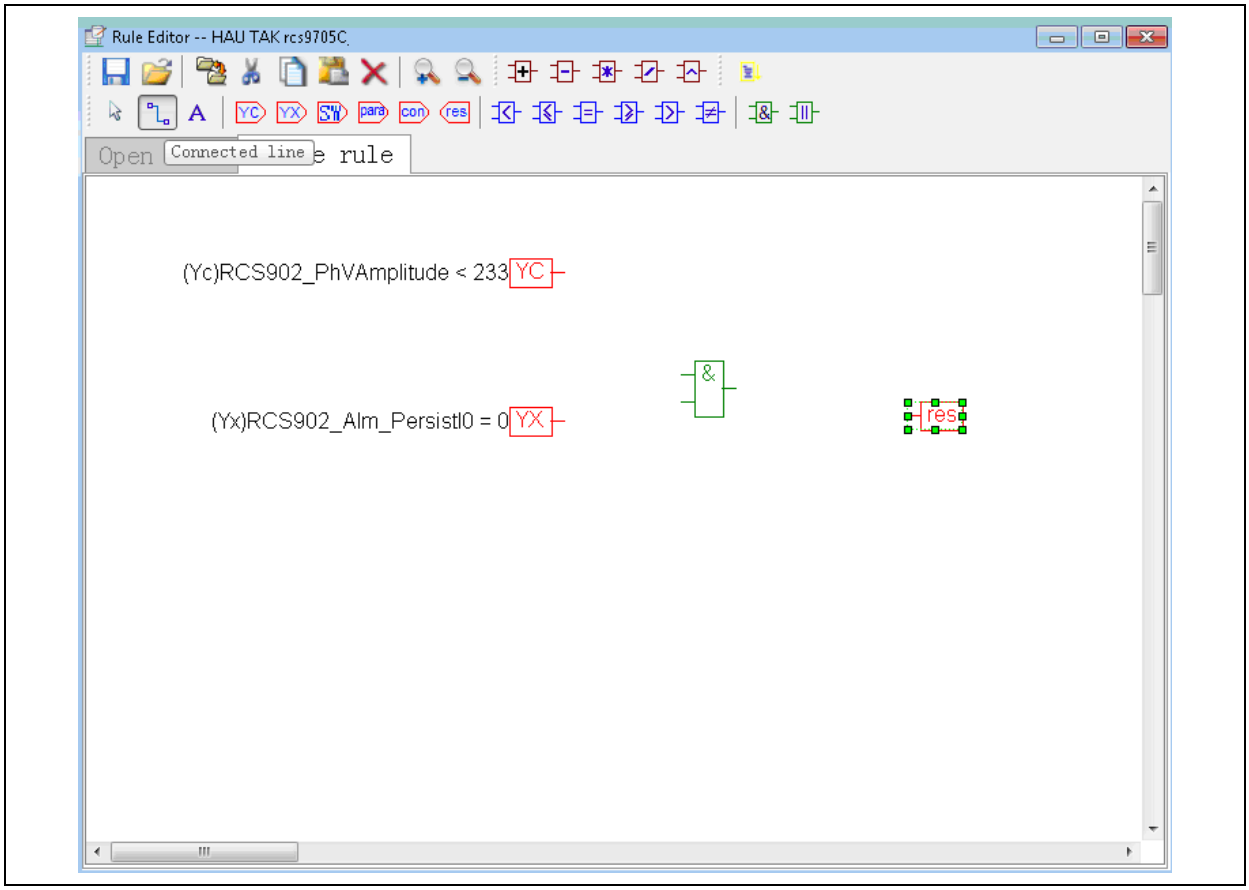


Figure 12.5-59 Select Connection line button

Left click and hold mouse to start definition of connection between measuring point and logic operator symbol:

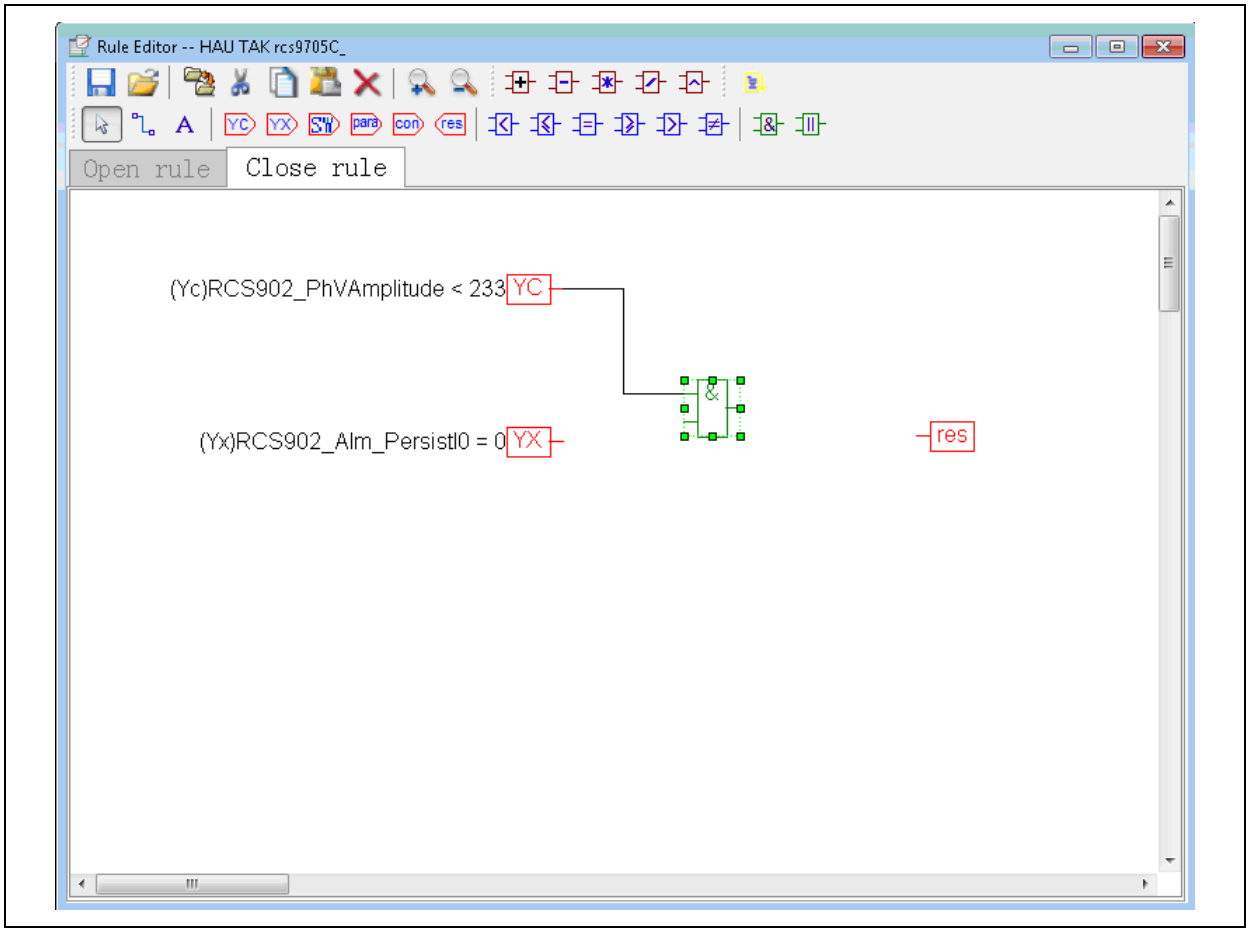


Figure 12.5-60 Define connection between measuring point and logic operator symbol

Define connection lines for all measuring point objects and finally the connection line between operator symbol and output icon. Click button Save:

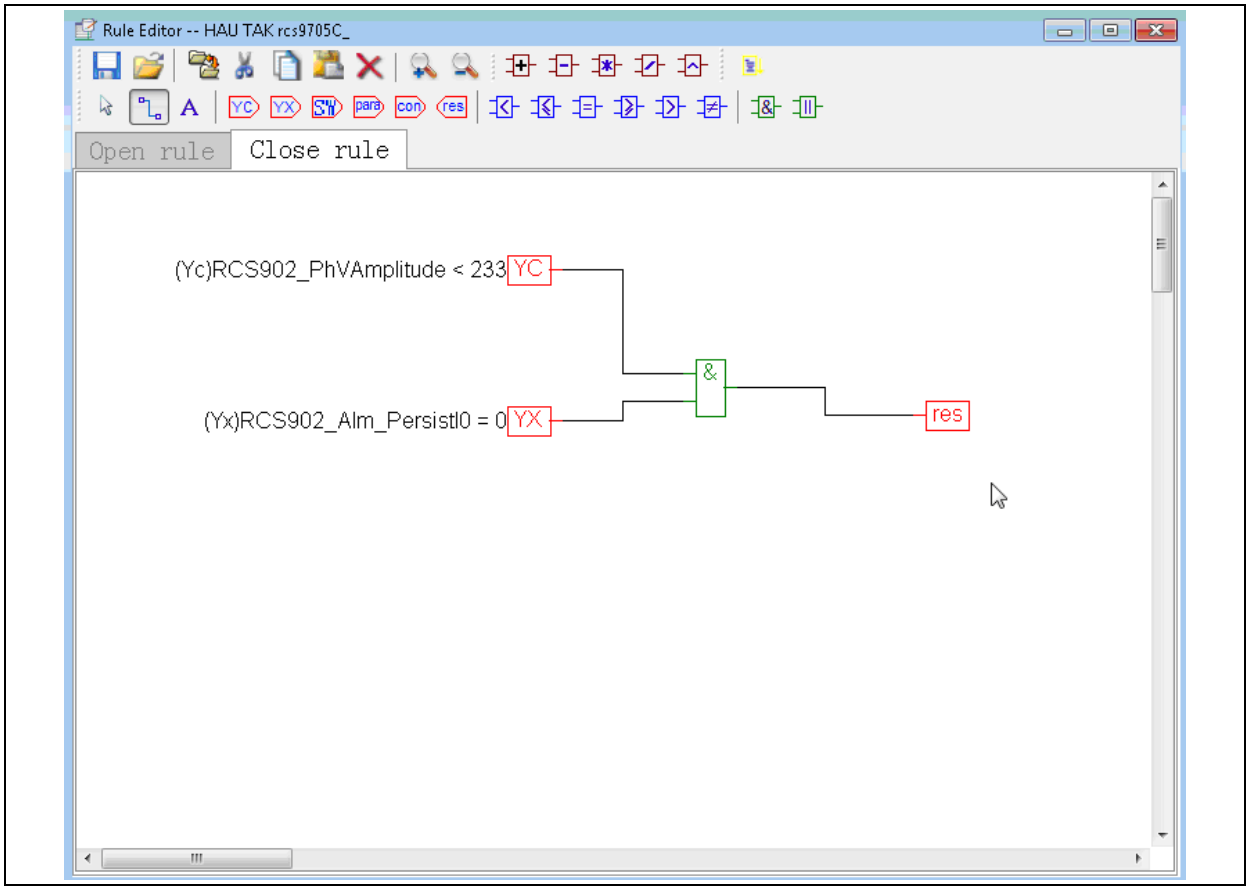


Figure 12.5-61 Click button Save to generate rule

Click button Save on Rule Editor to generate close rule of control “measuring point”:

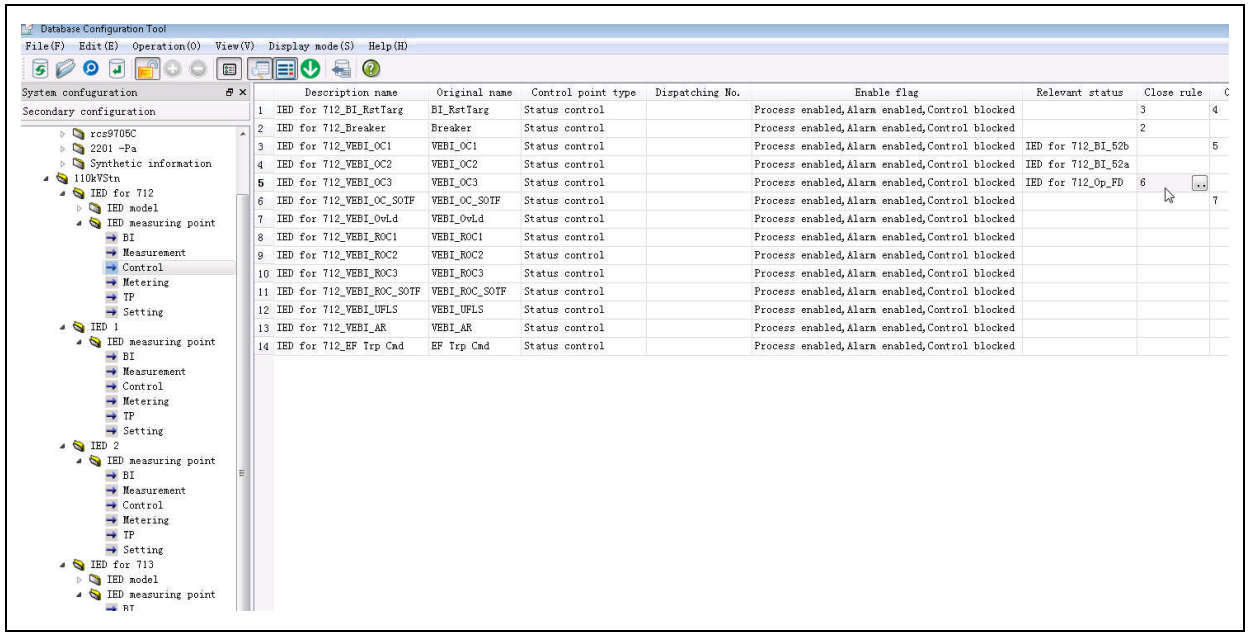


Figure 12.5-62 Generation of control “measuring point” close rule

Open rule of this control point can be similarly defined:

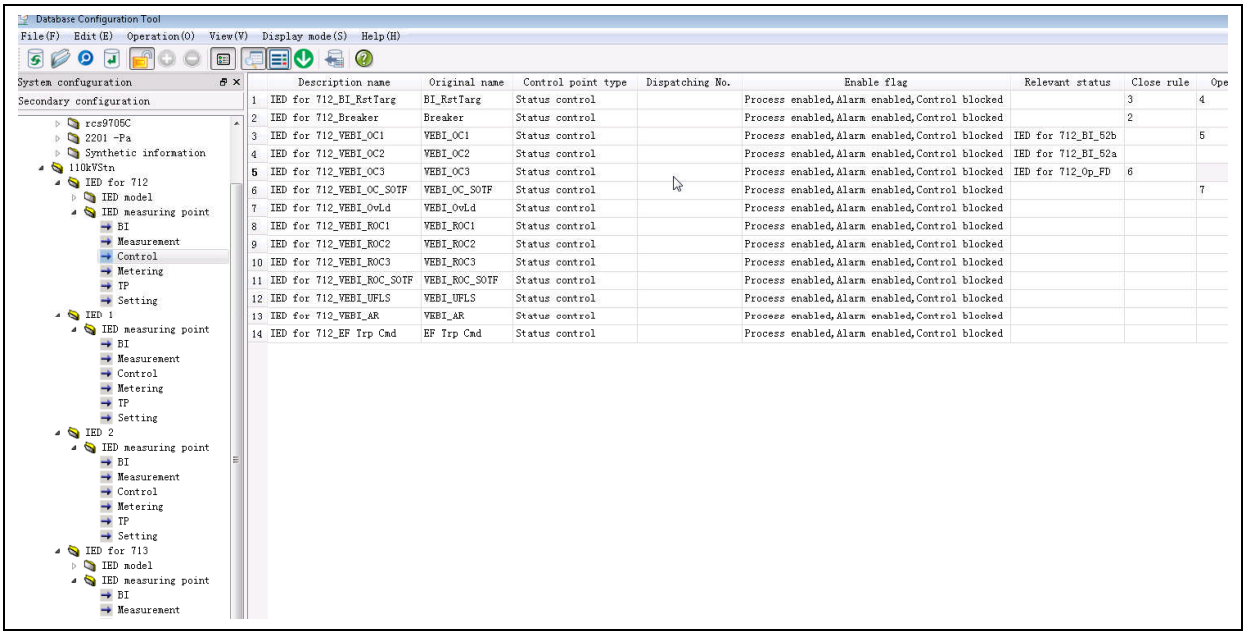


Figure 12.5-63 Define open rule of control point

In Rule editor dialog box, define and associate rule objects, and make connection lines between measuring points and related logic symbols. Save to generate open rule:

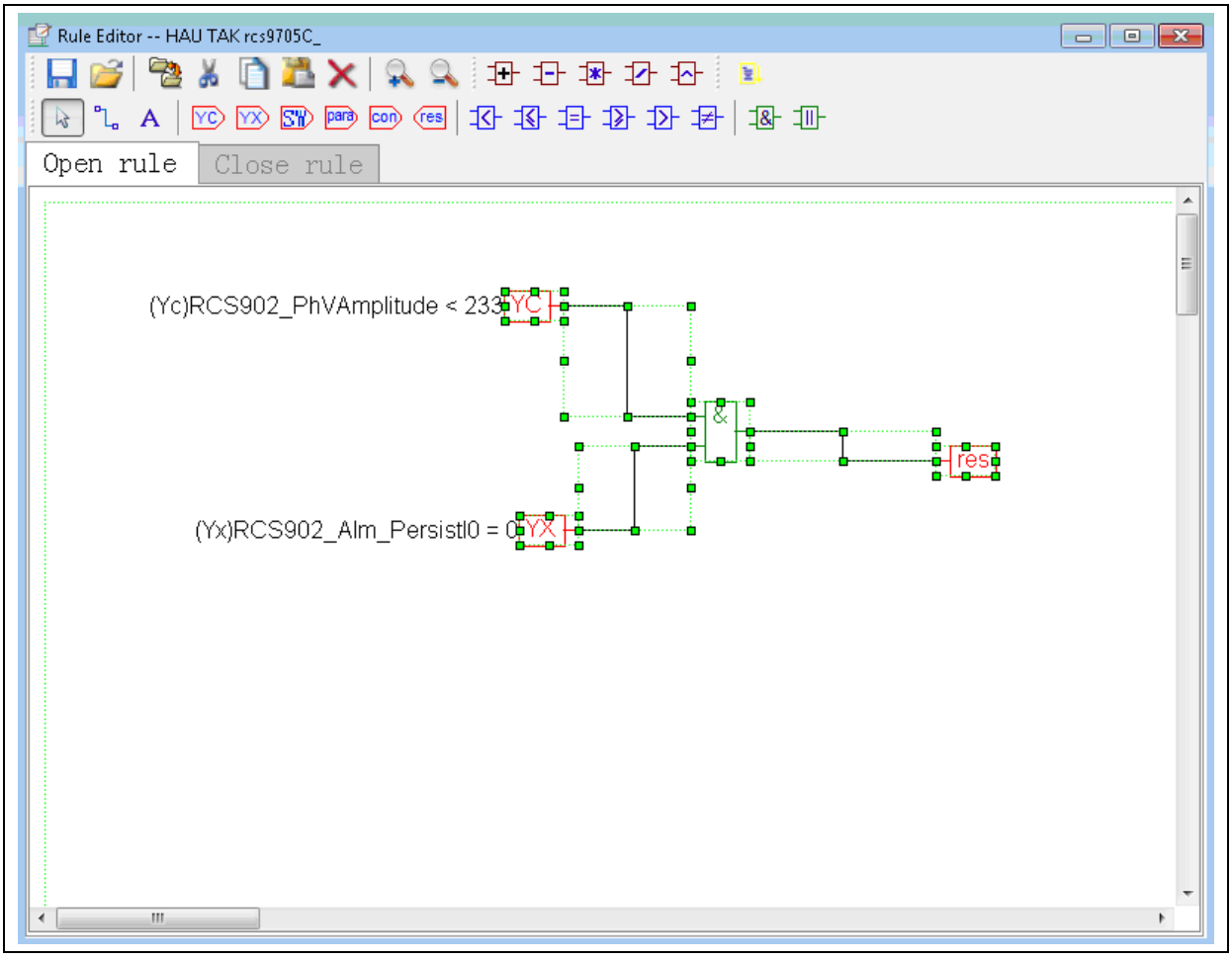


Figure 12.5-64 Definition of open rule

Finally, generate open rule of this control point:

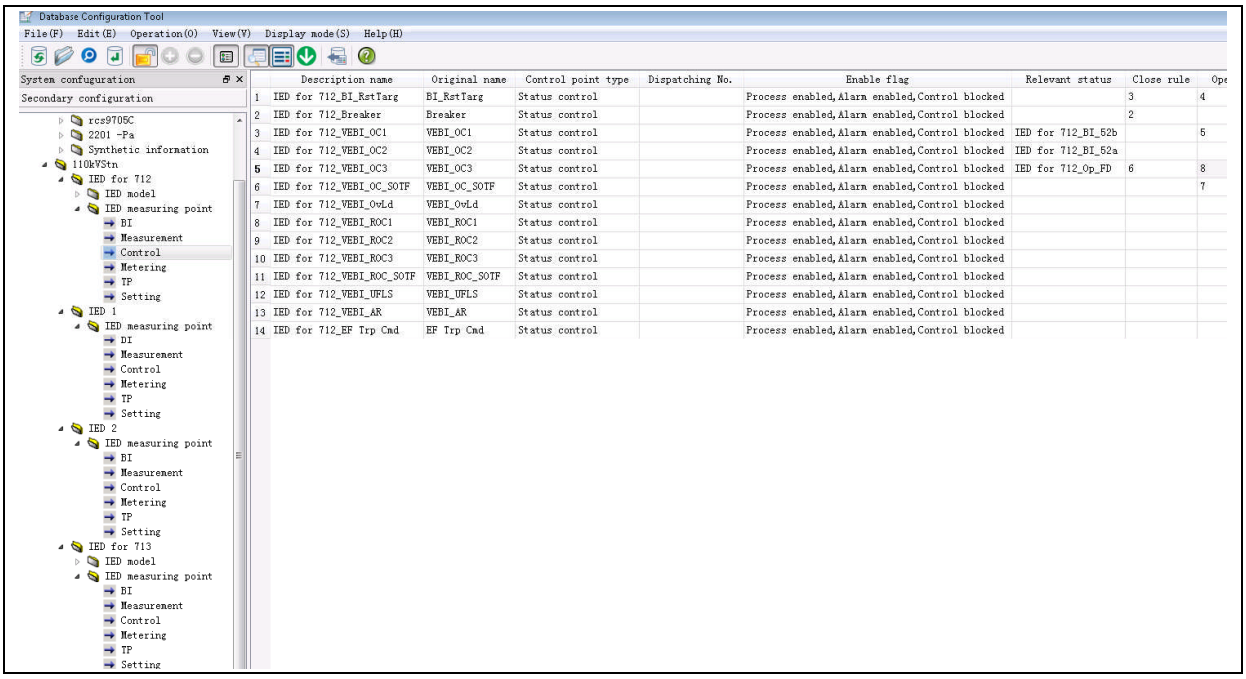


Figure 12.5-65 Generate open rule of control point

User can select and view close rule, open rule, and anti-maloperation rule of any control point of the whole substation. Click configuration tool Operation menu to pop up Export rule and Export anti-maloperation rules menu items:

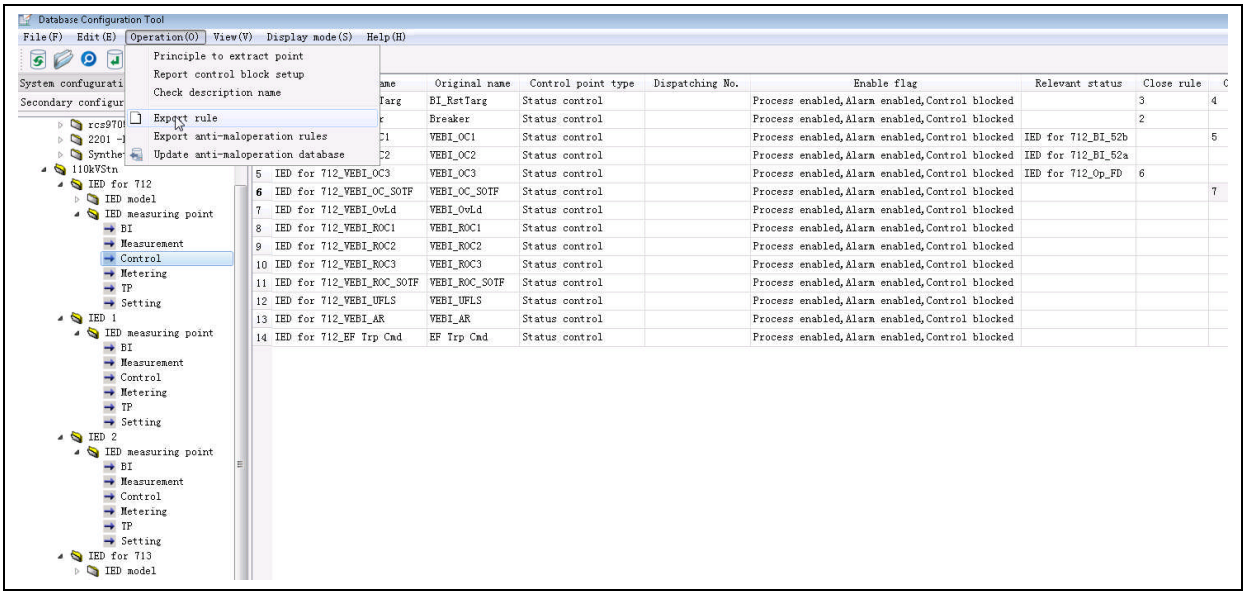


Figure 12.5-66 Export rule and export anti-maloperation rule menu items

Click Export rule to pop up open and close rules of control measuring points of all devices under all substations:

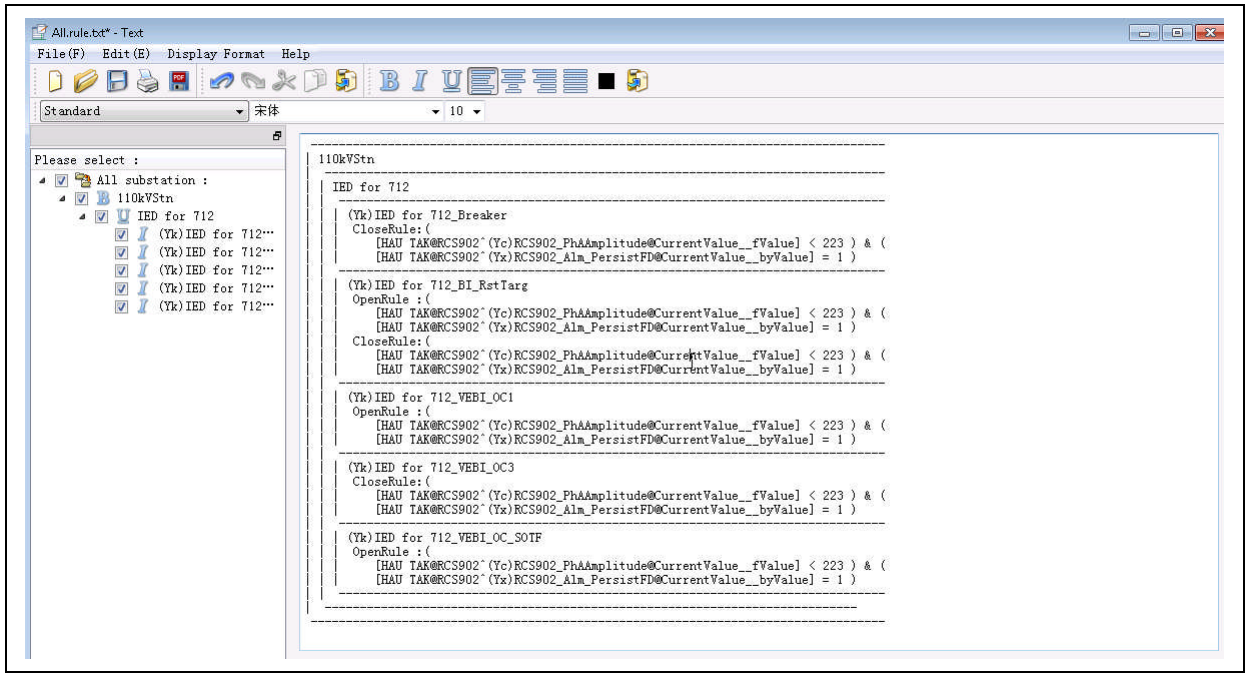


Figure 12.5-67 View text of open and close rules

In the tree type list at left side, user can select measuring points the open and close rules of which need to be viewed. User can also select viewing according to filtering conditions of device or substation:

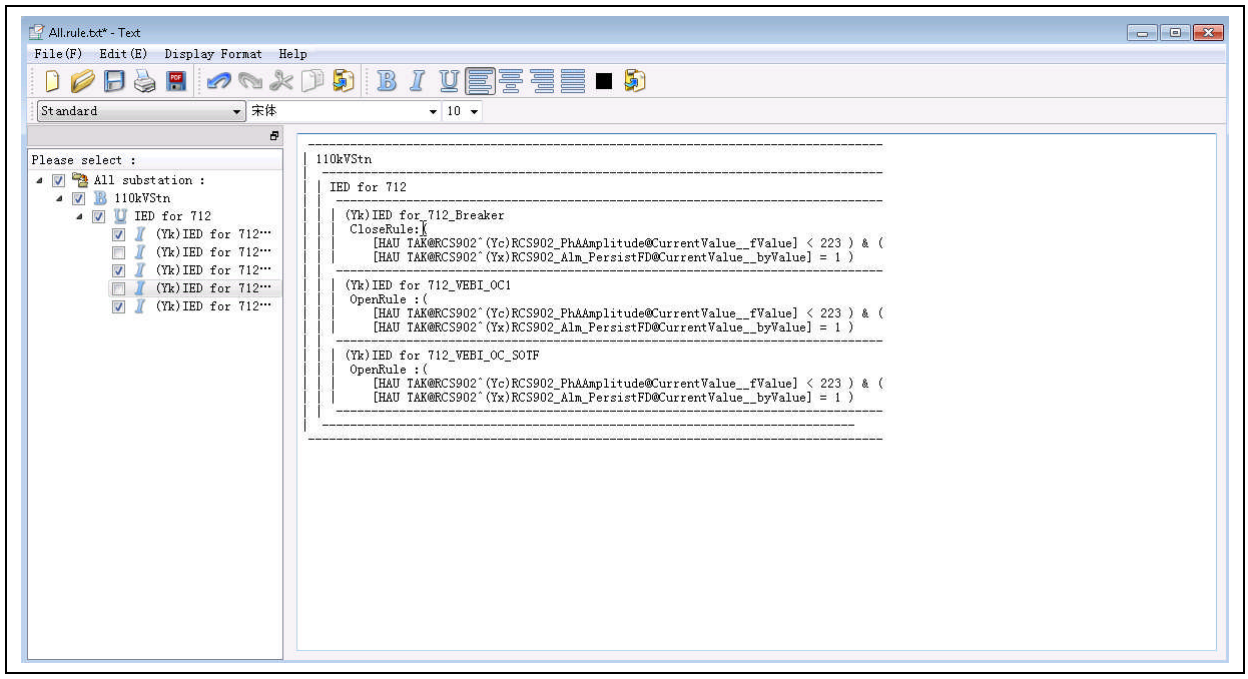


Figure 12.5-68 Find open and close rules of measuring point

On View rules tools bar, click button “Export PDF” to export rule text as .pdf file; name and save this file:

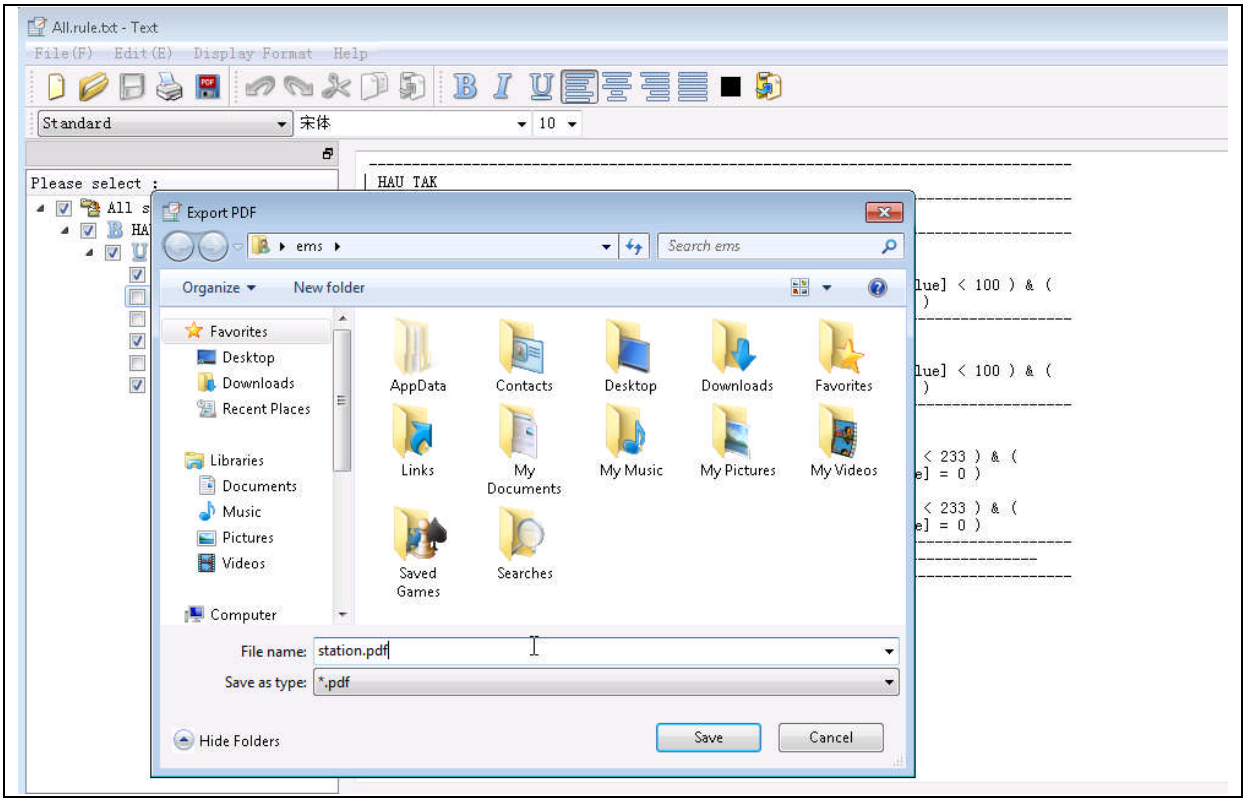


Figure 12.5-69 Export rule text as .pdf file

Similarly, click Export anti-maloperation rules menu item to pop up open and close rules of all anti-maloperation BI measuring points of all substations:

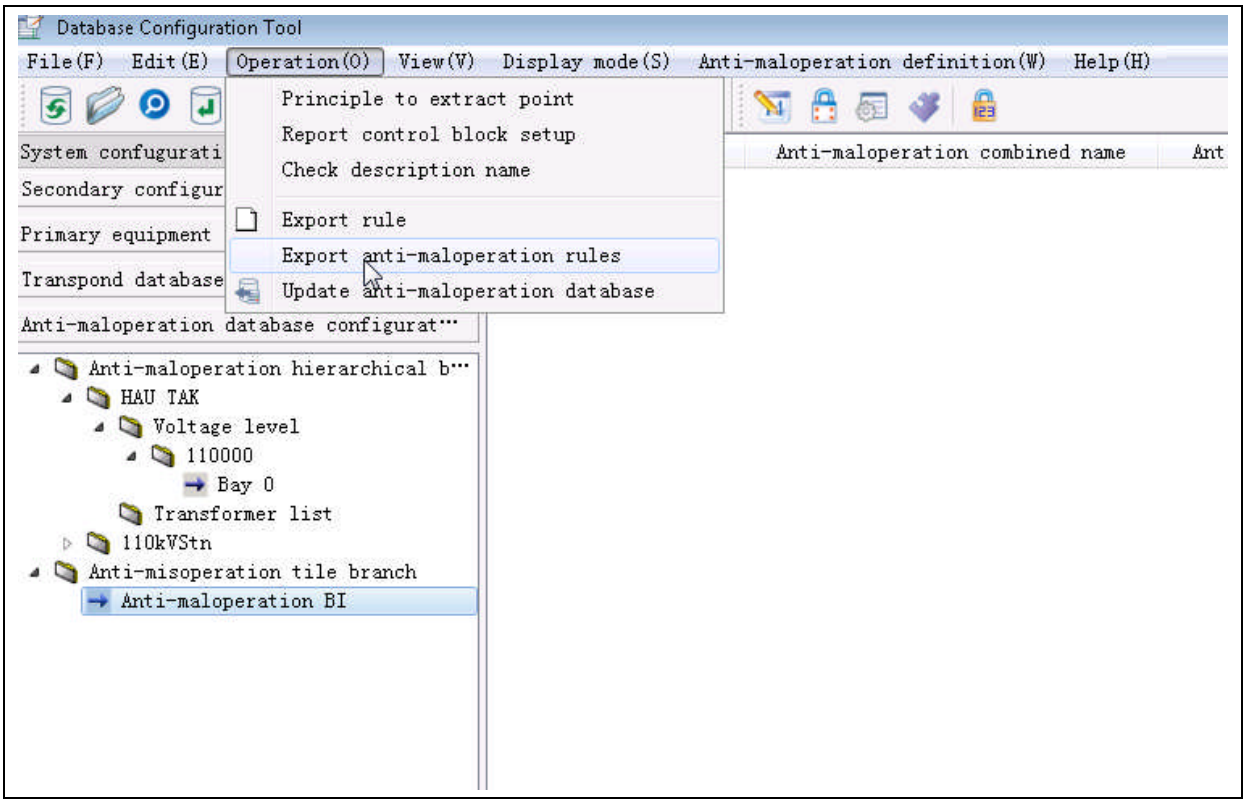


Figure 12.5-70 Export anti-maloperation rules

Open and close rules of all anti-maloperation BI measuring points of all substations will pop up:

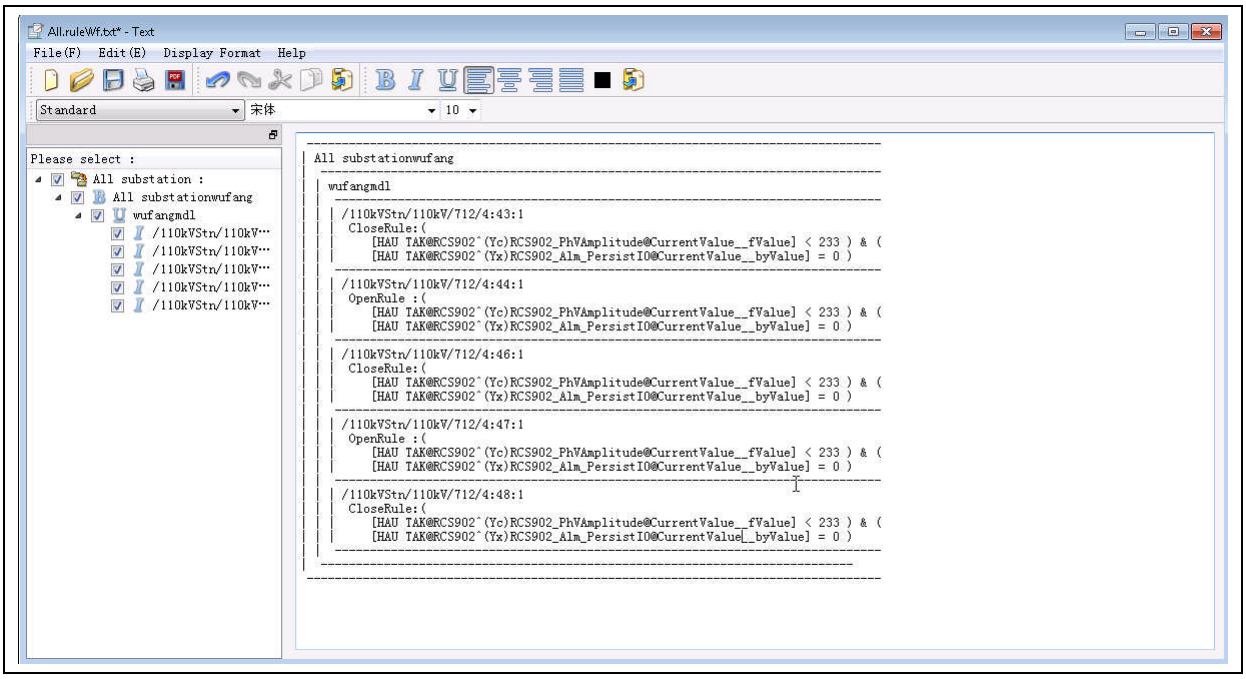


Figure 12.5-71 Open and close rules of anti-maloperation BI measuring points

The process of definition of open and close rules of anti-maloperation BI points is the same as that of definition of open and close rules of IED control points. Operation interface is shown below:

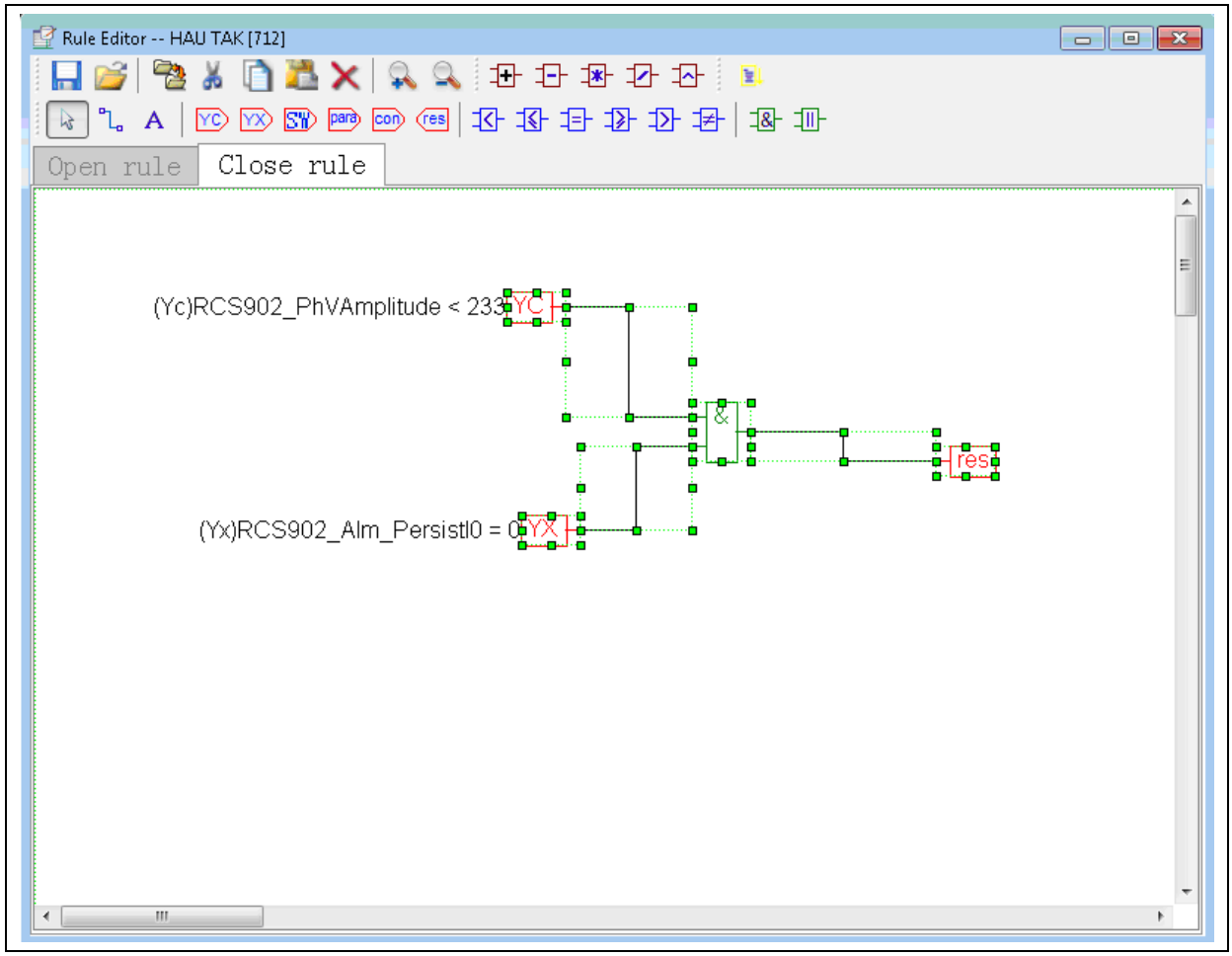


Figure 12.5-72 Definition of open and close rules of anti-maloperation BI points

12.5.2 Configuration of Primary System

In the dock window, when switched to primary equipment configuration mode, the topmost layer nodes are “primary equipment branch” nodes. Substation objects that have been added are sub-nodes. In the primary equipment configuration environment, substation objects cannot be added, deleted, or modified. Select and open a substation node; there will be two sub-nodes under it in default: “voltage level” and “transformer list”, displaying list of voltage levels and list of transformers under this substation.

12.5.2.1 Configuration of Voltage Levels

In the dock window, select a voltage level node. The list window will display all voltage level objects. Right click mouse on “voltage level” node and select “New voltage level” in the menu popped up, or right click the list and select “Add” in the menu popped up, or select “Add” in menu “Edit”, or click “Add” button on the tools bar, or directly press “Ctrl+A” shortcut, to pop up Voltage level configuration window as shown below:

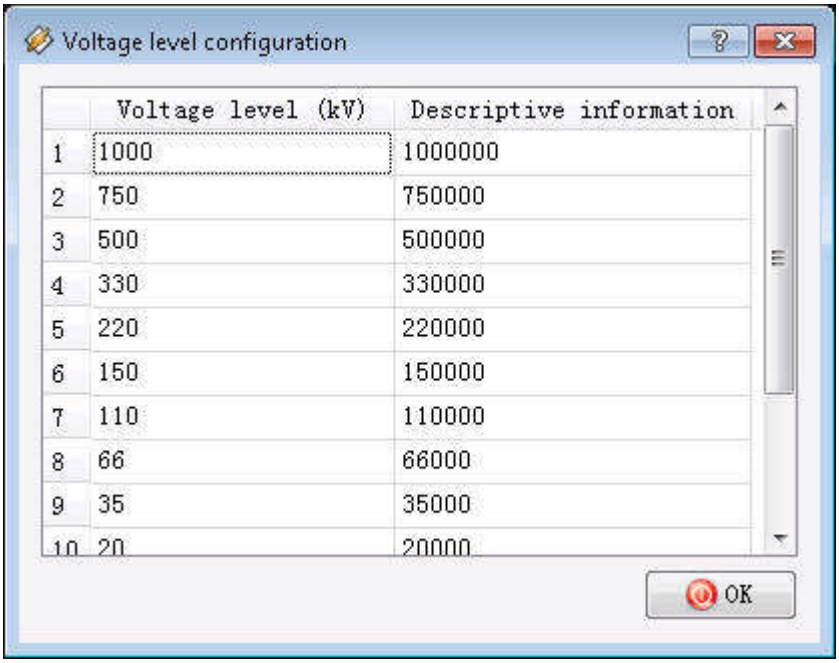


Figure 12.5-73 Voltage level configuration

Double click the voltage level entry to be added, or select a voltage level entry and click “OK”, to add a new voltage level. After successful execution, in the dock window, a new actual voltage level object node will be added under “voltage level” node, named in “voltage level: descriptive information” format.

In the list window, all voltage levels and corresponding descriptive information will be displayed. Values of voltage levels cannot be modified, while descriptive information can be modified in the form of character string, not exceed 128 English characters or 64 Chinese characters. After successful modification of descriptive information, corresponding node names in the dock window will be updated.

In the dock window, select a voltage level node and right click mouse. In the context menu popped up, select “Delete voltage level”. The database configuration tool will prompt “All configuration information under this voltage level will be deleted. Are you sure to delete current voltage level?”. Click “Yes” to execute deletion.

Or, in the dock window, select “voltage level” node and in the list window, select voltage level object to be deleted. Right click mouse and select “Delete” in the context menu popped up, or select “Delete” under menu “Edit”, or click button “Delete” on the tools bar, or directly press “Delete” key; the database configuration tool will prompt “Are you sure to delete all selected entries?”; click “Yes” to execute deletion.

12.5.2.2 Bay Configuration

Bay configuration functions include Add, Delete, Copy, Paste, and Modify attributes.

- **Add bay**

In the dock window, select a voltage level. Right click mouse on this voltage level and select “New bay” in the context menu popped up, or right click mouse on the list and select “Add” in the context

menu popped up, or select “Add” in menu “Edit”, or click button “Add” on the tools bar, or directly press “Ctrl+A” shortcut; a new bay object will be generated under current voltage level.

- **Modify bay attributes**

Bay attributes include: bay name, main equipment, main protection, Pop up graph?, Enable flag, abnormal criterion, outage criterion, maintenance criterion, communication abnormal criterion, and remark. Particular description is given in the table below:

Table 12.5-10 Description of configuration of bay

Name of attribute	Description
Bay name	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as “/”. To be unique under the substation.
Main equipment	Character string. Name of main equipment under the bay. Click this attribute column to display all primary equipment under this bay in a pull-down list. Set one item as main equipment under this bay.
Main protection	Character string. Name of main protection corresponding to the bay. Click this attribute column to display list of devices that have measuring point association with this bay and primary equipment under this bay in a pull-down list. Set a device as main protection of this bay.
Popup graph	Name of graph. Process of setup is the same as that of attributes of substation object substation graph.
Enable flag	Contents of selection: process enabled and alarm enabled. A number of items can be selected in the pull-down list.
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object control block point
Outage criterion	Ditto
Maintenance criterion	Ditto
Communication abnormal criterion	Ditto
Remark	Character string not exceeding 128 English characters or 64 Chinese characters.

- **Copy and paste bay**

In the dock window, select a bay node. The list window will display attributes corresponding to this bay. Right click this node and select “Copy bay” in the menu popped up. After successful Copy operation, when right clicking voltage level node in the dock window, menu item “Paste” in the menu popped up will be usable; or when right clicking a bay node, menu item “Paste and insert” in the menu popped up will be usable. The “Paste” operation adds a new bay at end of this voltage level, while “Paste and insert” operation inserts a bay before currently selected bay. Both ensure consistent attributes of new bay with source bay, and consistent primary equipment objects under the bays. After Paste operation, the following dialog box will pop up for setup of name of bay and name of primary equipment under the bay:

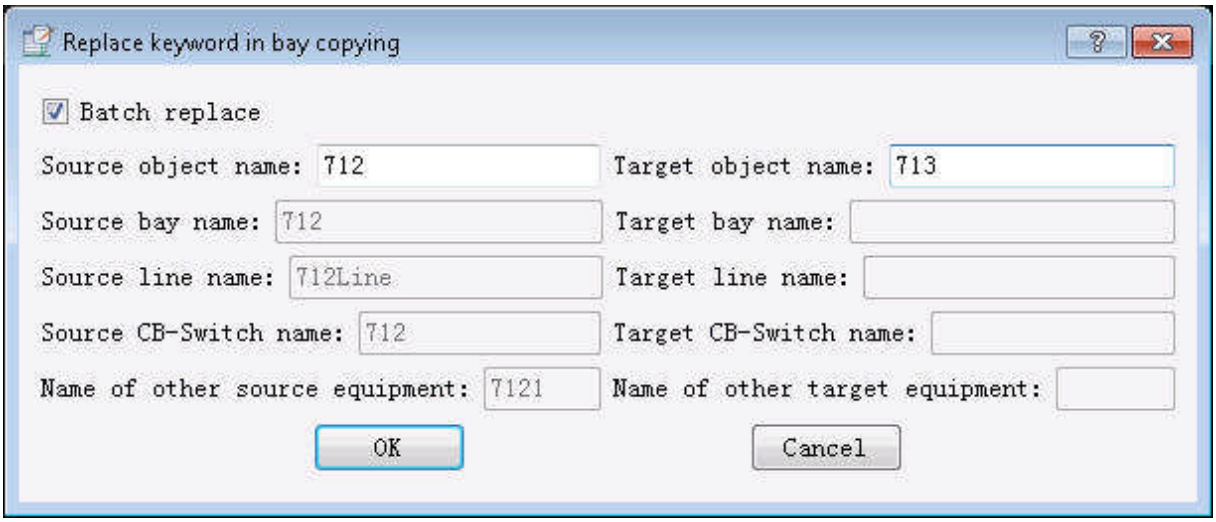


Figure 12.5-74 Equipment name replacement

For keyword replacement, the database configuration tool provides replacement of bay name, line name, CB-Switch name, and name of other primary equipment. If the bay name and names of all primary equipment under the bay contain a common character string, batch replacement function can be used. In source object name, enter this common character string, and in the target object name, enter replacement target character string. After clicking “OK”, the database configuration tool will replace character strings in corresponding source object names by name of target object. If button Cancel is clicked, the database configuration tool will not replace object names, and name of bay and names of primary equipment under the bay will be default names.

After modification of object names, if primary equipment under the bay has been associated with measuring points, the database configuration tool will guide association of measuring points for target bay. The dialog box shown below will pop up, for selection of related IED of primary equipment:

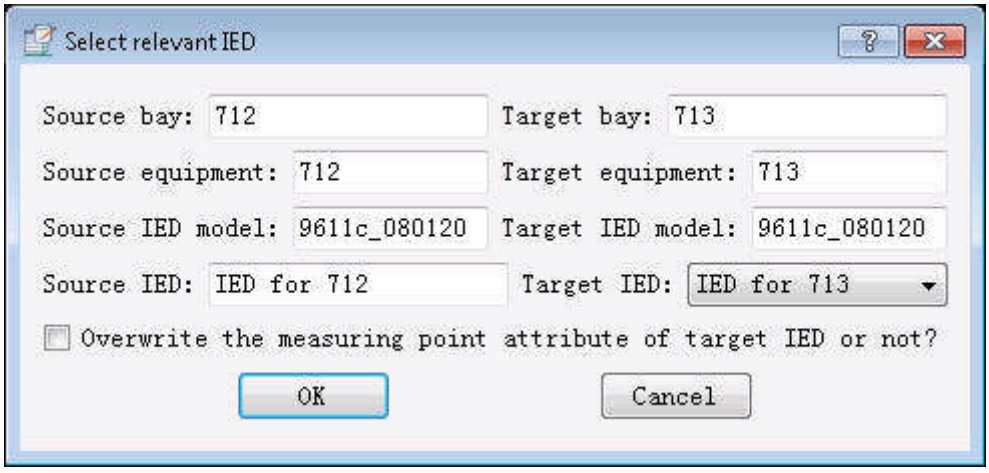


Figure 12.5-75 Select relevant IED of primary equipment

According to model of relevant IED of source primary equipment, all devices of this model under current substation will be displayed in list of target IEDs for selection. Select an IED and click “OK”;

the database configuration tool will automatically create association relation between target equipment and measuring points under target IED according to association relation between source primary equipment and measuring points under source IED. If “Overwrite the measuring point attribute of target IED or not” is selected, attributes of associated measuring point under source IED will be copied to corresponding measuring point under target IED.

- **Delete bay**

In the dock window, select a voltage level; the list window will display all bay objects under this voltage level. Select bay objects to be deleted. In the list window, right click mouse and select “Delete” in the right key menu popped up, or select “Delete” in menu “Edit”, or click button “Delete” on the tools bar, or directly press “Delete” key; the database configuration tool will prompt deletion of all selected entries. Click “Yes” to delete all selected bay objects and all primary equipment under these bays, and clear association relations between primary equipment and measuring points.

Or, in the dock window, select a bay object node and right click mouse. In the menu popped up, select “Delete bay” menu item; the database configuration tool will prompt deletion of currently selected bay object. Click “Yes” to delete currently selected bay object and all primary equipment under this bay, and clear association relations between primary equipment and measuring points.

12.5.2.3 Configure Equipment

In the primary system, 10 major types of equipment are defined: transformer, line, CB-Switch, capacitor-reactor, generator-motor, bus, VT, CT, arrestor, and other equipment.

Equipment configuration refers to addition or deletion of corresponding primary equipment object under established bay, or setup of attributes of existing primary equipment.

- **Add equipment**

In the dock window, select a bay node and right click mouse; select “Add primary equipment” in the menu popped up. Or, select “Add” in menu “Edit”; or click button “Add” on the tools bar; or directly press “Ctrl+A” shortcut; to pop up the dialog box shown below. Select type of the equipment to be added:

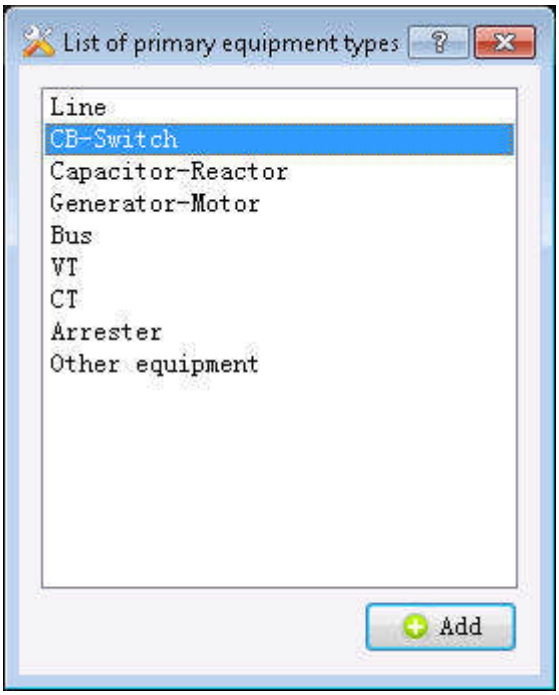


Figure 12.5-76 Select type of primary equipment

Double click type of primary equipment to be added, or select this entry and click “Add” button; a new equipment object will be added under current bay. After successful addition of equipment object, a new equipment object node will be added to the bay node in the dock window, with equipment name as node name, and 5 sub-nodes (“BI”, “measurement”, “control”, “TP”, and “metering”) under the equipment node in default, representing associations between the primary equipment and measuring points of corresponding type.

- **Modify equipment attributes**

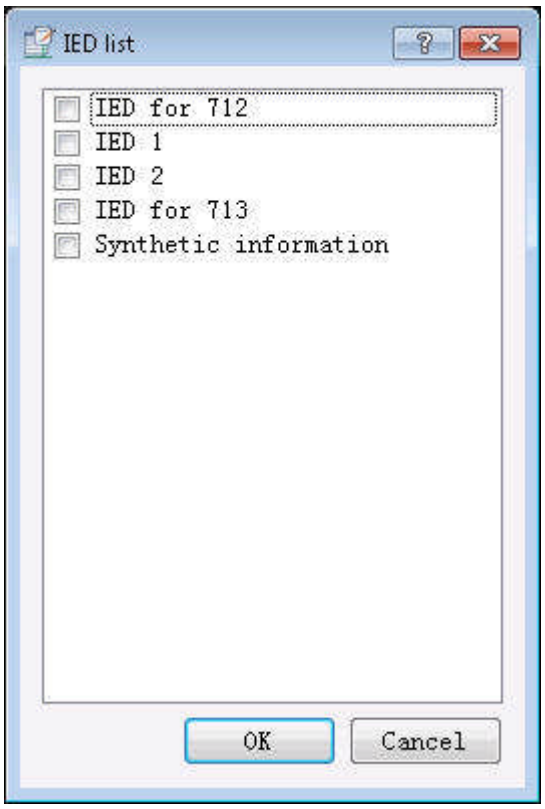
Each type of equipment has different attributes. These are described in the following:

- **Line:**

Table 12.5-11 Description of configuration of line

Name of attribute	Description
Name of line	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as “/”. Unique under the substation.
Type of line	Character string; all types of line will be displayed in the pull-down list: power line, tie-line, feeder, and incoming line. Correct type of line needs to be selected, in particular incoming line, which is topological status judgment criterion.
Equipment model	Character string not exceeding 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified; displays voltage level of this primary equipment
Line length (km)	Floating point number; click this attribute column to enter floating point number
Fault location coefficient	Setup same as above

Name of attribute	Description
Relevant current measuring point	Measurement point. The configuration method is the same as that of attributes of substation object block control point
Relevant PT	Name of PT object; click this attribute column to display all PT objects at current voltage level in a pull-down list. Select an object as relevant PT of current line.
Relevant CT	Name of CT object; click this attribute column to display all CT objects at current voltage level in a pull-down list. Select an object as relevant CT of current line.
Positive sequence resistance	Floating point number; click this attribute column to enter floating point number
Positive sequence reactance	Floating point number; setup of which same as above
Zero sequence resistance	Floating point number; setup of which same as above
Zero sequence reactance	Floating point number; setup of which same as above
Rated apparent power	Floating point number; setup of which same as above
Rated current	Floating point number; setup of which same as above
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commission date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance time	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Manually create association with primary equipment. Click this attribute column to pop up Select relevant IED dialog box shown in

Name of attribute	Description
	 **Figure 12.5-77** User can select a number of IEDs as relevant IEDs of primary equipment.

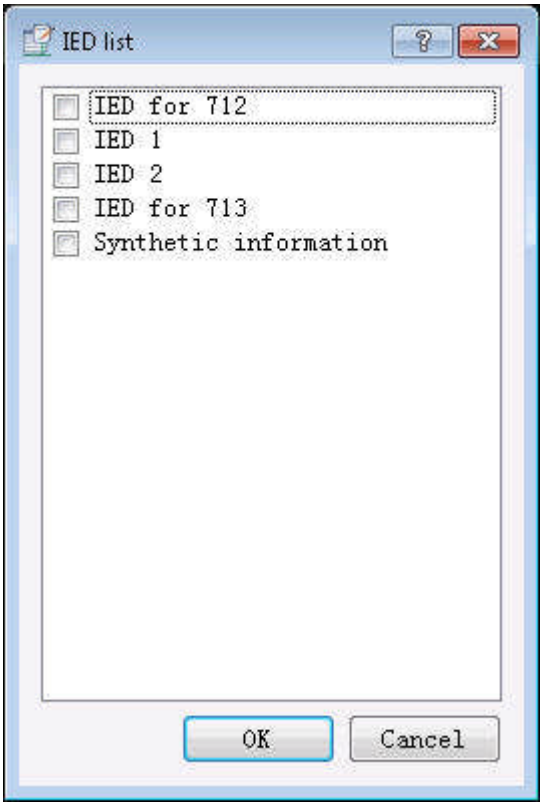
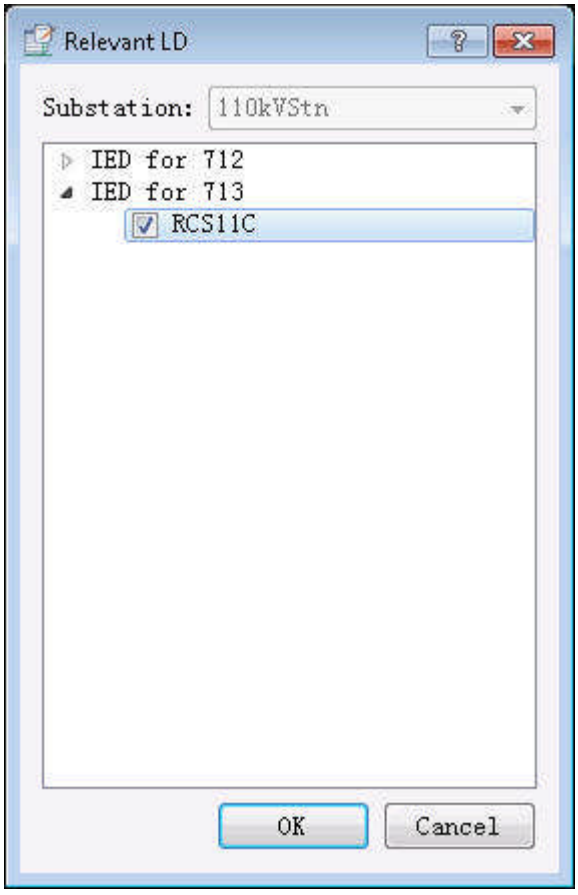


Figure 12.5-77 Select relevant IEDs

- **CB-Switch**

Table 12.5-12 Description of configuration of CB-Switch

Name of attribute	Description
Name of CB-Switch	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as "/". Unique under the substation.
Type of CB-Switch	Character string. All types of CB-Switch are displayed in the pull-down list: normal CB, bus coupler CB, transfer bus CB, bus section CB, 1½ CB, incoming feeder CB, outgoing feeder CB, capacitor CB, reactor CB, inner bridge CB, outer bridge CB, normal switch, load side switch, bus side switch, bus coupler switch, transfer bus DS, ES, and truck. As truck can be upper truck or lower truck, type of truck under the bay shall be clarified; this differentiation is required for incoming line topological state judgment and control operation. Other types of CB-Switch have corresponding setup description in other advanced applications.
Equipment model	Character string not exceed 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified. Displays voltage level of this primary equipment.
Tripping judgment point	BI point. Click this attribute column to pop up BI selection dialog box. Select a BI point as tripping judgment point for CB-Switch. If selected BI point is not yet associated to this CB-Switch, the database configuration tool will automatically create such association relation and list the tripping judgment point at the first place of relevant BI list. If this BI point has been associated to other primary equipment, the database configuration tool will prompt error and interrupt the operation. Click button "Clear" on the BI selection dialog box popped up to clear the tripping judgment point of the CB-Switch. If current CB-Switch has been associated to other CB-Switch as truck, and tripping judgment point has been set for such other CB-Switch, when clicking current attribute column, the prompt "Tripping judgment point has been associated to the truck object associated to current truck, it is forbidden to set the tripping judgment point again!" will pop up and the operation will be interrupted.
Relevant truck	Name of truck object. This attribute is only effective for trucks. Click this attribute column to display all CB-Switch objects in a pull-down list. Select another truck to form a complete truck with current truck object. Since these two trucks have consistent positions, they have a common tripping judgment point. For this reason, two circuit breakers for which different tripping judgment points have been set cannot be set as relevant trucks.
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance	Year, month, day. User can directly enter numbers or open Edit date window to select a

Name of attribute	Description
time	date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Process of setup is the same as that of attributes of relevant IEDs of line object.
Relevant logic device	List of names of relevant logic devices. Manually create association relation between primary equipment and logic device. Click this attribute column to pop up Select relevant logic device dialog box shown in  **Figure 12.5-78** User can select a number of logic devices as relevant logic devices of this primary equipment.

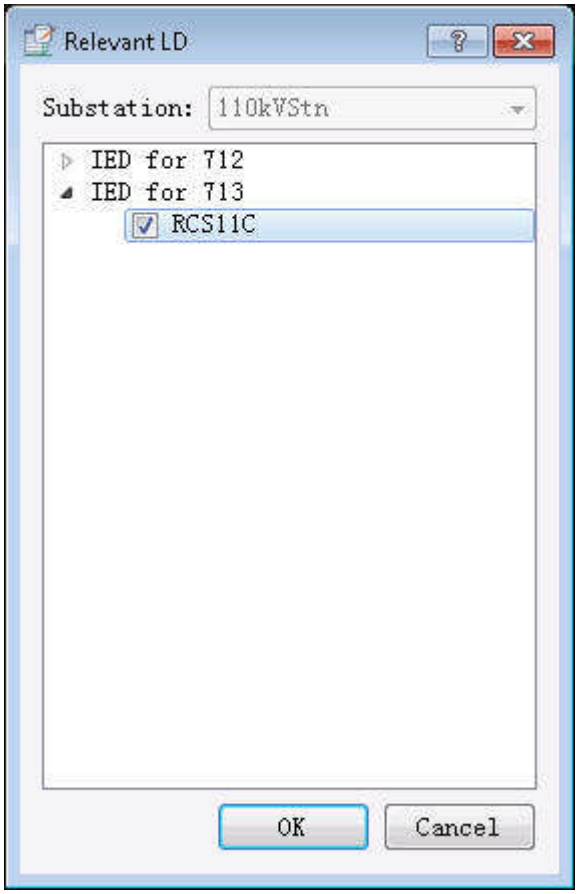


Figure 12.5-78 Select relevant logic device

- **Capacitor-reactor**

Table 12.5-13 Description of configuration of capacitor-reactor

Name of attribute	Description
Name of capacitor-reactor	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as "/". Unique under the substation.
Type of capacitor-reactor	Character string; displays all types of capacitor-reactor in the pull-down list: capacitor, reactor.
Equipment model	Character string not exceed 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified. Displays voltage level of this primary equipment.
Wiring mode	Character string. All wiring modes are displayed in the pull-down list: single Y, dual Y, and delta
Relevant CT	Name of CT object. Process of setup is the same as that of attributes of line object relevant CT.
Rated reactive power capacity	Floating point number; click this attribute column to enter floating point number
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be

Name of attribute	Description
	selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance time	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Process of setup is the same as that of attributes of line object relevant IEDs.

- **Generator-motor**

Table 12.5-14 Description of configuration of generator-motor

Name of attribute	Description
Name of unit	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as "/". Unique under the substation.
Type of unit	Character string. Types of unit are displayed in the pull-down menu: thermal power, hydropower, wind power. This attribute is effective if current object is generator.
Equipment model	Character string not exceed 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified. Displays voltage level of this primary equipment.
Adjustable	"Yes" or "No"
Rated apparent power (kVA)	Floating point number; click this attribute column to enter floating point number
Relevant CT	Name of CT object. Process of setup is the same as that of attributes of line object related CT.
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance	Year, month, day. User can directly enter numbers or open Edit date window to select a

Name of attribute	Description
time	date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Process of setup is the same as that of attributes of line object relevant IED.

- **Bus**

Table 12.5-15 Description of configuration of bus

Name of attribute	Description
Name of bus	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as "/". Unique under the substation.
Equipment model	Character string not exceed 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified. Displays voltage level of this primary equipment.
Relevant PT	Name of PT object. Process of setup is the same as that of attributes of line object relevant PT.
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance time	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Process of setup is the same as that of attributes of line object relevant IED.

- **VT**

Table 12.5-16 Description of configuration of VT

Name of attribute	Description
Name of VT	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as "/". Unique under the substation.
Equipment model	Character string not exceed 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified. Displays voltage level of this primary equipment.
VT ratio	Floating point number; click this attribute column to enter floating point number
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance time	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant	List of names of relevant IEDs. Process of setup is the same as that of attributes of line object relevant IED.

- **CT**

Table 12.5-17 Description of configuration of CT

Name of attribute	Description
Name of CT	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as "/". Unique under the substation.
Equipment model	Character string not exceed 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified. Displays voltage level of this primary equipment.
CT ratio	Floating point number; click this attribute column to enter floating point number
Zero sequence CT ratio	Floating point number; click this attribute column to enter floating point number
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be

Name of attribute	Description
	selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance time	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Process of setup is the same as that of attributes of line object relevant IED.

- **Arrestor**

Table 12.5-18 Description of configuration of arrestor

Name of attribute	Description
Name of arrestor	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as "/". Unique under the substation.
Equipment model	Character string not exceed 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified. Displays voltage level of this primary equipment.
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance time	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above

Name of attribute	Description
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Process of setup is the same as that of attributes of line object relevant IED.

- **Other equipment**

Table 12.5-19 Description of configuration of other equipment

Name of attribute	Description
Name of equipment	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as "/". Unique under the substation.
Type of equipment	Character string not exceed 32 English characters or 16 Chinese characters
Equipment model	Character string not exceed 32 English characters or 16 Chinese characters
Voltage level (kV)	Cannot be modified. Displays voltage level of this primary equipment.
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be selected in the pull-down list
Equipment parameters	Character string not exceeding 512 English characters or 256 Chinese characters
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance time	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication abnormal criterion	BI point; setup of which same as above
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Process of setup is the same as that of attributes of line object relevant IED.

- **Set association between primary equipment and measuring points**

Right click mouse on primary equipment node in the dock window, or right click mouse on measuring point type sub-node under primary equipment, and select "Associate measuring point" in the menu popped up. Or, select "Add" in menu "Edit", or click button "Add" on the tools bar, or directly press "Ctrl+A" shortcut, to pop up Select measuring point to be associated dialog box as shown below:

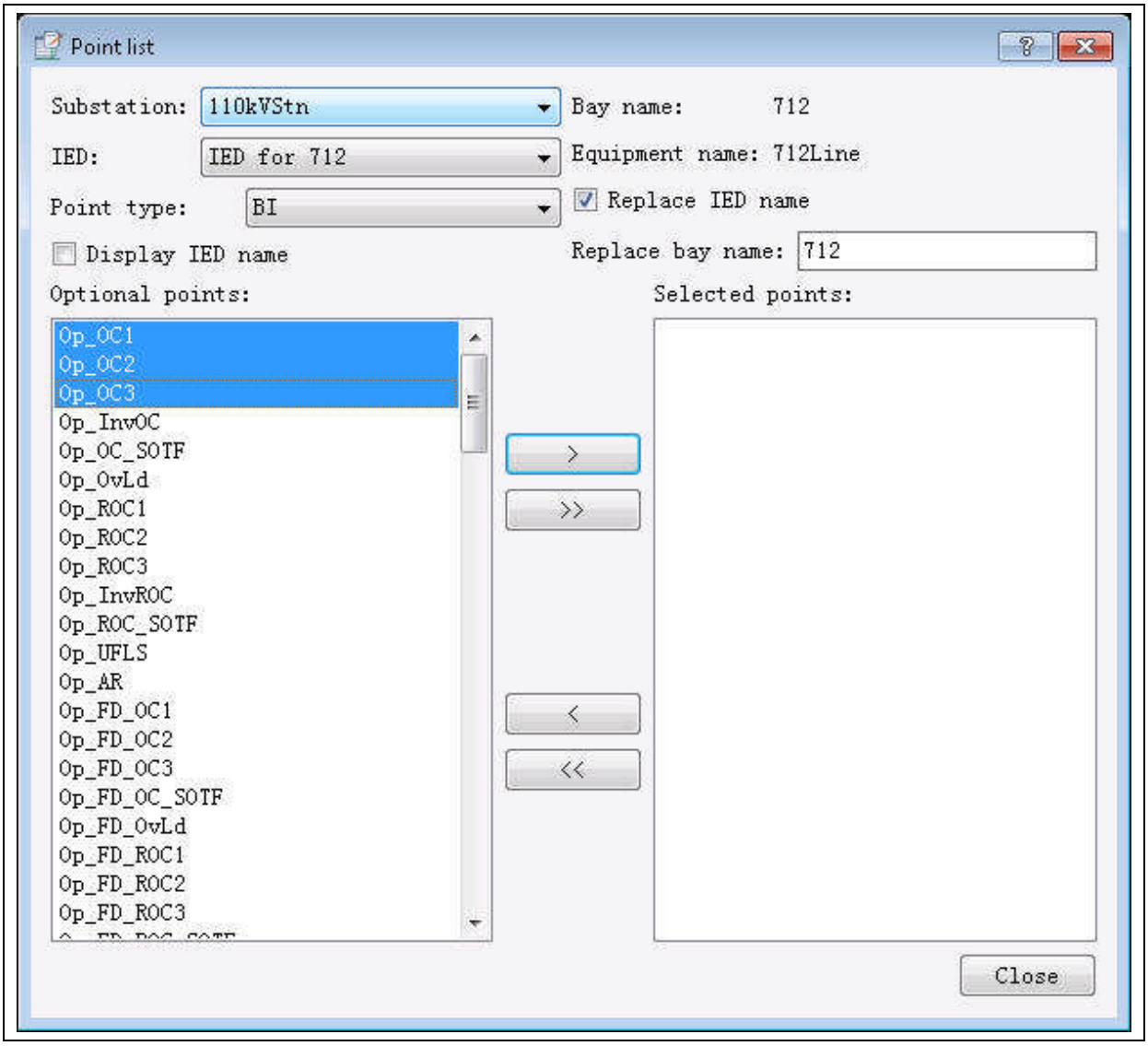


Figure 12.5-79 Select measuring point to be associated

In the IED pull-down list, user can select different IED for measuring point association. In the Point type pull-down list, select corresponding measuring point type. User can realize configuration of relevant measurement, relevant BI, relevant control, relevant TP, and relevant metering under primary equipment. To display completed measuring point names, select “Display IED name”; complete descriptive names of measuring points to be selected will be displayed in the Optional points list at left side. After measuring points are associated to primary equipment, measuring point descriptive names will be changed from “IED name_measuring point name” format to “[bay name] measuring point name” format, used to clarify if this measuring point has been associated and under what bay. If such format conversion is not required, cancel selection of “Replace IED name”. For replacement of bay name, name of target bay will be displayed in the editing box corresponding to “Replace bay name” in default. User can modify its content and customize bay name for replacement.

For association of CB-Switch with BI points, if there are only two BI points to be set, and both are CB or DS, the database configuration tool will first prompt to set them to double point BI, with the dialog box below popped up:

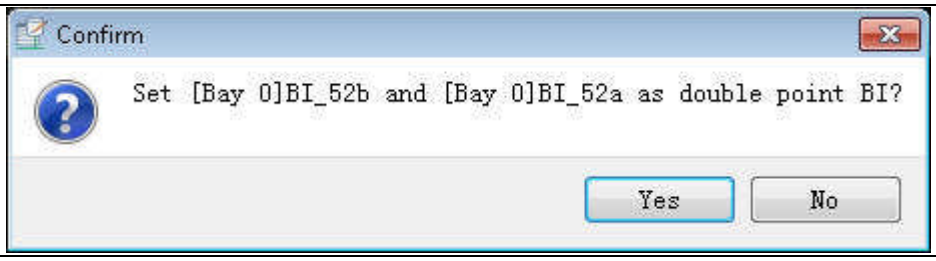


Figure 12.5-80 Set double point BI

Click Yes; the database configuration tool will automatically set these two BI points to double point BI.

If after above setup, the first BI object in the relevant BI list is not the tripping judgment point of current CB-Switch, the database configuration tool will prompt to set corresponding measuring point to judgment point of current CB-Switch. Click button “Yes” so that the database configuration tool will update tripping judgment point of current CB-Switch.

- **Delete equipment**

In the dock window, select an equipment node. Right click mouse and select “Delete equipment” in the menu popped up, or select “Delete” in menu “Edit”, or click button “Delete” on the tools bar, or directly press “Delete” key; the database configuration tool will prompt for confirmation of deletion of current primary equipment. Click “Yes” to delete current primary equipment from the bay; at the same time, all association relations with this equipment will be canceled, and measuring point descriptive names will be modified to format “IED name_measuring point name”.

12.5.2.4 Configuration of Transformer

This includes setup of transformer object and transformer windings.

- **Add transformer**

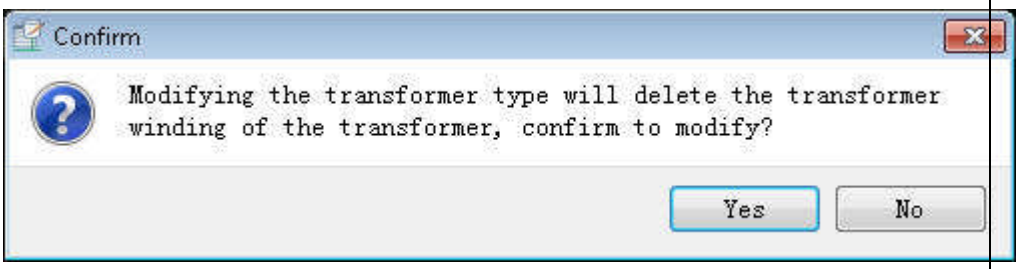
In the dock window, select “transformer list” node. Right click this node and select “Add transformer” in the menu popped up, or select “Add” in menu “Edit”, or click button “Add” on the tools bar, or directly press “Ctrl+A” shortcut; a new transformer will be added under current substation, and a new transformer node will be added under “transformer list” node, with name of transformer as node name. Default type of the newly generated transformer is Peterson coil, with no transformer winding configured.

- **Transformer attributes setup**

Transformer attributes include: transformer name, type, wiring mode, earthing type, OLTC, Enable flag, manufacturer, commissioning date, latest maintenance time, abnormal criterion, outage criterion, maintenance criterion, communication abnormal criterion, remark, and relevant IED. Particular description is given in the table below:

Table 12.5-20 Description of configuration of transformer

Name of attribute	Description

Name of attribute	Description
Transformer name	Character string not exceeding 128 English characters or 64 Chinese characters. Cannot be empty or contain special characters such as “/”. Unique under the substation.
Type	Character string; transformer types are displayed in the pull-down list: 3-winding transformer, 2-winding transformer, and Peterson coil transformer. Default type is Peterson coil with no transformer winding. When type of transformer is modified, existing transformer windings will be deleted and new transformer windings will be generated. The database configuration tool will pop up a dialog box as shown in  **Figure 12.5-81**. Click button “Yes” to confirm modification of type of transformer and automatic generation of corresponding transformer windings. Before setting voltage levels corresponding to transformer windings, nodes “transformer winding 0” and “transformer winding 1” will be displayed under transformer node in the dock window, to identify corresponding transformer windings. After modification of voltage levels of transformer windings, in the dock window, nodes corresponding to transformer windings displayed will adopt their voltage levels as their names.
Wiring mode	Character string. All transformer wiring modes are displayed in the pull-down list: Y/Y-12/Y-12/Y-12, Y/Y-12/Y-12/Δ-11, Y/Y-12/Δ-11/Δ-11, Y/Δ-11/Δ-11/Δ-11, Y/Y-12/Y-12/Δ-1, Y/Y-12/Δ-1/Δ-1, Y/Δ-1/Δ-1/Δ-1, Δ/Δ/Δ/Δ
Earthing type	“Earthed” or “Unearthed”; set earthing type of neutral point
OLTC	“Yes” or “No”; set according to site transformer
Enable flag	Contents of selection: process enabled, alarm enabled; a number of items can be selected in the pull-down list
Manufacturer	Character string not exceed 64 English characters or 32 Chinese characters
Commissioning Date	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Latest maintenance time	Year, month, day. User can directly enter numbers or open Edit date window to select a date
Abnormal criterion	BI point. The configuration method is the same as that of attributes of substation object block control point
Outage criterion	BI point; setup of which same as above
Maintenance criterion	BI point; setup of which same as above
Communication	BI point; setup of which same as above

Name of attribute	Description
abnormal criterion	
Remark	Character string not exceed 128 English characters or 64 Chinese characters
Relevant IED	List of names of relevant IEDs. Process of setup is the same as that of attributes of line object relevant IED.

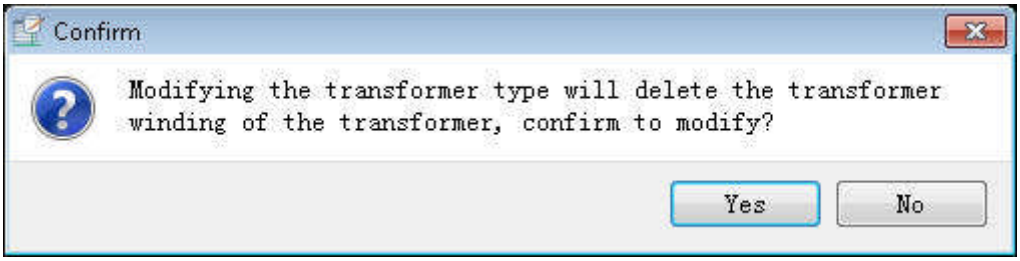


Figure 12.5-81 Set transformer type

- **Transformer windings setup**

Transformer windings are automatically generated according to type of transformer. Each transformer winding corresponds to a voltage level. Definition of their attributes is described in the table below:

Table 12.5-21 Description of configuration of transformer windings

Name of attribute	Description
Voltage level (kV)	Floating point number; click this attribute column; in the pull-down list popped up, voltage levels defined under current substation are displayed.
Rated capacity	Floating point number; click this attribute column to enter floating point number
Relevant CT	Name of CT object; click this attribute column to pop up a pull-down list in which all CT objects under current voltage level are displayed.
Relevant TP	Name of TP; click this attribute column; in the Select TP dialog box, select TP point corresponding to this transformer winding
Corresponding bay	Name of bay; click this attribute column; in the pull-down list popped up, all bay objects under current voltage level are defined.
Relevant logic device	List of names of relevant logic devices. Process of setup is the same as that of attributes of CB-Switch object relevant logic device

- **Delete transformer**

In the dock window, select “transformer list” node; all transformer objects will be displayed in the list window. Select some transformer objects to be deleted. In the list window, right click mouse and select “Delete” in the menu popped up; or select “Delete” in menu “Edit”, or click button “Delete” on the tools bar, or directly press “Delete” key; the database configuration tool will prompt

deletion of all selected items. Click “Yes” to delete all selected transformer objects, while clearing association relations with measuring points.

Or, in the dock window, select a transformer object node and right click mouse on it. In the menu popped up, select “Delete transformer”; the database configuration tool will prompt confirmation of deletion of currently selected transformer objects. Click “Yes” to delete currently selected transformer objects, while clearing association relations with measuring points.

12.5.3 Other Configurations

In addition to above basic configuration contents, the SCADA database also has configuration of other setup: limit scheme setup, duration setup, and trend scheme setup.

12.5.3.1 Limit Scheme Setup

Duration setup in limit scheme is in two layers: long duration and short duration. A long duration is used to define date duration up to month and day, indicating date range in which limit values are validated. A short duration divides time of a day, to define limit value used for each duration. Each long duration includes 10 short durations.

- **Add limit scheme**

Under secondary configuration in the dock window, select “limit scheme setup” node; the list window will display all limit scheme entries. Right click “limit scheme setup” node and select “Add limit scheme” in the menu popped up, or right click the list and select “Add” in the menu popped up; or select “Add” in menu “Edit”; or click button “Add” on the tools bar; or directly press “Ctrl+A” shortcut; to add a new limit scheme. Default duration type of the new limit scheme is “each year”, under which there is only one long duration.

- **Modify limit scheme**

Attributes of existing limit schemes can be modified according to site requirements. Limit scheme duration types include: each year, each season, each month, each 10 days, each day, and self-defined. Particular description is given in the table below:

Table 12.5-22 Description of configuration of limit scheme

Type name	Description
Each year	A long duration corresponding to date range: Jan. 1——Dec.31
Each season	4 long durations: spring, summer, autumn, and winter; corresponding date ranges: Spring: Jan.1——March 31 Summer: April 1——June 30 Autumn: July 1——Sept. 30 Winter: Oct.1——Dec.31
Each month	12 long durations: each such duration represents corresponding month.
Each 10 days	3 long durations: first 10 days, middle 10 days, and last 10 days of a month. Corresponding date ranges: First 10 days: 1^{st}——10^{th}

Type name	Description
	Middle 10 days: 11th——20th Last 10 days: 21st——31st
Each day	31 long durations, each representing a day of each month
Self-defined	According to engineering requirement, self-define date duration to be added, i.e. define start date and end date of the duration.

Since durations under each duration type are totally inconsistent, to modify duration type for limit scheme, the database configuration tool will first confirm modification of durations of limit scheme. After clicking “Yes”, the database configuration tool will first delete existing durations, and then automatically generate new durations according to the type.

- **Durations setup**

With the exception of self-defined type, for all other types, start date and end date of date duration under limit scheme are fixed and cannot be modified. Setup of attributes of date duration is shown in the table below:

Table 12.5-23 Description of configuration of durations

Attribute name	Description
Description name	Character string. Description name of self-defined type limit scheme is automatically generated according to sequence No. Description name is not written into database.
Start date	Date. Can be self-defined for self-defined type. Cannot be modified for other types of limit scheme.
End date	Date. Can be self-defined for self-defined type. Cannot be modified for other types of limit scheme.
Limit profile	Contents that can be selected: range limit and percentage limit. Compared according to reference value set in short duration.
Time delay	Integer. Defines delay to judge over-limit. Default is 0, in second.
Drop-off value	Floating point number. Used to judge critical point of over-limit return. For example, high limit is 100 and drop-off value is 10. If current value exceeds 100, the state is over high limit state. When current value returns to 90, return of over high limit is determined.
Over-limit judging mode	Contents that can be selected: not judge; only judge over upper limit; only judge over lower limit; judge over upper and lower limit

Under self-defined type limit scheme, date durations can be added or deleted. In the dock window, right click a self-defined limit scheme node, and select “New entry” in the menu popped out; or select “Add” in the menu “Edit”; or click button “Add” on the tools bar; or directly press “Ctrl+A” shortcut; to add a new date duration under current limit scheme.

After selection of a self-defined limit value, date durations already defined will be displayed in the list window. Select the duration to be deleted, right click mouse, and select “Delete” in the menu popped up; or select “Delete” in menu “Edit”; or click button “Delete” on the tools bar; or directly press “Delete” key, to delete currently selected duration.

NOTE: With the exception of self-defined type, duration cannot be added to or deleted from limit scheme of other types.

Short duration divides time of a day during a date duration and includes 10 divisions at most. Addition or deletion is not permitted. For each short duration, corresponding start time, end time, reference value, upper limit value, ultra high limit value, up limit invalid value, lower limit value, ultra low limit value, and low limit invalid value are defined.

- **Delete limit scheme**

In the dock window, right click a limit scheme node, and select “Delete limit scheme” in the menu popped up. Or select “limit scheme setup” node and select the limit scheme to be deleted in the list window, and then right click this selected scheme and select “Delete” in the menu popped up. Or, select “Delete” under menu “Edit”; or click button “Delete” on the tools bar; or directly press “Delete” key, to delete currently selected limit scheme.

12.5.3.2 Duration setup

Duration setup here refers to definition of peak and valley durations of metering data in SCADA database. The SCADA application obtains statistics of peak, mean, and valley quantities of metering according to corresponding durations set in the database.

Duration setup includes 2 layers: duration group and duration. A duration group includes a number of durations, which are mostly divisions of time of a day. Each duration can be self-defined according to site conditions.

- **Add duration group**

Under secondary configuration in the dock window, select node “duration setup”; all duration groups will be displayed in the list window. Right click node “duration setup” and select “Add duration group” in the menu popped up. Or, right click the list and select “Add” in the menu popped up. Or, select “Add” in menu “Edit”. Or, click button “Add” on the tools bar. Or, directly press “Ctrl+A” shortcut. A new duration group will be added.

- **Set durations**

With duration groups displayed in the list window, click “Description name” attribute column to set description name according to defined duration.

In the dock window, select a duration group node. The list will display duration s defined under this group. Right click this node and select “Add new duration” in the menu popped up; or right click the list and select “Add” in the menu popped up; or select “Add” in menu “Edit”; or click button “Add” on the tools bar; or directly press “Ctrl+A” shortcut; to add a new duration.

Click attribute column of start time or end time of duration to modify corresponding time points, in the format “00:00”.

In the dock window, after selection of a duration group node, the list window will display durations defined under this duration group. Select durations to be deleted. Right click mouse and select “Delete” in the menu popped up; or select “Delete” in menu “Edit”; or click button “Delete” on the

tools bar; or directly press “Delete” key; to delete currently selected durations.

- **Delete duration group**

In the dock window, select a duration group node and right click mouse. In the menu popped up, select “Delete duration group”. Or, select “duration setup” node in the dock window, and select duration group entries to be deleted in the list. Right click mouse and select “Delete” in the menu popped up; or select “Delete” in menu “Edit”; or click button “Delete” on the tools bar; or directly press “Delete” key; to delete currently selected duration groups.

12.5.3.3 Trend Scheme Setup

The trend scheme is the basis of measurement trend calculations by SCADA application. Its setup is relatively simple.

In the dock window, select “Trend scheme setup” node; the list window will display trend schemes already set. Select “Add” in menu “Edit”, or click “Add” button on the tools bar; or directly press “Ctrl+A” shortcut, to add a trend scheme.

In the list window, click corresponding attribute column to set attribute of trend scheme:

Table 12.5-24 Description of configuration of trend scheme

Name of attribute	Description
Scheme name	Character string not exceeding 32 English characters or 16 Chinese characters. Name of scheme can be self-defined according to setup.
Sampling period	Integer in the range 0－65535, in seconds
Type of dead zone	Enumeration. Absolute value type and percentage type. Method to judge change of current value.
Value of dead zone	Floating point number. Basis to judge change of current value.

To delete a trend scheme no longer required, select the object to be deleted in the list, and select “Delete” in menu “Edit”; or click “Delete” button on the tools bar; or directly press “Delete” key; to delete currently selected trend scheme.

12.6 Configuration of Alarm Database

Alarm database configuration includes alarm level setup and alarm group configuration. In case of change of status of measuring point object, the SCADA application will prompt Alarm application to generate corresponding warning or prompt operation according to set alarm group.

Under secondary configuration in the dock window, select and unfold “Alarm setup” node, which includes “alarm level configuration” and “alarm group configuration” sub-nodes. In the list window, set number of alarm levels and set number of alarm groups will be displayed.

12.6.1 Alarm Level Configuration

In the dock window, select “alarm level configuration” node. Alarm levels configured will be

displayed in the list. Right click “alarm level configuration” node and select “New alarm level” in the menu popped up, or right click the list window and select “Add”, or select “Delete” under menu “Edit”, or click button “Add” on the tools bar, or directly press “Ctrl+A” shortcut, to add a new alarm level.

After addition of a new alarm level, click “Name” attribute column to modify name of the alarm level; or click “Level” attribute column to modify alarm level.

Select the alarm level entry to be deleted in the list, right click mouse, and select “Delete” in the menu popped up. Or, select “Delete” under menu “Edit”. Or, click button “Delete” on the tools bar. Or, directly press “Delete” key. Currently selected alarm level will be deleted.

12.6.2 Alarm Group Setup

Under an alarm group, a number of alarm items are defined. In each alarm item, corresponding action handling scheme is set. Under an alarm item, definition of popup graph and definition of alarm reset are configured, which define subsequent handling after operation of relevant alarm.

12.6.2.1 Configuration of Alarm Groups

Alarm groups include system defined alarm groups, default alarm groups, and self-defined alarm groups. System defined alarm groups include: BI alarm, measurement over-limit, metering over-limit, TP alarm, protection fault information, system management, and other event alarm. Name and type of these groups cannot be modified, and alarm items under these groups cannot be deleted or modified. Default alarm groups include: operation of protection, operation alarm, and enable/disable VEBI/EBI. Name and type of these alarm groups cannot be modified. For self-defined alarm groups, names can be specified according to site conditions, e.g. CB status change, and communication status etc. Later, corresponding group type can be selected.

In the dock window, select “alarm group configuration” node. Alarm groups already configured will be displayed in the list. Right click “alarm group configuration” node, and select “New alarm group” in the menu popped up. Or, right click the list window and select “Add” in the menu popped up. Or, select “Add” in menu “Edit”. Or, click button “Add” on the tools bar. Or, directly press “Ctrl+A” shortcut. A new alarm group will be added.

Name of new alarm group can be modified, but must be unique. To modify type of alarm group, the database configuration tool will delete existing alarm items under this group, and initialize alarm items of this group according to alarm items defined for this type of alarm group.

In the dock window, right click an alarm group node and select “Delete alarm group” in the menu popped up; or select “alarm group configuration” node in the dock window, and select the alarm group to be deleted in the list window. Right click mouse and select “Delete” in the menu popped up. Or, select “Delete” in menu “Edit”. Or, click button “Delete” on the tools bar. Or, directly press “Delete” key. Currently selected alarm group will be deleted.

12.6.2.2 Alarm Item Configuration

After alarm group type is set, alarm items under the alarm group are automatically added. SCADA application generates alarm events according to defined alarm items. Setup of basic attributes of alarm items has the following contents:

Table 12.6-1 Description of configuration of alarm items

Name of attribute	Description
Alarm item name	Character string not exceeding 16 English characters or 8 Chinese characters. The application determines alarm prompt and subsequent operation according to name of alarm item. Names of alarm items under system defined alarm groups cannot be modified.
Event action name	Character string not exceeding 16 English characters or 8 Chinese characters. Description of action displayed during alarm.
Event level	Integer. Alarm levels already set are displayed in a pull-down list. ALARM application classifies events according to set alarm levels.
Event approach	Contents that can be selected: save into real-time database, save into history database, automatic Ack, Ack item, and Ack delay. A number of items can be selected at the same time. This attribute defines corresponding approach of ALARM application in case of an event.
Storage list type	Contents that can be selected: EventLog and SYSEventLog. Single item shall be selected. Name of corresponding table used for event recorded in database.
Ack delay time	Integer in 0－65535
Alarm approach	Contents that can be selected: automatic popup graph, automatic printing, audio alarm, voice alarm, SMS message, trigger user-defined process, and trigger subsequent treatment. A number of items can be selected at the same time. This attribute defines corresponding approach of ALARM application after an event.
Audio alarm times	Integer in 0－65535
Audio file name	Character string. Name of audio file. Click this attribute column to pop up list of audio files. User can set corresponding audio file.
Printer No.	Integer in -1－65535
SMS message class No.	Integer in -1－65535

In addition to above basic attributes, an alarm item can have definition of subsequent handling.

In the dock window, each alarm item always includes nodes “definition of popup graph” and “Definition of alarm Ack”, which set subsequent operation after alarm. Select one of these nodes to display corresponding items in the list window. User can add, delete, and modify settings of corresponding items.

12.7 Configuration of Transpond Database

Transpond database configuration includes definition of transpond substations and transpond tables. Under a transpond table, data objects of BI, control, measurement, metering, and TP are defined. Front end applications read object values from SCADA real-time database according to these settings for transpond to outside, or receive control commands from other terminals to perform control operations.

Under transpond database configuration in the dock window, select and unfold “transpond point branch” node. Corresponding transpond substations are sub-nodes under this node. In the list window, transpond substations already configured are displayed.

12.7.1 Configuration of Transpond Substations

- **Add transpond substation**

In the dock window, right click “transpond point branch” node, and select “New transpond substation” in the menu popped up; or select “Add” under menu “Edit”; or click button “Add” on the tools bar; or directly press “Ctrl+A” shortcut; to add a new transpond substation.

- **Modify attributes of a transpond substation**

Attributes of transpond substation are described below:

Table 12.7-1 Description of configuration of transpond substation

Name of attribute	Description
Transpond substation name	Character string not exceeding 20 English characters or 10 Chinese characters. Must not be empty or contain special characters such as “/”. Unique.
Transpond substation No.	Integer; unique.
Type	Integer. 3 values are used at present: 0: ordinary transpond substation 2: question and answer mode anti-maloperation (e.g. Eutech Anti-maloperation, Contron Anti-maloperation) 3: cyclic anti-maloperation (e.g. RCS9200 Anti-maloperation, Tianjin CDT Anti-maloperation)
Commissioned	Contents that can be selected: Yes; No.

- **Delete transpond substation**

In the dock window, right click a transpond substation node, and select “Delete transpond substation” in the menu popped up, to delete currently selected transpond substation. Or, select “transpond point branch” node in the dock window, and select the transpond substation to be deleted in the list window. Select “Delete” under “Edit”, or click button “Delete” on the tools bar, or directly press “Delete” key; to delete currently selected transpond substation.

When a transpond substation is deleted, all transpond tables under this substation and all their data will be deleted.

12.7.2 Transpond Table Setup

- **Add transpond table**

In the dock window, select a transpond substation node. This window will display transpond tables of this substation. Right click this transpond substation node and select “New transpond table” in the menu popped up; or select “Add” under “Edit”; or click button “Add” on the tools bar; or directly press “Ctrl+A” shortcut; to add a new transpond table.

- **Configure transpond table**

For a transpond table, name and No. need to be set. Name of transpond table must not exceed 20 English characters or 10 Chinese characters, must not be empty, must not contain special characters such as “/”, and must be unique under the transpond substation. Transpond table No. is an integer in 0－65535.

In the dock window, under each transpond table node, there are 5 sub-nodes in default: BI, control, measurement, metering, and TP, corresponding to transpond point types defined in the transpond table. Attributes of these are described below:

BI

Table 12.7-2 Description of configuration of transpond BI

Name of attribute	Description
Point No.	Integer in 0－65535; unique under this measuring point type
Description name	Character string not exceeding 20 English characters or 10 Chinese characters; must not be empty.
Application name	Character string; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
DB name	Ditto
Data source	OID; displayed by database configuration tool as name of path corresponding to this OID. Click this attribute column to pop up the search window shown in

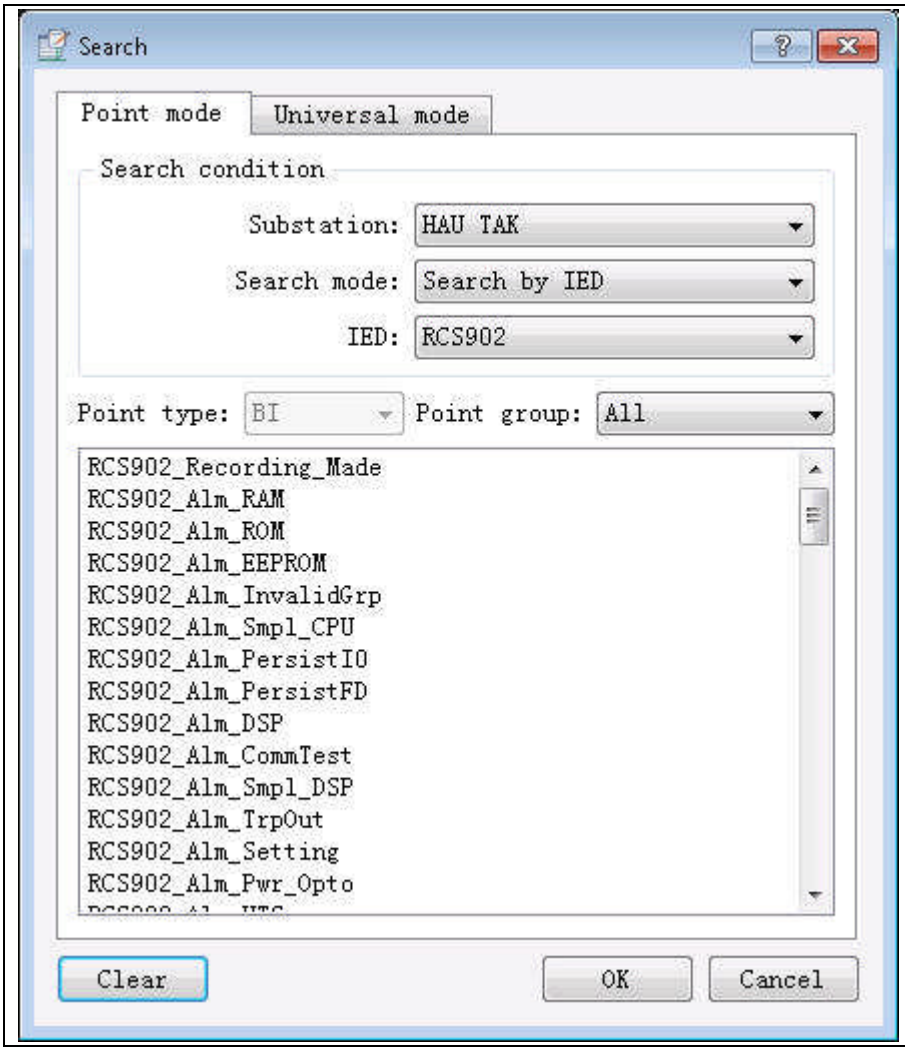


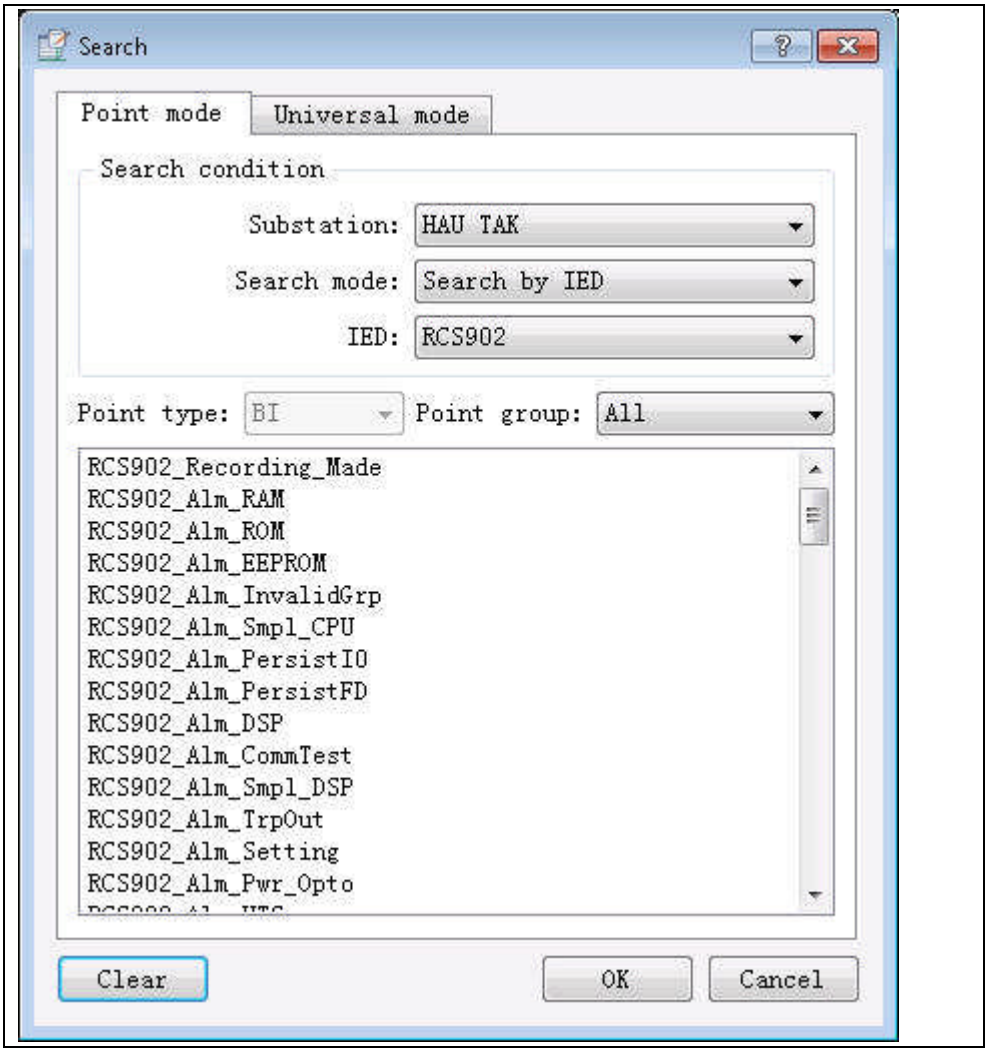
Figure 12.7-1. Current transpond data object can be modified.

Domain name	Character string; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
Domain ID	Integer; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
Polarity	Contents that can be selected: normal value; invert. This attribute sets if data object attributes are inverted before being forwarded.
Trigger sending	Contents that can be selected: Yes; No. If “Yes”, sending to outside is triggered when value of corresponding source data object attribute changes.
Sending period	Contents that can be selected: 1s, 3s, 5s, 10s, 30s, 1min, 5min, 1 hour

Measurement

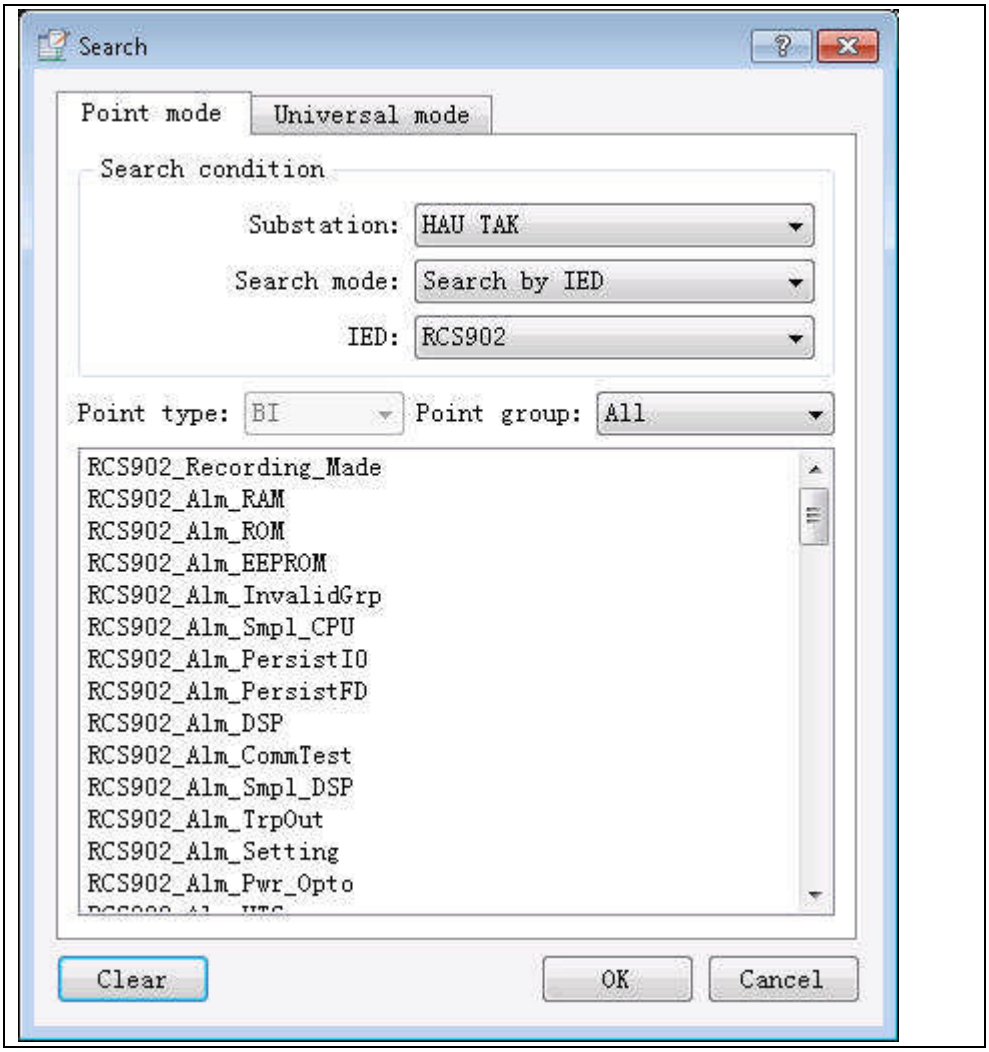
Table 12.7-3 Description of configuration of transpond measurement

Name of attribute	Description
Point No.	Integer in 0－65535; unique under this measuring point type
Description name	Character string not exceeding 20 English characters or 10 Chinese characters; must not be

Name of attribute	Description
	empty.
Application name	Character string; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
DB Name	Ditto
Data source	OID; displayed by database configuration tool as name of path corresponding to this OID. Click this attribute column to pop up the search window shown in  **Figure 12.7-1**. Current transpond data object can be modified.
Domain name	Character string; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
Domain ID	Integer; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
K value	Floating point number
B value	Floating point number
Dead zone value	Floating point number; used to judge change of source data
Sending period	Contents that can be selected: 1s, 3s, 5s, 10s, 30s, 1min, 5min, 1 hour

Control, regulation

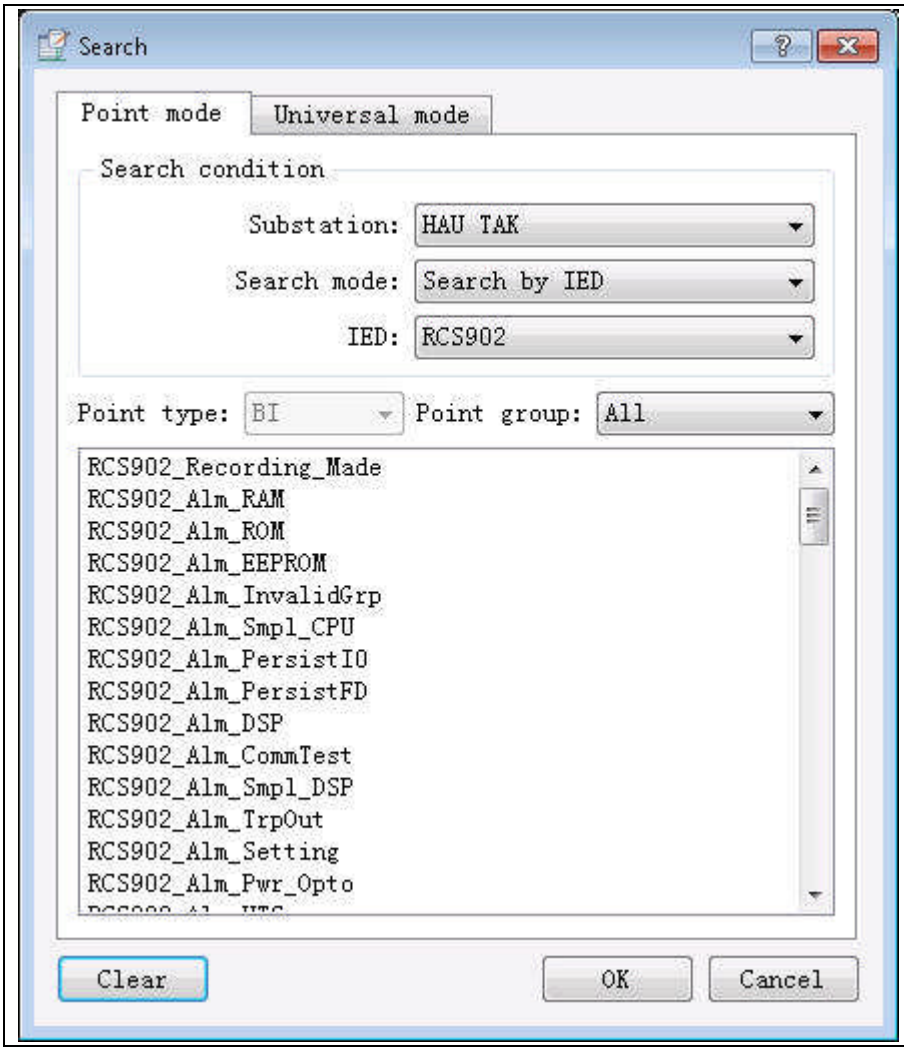
Table 12.7-4 Description of configuration of control/regulation

Name of attribute	Description
Point No.	Integer in 0—65535; unique under this measuring point type
Description name	Character string not exceeding 20 English characters or 10 Chinese characters; must not be empty.
Application name	Character string; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
DB Name	Ditto
Data source	OID; displayed by database configuration tool as name of path corresponding to this OID. Click this attribute column to pop up the search window shown in  **Figure 12.7-1**. Current transpond data object can be modified.
Domain name	Character string; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
Domain ID	Integer; obtained from object selected by searcher; this attribute is modified when transpond object is modified.

Trigger message	Contents that can be selected: Yes; No

Metering

Table 12.7-5 Description of configuration of transpond metering

Name of attribute	Description
Point No.	Integer in 0—65535; unique under this measuring point type
Description name	Character string not exceeding 20 English characters or 10 Chinese characters; must not be empty.
Application name	Character string; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
DB Name	Ditto
Data source	OID; displayed by database configuration tool as name of path corresponding to this OID. Click this attribute column to pop up the search window shown in  **Figure 12.7-1**. Current transpond data object can be modified.
Domain name	Character string; obtained from object selected by searcher; this attribute is modified when transpond object is modified.

Name of attribute	Description
Domain ID	Integer; obtained from object selected by searcher; this attribute is modified when transpond object is modified.
K value	Floating point number
B value	Floating point number
Sending period	Contents that can be selected: 1s, 3s, 5s, 10s, 30s, 1min, 5min, 1 hour

NOTE: In case source object defined in a transpond table does not exist, the entry in the list will be displayed in red and the data source will be displayed as “Invalid object OID value”.

Select a measuring point type sub-node; transpond measuring points of this type defined in the transpond table will be displayed in the list window. Right click this list window and select “Add” in the menu popped up; or select “Add” in menu “Edit”; or click button “Add” on the tools bar; or directly press “Ctrl+A” shortcut; to pop up searcher window and set database objects and attributes to be forwarded.

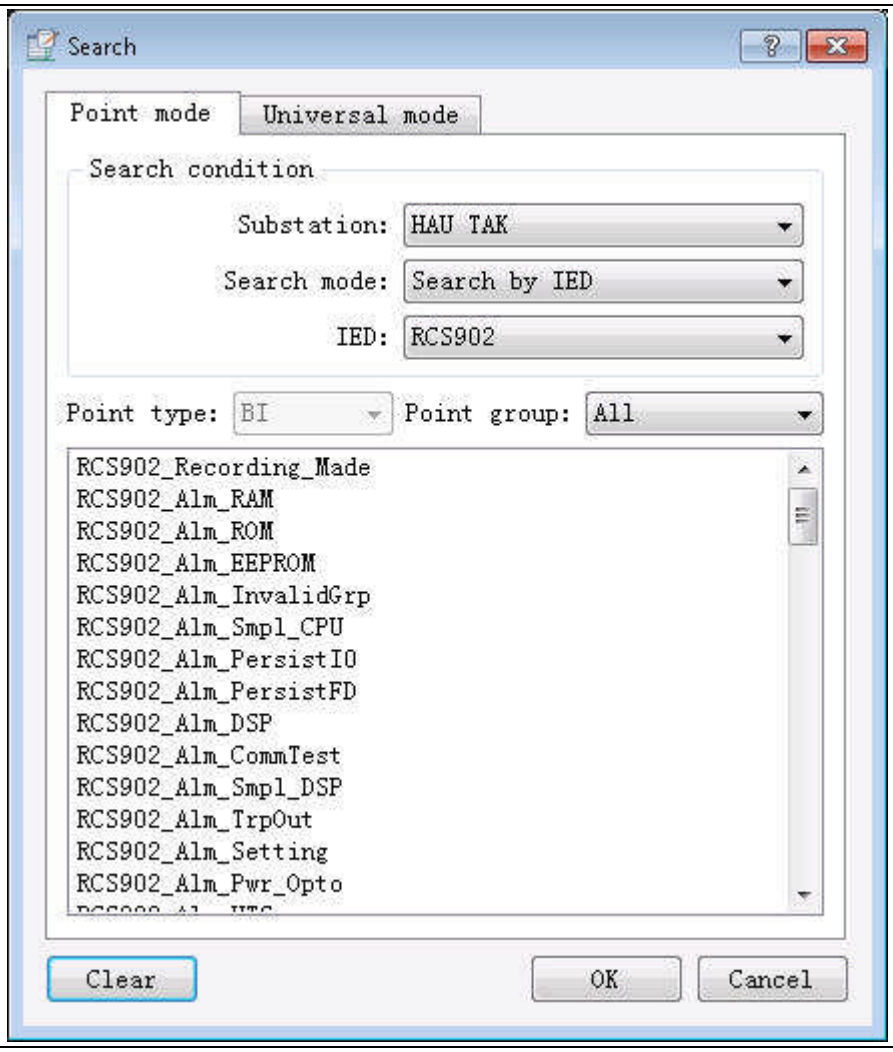


Figure 12.7-1 General purpose searcher

In Point mode, default selected object is measuring point object under the IED and transpond attribute is “current value”. Measuring points can be searched according to IED or bay. In the list, select the measuring point object to be transponded and click “OK”. The selected object will be added in the transpond table. In universal mode, user can select any attribute of any object in any database under any application as transponded data.

In the list window, after selection of a transpond measuring point, “Insert” and “Delete” menu items in the context menu will be effective. Select “Insert” in this menu or “Insert” in menu “Edit”, searcher window will pop up. A transpond object will be added before currently selected object. Select menu item “Delete” in the right mouse key menu or the “Edit” menu, or click button “Delete” on the tools bar, or directly press “Delete” key, to delete currently selected transpond object.

When the database configuration tool adds or deletes a transpond data object, point Nos. are automatically continuous. If a point No. is modified manually, continuous point Nos. of transpond objects need to be ensured afterwards, user can right click this transpond object, and select “Point Nos. are sequential” in the menu popped up, to automatically modify measuring point numbers of the transpond object to continuous numbers.

- **Delete transpond table**

In the dock window, select a transpond table node. Right click this node and select “Delete transpond table” in the menu popped up; or select a transpond substation in the dock window to display transpond tables configured under this substation in the list box. Select the transpond table to be deleted, and select “Delete” in the menu “Edit”; or click button “Delete” on the tools bar; or directly press “Delete” key; to delete currently selected transpond table.

12.8 Configuration of Anti-maloperation Database

With the dock window switched to configuration of anti-maloperation database, operation menu items related to anti-maloperation and the anti-maloperation tools bar will be displayed. User can set description of anti-maloperation measuring points, anti-maloperation lock type, operation terms, and rules for combined names. Click “Update anti-maloperation database” menu item in “Operation” menu, or click button “Update anti-maloperation database” on the tools bar; contents of the anti-maloperation database will be updated according to anti-maloperation-related setup in the SCADA database. To update anti-maloperation database, BI points in SCADA database and BI points of primary equipment management which are set to anti-maloperation points, will be read into the anti-maloperation database. Hierarchical relations in the anti-maloperation database are the same as in primary equipment model in the SCADA database.

12.8.1 Anti-maloperation-related Setup

12.8.1.1 Definition of Description of Anti-maloperation Measuring Point

Select “Point description definition” in menu “Anti-maloperation definition” menu, or click button “Point description definition” on the tools bar, to open Point description dialog box as shown below:

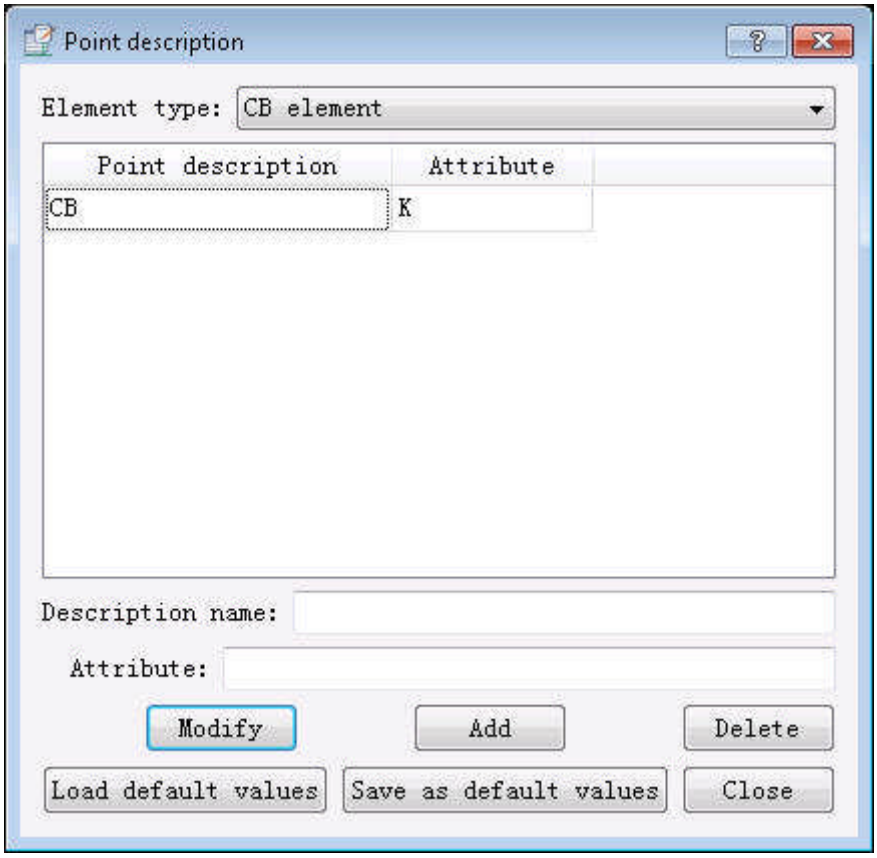


Figure 12.8-1 Point description

In the Point description window, switch element type. Corresponding description and attribute of measuring point will be displayed in the list. Select a point description object to modify measuring point description name and attribute in the editing window below the list. Description name and attribute must not be repeated as a whole set. After modification, click button “Modify” to write contents of modification into the database. Or, user can enter new description name and attribute, to add a new point description. After selecting a point description, click button “Delete” can delete selected object.

Click “Save as default values” button; the database configuration tool will save currently set point descriptions into default_mpdd.ini configuration file under relative directory “etc/wufang”. Click button “Load default values”; the database configuration tool will read defined contents from file default_mpdd.ini under relative directory “etc/wufang”, and update definitions in the anti-maloperation database.

12.8.1.2 Definition of Anti-maloperation Lock Type

Select “Definition of anti-maloperation lock type” under menu “Anti-maloperation definition”; or click button “Definition of anti-maloperation lock type” on the tools bar; to open Anti-maloperation lock type dialog box as shown below:

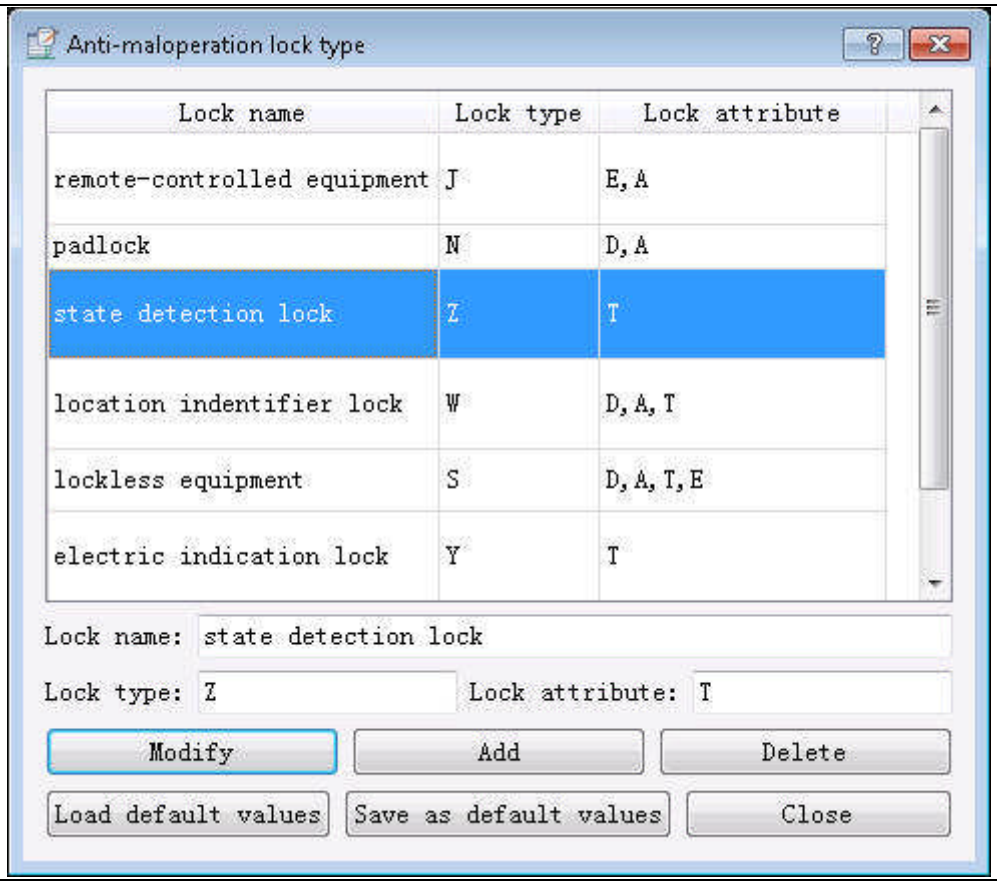


Figure 12.8-2 Definition of anti-maloperation lock type

In the Anti-maloperation lock type window, select an anti-maloperation lock object. User can modify name, type, and attribute of this lock in the editing box below the list. Lock entries of identical name and type are not permitted. In case of a number of lock types, separate them by comma. After modification, click button “Modify” to write contents of modification into the database. Or, directly enter name, type, and attribute of lock, and then click “Add” button to add a new anti-maloperation lock type. After selecting a lock type in the list, click button “Delete” can delete the selected object.

Click button “Save as default values”; the database configuration tool will save currently set lock type definition into default_locktype.ini configuration file under relative directory “etc/wufang”. Click button “Load default values”; the database configuration tool will read anti-maloperation lock type defined in file default_locktype.ini under relative directory “etc/wufang” and update contents of the anti-maloperation database.

12.8.1.3 Definition of Operation terms

Select “Definition of operation terms” under menu “Anti-maloperation definition”, or click button “Definition of operation terms” on the tools bar, to open Operation term dialog box as shown below:

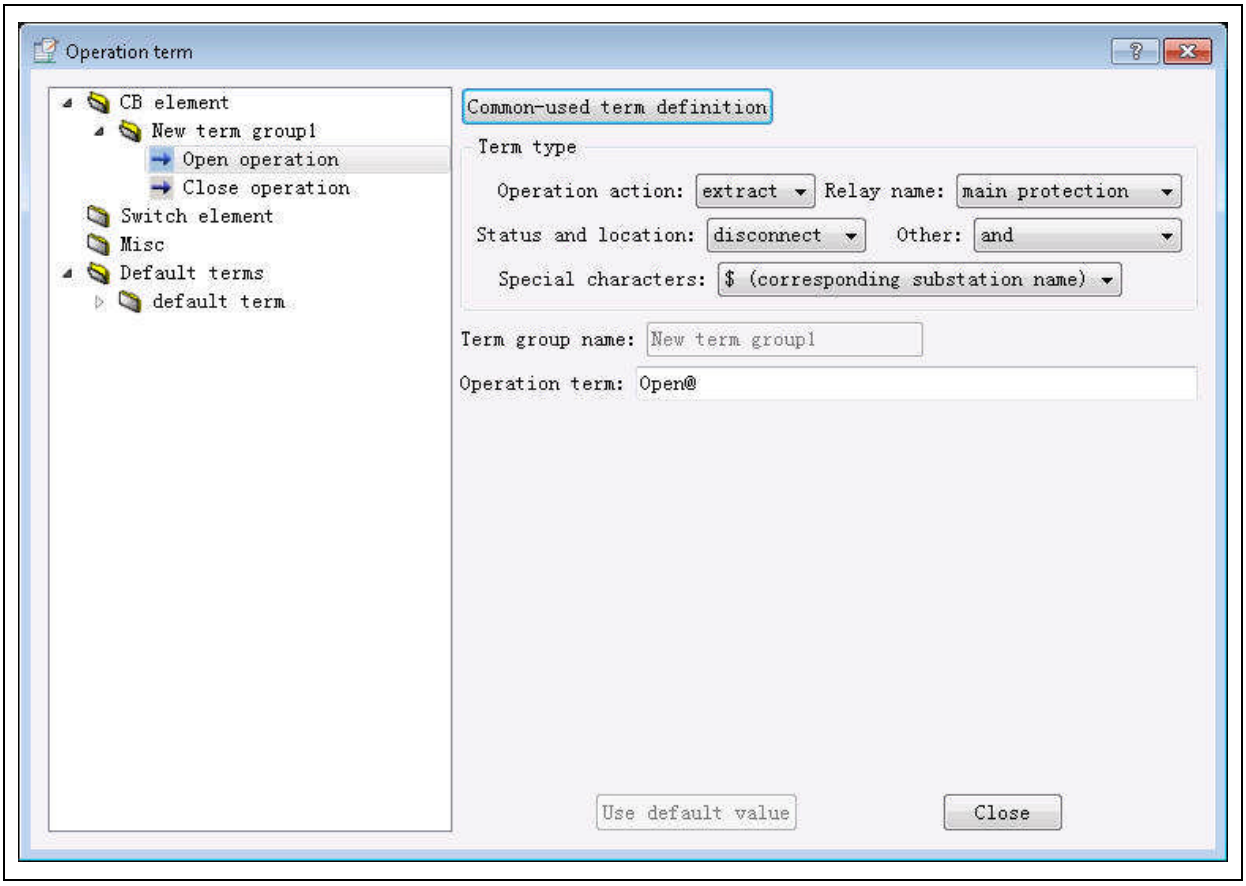


Figure 12.8-3 Definition of operation term

In the Operation term window, user can define different operation term groups and operation terms for different types of elements. Terms under default term group cannot be added or deleted. Only description of terms can be modified.

Right click an element node and select “Add operation term group” in the menu popped up. After execution of this operation, two operation terms “Open operation” and “Close operation” will be added under the new operation term group in default, and cannot be deleted. After selection of an operation term group, user can modify its name in the “Term group name” editing box. Right click an operation term group node and select “Delete operation term group” in the menu popped up, to delete currently selected operation term group. Select “Add prompt operation” to add a new term “Prompt operation” under current term group.

Select an operation term or prompt operation under an operation term group; in term type group, select corresponding operation action, relay name, status and location etc. to constitute description of the operation term. Click button “Commonly-used term definition” to pop up Commonly-used term definition dialog box, and set corresponding commonly-used terms.

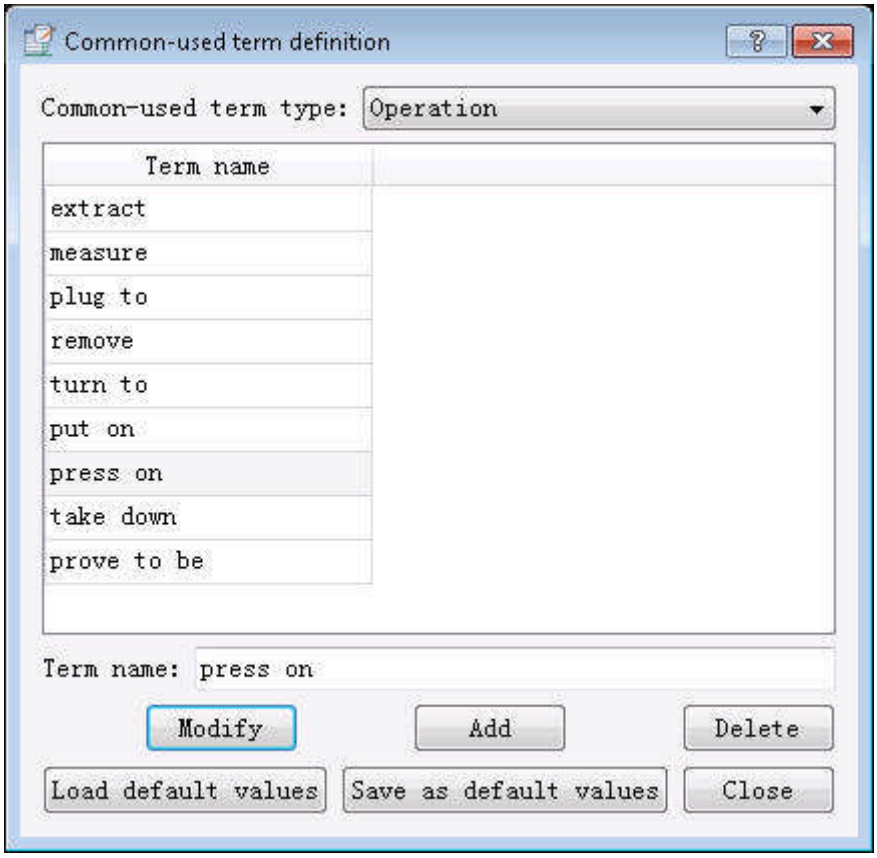


Figure 12.8-4 Commonly-used term definition

In the pull-down list, select a type of commonly-used term. Names of defined terms of this type will be displayed in the list. Select a term name in this list. User can make modification in the “Term name” editing box below the list. After modification, click button “Modify” to write content of modification into the database. Or, user can enter a new term name and click button “Add” to add a new term name. After selecting a term name in the list, click button “Delete” to delete the selected object.

Click button “Save as default values”; the database configuration tool will save currently set term name in the default_glossary.ini configuration file under relative directory “etc/wufang”. Click button “Load default values”; the database configuration tool will read term names defined in file default_glossary.ini under relative directory “etc/wufang”, and update contents in the anti-maloperation database.

12.8.1.4 Define Rules for Combined Names

Select “Set rules for combined names” under menu “Anti-maloperation definition”, or click button “Set rules for combined names” on the tools bar, to open the Set combined name of anti-maloperation BI point dialog box as shown below:

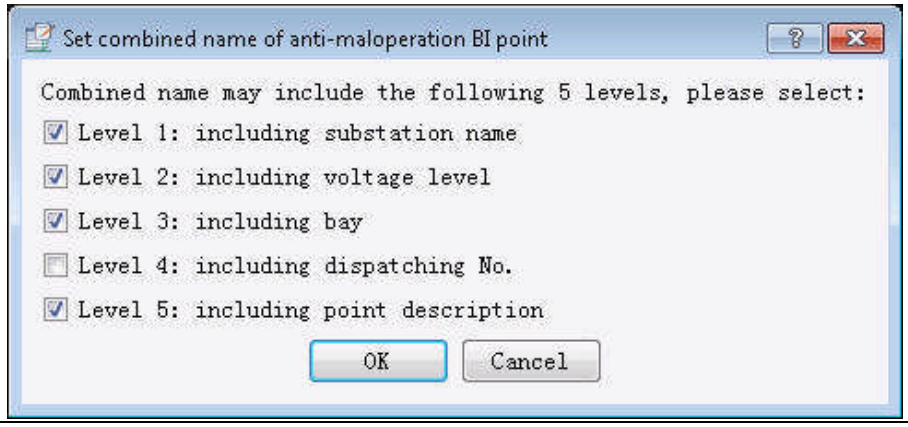


Figure 12.8-5 Define rules for combined names

12.8.2 Configuration of Anti-maloperation Data

12.8.2.1 Configuration of Anti-maloperation BI Points

In the dock window, hierarchical relations in the anti-maloperation system are: substation, voltage level, and bay; consistent with SCADA database. Click “Update anti-maloperation database” under menu “Operation” or click button “Update anti-maloperation database” on the tools bar; the database configuration tool will first update primary equipment information in the anti-maloperation database. BI points in the SCADA database that have established association relation with primary equipment and have been set as anti-maloperation points will be copied under corresponding bay in the anti-maloperation database, to generate anti-maloperation BI points. Select a bay node in the dock window; all anti-maloperation BI points under this bay will be displayed in the list window. Or, user can select “Anti-maloperation tile branch” in the dock window to display all anti-maloperation BI points in the anti-maloperation database.

Attributes related to anti-maloperation BI points are described in the table below:

Table 12.8-1 Description of configuration of anti-maloperation BI

Name of attribute	Description
SCADA name	Character string that cannot be modified. Path of BI corresponding to this anti-maloperation BI point in SCADA database is obtained according to SCADA database data object OID.
Anti-maloperation combined name	Character string. Generate anti-maloperation combined name according to corresponding rules for anti-maloperation combined names set by anti-maloperation; direct manual modification is not permitted.
Anti-maloperation customized name 1	Character string not exceeding 256 English characters or 128 Chinese characters. Consistent with measuring point description name in SCADA database in default.
Anti-maloperation customized name 2	Ditto
Description of anti-maloperation point	Character string. All measuring point description names for definition of anti-maloperation measuring points are displayed in the pull-down list.
Dispatching No.	Character string not exceeding 64 English characters or 32 Chinese characters.

Name of attribute	Description
Transpond flag	Character string. In case device model corresponding to measuring point in SCADA database is virtual device, this flag is “receive from SCADA”; in all other cases, this is “send to SCADA”. This attribute is automatically filled when updating anti-maloperation database and cannot be modified.
Operation flag	Character string. Contents in pull-down list for selection: control operation, local operation, and force measurement operation
Operation term group	Character string. Operation term groups defined are displayed in the pull-down list.
Close rule	Edit rule. Click this attribute column to pop up Rule editor dialog box; and user can set close rule. For controlled close operation by anti-maloperation application, if this rule meets requirements (calculation result is true) will first be judged.
Open rule	Edit rule. Click this attribute column to pop up Rule editor dialog box; and user can set open rule. For controlled open operation by anti-maloperation application, if this rule meets requirements (calculation result is true) will first be judged.
Lock type	Character string. Types of anti-maloperation lock defined are displayed in a pull-down list.
Main lock No.	Integer. Display mode and value range of main lock No. vary with different types of key set in anti-maloperation application: NR USB key 1—display mode: decimal; value range: 0－32767 Contron 26 key—display mode: hexadecimal; value range: 0x0100－0x03FF Contron 27 key—display mode: hexadecimal; value range: 0x0400－0x0FFF Main lock No. shall be unique.
Close lock No.	Setup same as above
Open lock No.	Setup same as above
Lock No.1. . . Lock No.9	Setup same as above

For main lock No. of anti-maloperation BI points, the database configuration tool provides automatic setting function. Select “Automatically generate lock No.” under “Anti-maloperation definition”, or click button “Automatically generate lock No.” on the tools bar; the database configuration tool will prompt for confirmation, after which this tool will automatically allocate main lock No. to anti-maloperation BI points already set to anti-maloperation lock type. For anti-maloperation BI points for which main lock No. has been manually set, setup will not be repeated.

12.8.2.2 Generation of Lock Information File

Anti-maloperation application needs to match the key. Therefore, for configuration in database, corresponding configuration file needs to be generated and provided to the key, to allow interaction between such application and key. Click “Generate lock information file” under menu “Anti-maloperation definition” to execute corresponding sub-menu and generate corresponding anti-maloperation lock information files. These lock information files generated will be saved under relative directory data/wufang/fil and have names of loctab.fil, ktndat.fil, rdata.fil, and typtab.fil etc. in this sequence. For particular method of use, refer to description of operation of anti-maloperation application.

13 Primitive Editor

13.1 General

Primitive Editor is the tool used to create and modify primitives. It has the same basic functions as graph editor and can draw points, lines, circles, and text information etc. However, the purpose and method of realization of the two tools are different. Primitives generated by Primitive Editor are called by graph editor and online tools. A primitive may consist of points, lines, circles, and texts. After being generated, the primitive cannot be divided. Topological link node number and positions of primary equipment are also determined in Primitive Editor.

13.2 Start Primitive Editor

There are two methods to start Primitive Editor:

- Start by console PCSCON

On the shortcut bar of the console, click “Tool”→“Graph”→ “Primitive Editor” to start Primitive Editor.

- Start by command

In the command line window, enter “icon” and press Enter to start Primitive Editor.

After successful start, main interface of Primitive Editor will be entered, as shown below.

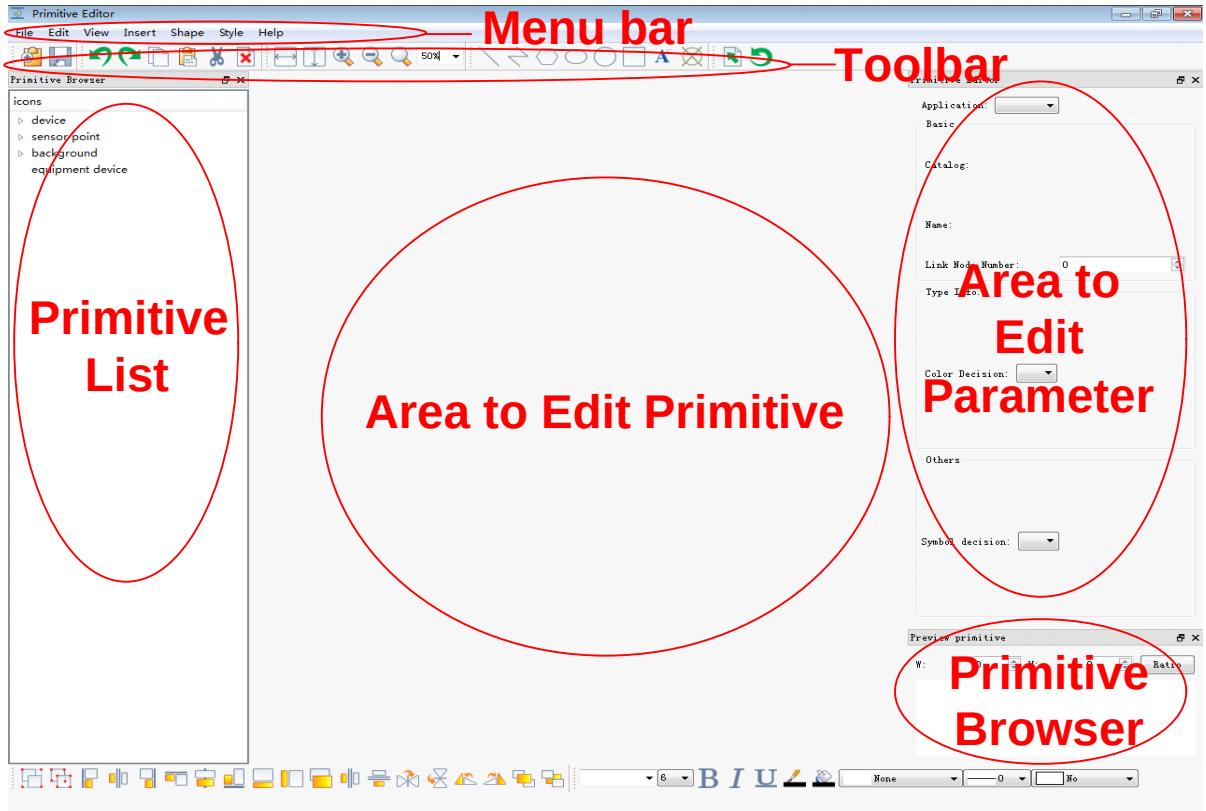


Figure 13.2-1 Main interface

13.2.1 Primitive Editor Structure

13.2.1.1 Menu Bar

The menu bar includes File menu, Edit menu, View menu, Insert menu, Shape menu, Style menu, and Help menu. All operations can be selected under menu directory.

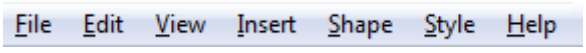


Figure 13.2-2 Menu bar

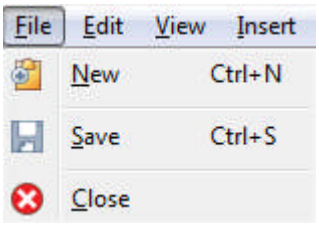


Figure 13.2-3 File menu

Table 13.2-1 Description of file menu items

File menu items	Description

New	Create a new primitive
Save	Save drawing work performed
Close	Close Primitive Editor

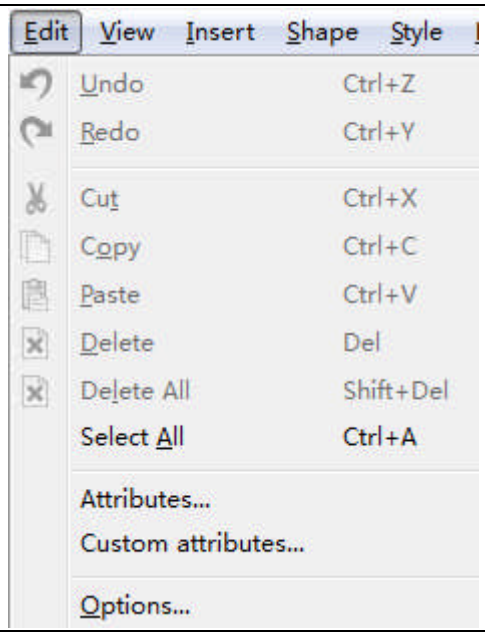


Figure 13.2-4 Edit menu

Table 13.2-2 Description of edit menu items

Edit menu item	Description
Undo	Cancel drawing just made
Redo	Restore drawing just canceled
Cut	Cut to clipboard
Copy	Copy to clipboard
Paste	Paste copied shape in clipboard to current graph
Delete	Permanently delete selected shape; this deletion operation cannot be canceled.
Delete all	Delete selected shapes; user can undo this operation
Select all	Select all shapes on the canvas
Attributes	Select attributes of shape on the canvas
Custom attributes	Set respective attributes of each part of primitive
Options	Set basic attributes of canvas

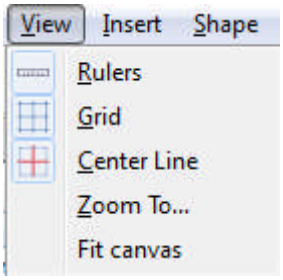


Figure 13.2-5 View menu

Table 13.2-3 Description of view menu items

View menu item	Description
Rulers	Show or hide rulers
Grid	Show or hide grid
Centerline	Show or hide centerline
Zoom to	Zoom according to proportion
Fit canvas	Adjust all shapes on canvas to the size of canvas so that they fully occupy the canvas at equal proportion

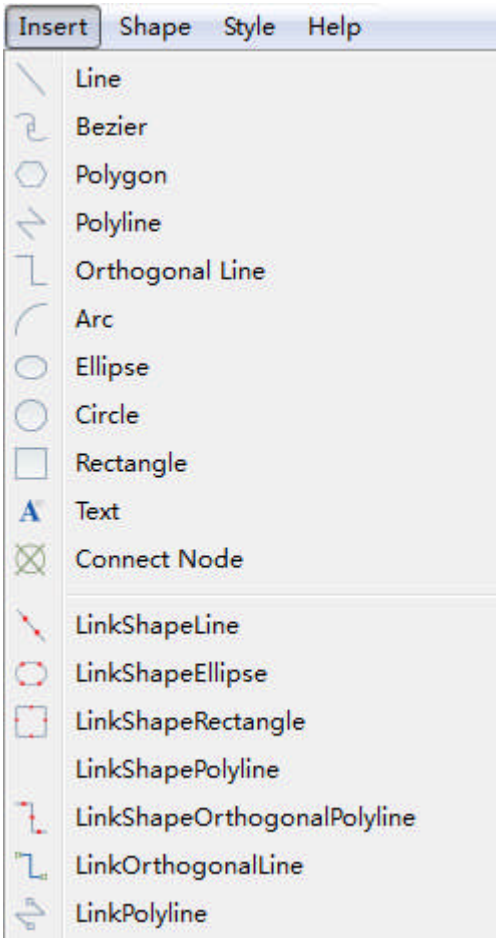


Figure 13.2-6 Insert menu

Table 13.2-4 Description of insert menu items

Insert menu item	Description
Line	Draw straight line
Bezier	Draw Bezier curve
Polygon	Draw polygon
Polyline	Draw polyline
Orthogonal line	Draw orthogonal line
Arc	Draw arc
Ellipse	Draw ellipse
Circle	Draw circle
Rectangle	Draw rectangle
Text	Draw text
Connect node	Draw connect node
LinkShapeLine	Draw straight line type link
LinkShapeEllipse	Draw ellipse type link
LinkShapeRectangle	Draw rectangle type link
LinkShapePolyline	Draw polyline type link
LinkShapeOrthogonal Polyline	Draw orthogonal polyline type link
LinkOrthogonalLine	Draw orthogonal line type link
LinkPolyline	Draw polyline type link

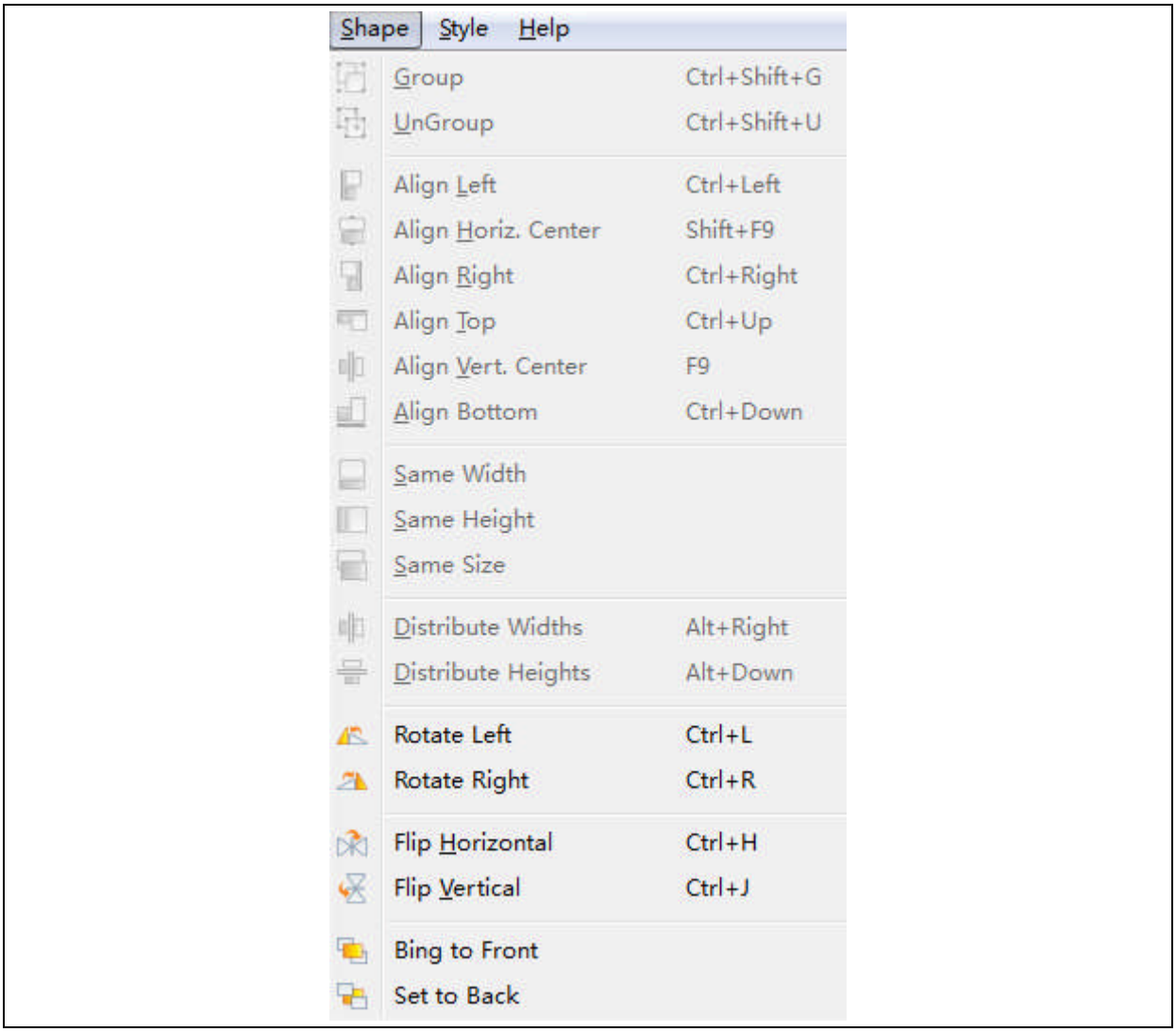


Figure 13.2-7 Shape menu

This menu performs unified operation of a number of groups of shapes. For particular operations, refer to section “13.3.3.4 Use of Shape toolbar”.

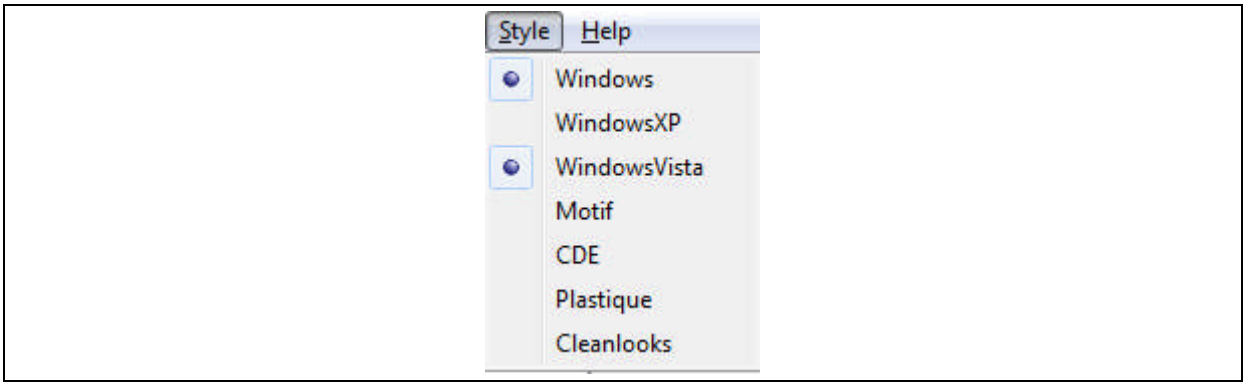


Figure 13.2-8 Style menu

Table 13.2-5 Description of style menu items

Style menu item	Description
Windows	Display all menus in WINDOWS window style
WindowsXP	Display all menus in WindowsXP window style
WindowsVista	Display all menus in WindowsVista window style
Motif	Display all menus in Motif window style
CDE	Display all menus in CDE window style
Plastique	Display all menus in Plastique window style
Cleanlooks	Display all menus in Cleanlooks window style

13.2.1.2 Toolbars

Right click mouse on the tools bar to pop up the following menu bar, which can be used to set automatic hide/show of toolbars in the whole primitive editing tool.

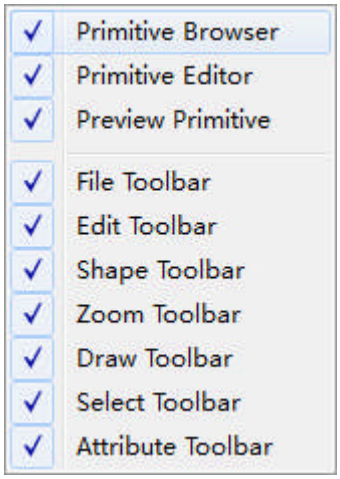


Figure 13.2-9 Context menu of toolbars

Table 13.2-6 Description of File toolbar

File toolbar	Description
New	Create a new primitive
Save	Save drawing performed

Table 13.2-7 Description of Edit toolbar

Edit toolbar	Description
Undo	Cancel drawing just made
Redo	Restore drawing just canceled

Edit toolbar	Description
Copy	Copy to clipboard
Paste	Paste copied shape in clipboard to current graph
Cut	Cut to clipboard
Delete	Delete selected shape

- **Shape toolbar**

Set primitive attributes such as group, align mode, zoom mode, and rotation mode etc.

Table 13.2-8 Description of zoom toolbar

Zoom toolbar	Description
Fit to width	Fit primitive currently drawn to width of drawing area
Fit to height	Fit primitive currently drawn to height of drawing area
Zoom in	Amplify primitive currently drawn according to default proportion
Zoom out	Reduce primitive currently drawn according to default proportion
Zoom free	Zoom primitive currently drawn freely by dragging of mouse
60% Fixed zoom	Zoom primitive currently drawn according to a proportion entered

Table 13.2-9 Description of draw toolbar

Draw toolbar	Description
Line	Draw straight line
Bezier curve	Draw Bezier curve
Polyline	Draw polyline
Polygon	Draw polygon

Draw toolbar	Description
 Orthogonal line	Draw orthogonal line
 Arc	Draw arc
 Ellipse	Draw ellipse
 Circle	Draw circle
 Rectangle	Draw rectangle
 Text	Draw text
 Connect node	Draw connect node
 LinkShapeLine	Draw straight line type link
 LinkShapePolyline	Draw polyline type link
 LinkShapeOrthogonal Polyline	Draw orthogonal polyline type link
 LinkShapeEllipse	Draw ellipse type link
 LinkShapeRectangle	Draw rectangle type link
 LinkPolyline	Draw polyline type link
 LinkOrthogonalLine	Draw orthogonal line type link
 Select	Select Primitive status
 Rotate	Rotate Primitive status

- **Attribute toolbar**

Set attributes of primitive, e.g. line style, line width, font, and color etc.

13.2.1.3 Primitive Browser

Primitive tools saving directory. User can click and open corresponding primitive here, and create new primitive or delete a primitive.

13.2.1.4 Preview Primitive

Preview primitives. User can view primitives drawn in the Graph Editor in their original size.

13.2.2 Operations in the Primitive Browser

13.2.2.1 Search Primitive

The tree type structure at left side of the Primitive Editor (similar to explorer in WINDOWS) has two layers: the first layer shows types of primitives, e.g. “switch”, and “circuit breaker” etc.; the second layer shows primitives. Click a primitive to be viewed so that it can be seen in the primitive editing area at right side.

13.2.2.2 Add Primitive

Select a primitive type and right click mouse. In the menu popped up, select “New primitive”

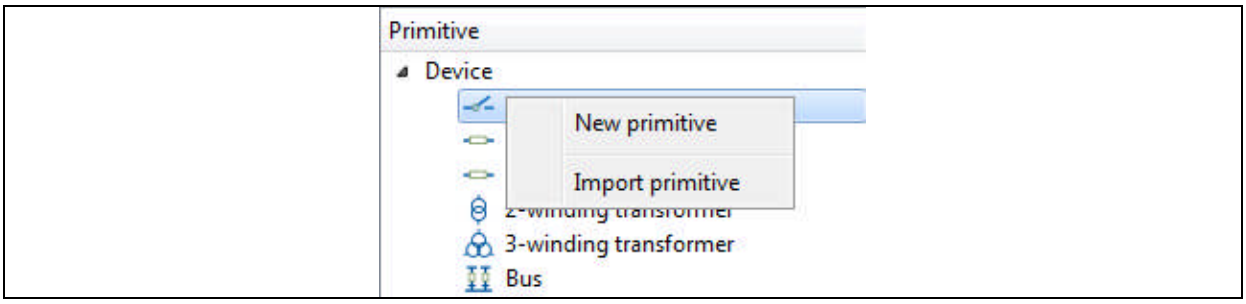


Figure 13.2-10 New primitive context menu

In the dialog box that pops up later, enter primitive name and other necessary parameters to complete addition of new primitive, as shown below.

Figure 13.2-11 Add primitive dialog box

13.2.2.3 Import Primitive

Select a primitive type and right click mouse. In the menu popped up, select “Import primitive”. In

the dialog box that pops up later, select the primitive file to be imported. After preview of the primitive to be imported at the right side, click OK to complete import of the primitive.

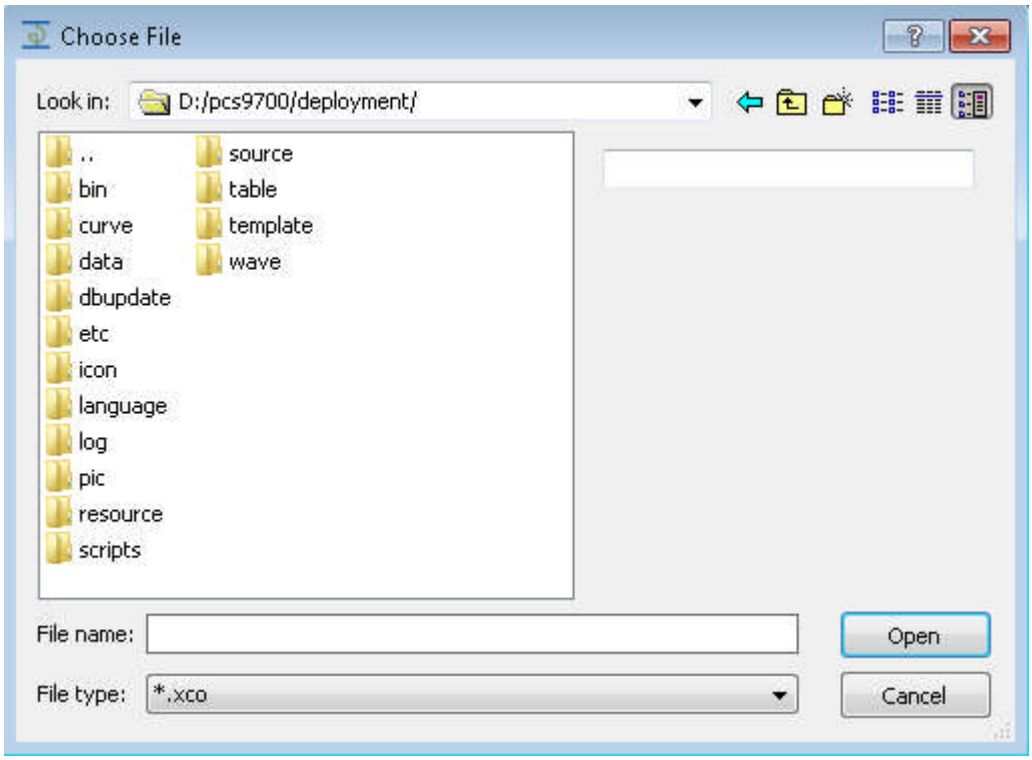


Figure 13.2-12 Import primitive dialog box

13.2.2.4 Delete Primitive

Select a primitive type or a primitive. Right click mouse and select “Delete primitive” in the menu popped up. Later, a warning box will pop up. Select OK to complete deletion of primitive.

NOTE: “Delete” operation completely deletes the primitive, which cannot be restored later. Please be prudent in using this operation.

13.2.2.5 Rename Primitive

Select a primitive and right click mouse. In the menu popped up, select “Rename primitive”. In the dialog box that pops up later, user can modify name of the primitive.

13.3 Primitive Drawing Flow

13.3.1 Drawing of Basic Primitives

Click buttons in the “Tools” menu or on the Draw toolbar to draw basic primitives in a graph. The following introduces the method to draw various basic primitives:

13.3.1.1 Line, Rectangle, Circle, Ellipse, and Text

These basic primitives have a feature in common: they can be determined by two points.

1) Line: start point and end point
2) Rectangle: two points of a diagonal
3) Circle: center of circle and any point on the circle
4) Ellipse: two points of diagonal of the externally tangent rectangle
5) Text: two points of a diagonal of the externally tangent rectangle

Steps to draw these primitives:

1) Click required button in menu “Tools” or on Draw toolbar;
2) Left click mouse in the drawing area;
3) Move mouse to target position and left click to draw a primitive;
4) To end drawing of this type of primitive, right click mouse;
5) To continue drawing of this type of primitive, repeat steps 2-3.

13.3.1.2 Polyline, Polygon, and Orthogonal Line

These basic primitives have a feature in common: they are determined by a number of points.

Steps to draw these primitives:

1) Click required button in menu “Tools” or on Draw toolbar;
2) Left click mouse in drawing area;
3) Move mouse to the next node and left click;
4) To end drawing of this primitive, right click mouse;
5) To continue drawing of this primitive, repeat step 3.

13.3.1.3 Arc

Steps to draw an arc primitive:

1) Click Arc button in menu “Tools” or on Draw toolbar;
2) Left click mouse in drawing area;
3) Move mouse; an ellipse will be displayed. Left click mouse again to determine size of this ellipse;
4) Click a point on the arc of the ellipse to determine starting angle of the arc to be drawn;
5) Move mouse and click another point on the arc of the ellipse to determine ending angle of the arc to be drawn;
6) To end drawing of arc, right click mouse;
7) To continue drawing of arc, repeat steps 3-5.

13.3.1.4 Bezier Curve and Connect Node

Steps to draw these two primitives:

1) Click required button in menu “Tools” or on Draw toolbar;

2) Left click and hold mouse in the drawing area;

3) Move mouse to target position and then release it;

4) To end drawing of this type of primitive, right click mouse;

5) To continue drawing of this type of primitive, repeat steps 2-3.

13.3.2 Operations of Primitive Attributes

13.3.2.1 Operations of Pattern

Primitive patterns refer to different representation forms of a primitive. A primitive can have only one pattern or a number of patterns. A primitive can display its different patterns under different conditions.

Right click a tab above horizontal ruler to pop up the menu as shown below. User can add, delete, rename, edit, and move primitive pattern, as shown below:

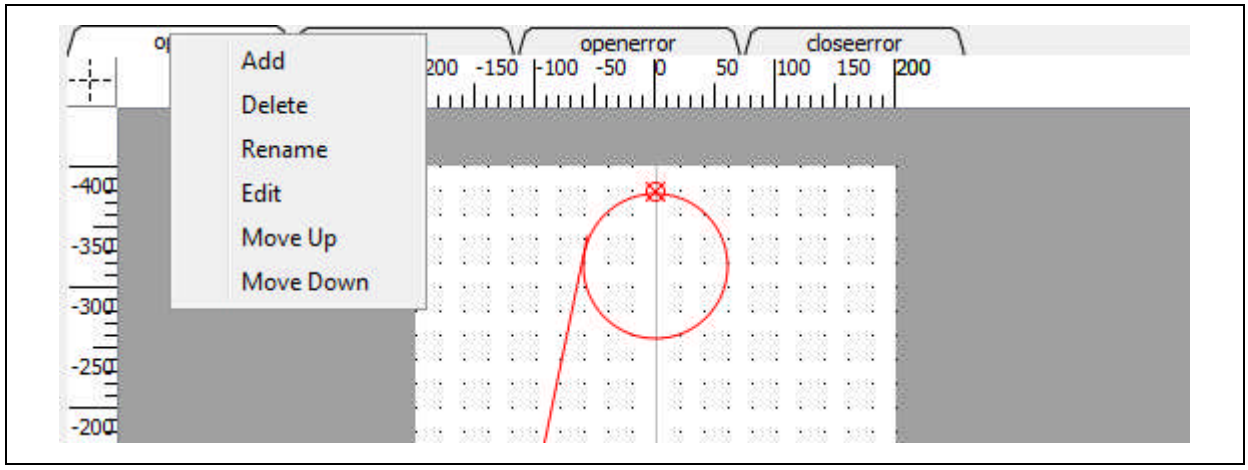


Figure 13.3-1 Primitive context menu

1） Add pattern. Select “Add” menu item; the dialog box shown below will pop up. You can enter name of new pattern.

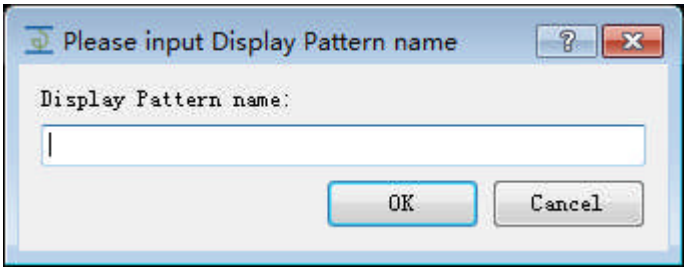


Figure 13.3-2 Display Pattern dialog box

2） Rename pattern. Select “Rename” menu item to enter a new name of the pattern.

3） Edit pattern. Select “Edit” menu item to pop up a dialog box shown below. The “Display Pattern” box shows existing pattern(s) of this primitive. The “Available items” box shows currently usable basic primitives drawn in the drawing area of this primitive. The “Selected Display Pattern” box shows basic primitives selected by current style.

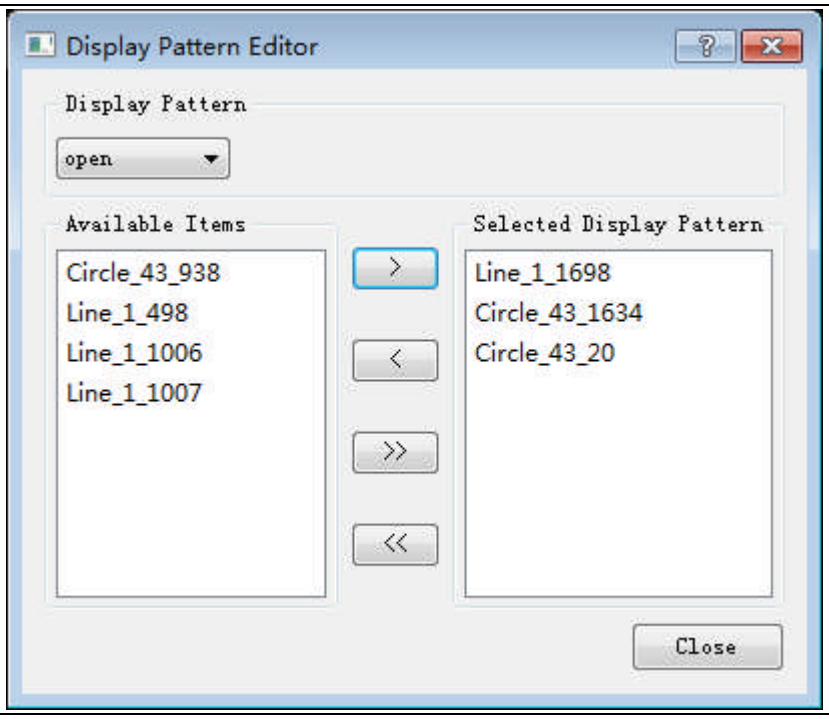


Figure 13.3-3 Edit Display Pattern window

13.3.2.2 Rename and Delete Primitive

Right click a primitive name in the Primitive Browser. You can rename or delete this primitive in the menu popped up.

13.3.2.3 Operations in the Primitive Editor

1） Application: application attribute of a primitive. Under different applications, primitive attributes vary. Therefore, by switching applications, primitive attributes under different applications can be configured. At present, in PCS-9700 primitive applications, SCADA application is default.

2） Link Node Number: number of link nodes of a primitive when it participates in topology. This number has different default values for different primary equipment. Normally, it is not modified. However, for some special needs, it can be modified according to actual application. For example, number of link nodes of a transformer can be selected and set.

3） Color decision. Click the button at right side of Color Decision label. A menu will pop up and include two menu items: “Edit” and “Delete”, as shown below.

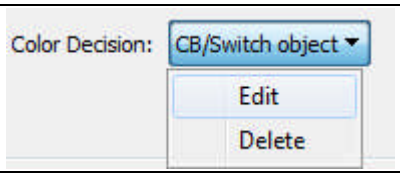


Figure 13.3-4 Color decision buttons

Click “Edit” to pop up a Color Decision selection dialog box as shown below.

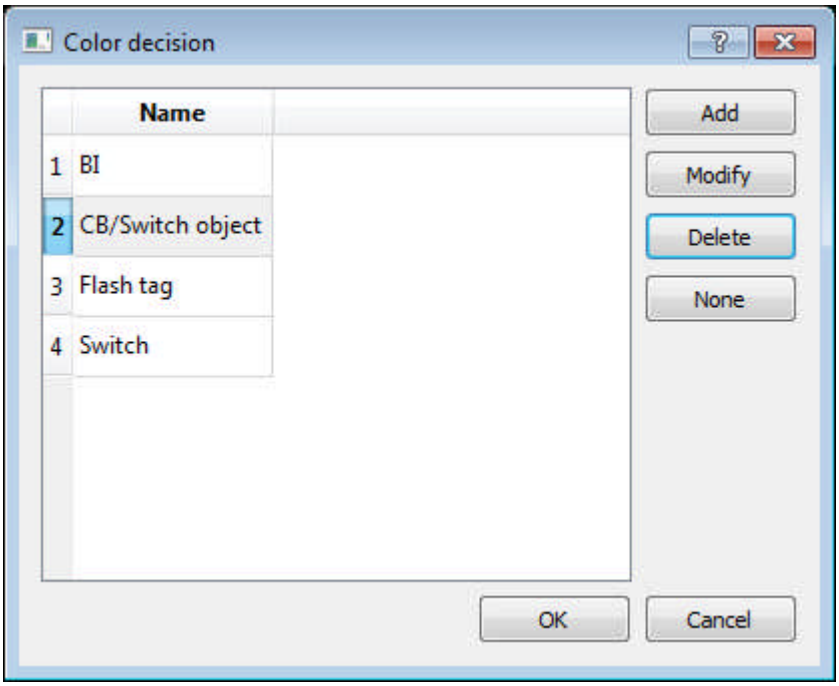


Figure 13.3-5 Color decision selection dialog box

Some default color decisions of the system can be selected. User can also click “Add” to customize a color decision. Or, user can select an item and click “Modify” to modify attributes of this selected color decision. Clicking of both “Add” and “Modify” will pop up “Color Decision Editor” window as shown below. User can modify name of color decision, select a table corresponding to the color decision, and add, delete, move up, and move down color decision items.

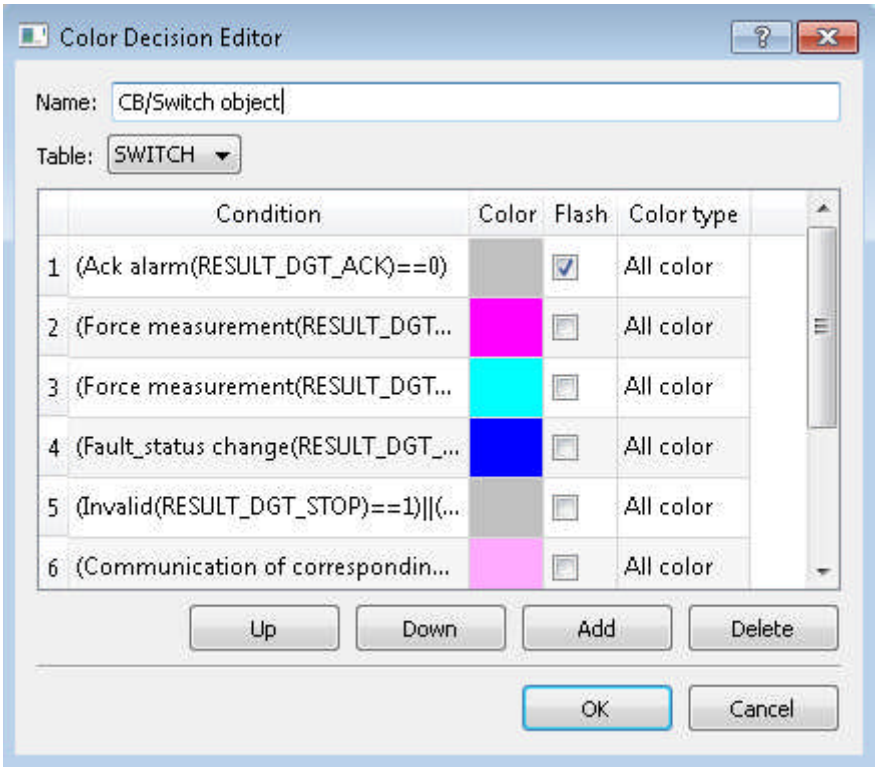


Figure 13.3-6 Color decision editor window

Double click cell “Condition” of color decision item to pop up the “Condition Editor” window shown below for selection of conditions.

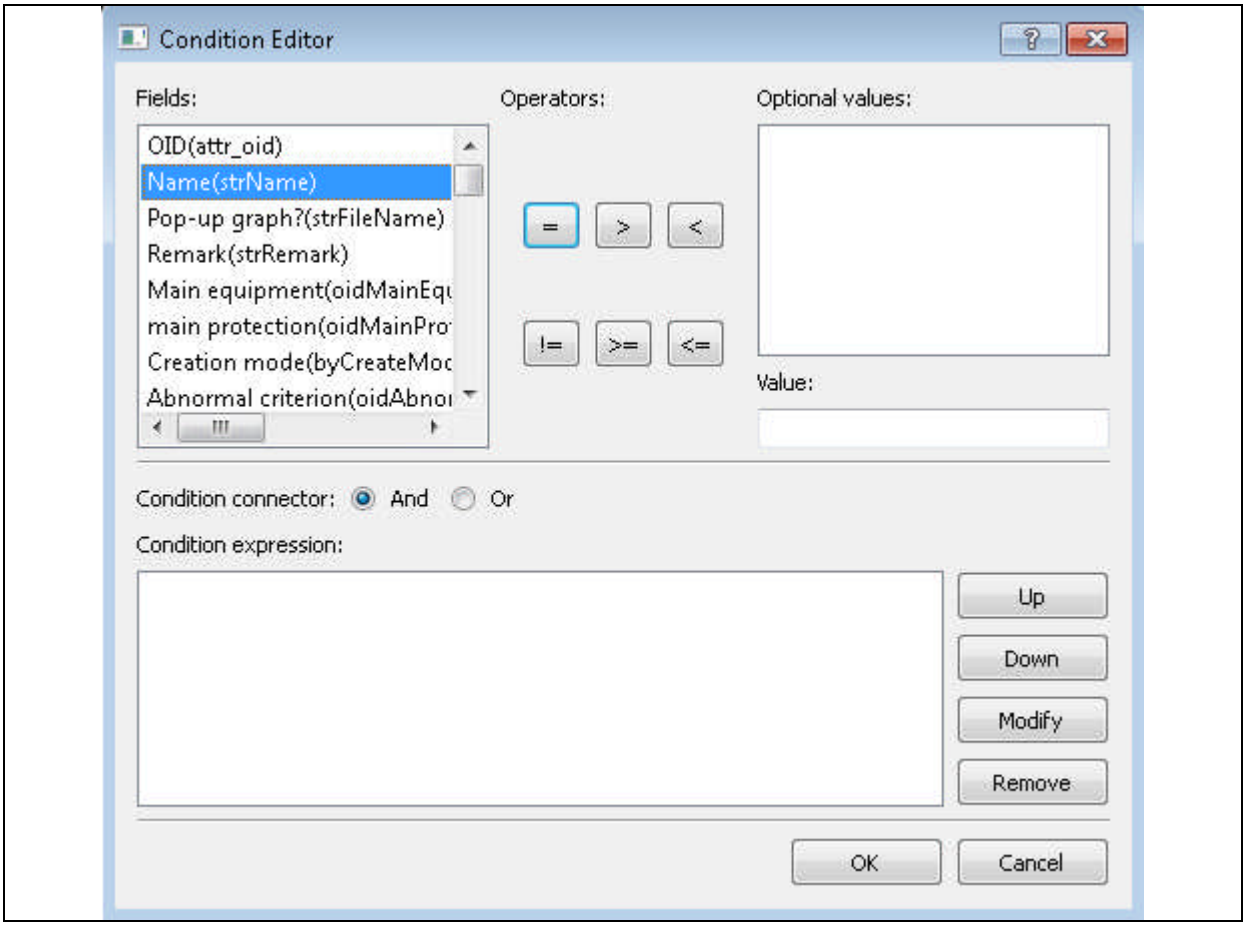


Figure 13.3-7 Condition Editor window

1） Symbol decision. Click the button at right side of the Symbol Decision label to pop up a menu that includes 2 items: “Edit” and “Delete”, as shown below.

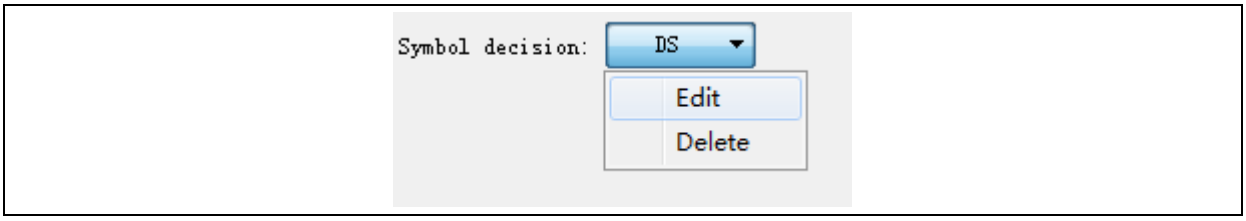


Figure 13.3-8 Symbol decision button

Click “Edit” to pop up a Symbol Decision Editor dialog box as shown below. User can modify name of symbol decision, select name of table corresponding to the symbol decision, and “Add” or “Delete” symbol decision item. Double click cell “Condition” of symbol decision item.

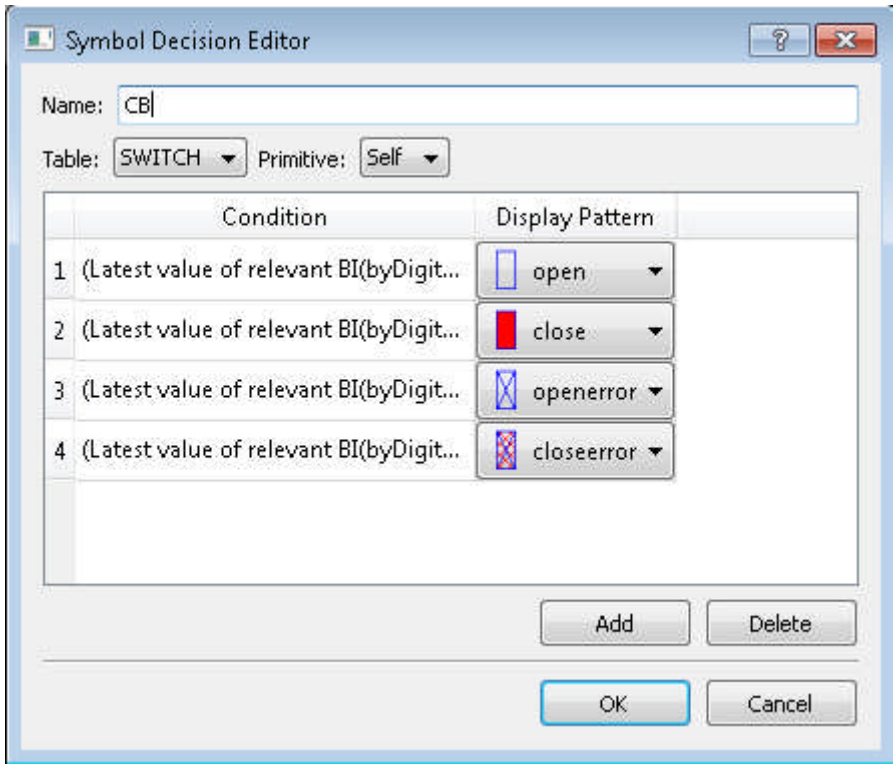


Figure 13.3-9 Symbol Decision Editor window

A “Condition Editor” window similar to that of color decision will pop up. User can select conditions. Click cell “Display Pattern” to select style of the primitive.

2） Customized attributes. In Primitive Browser, select a primitive and select “Custom attributes” in menu “Edit”; a dialog box as shown below will pop up. User can set attributes of each part of the primitive. As shown below, attribute types include color and integer etc. At present, the main purpose of this function is to set “color” attribute of different windings of transformer. For default 2-winding and 3-winding transformer primitives, the color attribute has been defined and cannot be changed. If you wish to draw a transformer primitive at a place beyond default types, take 2-winding transformer as an example, select the primitive under 2-winding transformer and set two customized attributes wind1 and wind2 as shown in the figure below; type of attribute is “color”.

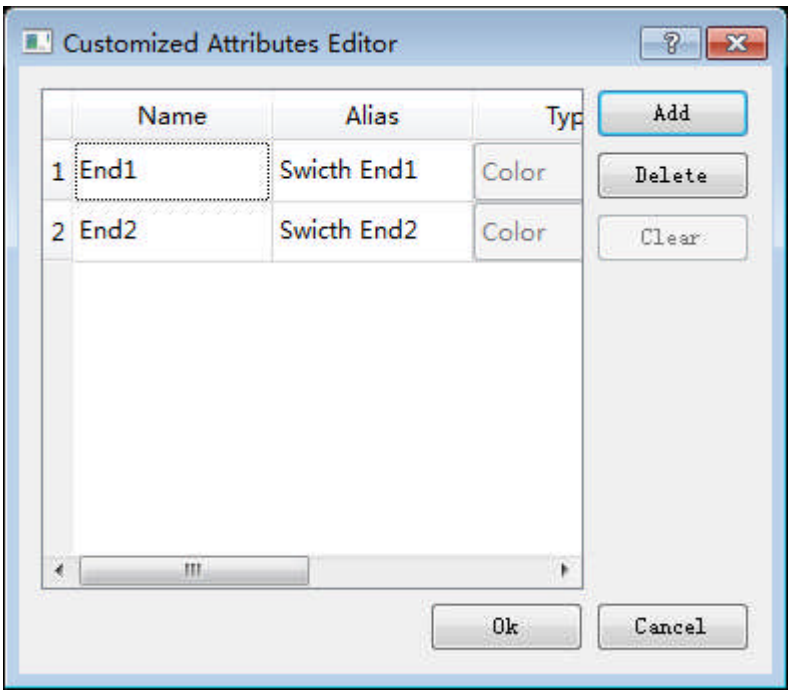


Figure 13.3-10 Customized Attributes Editor window

After clicking “OK”, double click transformer winding in primitive drawing area to pop up the dialog box shown below. Click “Associate” tab to associate winding attributes, as shown below. For internal attribute, select “LineColor”; for external attribute, select customized attribute. If the two windings are associated to the same external attribute, they will have the same color in online display. If they are associated to different external attributes, the windings can be differentiated by different voltage level colors in online display.

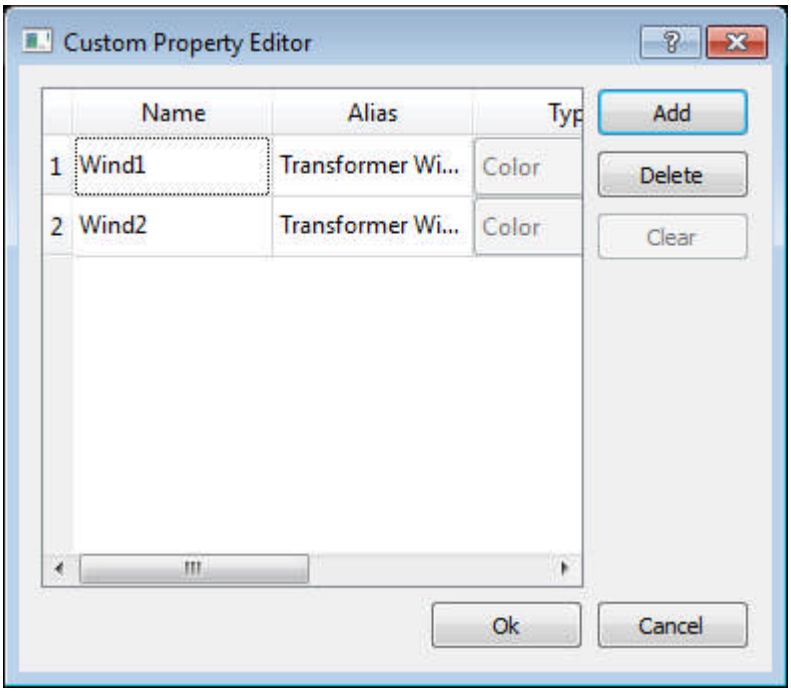


Figure 13.3-11 Attribute Editor window

13.3.3 Operations of Auxiliary Functions

13.3.3.1 Set Basic Attributes of Drawing Area

Description of operation: click “Options” in menu “Edit” to pop up the dialog box shown below.

1) Background color: click button “…” to set background color of drawing area. The box at left side of this button shows color preview.

2) Grid: size of grid can be selected. “Snap to grid” can be selected for drawing of primitive as required.

3) Rulers: horizontal ruler height and vertical ruler width can be configured.

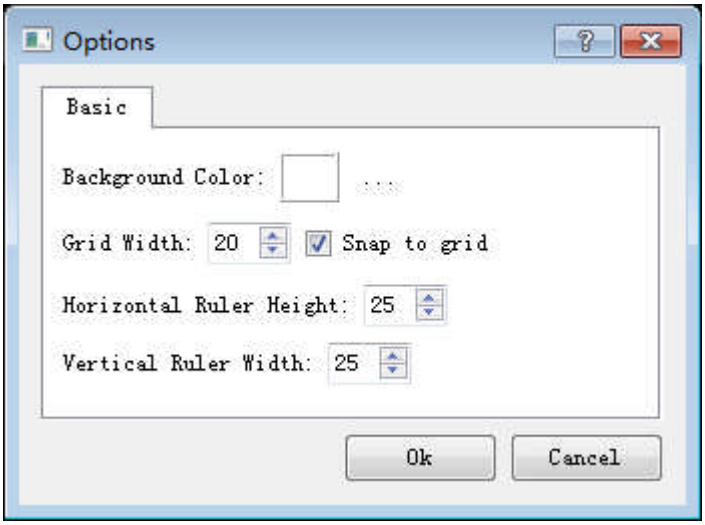


Figure 13.3-12 Options dialog box

13.3.3.2 Use of Select Toolbar

1) Select. Click side line of a basic primitive to select it. To select a number of primitives at the same time, after selecting the first primitive, press and hold Ctrl key and then select other primitives. User can also draw a rectangle on the screen by mouse; all basic primitives contained therein will be selected.

2) Rotate. The “Rotate” function is only effective when at least one primitive is selected. Click “Rotate”; when mouse is moved to a hot point of primitive, it will change to the shape of a hand. Press and hold left mouse key and drag mouse; the primitive will rotate following such movement.

13.3.3.3 Use of Edit Toolbar

1) Delete. Used in Select status to delete selected primitive. Use of Delete key is supported.

2) Copy. Used in Select status to copy selected primitive. Use of Ctrl＋C is supported.

3) Cut. Used in Select status to cut selected primitive. Use of Ctrl＋X is supported.

4) Paste. Paste primitive in clipboard. Use of Ctrl＋V is supported.

13.3.3.4 Use of Shape Toolbar

1)  Group: used when a number of primitives are selected. These primitives can be grouped to one entity for operations.

2)  UnGroup: usable when a group is selected. Undo grouping.

3)  Align Left: used when a number of primitives are selected. Align primitives with left side border of first primitive selected as reference.

4)  Align Right: used when a number of primitives are selected. Align primitives with right side border of first primitive selected as reference.

5)  Align Vert. Center: used when a number of primitives are selected. Align primitives with the vertical bisector of the left most side border and right most side border of the primitives selected as reference.

6)  Align Top: used when a number of primitives are selected. Align primitives with upper side border of first primitive selected as reference.

7)  Align Horiz. Center: used when a number of primitives are selected. Align primitives with the horizontal bisector of the up-most side border and bottom-most side border of the primitives selected as reference.

8)  Align Bottom: used when a number of primitives are selected. Align primitives with bottom side border of first primitive selected as reference.

9)  Same Width: used when a number of primitives are selected. Zoom selected primitives with width of the first primitive selected as standard.

10)  Same Height: used when a number of primitives are selected. Zoom selected primitives with height of the first primitive selected as standard.

11)  Same Size: used when a number of primitives are selected. Zoom selected primitives with width and height of the first primitive selected as standard.

12)  Distribute Widths: used when at least 3 primitives are selected. Arrange selected primitives at equal transverse spacing.

13)  Distribute Heights: used when at least 3 primitives are selected. Arrange selected primitives at equal vertical spacing.

14)  Flip Horizontal: used when at least one primitive is selected. Flip selected primitive(s) with central longitudinal axis of the externally tangent rectangle of selected primitive(s) as symmetric axis.

15)  Flip Vertical: used when at least one primitive is selected. Flip selected primitive(s) with central transverse axis of the externally tangent rectangle of selected primitive(s) as symmetric axis.

16)  Rotate Left: used when single primitive is selected. Rotate the primitive by 90 degrees counterclockwise with center point of the primitive as center of circle.

17)  Rotate Right: used when single primitive is selected. Rotate the primitive by 90 degrees clockwise with center point of the primitive as center of circle.

13.3.3.5 Use of Attribute Toolbar

By means of the attribute toolbar, user can set font, character size, bold, italic, underline, line color, fill color, line style, line width, and filling scheme of primitives.

14 Graph Editor

14.1 General

The graph editor is an important part of PCS-9700 system MMI. It is graphic software suitable for power system automation. It is used to generate various monitoring graphs, including substation diagram, system single line diagram, load flow diagram, geographic map, configuration graph, contents graph, menu graph, navigation graphs of various applications in automation system, and other graphs that reflect status of power equipment and computer equipment etc.

This graph editor adopts Qt as graphic window language and object-oriented technology. It is written in C++ language so that it has good cross-platform characteristics.

Main functions of this graph editor include:

- Generation of basic graph elements, e.g. point, line, circle, rectangle, polygon, and text
- Generation of various controls on graph, e.g. pie chart, bar chart, curve, and 2D table etc.
- Generation of components on graph
- Definition of foreground on graph
- Editing and modification of various elements on graph
- Generation of topological relations among electric power components on graph
- Reading, writing, and synchronization of graph
- Graph version management
- Generation of graphic guided database and model
- Import and export of graph
- Template functions
- Other auxiliary functions.

14.2 Description of Interface

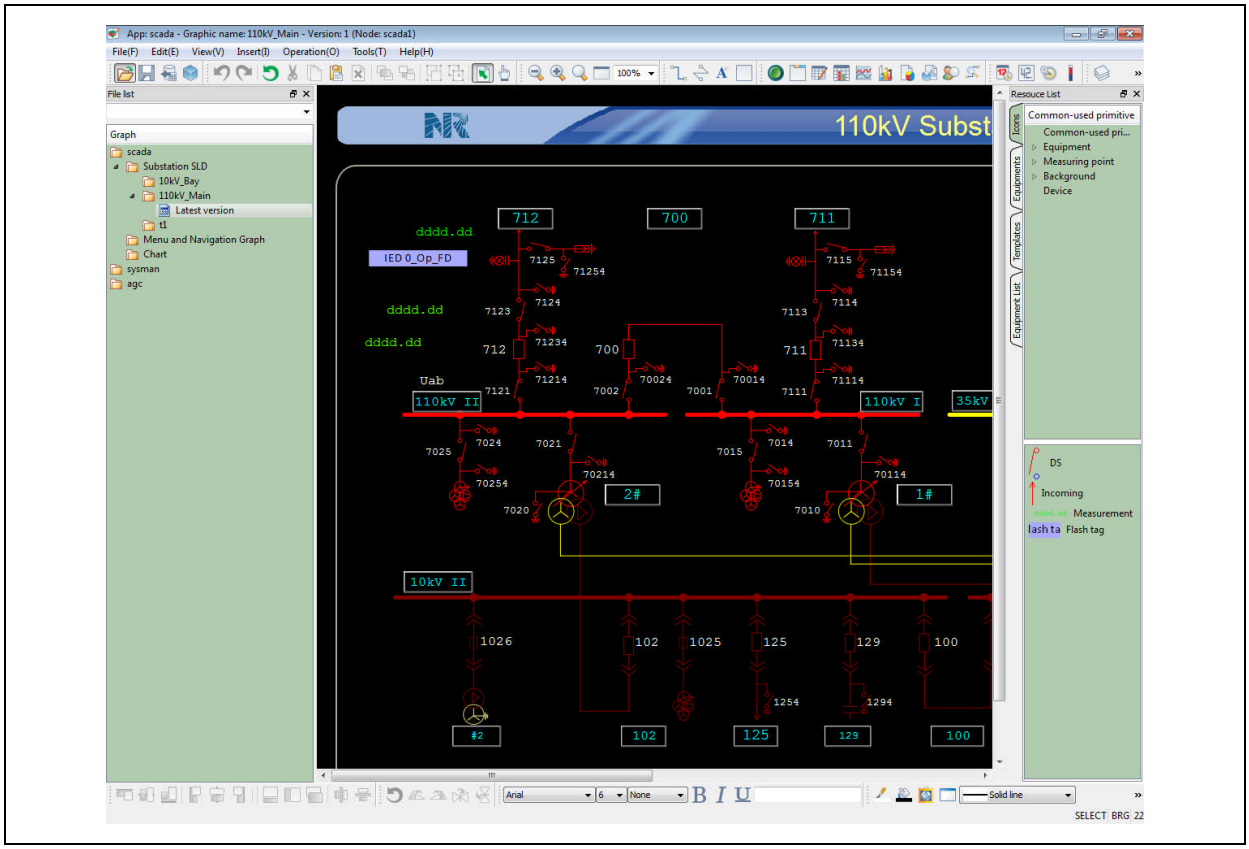


Figure 14.2-1 Main interface

- Menu bar

Including menus File, Edit, View, Insert, Operation, Tools, and Help.

- Toolbars

Including File tools, Edit tools, Zoom tools, DrawObject tools, Align tools, and Plugin tools etc. Right click a blank place of toolbar to select toolbars to be displayed at present in the menu popped up, as shown below.

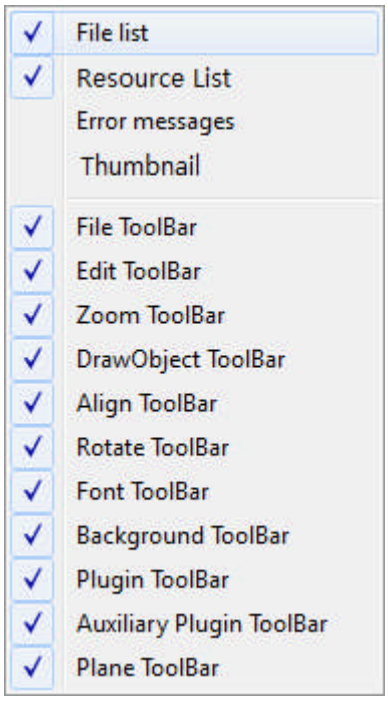


Figure 14.2-2 Toolbars menu

Table 14.2-1 Description of File toolbar

File toolbar	Description
Open	Open resource list at left side. This list is open if this button is pressed down and closed if this button is raised.
Save	Save current graph. Shortcut is Ctrl + S.
Fill model	Perform Fill model operation for current graph. This function is mainly used for substation diagram.
Preview	Call Graph Browser to preview the graph currently being edited.

Table 14.2-2 Description of Edit toolbar

Edit toolbar	Description
Undo	Cancel last step of editing operation. Shortcut is Ctrl + Z.
Redo	Repeat the operation that has been canceled by Undo. Shortcut is Ctrl + Y.
Update	Update current graph
Cut	Cut currently selected object. Shortcut is Ctrl + X.

Edit toolbar	Description
 Copy	Copy currently selected object. Shortcut is Ctrl + C.
 Paste	Paste currently cut or copied content. Shortcut is Ctrl + V.
 Delete	Delete currently selected object. Shortcut is Delete.
 Raise	Raise currently selected object to the top. Shortcut is Ctrl + R.
 Lower	Lower currently selected object to bottom. Shortcut is Ctrl + L.
 Group	Combine currently selected basic objects to an integral object.
 Ungroup	Cancel selected group and restore combined objects to basic objects.
 Select	Place current mouse in Select status. The mouse will be in the shape of an arrow. Multiple selection by press and hold Ctrl key is supported.
 Pan	Place current mouse in Pan status. The mouse will be in the shape of a hand. User can press and hold left mouse key and drag mouse.

Table 14.2-3 Description of Zoom toolbar

Zoom toolbar	Description
 Zoom out	Reduce graph. After selecting this button, each time left mouse key is pressed, the graph will be reduced to 2/3 of original size.
 Zoom in	Amplify graph. After selecting this button, each time left mouse key is pressed, the graph will be amplified to 1.5 times original size.
 Zoom free	After this button is selected, user can zoom the graph using the mode of dragging a box by mouse.
 Zoom to 100%	Restore original size of the graph.

Table 14.2-4 Description of DrawObject toolbar

DrawObject toolbar	Description
 Rectangle	Draw a rectangle in the drawing area.
 Text	Draw a polygon in the drawing area.
 Linking orthogonal line	Draw orthogonal connecting line in drawing area.

DrawObject toolbar	Description
 Linking polyline	Draw polyline type connecting line in drawing area.

Table 14.2-5 Description of Plugin toolbar

Plugin toolbar	Description
 Hot point	Draw hot point in drawing area
 Tab page	Draw tab page in drawing area
 Table	Draw table in drawing area
 2D table	Draw 2D table in drawing area
 Curve	Draw curve in drawing area
 Bar chart	Draw bar chart in drawing area
 Pie chart	Draw pie chart in drawing area
 Load rate pie chart	Draw load rate pie chart in drawing area
 Show link node	Display all link nodes between equipment and connecting lines using green dots on the graph.

Table 14.2-6 Description of Auxiliary Plugin toolbar

Aux. Plug-in toolbar	Description
 Analog clock	Draw analog clock in drawing area
 Digital clock	Draw digital clock in drawing area
 Dial	Draw dial in drawing area
 Thermometer	Draw thermometer in drawing area

Table 14.2-7 Description of Plane toolbar

Plane toolbar	Description

Plane toolbar	Description
 Plane selection box	Display current plane. User can also select a plane in the pull-down box for display.

Table 14.2-8 Description of Align toolbar

Align toolbar	Description
 Align Top	Align selected objects to top (with first selected object as reference; same below)
 Align H Center	Align selected objects to horizontal center
 Align Bottom	Align selected objects to bottom
 Align Left	Align selected objects to the left
 Align V Center	Align selected objects to vertical center
 Align Right	Align selected objects to the right
 Same Width	Set width of selected objects to the same value
 Same Height	Set height of selected objects to the same value
 Same Size	Set selected objects to the same size
 Same Horizontal Space	Arrange selected objects at equal horizontal spacing.
 Same Vertical Space	Arrange selected objects at equal vertical spacing.

Table 14.2-9 Description of Rotate toolbar

Rotate toolbar	Description
 Rotate	Click button Rotate. Mouse in the shape of a hand will appear at border of selected object. Move mouse to rotate the object.
 Flip Left	Rotate selected object counterclockwise by 90 º
 Flip Right	Rotate selected object clockwise by 90 º

Flip Horizontal	Flip selected object in horizontal direction by 180 º
Flip Vertical	Flip selected object in vertical direction by 180 º

Table 14.2-10 Description of Font toolbar

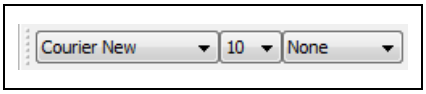
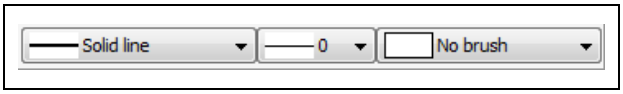
Font toolbar	Description
 Set text font	In the 3 pull-down boxes, select text font, size, and layout respectively.
 Text effect	Use these 3 buttons to select bold, italic, and underline effect respectively.

Table 14.2-11 Description of Background toolbar

Background toolbar	Description
Foreground color	Set selected color as current foreground color
Fill color	Set selected color as current fill color
Background setup	Click this button to pop up “Graph background setup” dialog box. User can set background color, background picture, and picture display mode of the graph.
 Set line and filling	The 3 pull-down boxes allow selection of line style, line width, and filling mode respectively.

File list: displays graph index.

Resource list: including 4 tabs, namely

Primitive——displays list of primitives

Equipment——displays existing substations and equipment in current database

Template——edit and use templates

Equipment list——displays list of equipment in current graph.

Thumbnail: view thumbnail of current graph. Click thumbnail to view different parts of the graph. Drag mouse on thumbnail to zoom the graph.

Status bar: some operation prompts. At peacetime, graph amplification multiple, mouse coordinates, and current graph format are prompted.

Drawing area: area where graphs are drawn.

14.3 Description of Various Operations

14.3.1 Creation and Management of Graph Dictionary

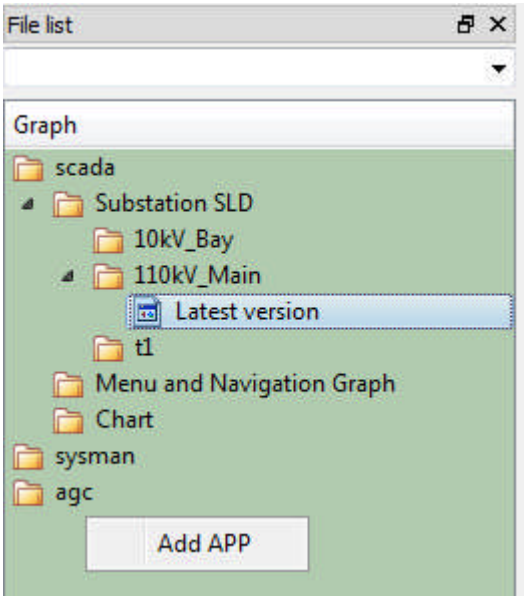


Figure 14.3-1 File list window

14.3.1.1 Add Application

Right click a blank place on the graph index. In the menu popped up, click button “Add APP”. A dialog box as shown below will pop up:

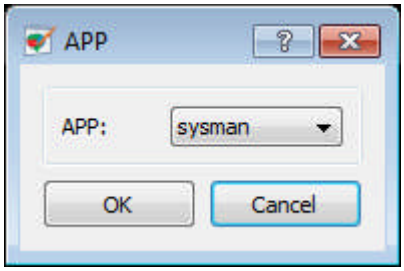


Figure 14.3-2 Add application

Select corresponding application and click “OK” to create a new application. If selected application already exists, a window will pop up to prompt this.

14.3.1.2 Delete Application

Right click current application and click button “Delete APP” in the menu popped up. A warning dialog box “Confirm deletion of application: xxx” will pop up. Click “Yes” to delete this application, as shown below.

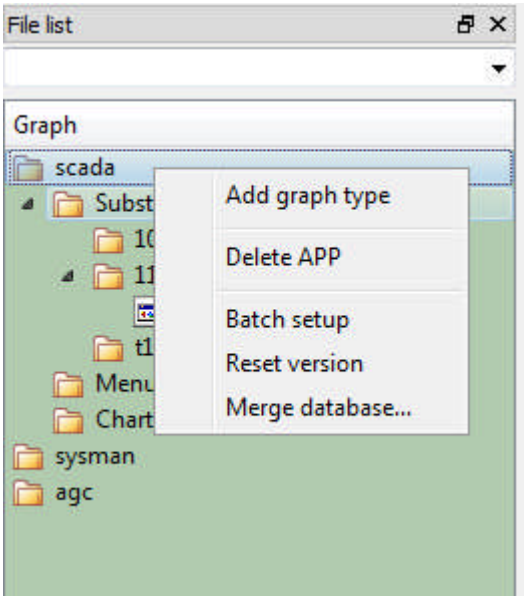


Figure 14.3-3 Delete application

14.3.1.3 Add Graph Type Under Application

Right click current application. In the menu shown above, select “Add graph type”; a type selection dialog box will pop up, as shown below.

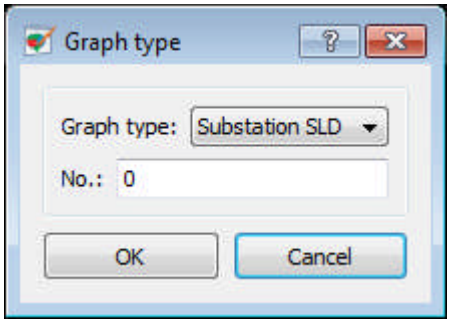


Figure 14.3-4 Add graph type

Select the type to be added and click “OK”. Similarly, if this graph type already exists, a window will pop up to prompt this.

14.3.1.4 Reset Version

Right click current application. In the menu shown in *Figure 14.3-3*, select “Reset version”; latest version of all graphs under current application will change to 1.

14.3.1.5 Delete graph type under application

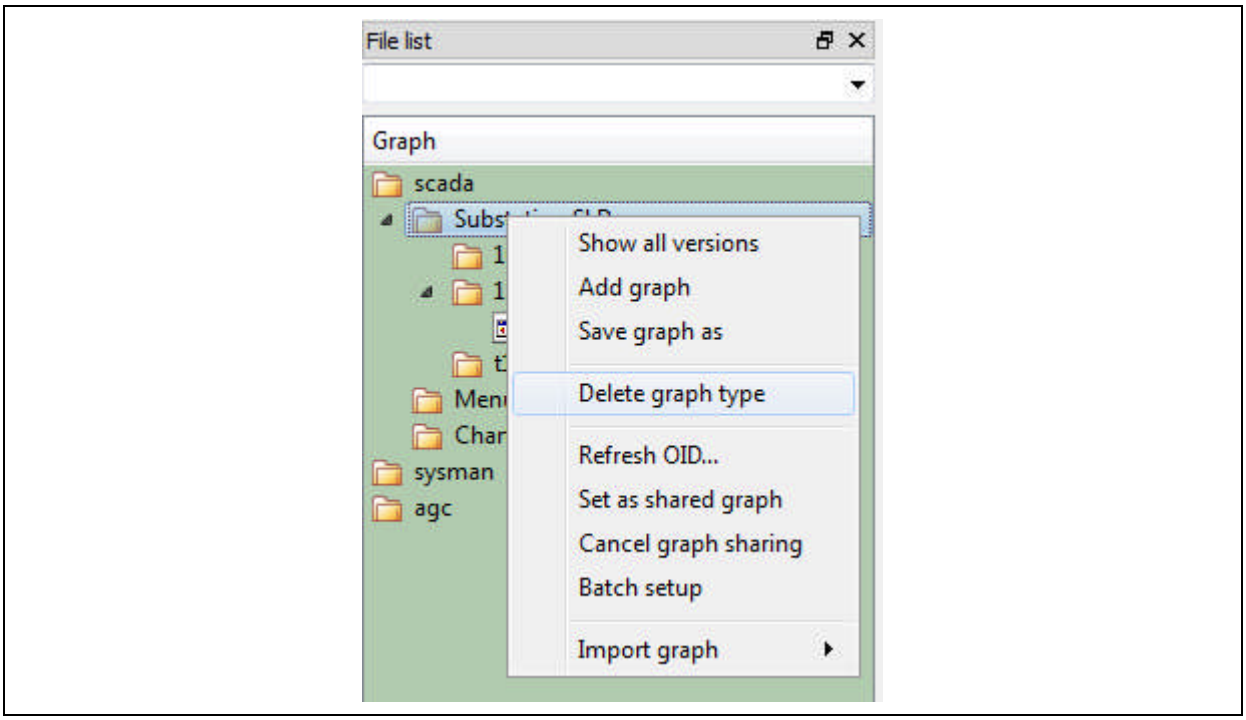


Figure 14.3-5 Delete graph type

Right click a graph type under current application. In the menu popped up (as shown above), click “Delete graph type”. A warning dialog box “Confirm deletion of graph type: xxx” will pop up. Click “Yes” to delete this graph type.

14.3.1.6 Show All Versions

In the menu shown above, click “Show all versions”. A “History version” branch will appear under all graphs under this graph type directory. In this branch, all versions of graph will be listed according to time sequence. Click a version to open the graph of this version, as shown below.

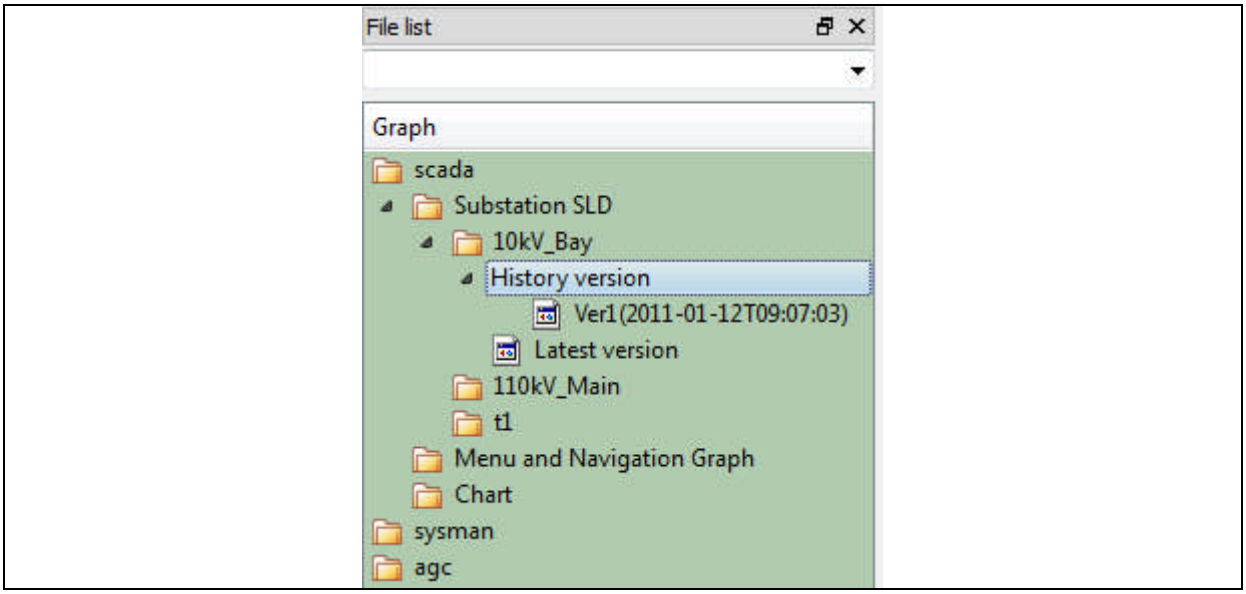


Figure 14.3-6 Show all versions

14.3.1.7 Add Graph

In the menu shown in *Figure 14.3-5*, click “Add graph”; the Add Graph dialog box will pop up. Enter name of graph and click OK; name of this graph will be added under the graph type. At the same time, the drawing area will change to that of the new graph.

14.3.1.8 Save Graph As

In the menu shown in *Figure 14.3-5*, click “Save graph as”. In the dialog box popped up, enter new graph name. After clicking OK, contents of current graph will be copied to the new graph, to realize the function of copying of graph.

14.3.1.9 Refresh OID

In the menu shown in *Figure 14.3-5*, click “Refresh OID”. All OID objects in all graphs under selected graph type will be acquired again once.

14.3.1.10 Set As Shared Graph

In the menu shown in *Figure 14.3-5*, click “Set as shared graph”. All graphs under selected graph type will be set to shared graph. Use “Cancel graph sharing” to cancel all sharing of graphs.

14.3.1.11 Import Graph

Use “Import graph” in the menu shown in *Figure 14.3-5* to select “Import file” or “Import folder”. If “Import file” is selected, user can further select version of the file to be imported. If “Import folder” is selected, user will be prompted to import draft or latest version. Click OK to import selected graph into current graph type.

14.3.1.12 Delete Graph

Right click name of graph in the tree type directory to pop up the menu as shown below.

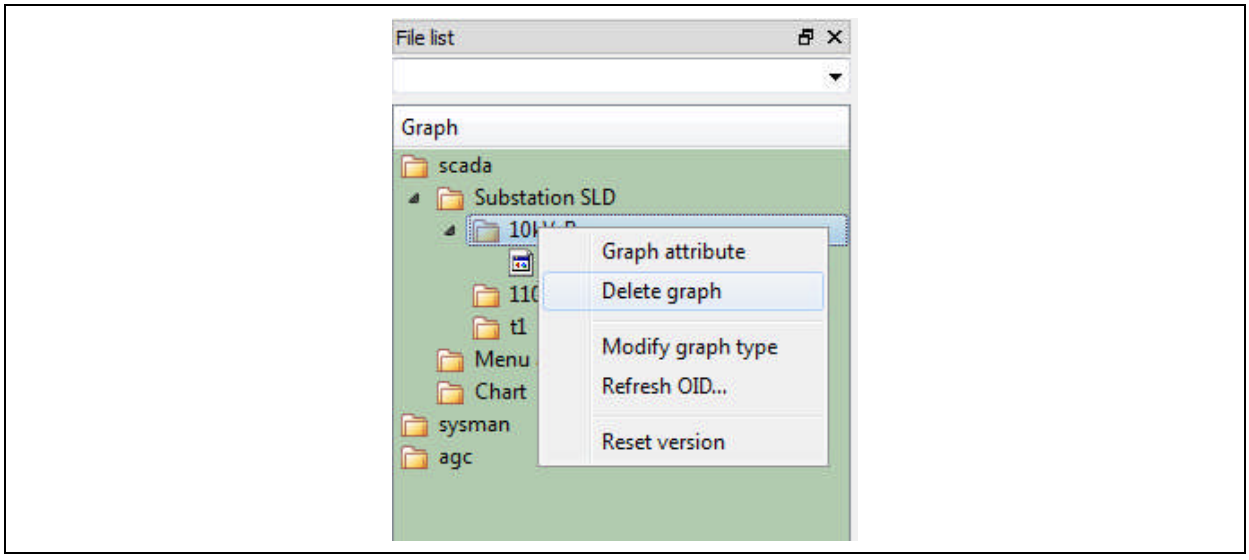


Figure 14.3-7 Delete graph

Click “Delete graph”. Warning dialog box “Confirm deletion of graph: xxx?” will pop up. Click “Yes” to delete the graph.

14.3.1.13 Publish Graph

"Publish graph" will submit current draft graph as formal version file, to be published in the whole network and saved.

Left click a graph under current graph type. If this graph has a draft, the menu popped up will include "Publish graph" menu item. Click this menu item to execute "Publish graph" and pop up the dialog box shown below, to prompt increase of version No.

If "Yes" is selected, version No. will increase by 1.

If "No" is selected, existing latest version will be overwritten.

If "Cancel" is selected, the graph will not be published.

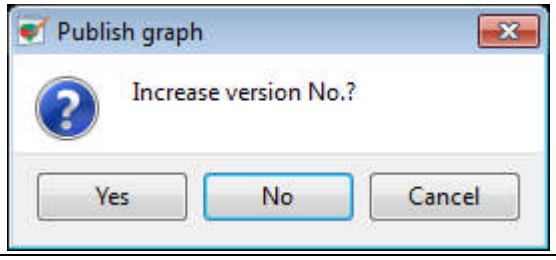


Figure 14.3-8 Publish graph

At end of graph publishing, successful publishing of graph will be prompted. Any abnormity will also be prompted to user via a message window.

14.3.1.14 Modify Graph Type

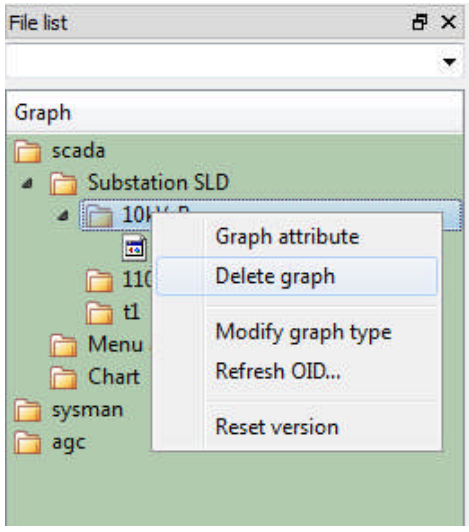
In the menu shown in 

Figure **14.3-7**, select "Modify graph type". In the dialog box popped up, user can select a graph type other than current graph type under this application. After clicking OK, this graph will appear in the selected graph type.

14.3.1.15 Graph Attribute

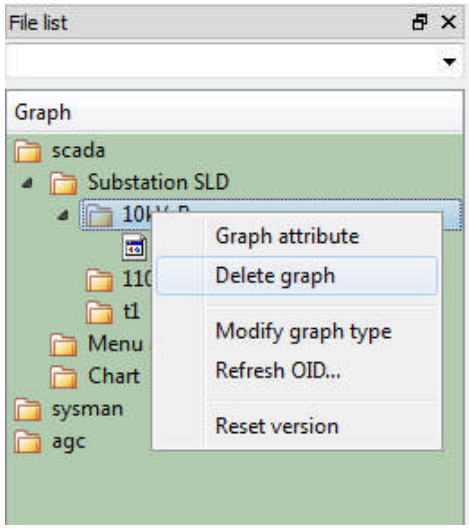
In the menu shown in 

Figure 14.3-7, select “Graph attribute” to pop up the window below and display attributes of current graph:

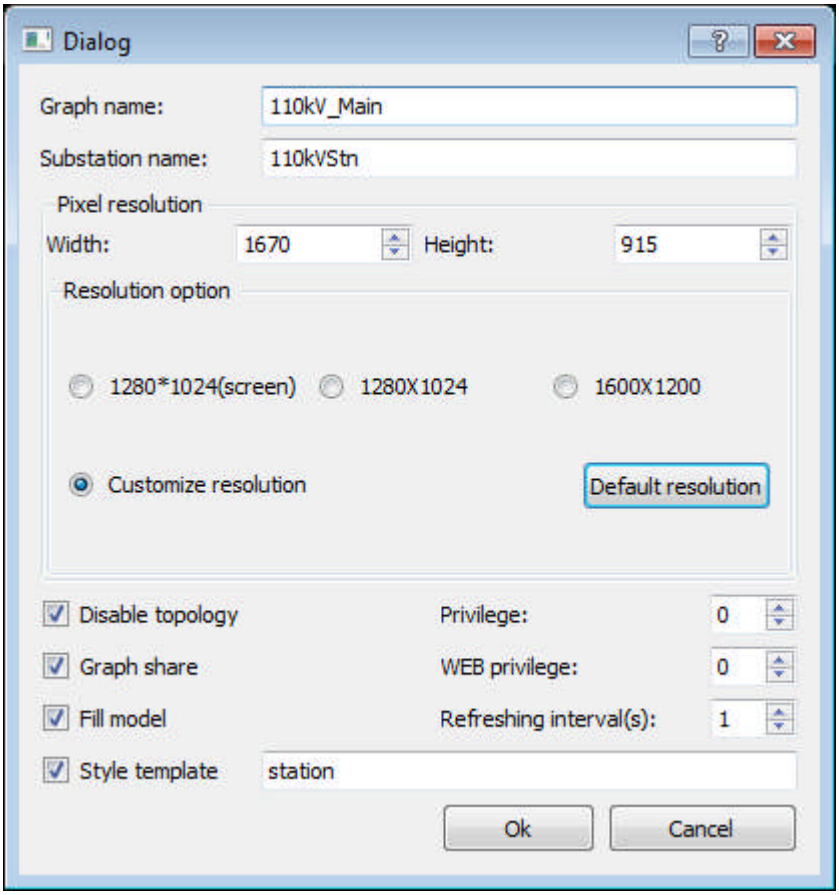


Figure 14.3-9 Graph attribute

Table 14.3-1 Description of graph attribute configuration

Graph attribute	Description

Graph attribute	Description
Graph name	Display name of current graph. To modify this name, enter new name here and click OK.
Substation name	Only graphs of “substation single line diagram” type have this attribute, which displays name of substation of current graph. User can modify name of substation here. After such modification, substation name in all foregrounds of this graph will change.
Pixel resolution	User can set size of graph in this attribute. Under this attribute, several commonly used resolutions are provided. After selection, click “Default resolution”. While the width will remain unchanged, the height will automatically adapt to screen size. If “Customize resolution” is selected, both width and height can be configured freely.
Shared with mode diagram	Select to set this graph to be shared with mode diagram or not
Graph share	Select to share this graph with other applications
Fill model	Set if model filling is required for this graph, it is only allowed if this item is selected
Style template	Display what style template is used for this graph
Privilege	Display privilege of this graph. This graph cannot be seen if browsing authority of the role is lower than this privilege.
WEB privilege	Display WEB privilege for this graph. This graph cannot be seen if WEB privilege of the role is lower than corresponding setting.
Responsibility zone	Display responsibility zone of this graph. This graph cannot be seen by roles not in this responsibility zone.
Refreshing interval (s)	Display refreshing interval of this graph in the Graph Browser (in seconds)

14.3.2 Use of Primitive Toolbar

The interface of Primitive toolbar is shown in *Figure 14.3-10* and includes an upper part and a lower part. The upper part displays all primitive types in the form of tree type list. Select a particular primitive type to display all primitive templates of this type in the lower part. Right click a primitive template to pop up the menu shown in *Figure 14.3-11*. Select “Default primitive” to set selected primitive as default primitive of this type of equipment. A label (default) is shown near the name of the default primitive. Select “Add to common-used primitives” to add selected primitive to the Common-used primitives label at top of the screen to facilitate use.

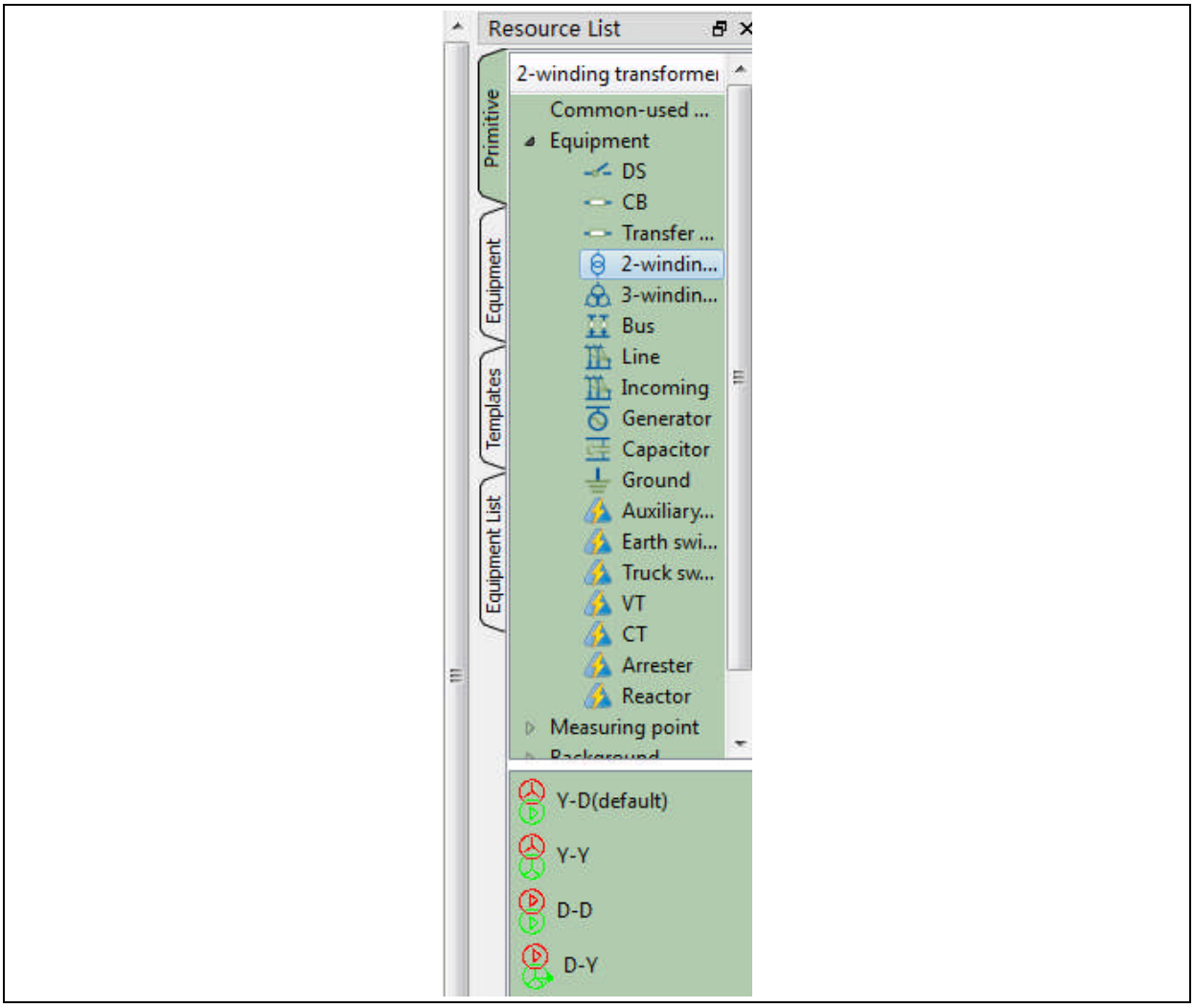


Figure 14.3-10 List of primitives

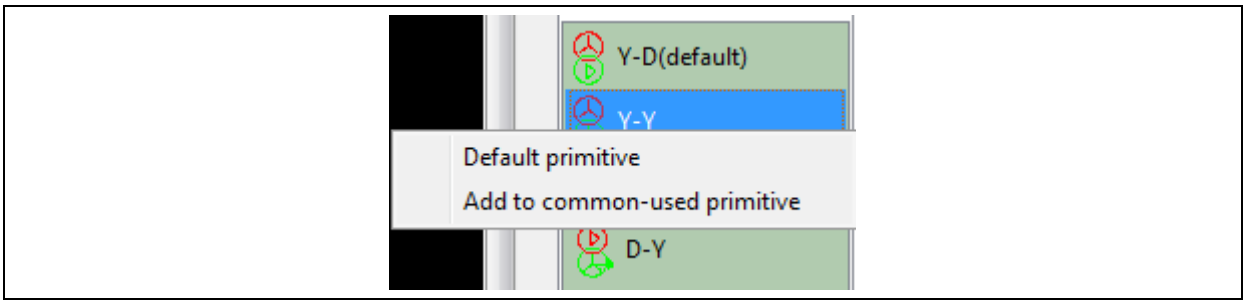


Figure 14.3-11 Default primitive

14.3.2.1 Generation of Power Equipment Graphs

1） Connecting line

Connecting lines connect power equipment. User can select  or  on the toolbar to draw connecting lines. The former is orthogonal line, mainly used for substation diagrams. The latter is polyline and mainly used for load flow diagrams. Connecting lines have connection attribute. When connected to power equipment, a small prompting rectangle will appear, as shown below.

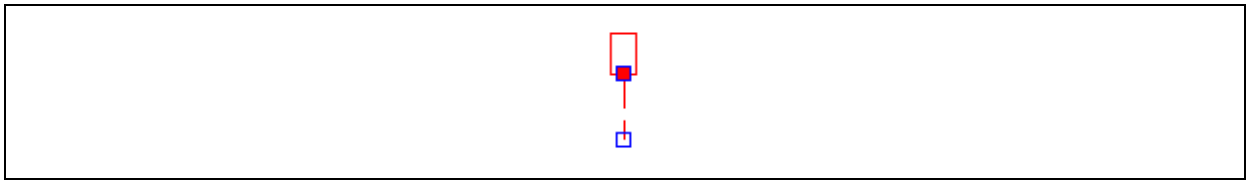


Figure 14.3-12 Connecting line

Select Connecting line and then left click the graph. User can continue to left click repeatedly, and end with a right click, to draw a connecting line.

2） Power equipment

Select required power equipment and drag it to the drawing area. An Equipment Attribute Setup dialog box will pop up:

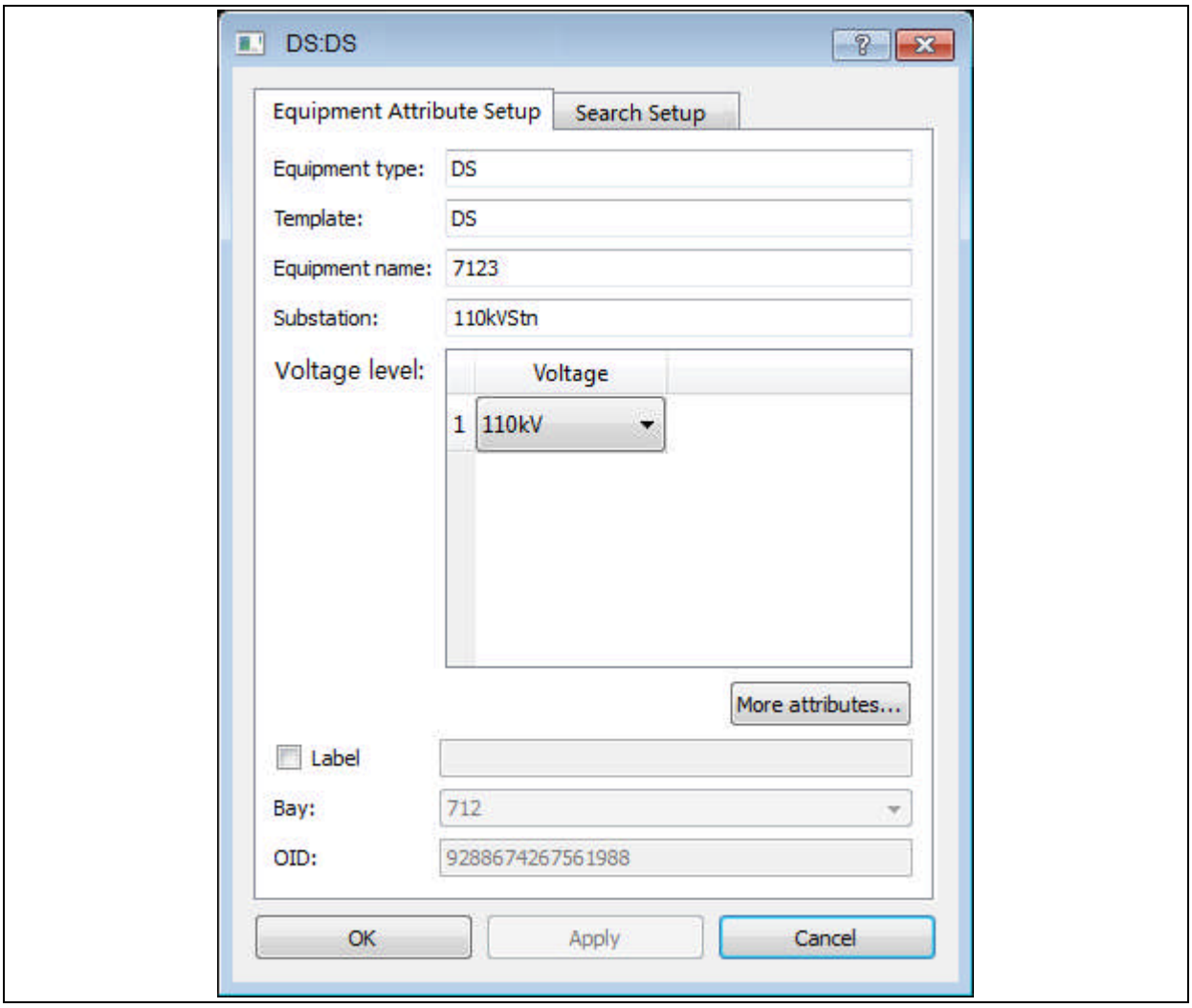


Figure 14.3-13 Equipment attributes

Table 14.3-2 Description of equipment attribute configuration

Device attribute	Description
Equipment type	Type of current equipment

Device attribute	Description
Template	Name of template of current primitive; i.e. name in Primitive Editor.
Equipment name	Display name of equipment; unnamed equipment is shown in dotted line
Substation	Name of the substation to which the equipment belongs. This item is normally filled directly by the program according to name of station of current graph.
Voltage level	Select voltage level of equipment. Different levels are displayed in different colors. For equipment including a number of voltage levels (e.g. transformer), select voltage levels one by one.
Bay	Name of bay to which the equipment belongs. User can select voltage level and bay according to “Search Setup” tab, and then select an item of equipment in the list shown, to assign its attributes to current equipment, as shown in *Figure 14.3-14*
OID	Value of object ID of equipment. This item is normally automatically generated when filling model.
Label	Select this item to automatically generate a text label for current equipment. User can enter its content, which is name of current equipment in default.
More attributes	Click this button to pop up the dialog box shown in *Figure 14.3-15*. The Primitive tab displays appearance, line style and line weight etc. of this primitive template. The Basic tab displays position, size, and flip or not of this primitive.

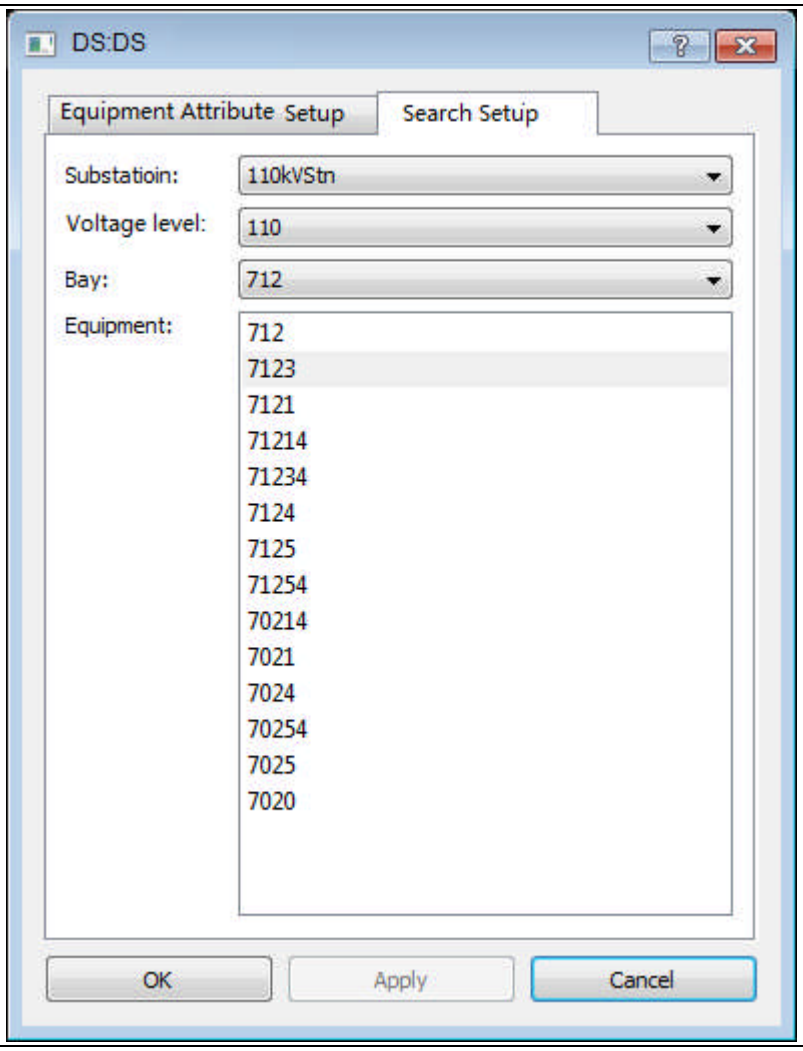


Figure 14.3-14 Search equipment

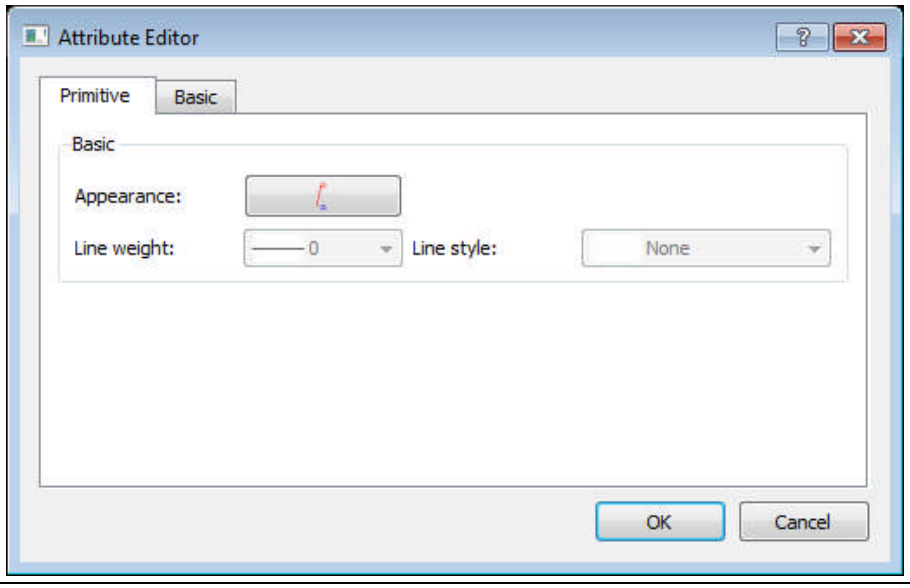


Figure 14.3-15 Attribute editor

Click button “Appearance” to pop up the dialog box shown in *Figure 14.3-16*. This dialog box lists

all primitive templates of the type of this primitive, including their names and shapes. User can select one of them and click “OK” to replace current primitive.

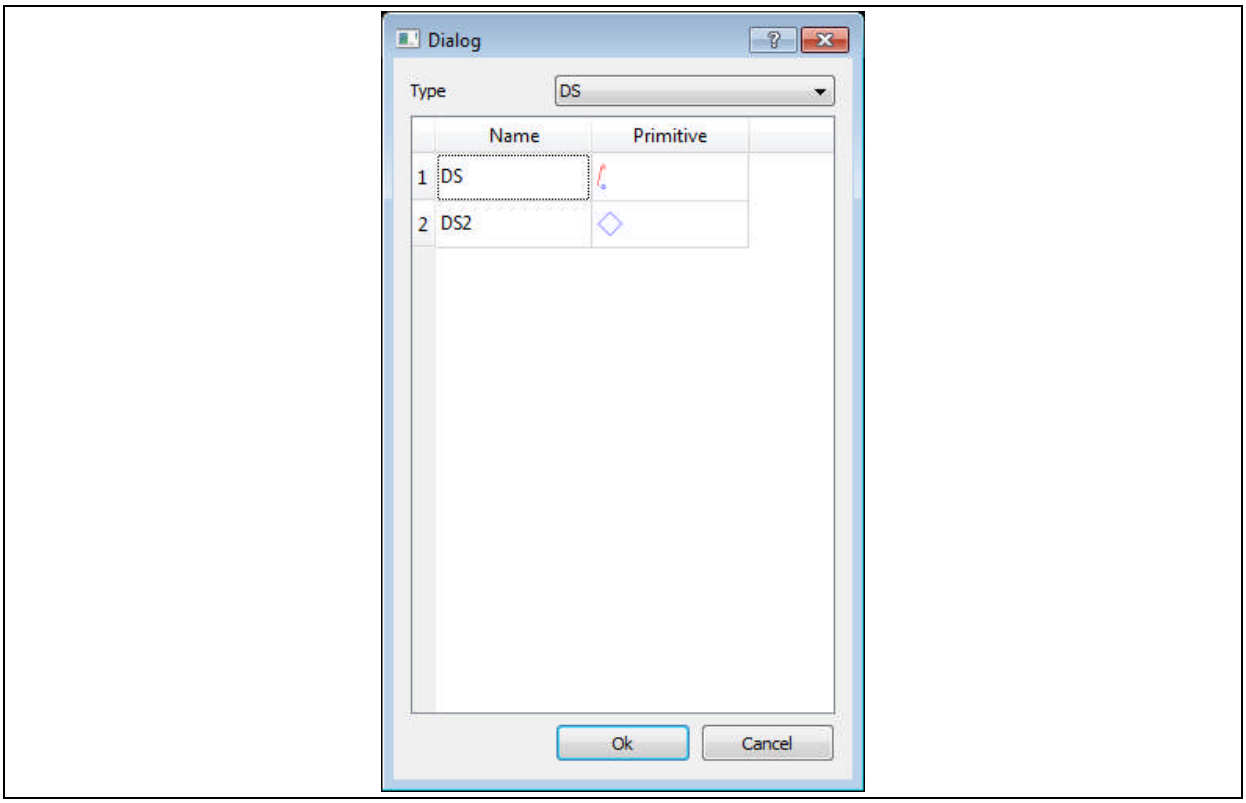


Figure 14.3-16 Select appearance

After configuration of attributes, click “OK” so that this equipment appears on the graph. To modify its attributes, double click this equipment to pop up the Attribute dialog box shown in *Figure 14.3-13*.

14.3.3 Use of Auxiliary Tools

14.3.3.1 Auxiliary Options

Select “Tools”→“Setup” to pop up the dialog box shown below.

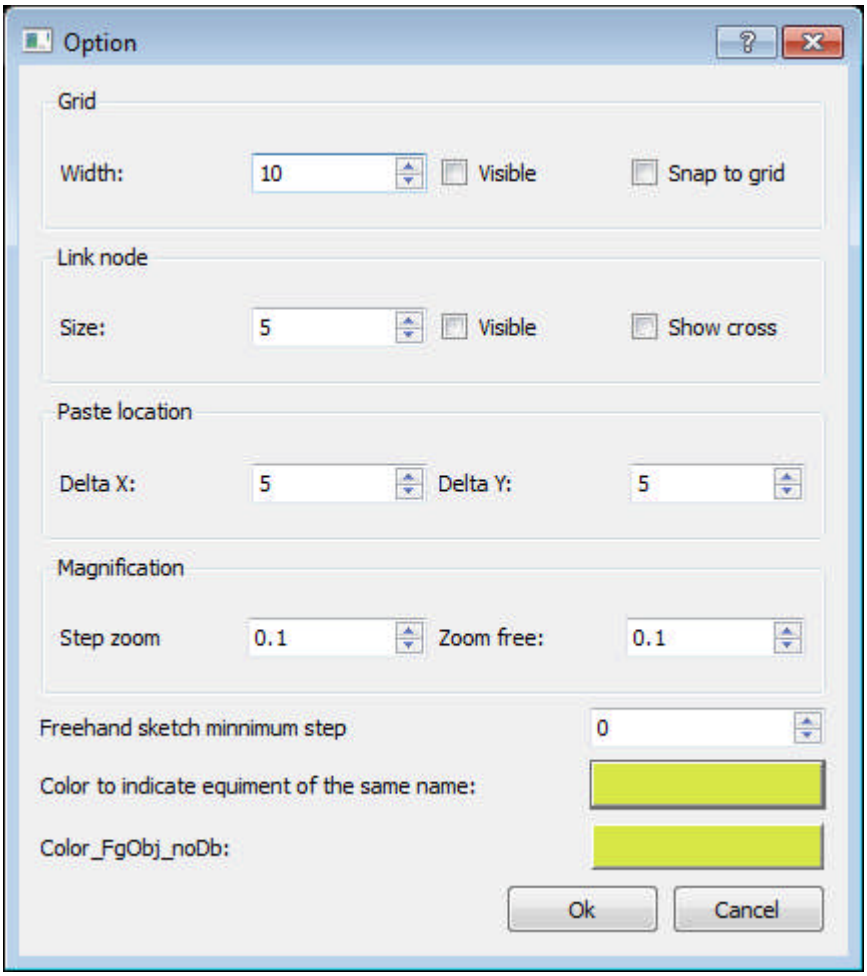


Figure 14.3-17 Setup dialog box

Table 14.3-3 Description of configuration of options

Configuration of options		Description
Grid	Width	Set size of each grid
	Visible	Set if grid is visible
	Snap to grid	If “snap to grid” function is required
Link node	Size	Set size of link node
	Visible Show cross	Set if link node is visible and if display of cross on bus link node is required. Green——connected link node; Red——unconnected link node
Paste location	Delta X	Offset (horizontal and vertical) of pasted object in relation to original object when using Copy and Paste.
	Delta Y	
Magnification		Set zoom magnification for step zoom and zoom free. For example, if step zoom magnification in above figure is 1.5, each time the graph is amplified by step zoom, it will become 1.5 times of its original size; each time it is reduced by step zoom, it will become 1/1.5 of original size.

Configuration of options	Description
Freehand sketch minimum step	Set distance between 2 points when drawing a line manually
Color to indicate equipment of the same name	In case the same graph includes equipment of the same name, such equipment will be displayed in the color set here. Click the button at right side to change this color.
Color_FgObj_noDb (color of foreground object not connected to database)	If a foreground is not connected to database, i.e. OID is not available, this foreground will be displayed in this color for differentiation with other foregrounds. Click button at right side to change this color.

14.3.3.2 Use of Alignment Modes

On lower toolbar, click alignment buttons  to align selected primitives with the first selected primitive as reference. These 6 buttons are (from left to right): Align Top, Align H Center, Align Bottom, Align Left, Align Right, and Align V Center. With Align V Center as an example, the effect of operation is shown as below:

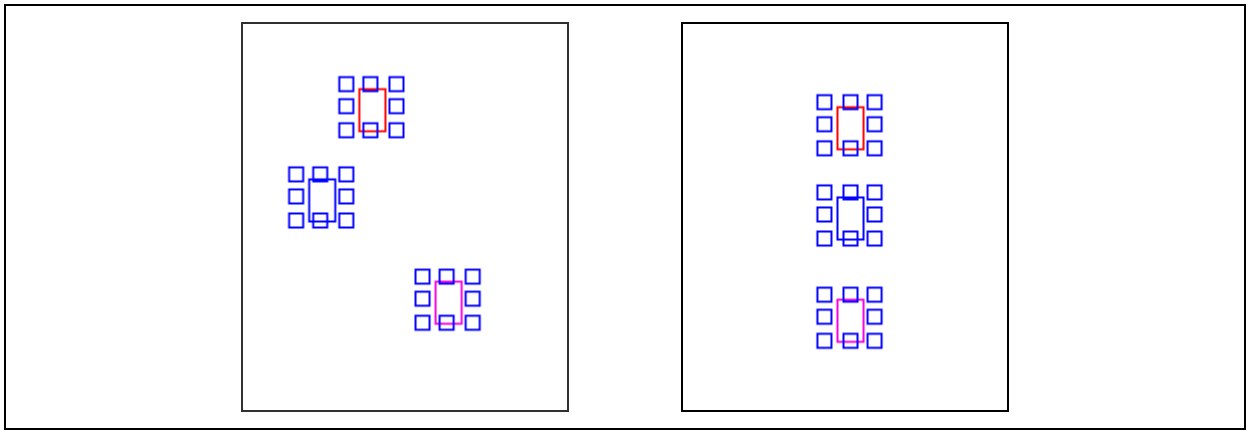


Figure 14.3-18 Alignment

1）Use of Same Size function

Click  button to zoom selected quantities of the same type (primitive, foreground etc.) to size of the first object selected, with the effect shown below:

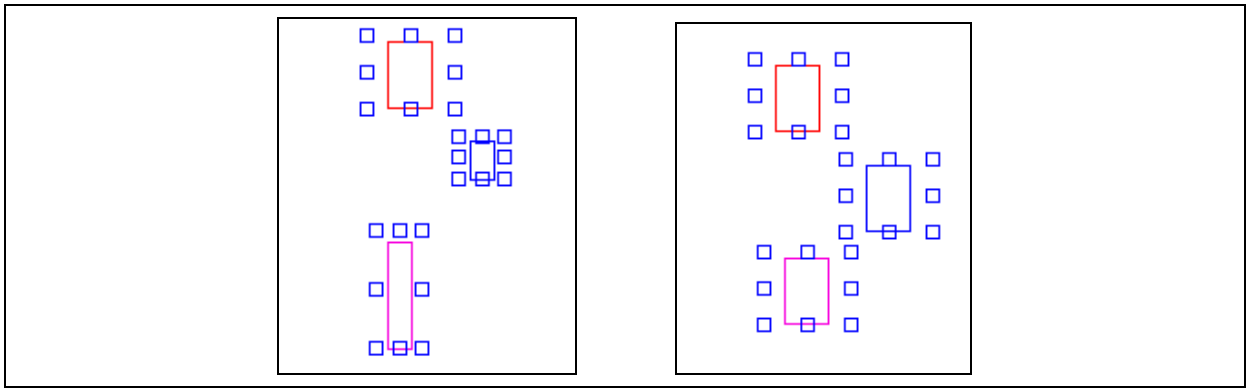


Figure 14.3-19 Zoom

2）Same Horizontal Space and Same Vertical Space

Same Horizontal Space button and Same Vertical Space button can be used to separate selected primitives or foregrounds of the same type at equal spacing. Take Same Vertical Space as an example, first select objects to be arranged and then click Same Vertical Space button. The effect is shown below.

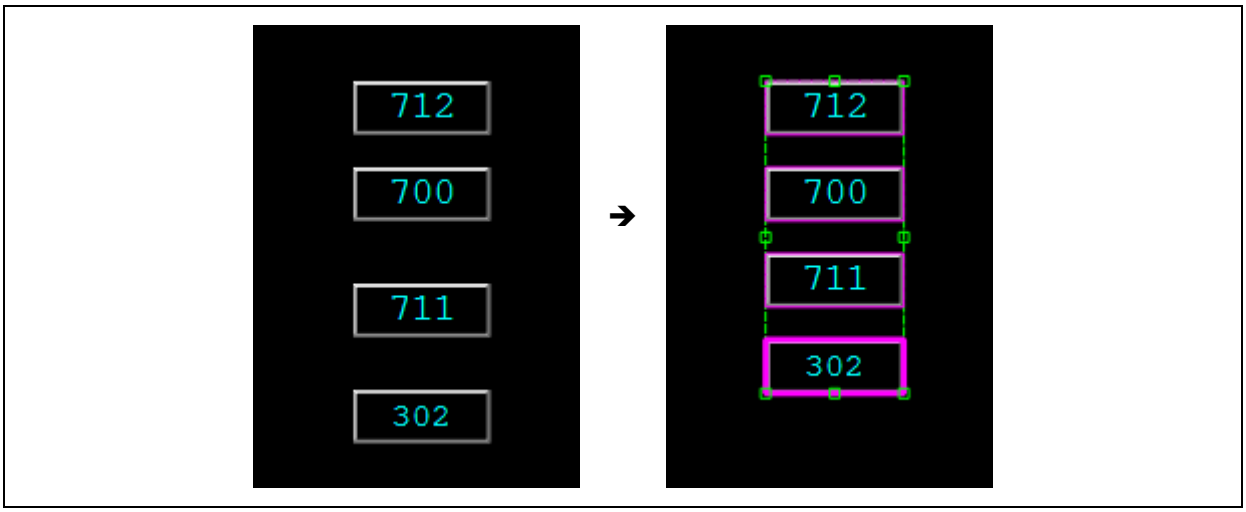


Figure 14.3-20 Same Space

3）User-defined Same Horizontal Space and Same Vertical Space

For multiple rows or columns, the function of user-defined Same Horizontal Space and Same Vertical Space can be used for fast alignment. Select all objects to be aligned and then select “Edit”→“Same Horizontal Space” or “Same Vertical Space”. In the window popped up, select number of objects in each row or column (consistent number of objects in each row or column shall be ensured). After clicking OK, these objects can be automatically arranged.

14.3.3.3 Refresh Primitives

Use “Operation”→“Refresh primitive” to again read currently selected primitives once, so that after modification of primitive attributes in the Primitive Editor, user do not need to open Graph Editor again; just refresh once to use new primitives.

14.3.3.4 Lock and Unlock Graph

When user opens a graph for editing, if this graph has been opened, the following dialog box will pop up:

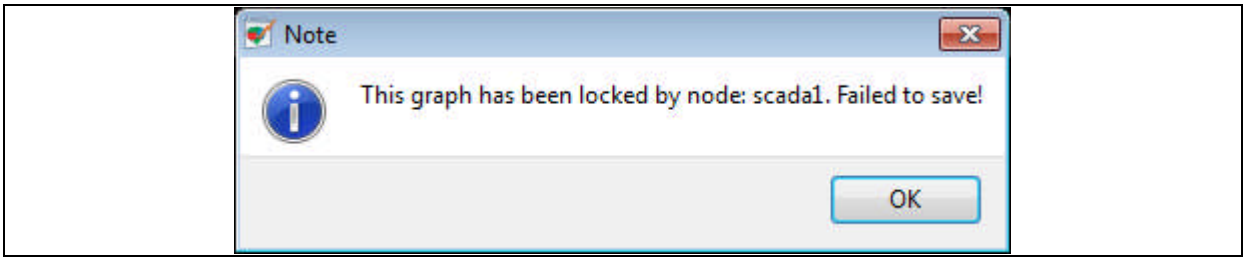


Figure 14.3-21 Locked graph

At this time, although user can edit the graph, modification made cannot be saved. To cancel locking, click “Operation”→“Unlock graph”.

14.3.3.5 Verify Graph

Select “Operation”→“Verify graph” to pop up the dialog box shown below:

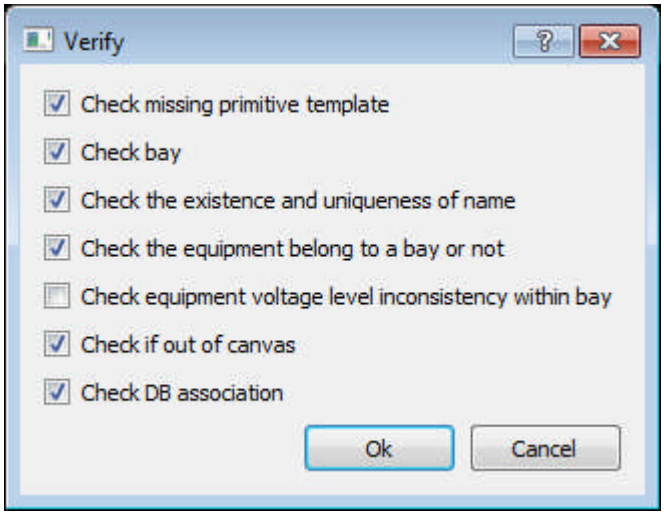


Figure 14.3-22 Verify graph

In this dialog box, select items to be verified. After clicking OK, user can check the graph without saving it. Results of verification will be displayed in the Error Message bar below in a classified manner.

14.3.3.6 Show Link Nodes

Click “Plugin toolbar”→“Show link node”  ; in current graph, all link nodes will be displayed, as shown below.

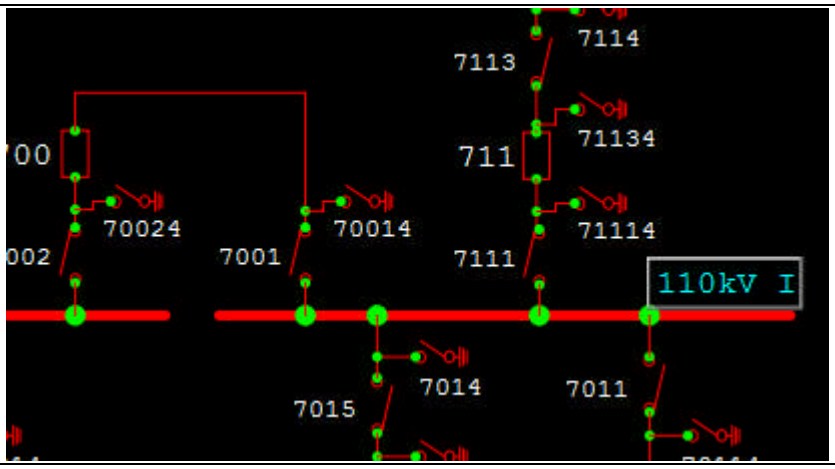


Figure 14.3-23 Show link nodes

14.3.3.7 Refresh Flash Tag Text

Select “Operation”→“Refresh Flash Tag Text”; text of all flash tags in current graph will be

refreshed according to names of measuring points in the database.

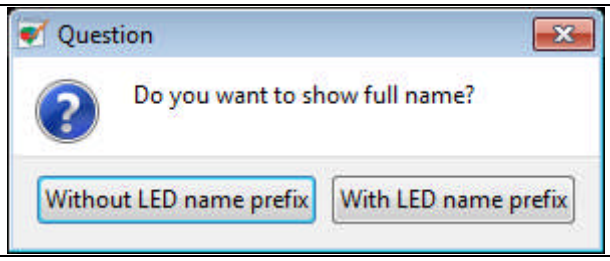


Figure 14.3-24 Refresh flash tag text

14.3.3.8 Find Equipment Character String

To find equipment character string in the graph currently edited, click “Edit”→“Find” or use Ctrl+F shortcut to pop up the dialog box shown below. Similar to Find common text, after entering Find What, user can select Find Whole Words Only, Match Case, and Include Content. After selection of these parameters, click “Find next”; the first item of equipment meeting these conditions will be selected. If user clicks “Mark all”; all equipment in current graph containing this character string will be selected. If there is no matching entry, String Not Found will be prompted.

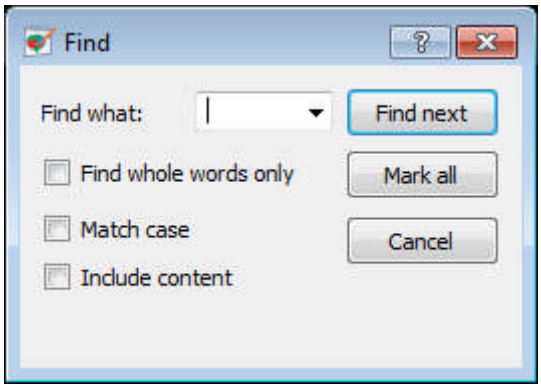


Figure 14.3-25 Find

14.3.3.9 Auto-generate Measurement Table

Select “Insert”→“Auto-generate measurement table”; the following dialog box will pop up.

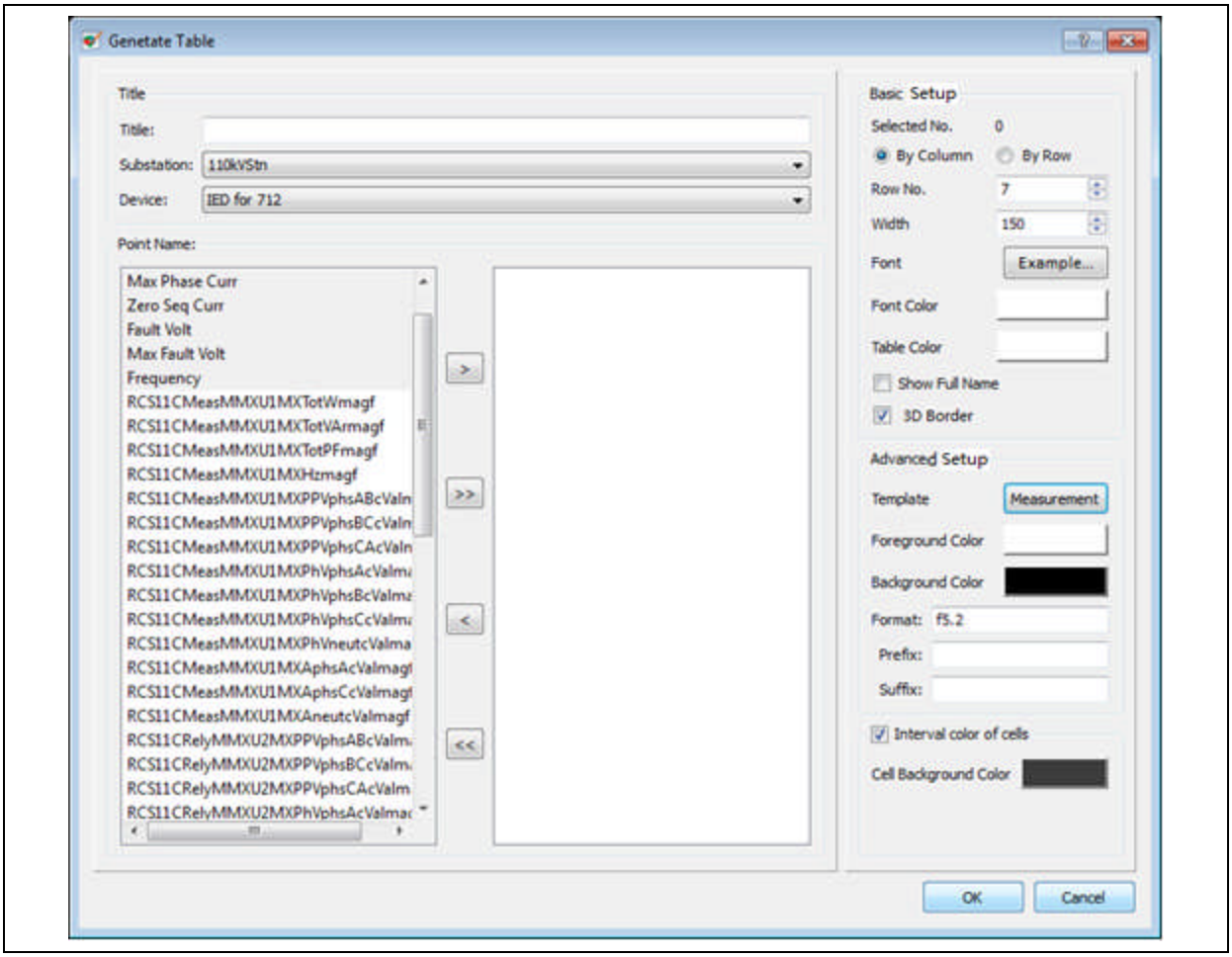


Figure 14.3-26 Auto-generate measurement table

Table 14.3-4 Description of configuration of auto-generated measurement table

Configuration options		Description
Title	Title	Generate title of measurement table
	Substation; Device	Select device for which the table needs to be generated
Point Name		Select measuring points of the table; a number of points and all points can be selected.
Basic setup	By Row; By Column	Select table arrangement mode: horizontal or vertical
	Row No.	When this number is exceeded, a new row will be generated for the table
	Font	Font of text in the table
	Show Full Name	Include or exclude device name prefix in measuring point name
Advanced setup	Template	Select primitive for foreground point
	Foreground color, background color	Select foreground point color
Interval color of cells		Display different background color between cell rows in table

Measurement table generated is shown as below:

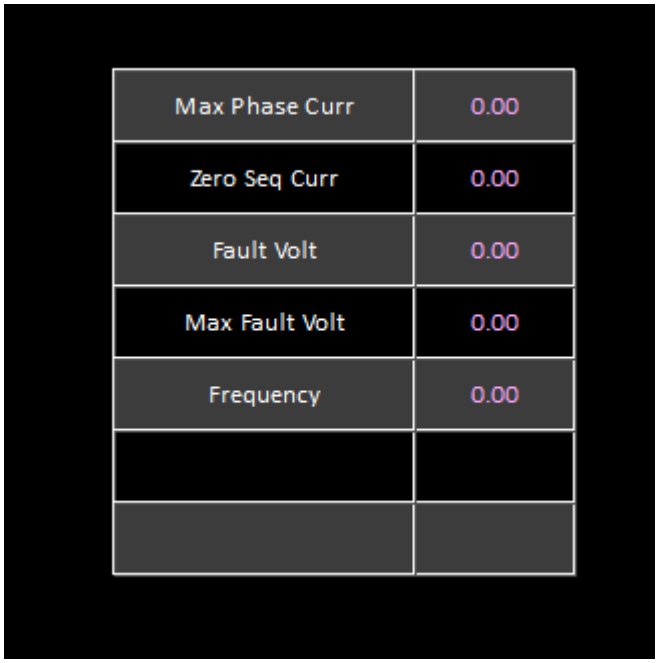


Figure 14.3-27 Measurement table

14.3.3.10 Auto-generate BI Table

Select “Insert”→“Auto-generate BI table”. The following dialog box will pop up.

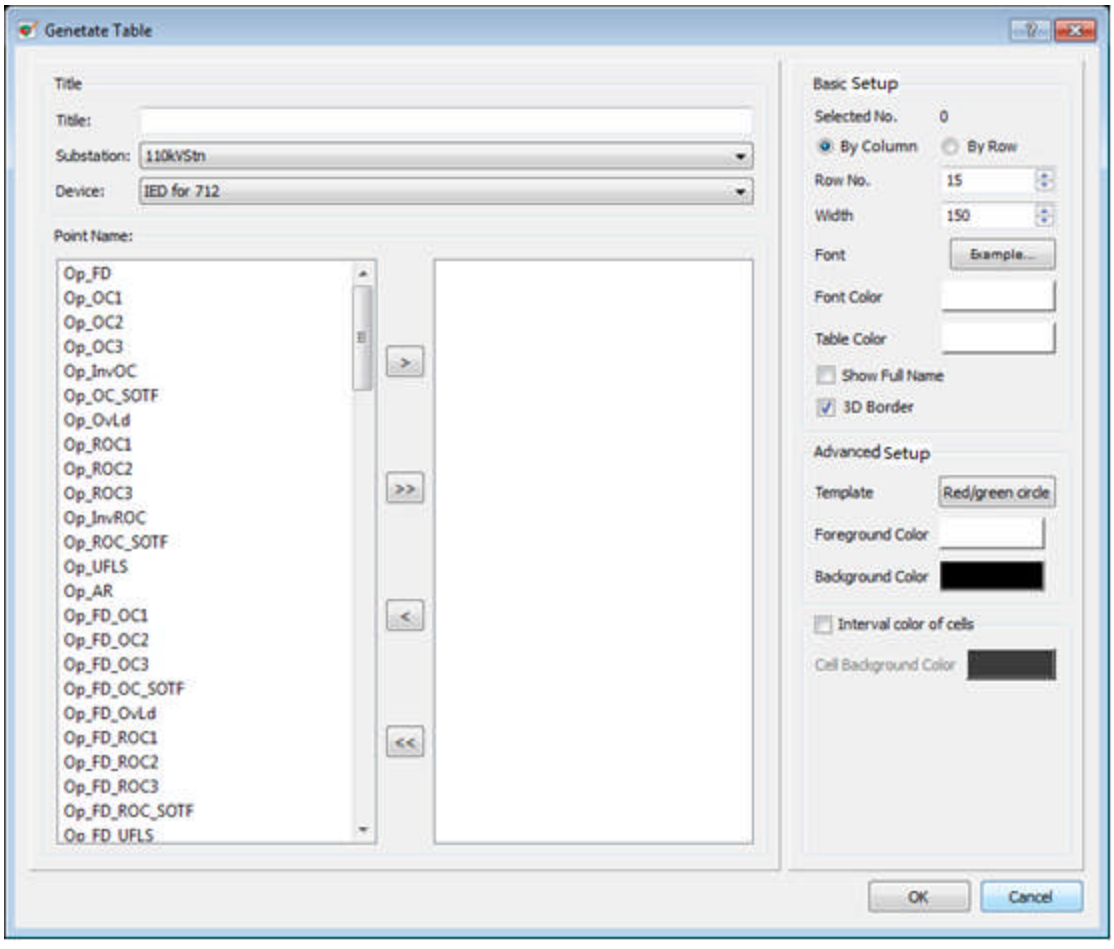


Figure 14.3-28 Auto-generate BI Table

The BI table generated is shown below:

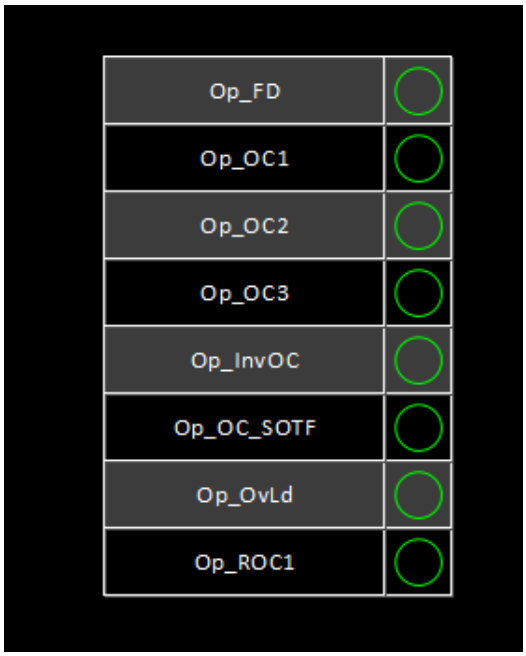


Figure 14.3-29 BI table

14.3.3.11 Auto-generate TP Table

Same as “Auto-generate measurement table”.

14.3.3.12 Auto-generate Metering Table

Same as “Auto-generate measurement table”.

14.3.3.13 Auto-generate Control Table

Same as “Auto-generate BI table”.

14.3.3.14 Auto-generate Flash Tag Table

Select “Insert”→“Auto-generate flash tag table”. The following dialog box will pop up.

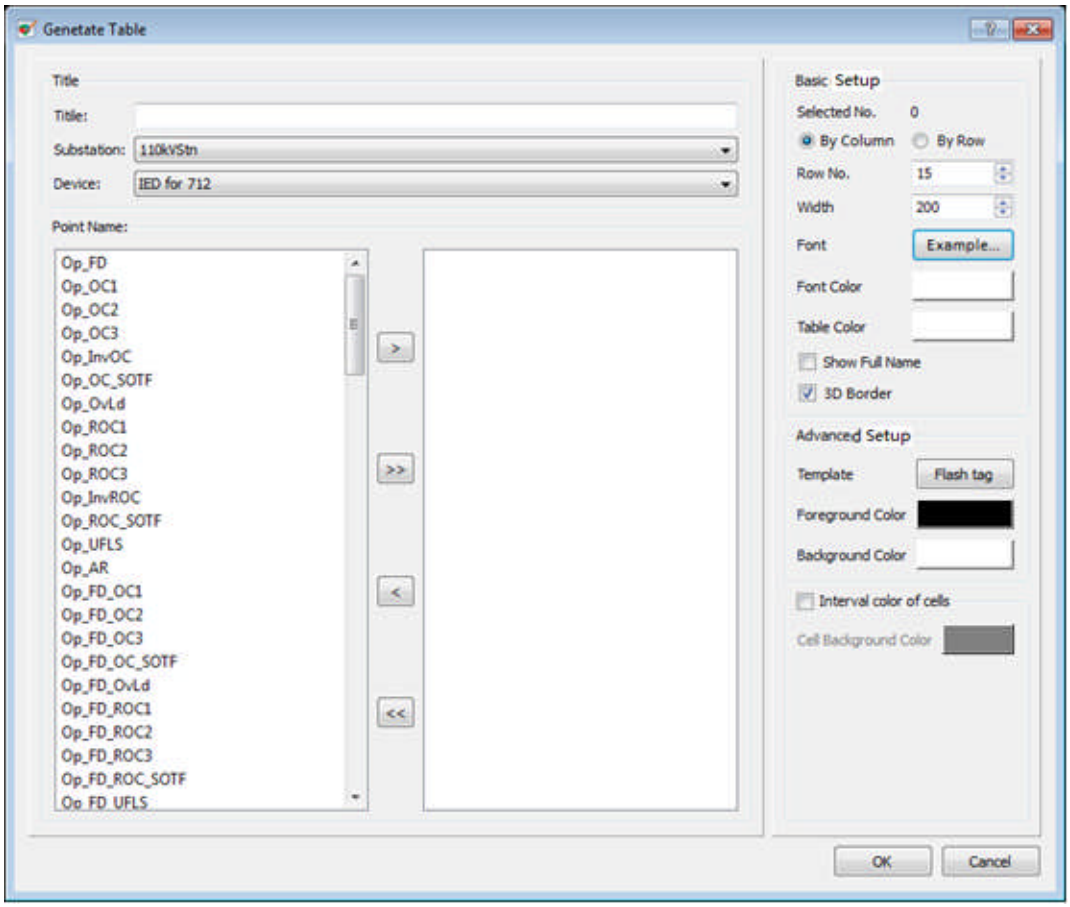


Figure 14.3-30 Auto-generate flash tag

The table of flash tag generated is shown as below:

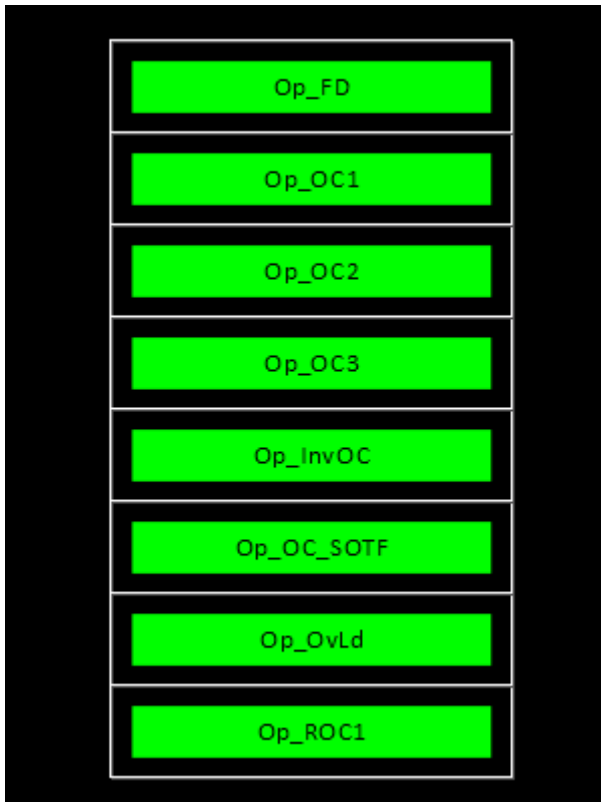


Figure 14.3-31 Flash tag

14.3.4 Various Auxiliary Operations

14.3.4.1 Draw Orthogonal Line

Select Draw Line operation. Left click starting point. Then, press and hold Ctrl key and draw end point.

14.3.4.2 Use of Key Pad for Selection

Continuous selection ——press and hold Ctrl key and continuously click targets to be selected.

Cancel selection of single target ——press and hold Ctrl key; click the target to be canceled.

14.3.4.3 Keyboard Functions Supported

After selecting the target to be operated:

Delete —Delete

Copy —Ctrl + C

Paste —Ctrl + V

Cancel selection —Esc

Select all —Ctrl + A.

14.3.5 Generation of Ordinary Background

14.3.5.1 Straight Line

Select Line operation. Left click the graph to establish starting point. Move and click the graph again to establish end point. A straight line is drawn.

Polyline:

Select Polyline operation. Left click the graph to establish starting point. Move mouse and click the graph again to establish second point. Continue this operation till right clicking to end the operation. A polyline is drawn.

Select Freehand Sketch. Press and hold left mouse key and drag mouse on the graph to draw irregular polyline with many twists. Distance between two points of freehand polyline can be configured in the Options.

14.3.5.2 Rectangle

Select Rectangle operation. Left click the graph to establish starting point. Move mouse and click the graph again to establish end point. A rectangle is drawn.

14.3.5.3 Polygon

Select Polygon operation. Left click the graph to establish starting point. Move mouse and click the graph again to establish second point. Continue till right clicking to end the operation. Finally, connect the last point to the starting point. A polygon is drawn.

Select Freehand Polygon. Press and hold left mouse key and drag mouse on the graph to plot irregular polygon with many twists. Distance between two points on freehand polygon can be configured in the Options.

14.3.5.4 Circle

Select Circle operation. Left click the graph to establish the center point. Move mouse and click the graph again to establish a point on the circle. A circle is drawn.

14.3.5.5 Ellipse

Select Ellipse operation. Left click the graph to establish starting point. Move mouse and click the graph again to establish end point. A rectangle is drawn.

14.3.5.6 Arc

Select Ellipse operation. Left click the graph to establish starting point. Move mouse and click graph again to establish end point. A rectangle is drawn. Then, define the third point that forms starting angle with center of the ellipse. Move mouse again to define the fourth point, to form ending angle. An arc is drawn.

14.3.5.7 Text

Select Text operation. Drag a rectangle on the graph to define the range of display of text. The following dialog box will pop up:

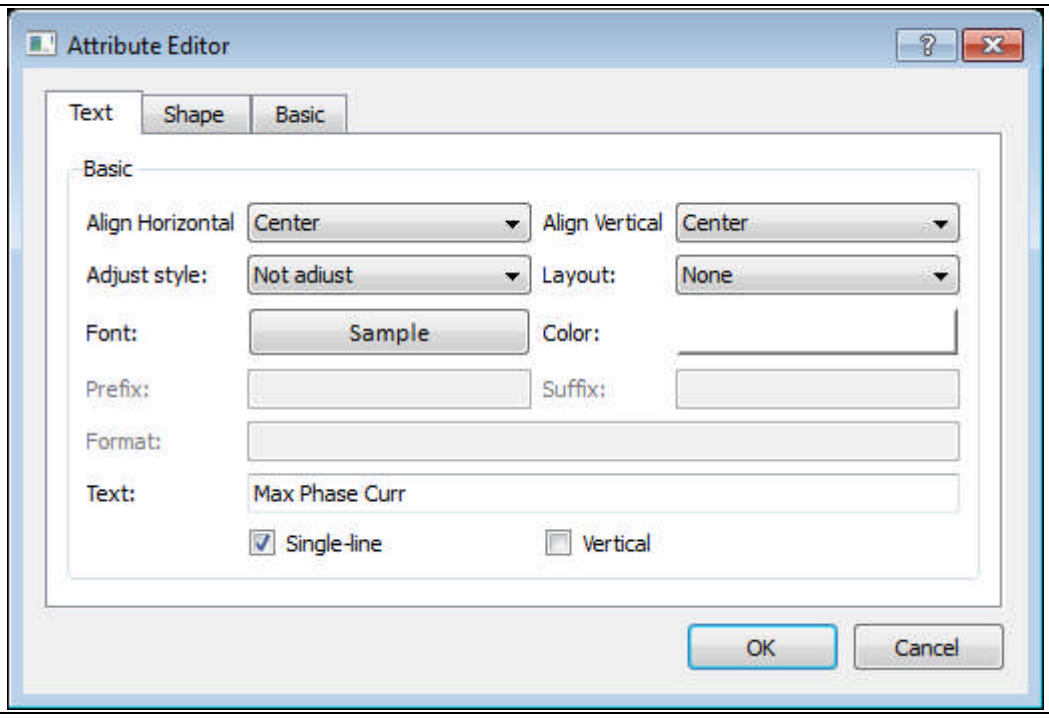


Figure 14.3-32 Text

Enter text to be displayed in the “Text” column on the “Text” tab. User can perform basic setup of the text on this tab, i.e. Align Mode, Layout, Font, and Color etc.

In the “Shape” tab, user can perform advanced setup, e.g. borders, filling, and 3D effect etc. These are not described here. For modified attribute, name of attribute will become red.

14.3.6 Generation of Foreground Quantities and Controls

14.3.6.1 BI

Method to generate BI: select BI label in the Template column at right side. Select a type of primitive and drag it to the graph. The following dialog box will pop up:

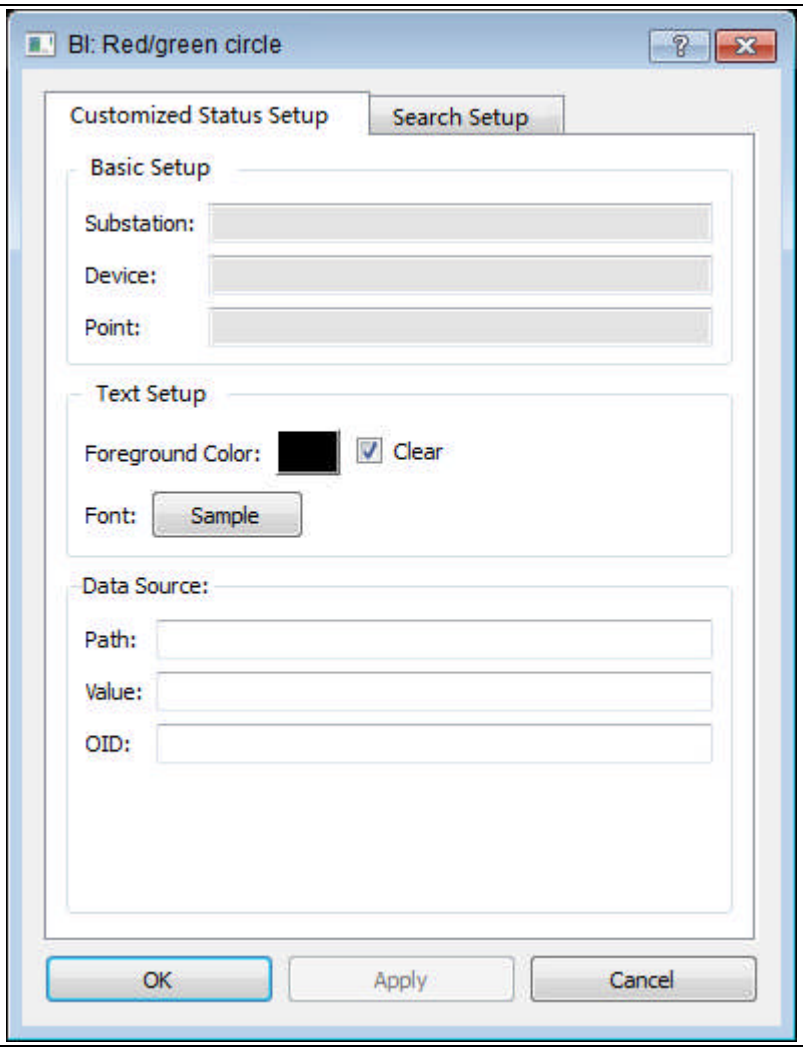


Figure 14.3-33 BI attribute box

1） In “Text Setup”, user can change Foreground Color and Font of BI. However, color and font of BI are normally decided by color decision and symbol decision. Therefore, these items normally do not require setting. BI color decision and symbol decision can be modified in the Primitive Editor.

2） Click “Search Setup” tab to enter the page shown below. Double click measuring point to perform association of BI points.

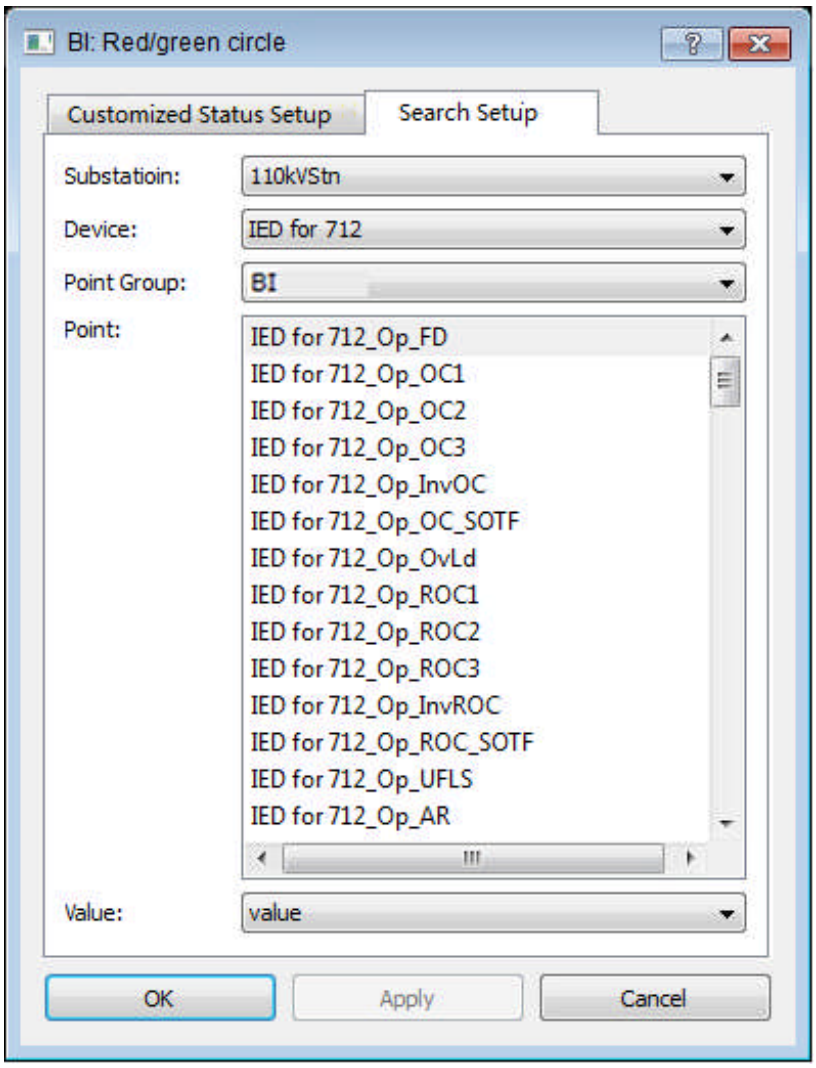


Figure 14.3-34 BI search

3） As shown below, after saving of the graph, corresponding values will appear in columns “Path”, “FieldId”, and “OID”, indicating successful search.

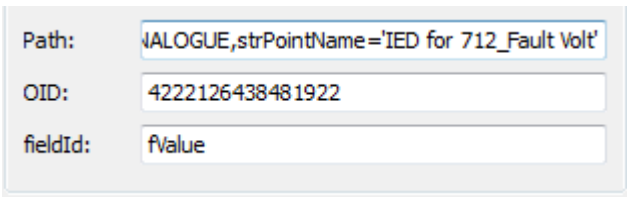


Figure 14.3-35 Data source

14.3.6.2 Measurement

Method to generate measurement: select measurement label in the Template column at right side. Select a type of primitive and drag it to the graph. The following dialog box will pop up:

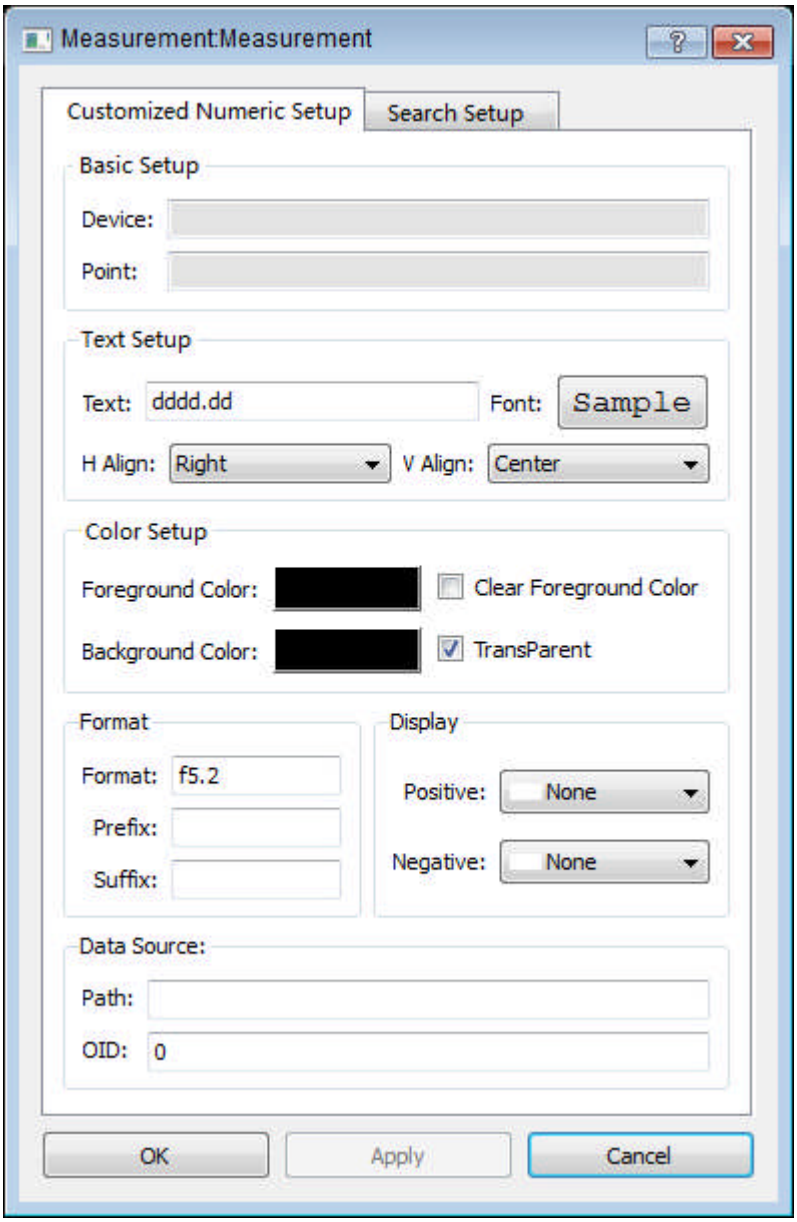


Figure 14.3-36 Measurement attribute box

1） The format includes default mode, float, and integer. If not filled, default mode will be used. Float definition mode is fx.y: f represents floating point number, x represents total number of places, and y represents number of places after decimal point. Integer definition mode is Ix: I represents integer, and x represents number of places of the integer.

2） Positive and negative signs of measurement can be configured to be represented by graphic arrows.

3） Click “Search Setup” tab to enter the page shown below. Double click measuring point for association with measurement points.

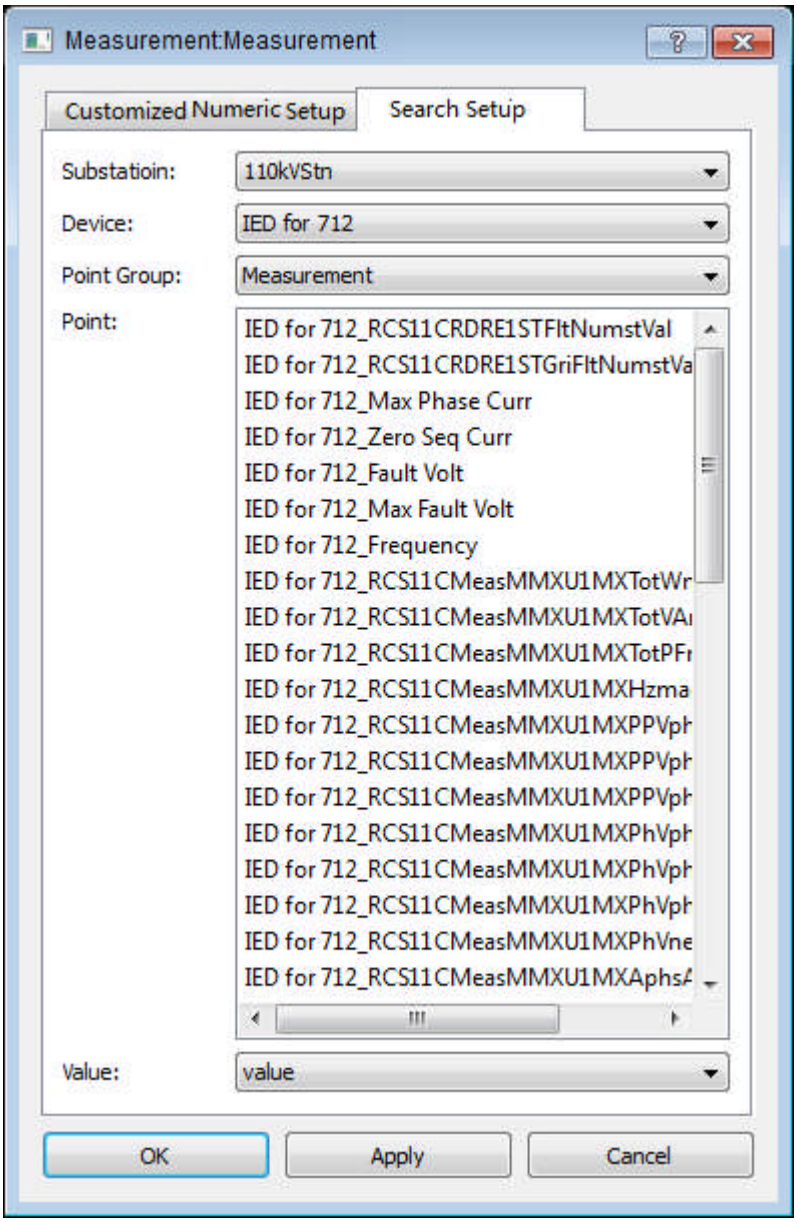


Figure 14.3-37 Measurement search

14.3.6.3 Flash Tag

Same as BI.

14.3.6.4 Telecontrol

Same as BI.

14.3.6.5 Metering

Same as measurement.

14.3.6.6 TP

Same as measurement.

14.3.6.7 Status Quantities

A status quantity is data that displays any 2-value quantity in database. Main display mode is primitive mode. Method to generate status quantity: select status quantity label in the Template column at right side, and then select a type of status quantity and drag it to the graph. The following dialog box will pop up:

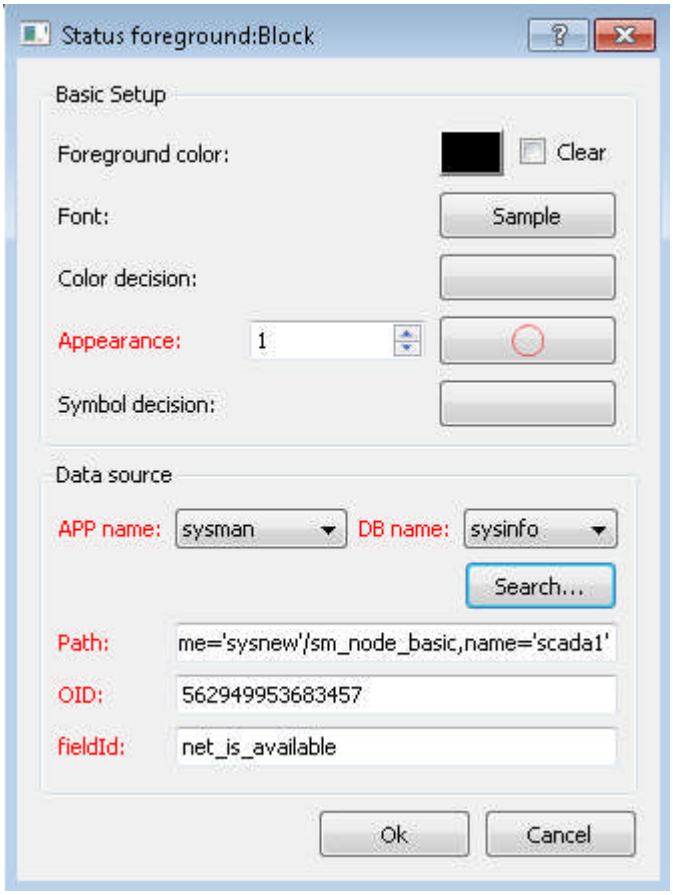


Figure 14.3-38 Status quantity attribute box

1） In “Basic Setup”, user can change foreground color and font of the status quantity. However, color and font of status quantity are normally determined by color decision and symbol decision, hence these items normally need not be set.

2） “Appearance” displays primitive template of current status quantity. The number that follows indicates the primitive scheme displayed in Graph Editor. Click this button. In the dialog box popped up, User can select primitive template for all status quantities. User can select required template for replacement.

3） “Color decision” determines color of a value according to quality bit status and priority of the value in database object. Click Color Decision button to pop up the color decision dialog box shown below. User can select the color decision to be used in the list.

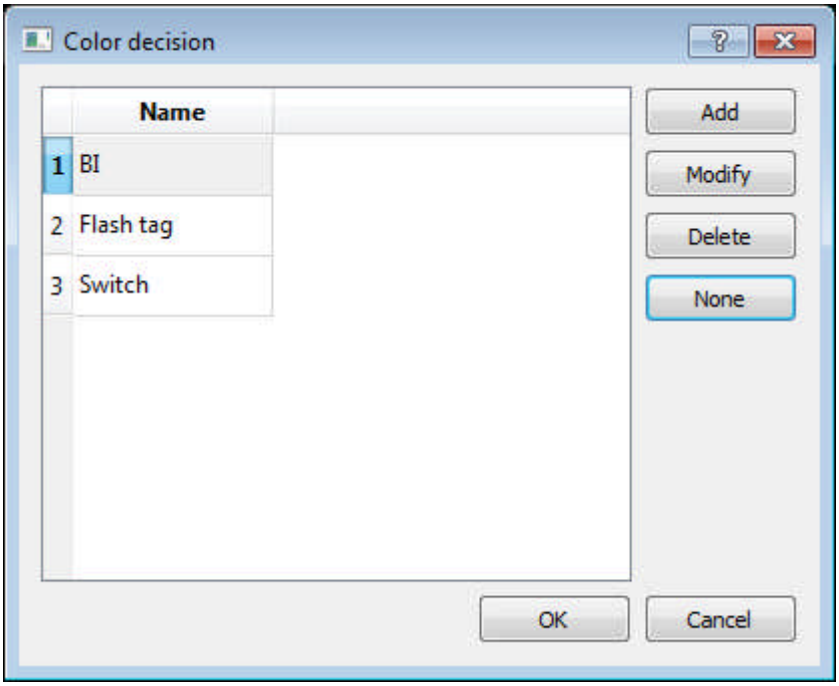


Figure 14.3-39 Color decision

User can select one of the default color decisions of the system, or click “Add” to customize a color decision. User can also select a color decision and click “Modify” to change attributes of this color decision. Press “Add” or “Modify” to pop up the “Color Decision Editor” window shown below. Take addition of a color decision as an example, in the “Name” column in the figure below, enter name of color decision. In the “Table” column, select the table to which current foreground belongs, normally the last item in the list. Then, click button “Add” below to add a color decision item. Double click “Color” cell to select the color of display. If “Flash” is checked, when conditions are satisfied, selected color and original color of foreground will flash alternatively. Use the last item “Color type” to select area affected by the decision, including all colors, line color, border color, text color, and fill color. User can select one of them for coloring. A decision item has higher priority than those behind it. That is to say, if conditions for a number of decision items are satisfied at the same time, color of the front-most decision item will be adopted for display. Use buttons “Up” and “Down” below to adjust decision item priority.

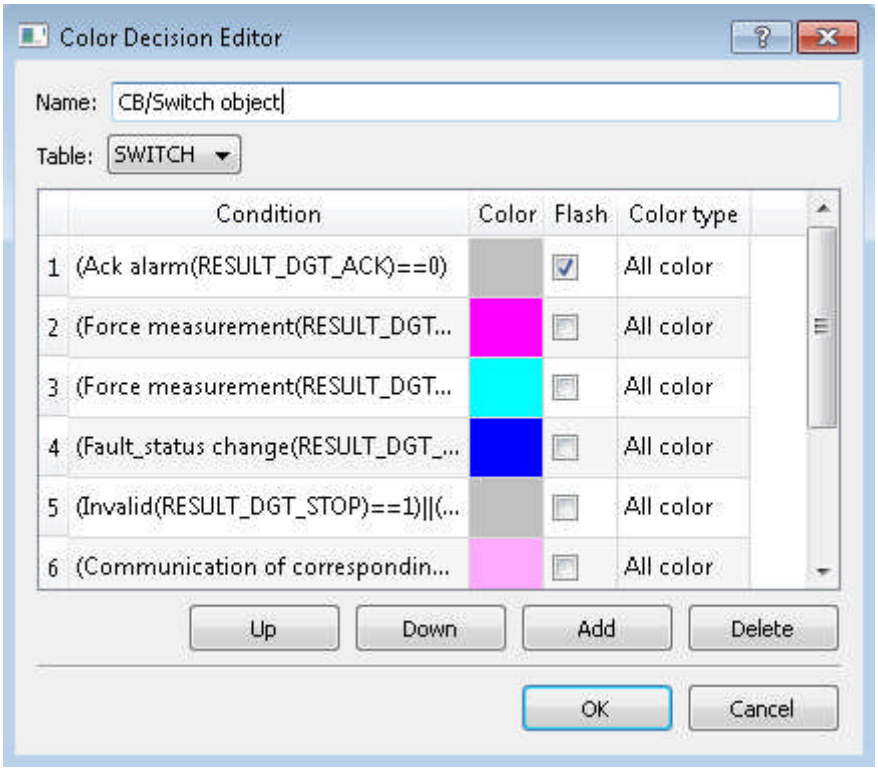


Figure 14.3-40 Color decision editor

Double click the “Condition” cell to pop up the Condition Editor window shown below. Edit required conditions and click OK.

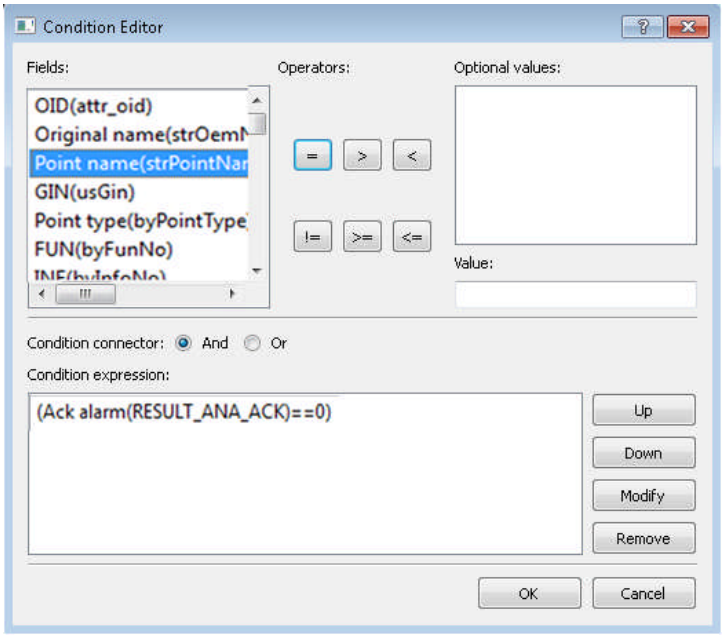


Figure 14.3-41 Edit conditions of decision

4） Symbol decision. Click button “Symbol Decision” to pop up the Symbol Decision Editor dialog box shown below. Select the symbol decision to be used in the list. Similar to color decision, user can “Add” or “Modify” symbol decision, as shown below.

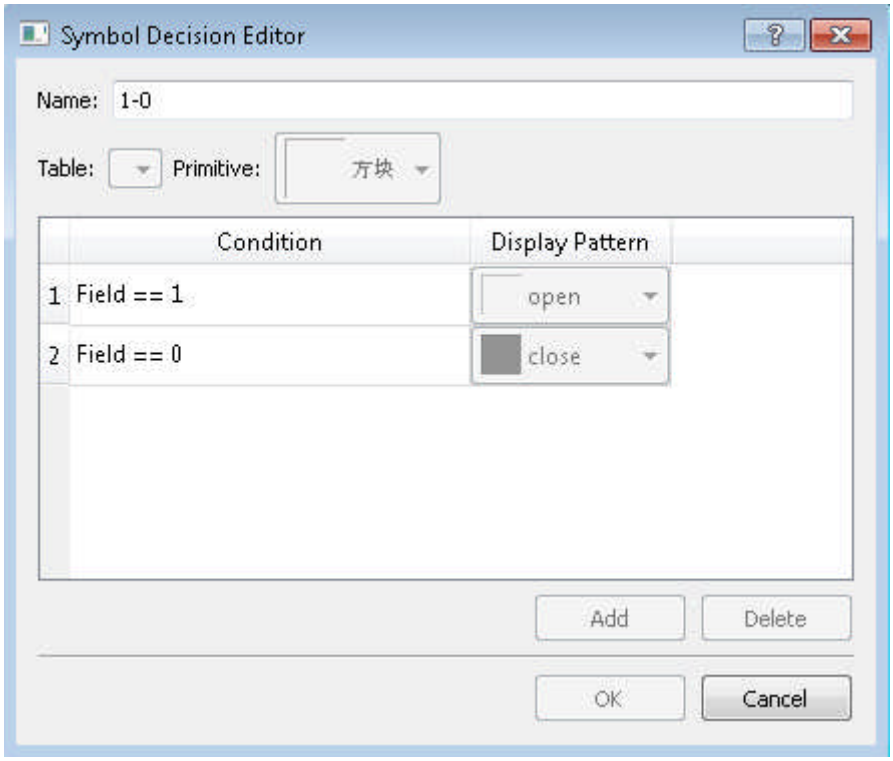


Figure 14.3-42 Symbol Decision Editor

5） Data source defines association between status quantity and database. Select name of application and name of database, and click button “Search”; Database search window will pop up:

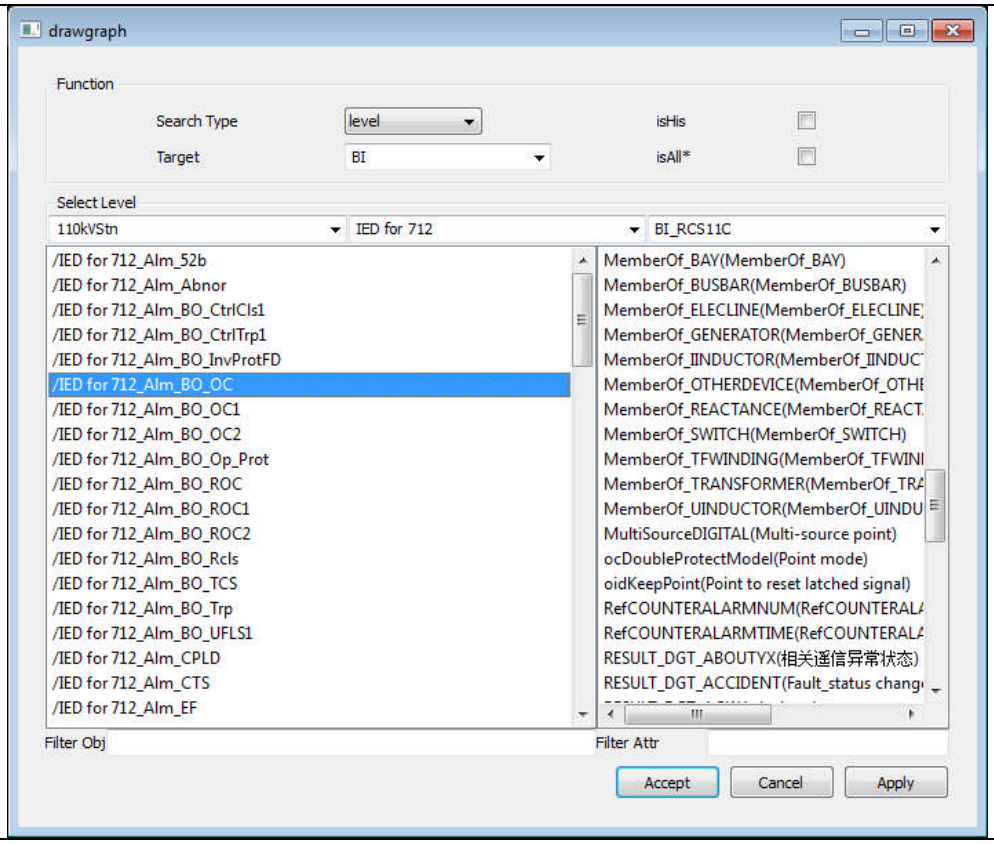


Figure 14.3-43 Search of data source

Different from analog quantity, select “status quantity” as target. Then, search according to layers to find corresponding path. As shown below, corresponding values will appear in 3 columns of “Path”, “OID”, and “FieldId”, indicating successful search.

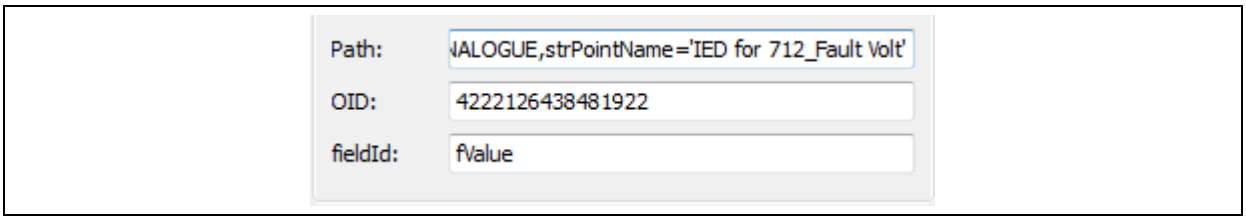


Figure 14.3-44 Data source

After database link is defined, definition of status quantity is successful.

14.3.6.8 Numeric Quantities

A numeric quantity is a type of database object member and includes types of integer, float, string, and time date. To draw a numeric quantity, select “Measuring point”→“Numeric quantity” label in the Template column at right side; the following dialog box will pop up.

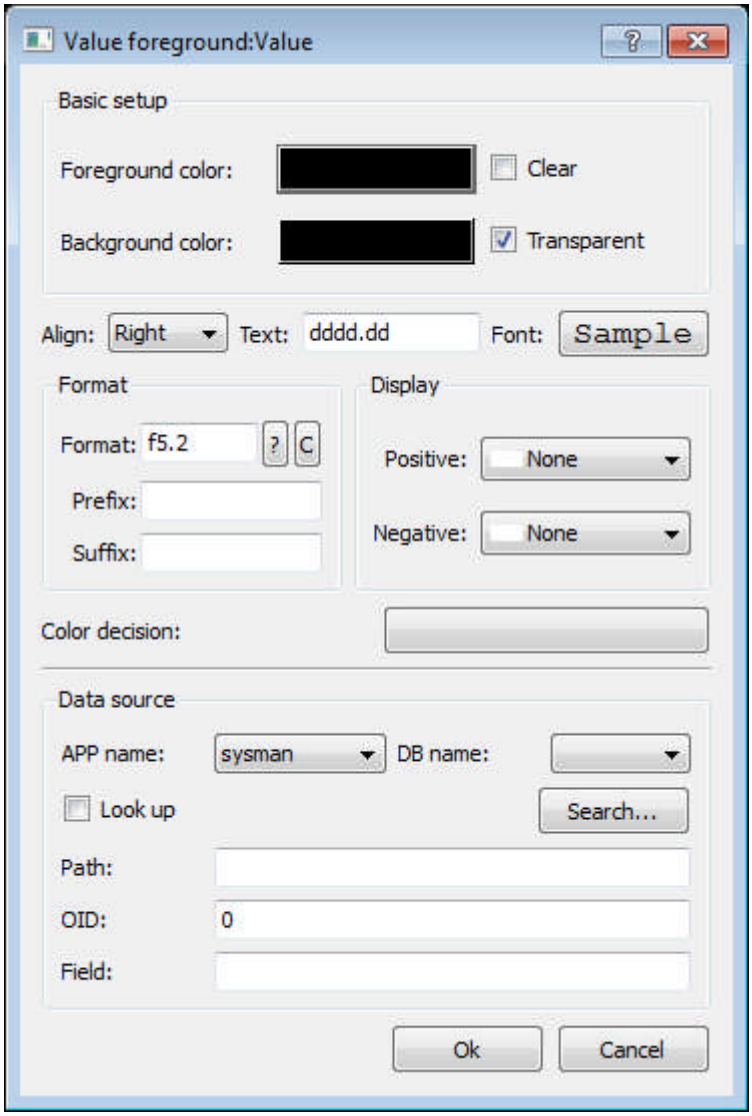


Figure 14.3-45 Numeric quantity (value) attribute box

1） The foreground color is used to determine default color of foreground during online operation. Click color button to pop up a dialog box, in which suitable color can be selected. If foreground color is not required, check “Clear”; color of foreground will be restored to initial value.

2） The background color is the fill color of background rectangle of foreground. In default, background color is transparent, that is to say, background color of foreground is consistent with graph background color. To set different background color, de-select Transparent option and click color button to select a suitable color.

3） Alignment modes include: Align Center, Align Left, and Align Right.

4） In the Text column, default displayed content of the foreground in Graph Editor is set.

5） Click button “Example” to modify foreground font and character size in the dialog box shown below. In the Example box at lower right corner, user can preview effect of changed font and character size:

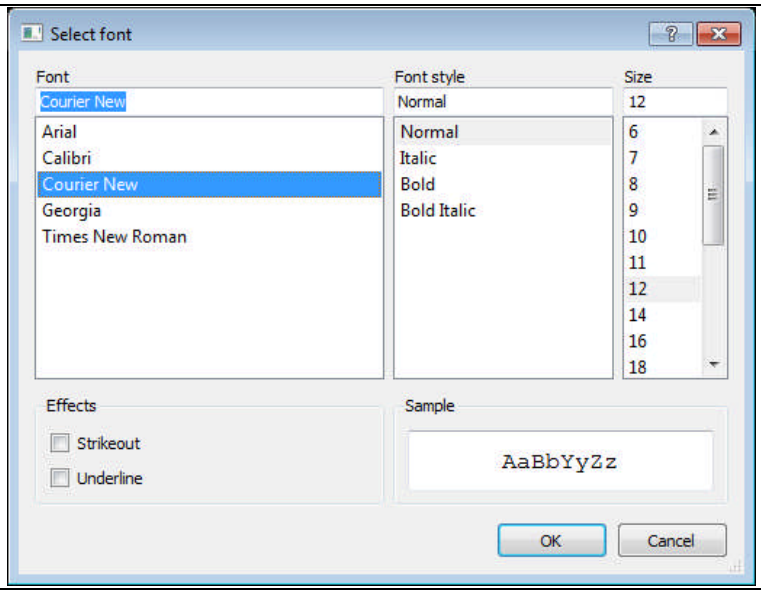


Figure 14.3-46 Select font

6） Foreground display format includes default mode, float, and integer. If not filled, default mode is used. Float definition mode is fx.y, in which f represents floating point number, x represents total number of places, and y represents of number of places after decimal point. Integer definition mode is Ix, in which I represents integer and x represents number of places. “?” after the format can be clicked to display Help. Button “C” represents expression. Click this button to display the dialog box below. User can perform simple arithmetic operation or logical operation of displayed data, e.g. add a number or perform AND operation with a specified value. Yielded value will be displayed in the graph.

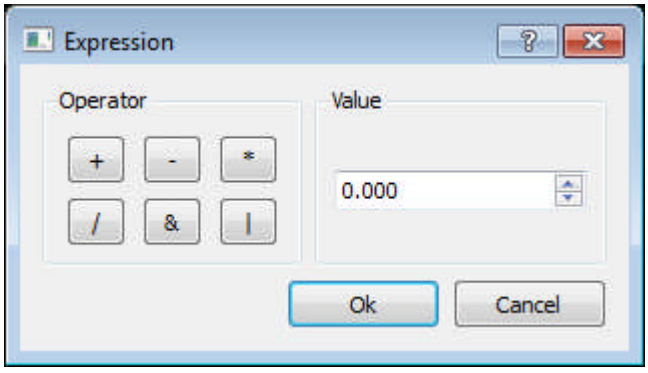


Figure 14.3-47 Calculated value

7） “Color decision” is similar to that of status quantity and not described here.

8） Select application and database to be linked, and click “Search”; the Search is used to define foreground database attributes.

9） In the value foreground definition window, click “OK” to complete definition.

14.3.6.9 Hot Point

Hot point is used to realize various operations in button mode. Click button  and drag mouse

to draw the range of hot point button. The following dialog box will pop up:

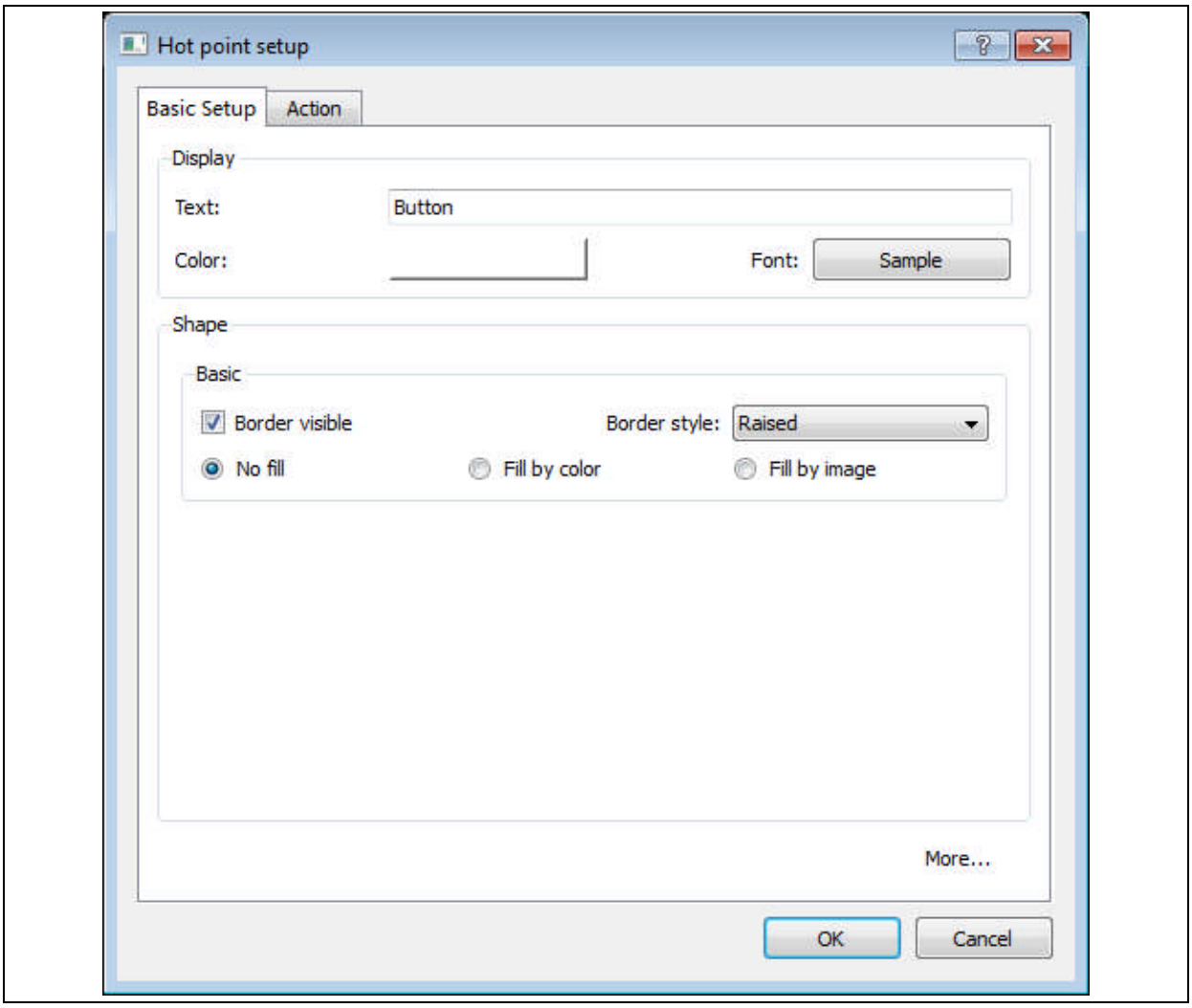


Figure 14.3-48 Hot point setup

Click “Action” to select functions for the hot point.

1） Display graph

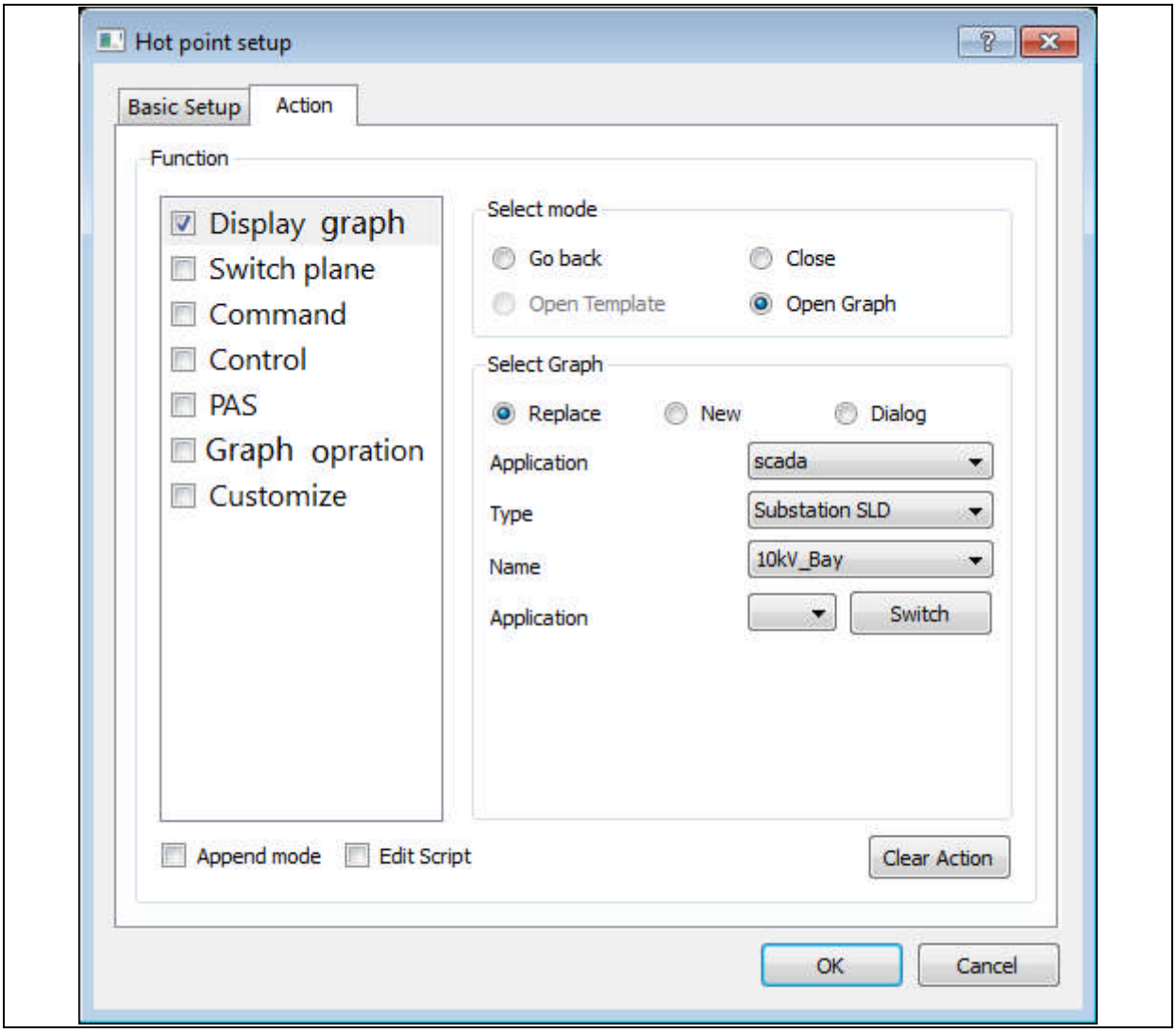


Figure 14.3-49 Hot point setup

- Select mode

Go back——return to last graph opened;

Close——close current graph;

Open graph——open a new graph.

- Select graph

Replace——open a new graph in current browser window;

New——open a new browser window to open a new graph;

Dialog——open a new dialog box type browser window to open a new graph (excluding menu bar, toolbar, and status bar).

- Application: select the application as target of switching. In the Graph Browser, click the hot point to switch to corresponding application.

- Switch: click Switch to pop up the following dialog box:

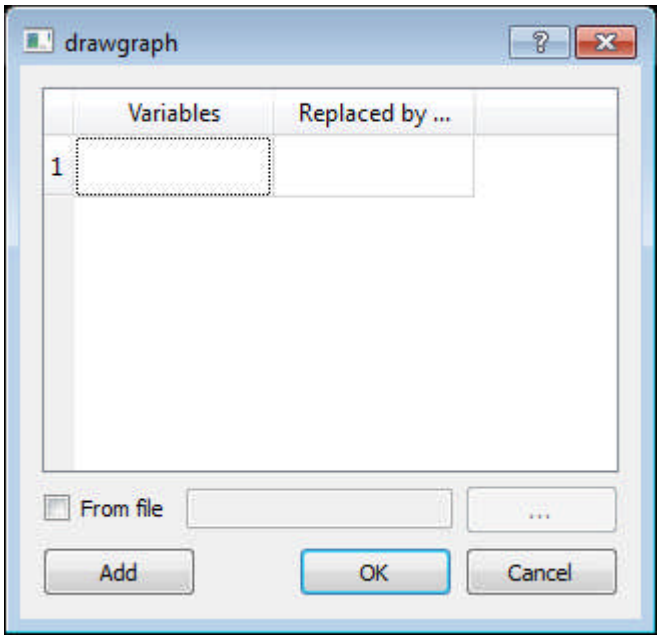


Figure 14.3-50 Define variable

User can define original variable and replacement variable here. When hot point is used to switch graph, automatic variable replacement can be executed for target graph. Note that objects requiring variable replacement in target graph must be added into “VARPLANE” plane; otherwise replacement will not be performed.

Append mode: After this item is checked, user can set a number of actions at the same hot point. After such hot point is clicked, a number of actions will be carried out in sequence.

Edit script: After this item is checked, script of the hot point can be manually modified.

Clear action: clear existing action(s) of this hot point.

Note: “Append mode”, “Edit script”, and “Clear action” have the same effects in each function of hot point, which are not repeated below.

2） Switch plane

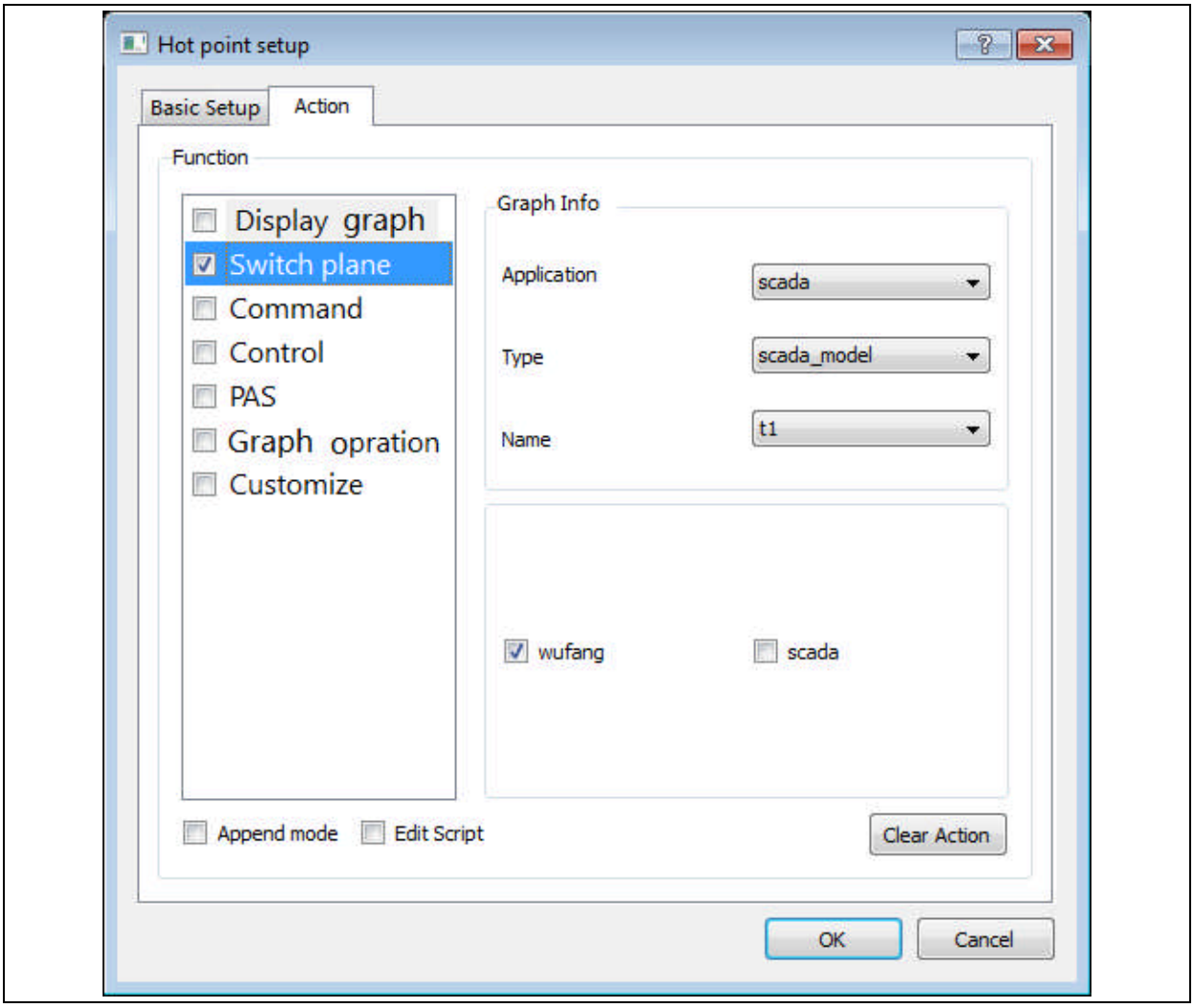


Figure 14.3-51 Hot point setup

In case this graph has a number of planes, user can define the plane to be displayed.

3） Command

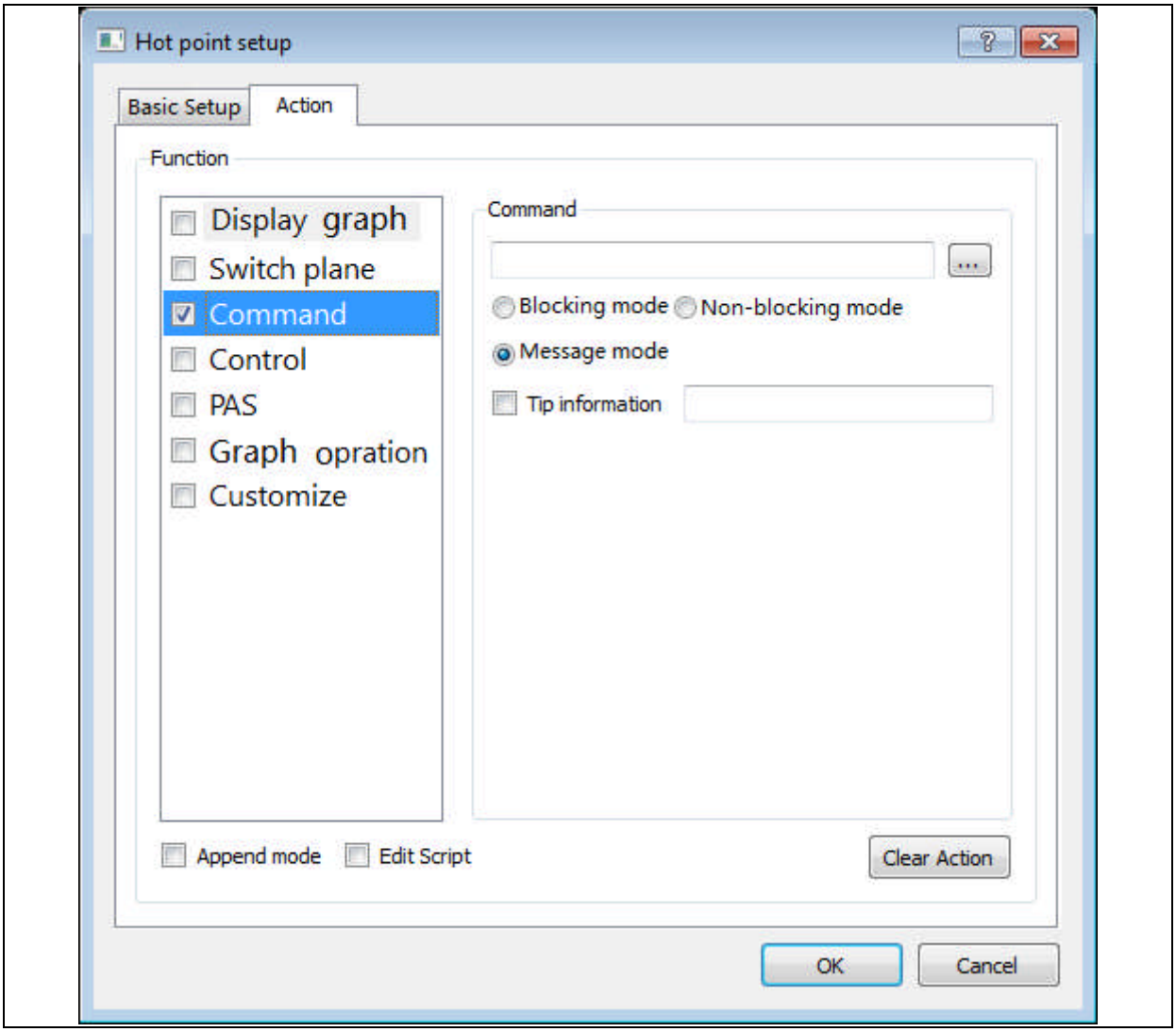


Figure 14.3-52 Hot point setup

- Command: enter full path of the program to be executed here. User can also click “Browse” button to pop up a File dialog box, in which a program can be selected. After clicking OK, its path will be automatically filled in the command box.
- Blocking mode: operation can only continue after command execution
- Non-blocking mode: operation can continue before end of command execution.
- Message mode: This mode allows interaction with command execution after hot point is clicked in the Graph Browser, e.g. call of Curve tool to open specific curve.

4） Control

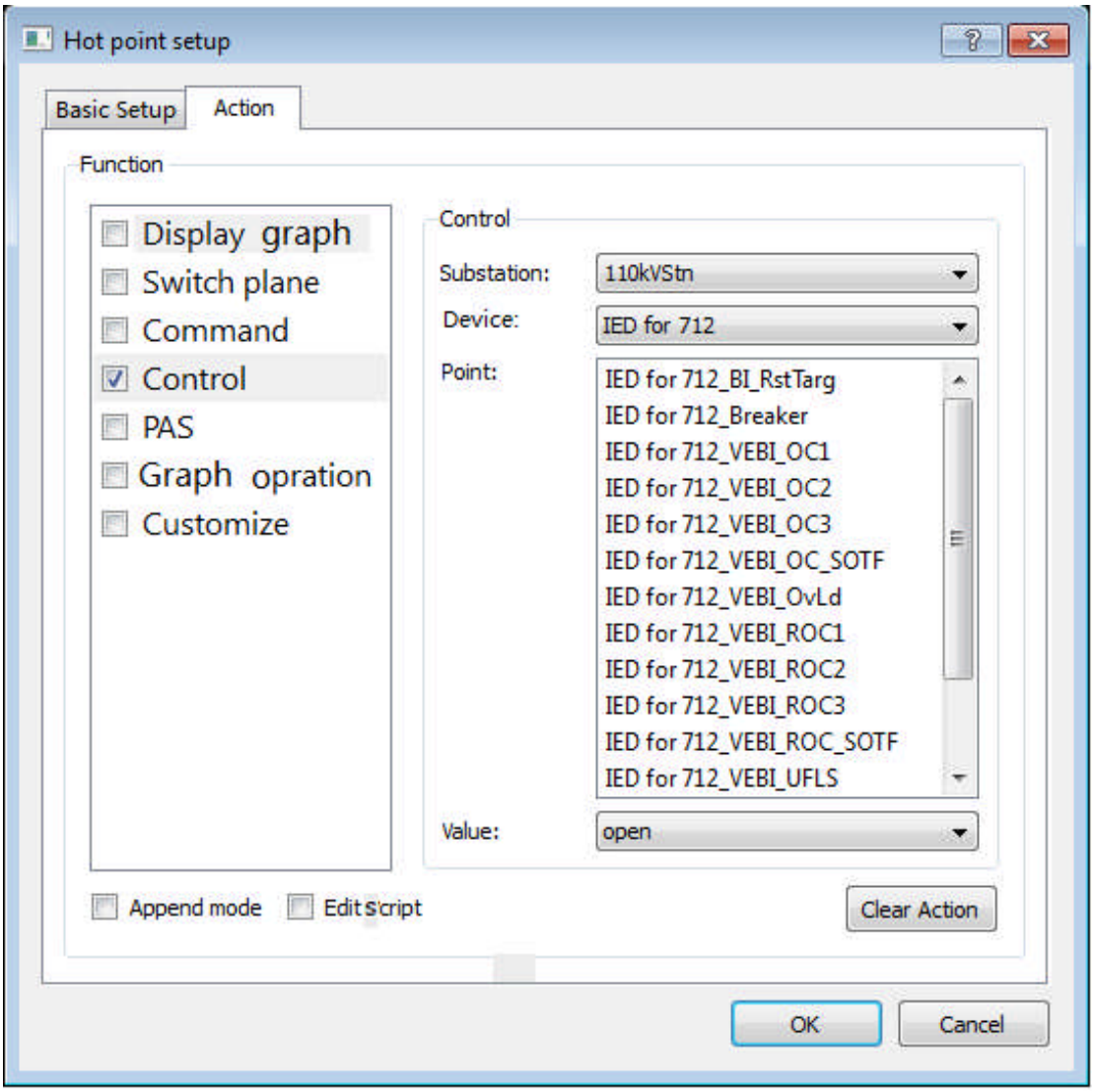


Figure 14.3-53 Hot point setup

- Substation: select substation.
- Device: select device
- Point: select control point
- Value: open, close, or optional

5） PAS

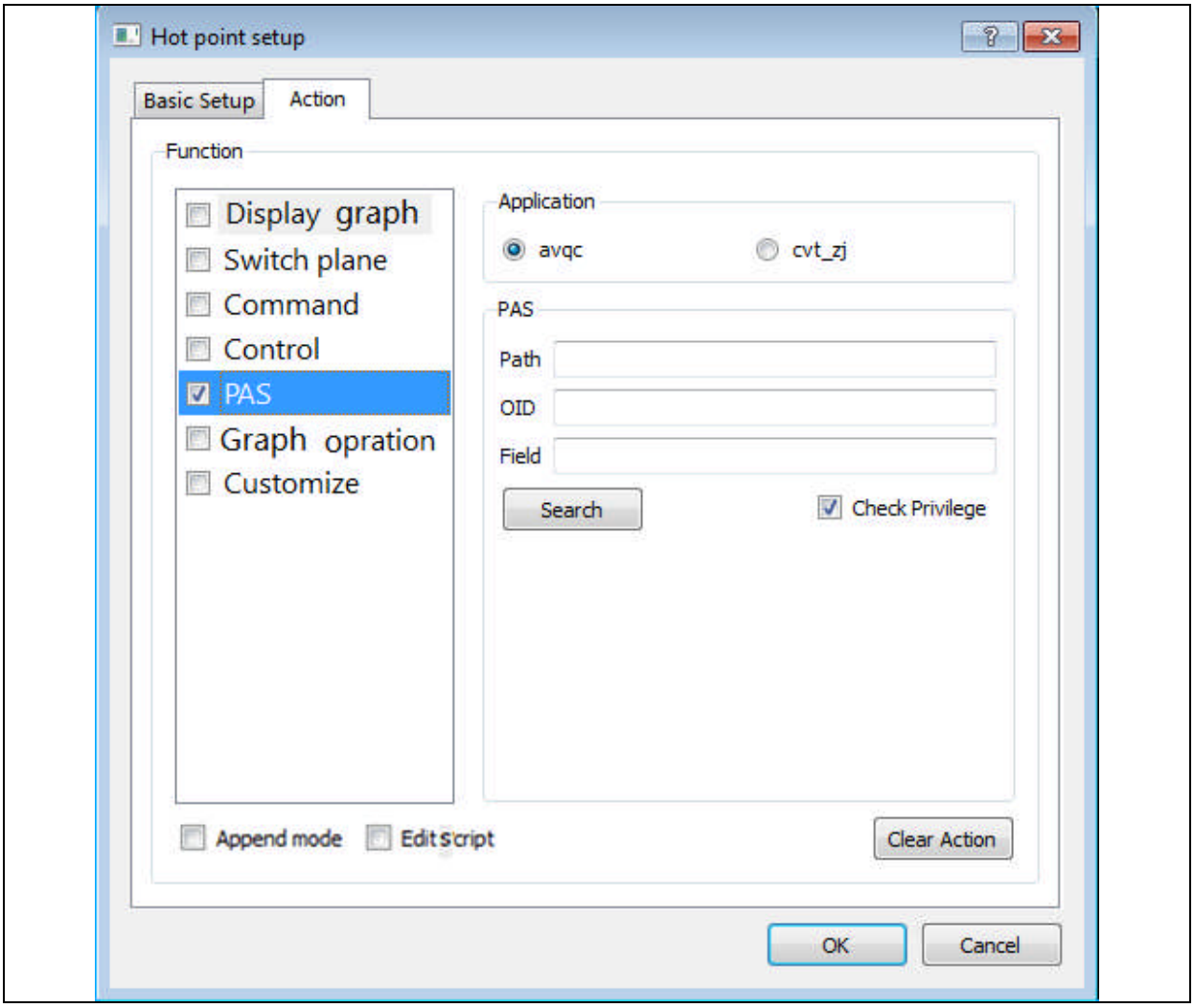


Figure 14.3-54 Hot point setup

Here, you can set hot point actions of PAS such as VQC and CVT etc. Click “Search” button to select related actions of PAS.

6） Graph operation

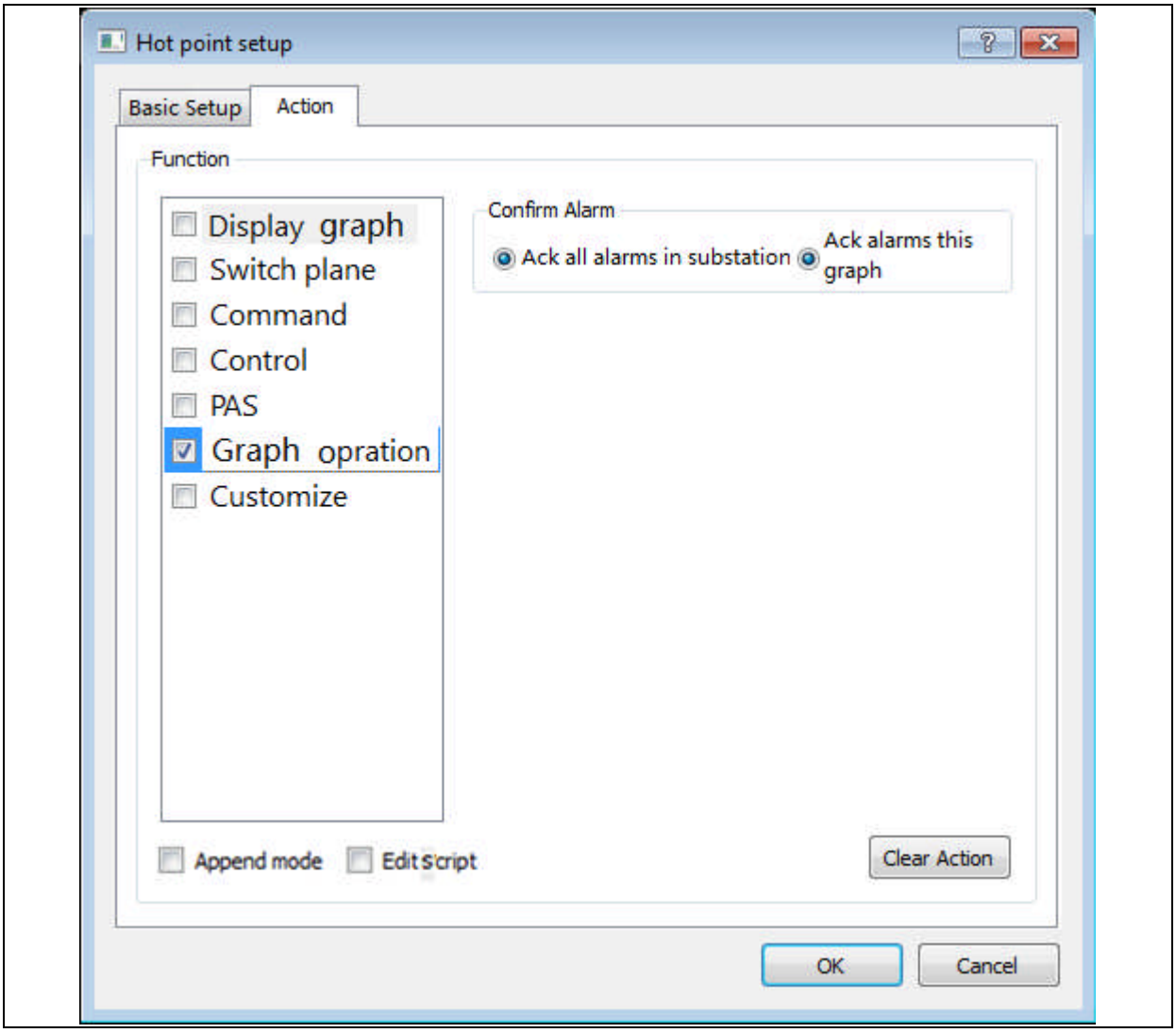


Figure 14.3-55 Hot point setup

- Ack all alarms in substation: after clicking the hot point, perform alarm acknowledgement for this substation
- Ack alarms this graph: after clicking the hot point, perform alarm acknowledgement for this graph.

7） Customize

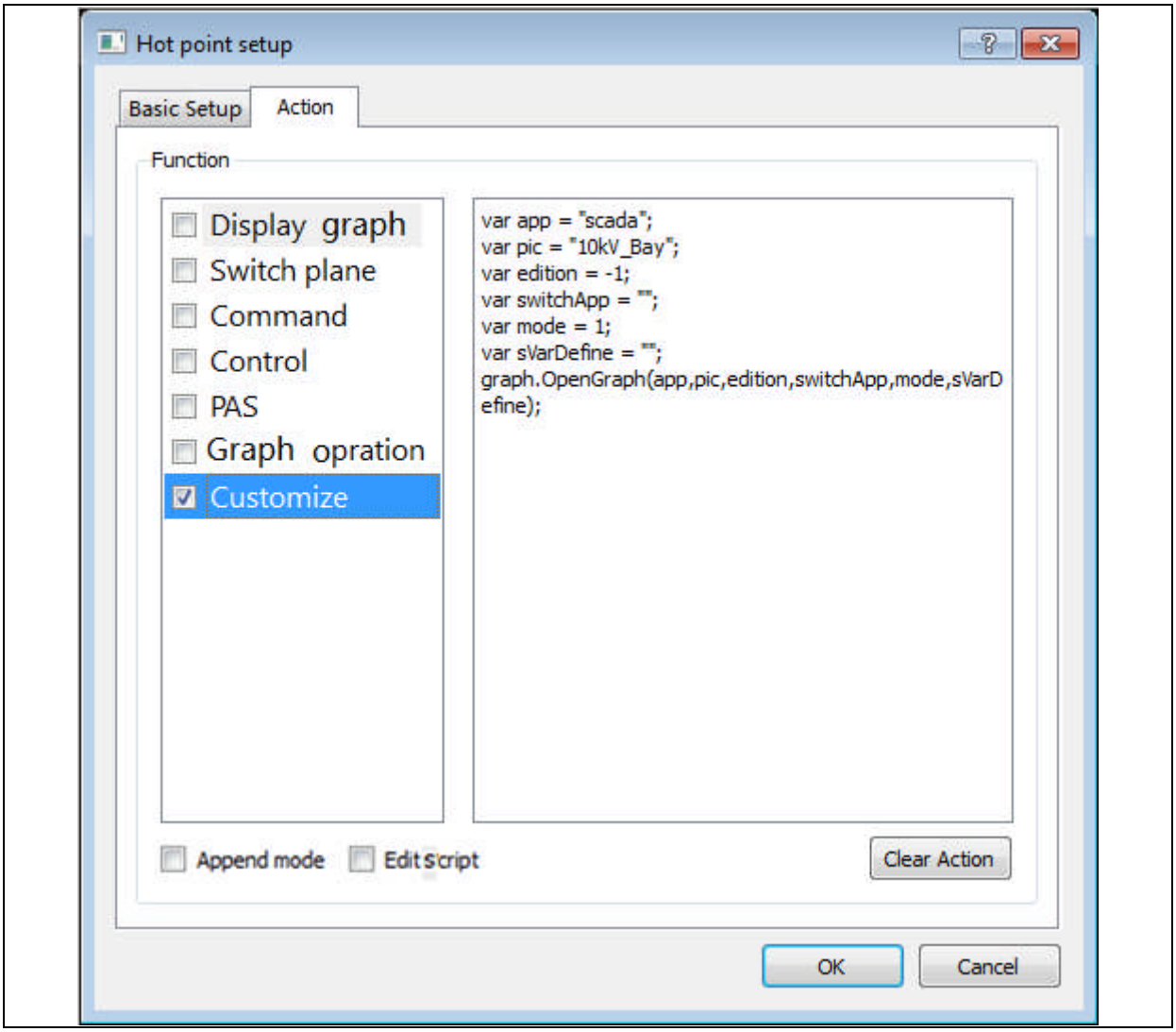


Figure 14.3-56 Hot point setup

In this mode, user edits script of hot point actions for himself.

14.3.7 Template Function

The template function is an important part of the Graph Editor. By generating a template from all or part of a graph and reuse thereof, generation of graphs can be much accelerated to increase work efficiency.

14.3.7.1 Generation of Bay Template

To generate a template, first select objects to be used as template in the graph and then click button  (group). Right click the grouped objects and select “Save as bay template”, as shown below.

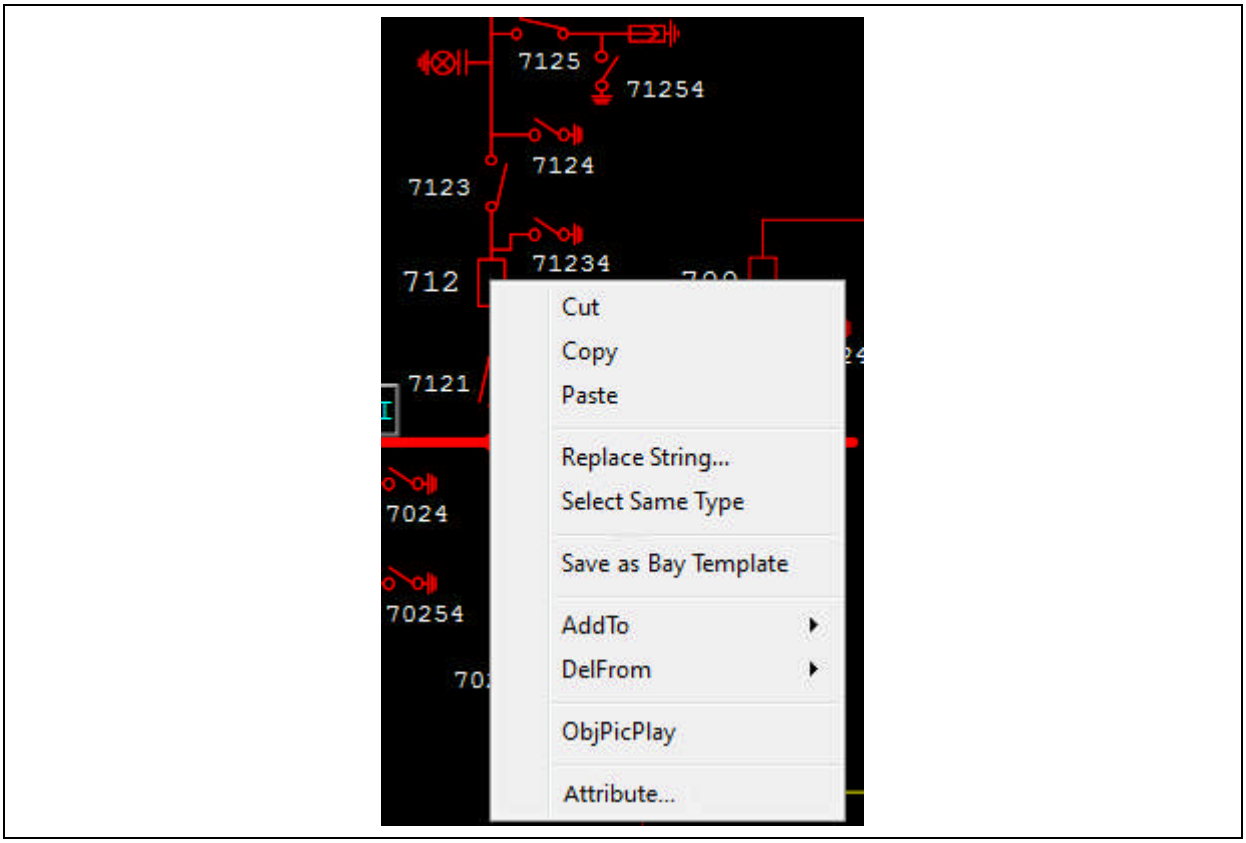


Figure 14.3-57 Generate template

In the dialog box popped up, enter name of bay template. After clicking OK, a new Graph Editor window will pop up, in which the bay template just saved will be displayed, as shown below.

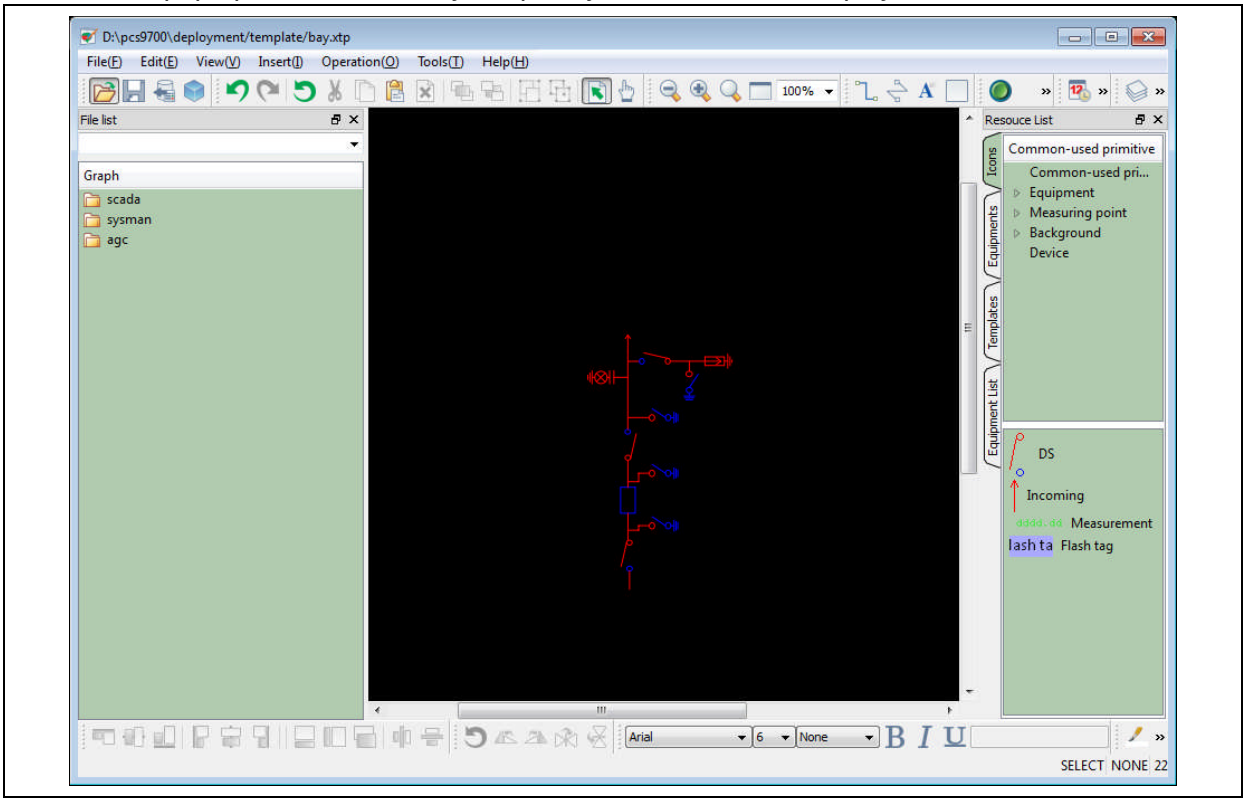


Figure 14.3-58 Edit template

Right click a blank place outside the template and select “Simple template” to pop up the following dialog box. At left side, equipment names in the template are listed. Click an item of equipment; its name will appear in the middle editing box. After being edited, click button “>>” to add this name to the “Replaced keywords” column. Contents of “Replaced keywords” will be replaced when the bay template is used. Take the following figure as an example, set “Replaced keywords” to “2012”, so that when this template is used, 2012 will be replaced by other bay name, realizing change of bay name. After editing, save to validate the setup.

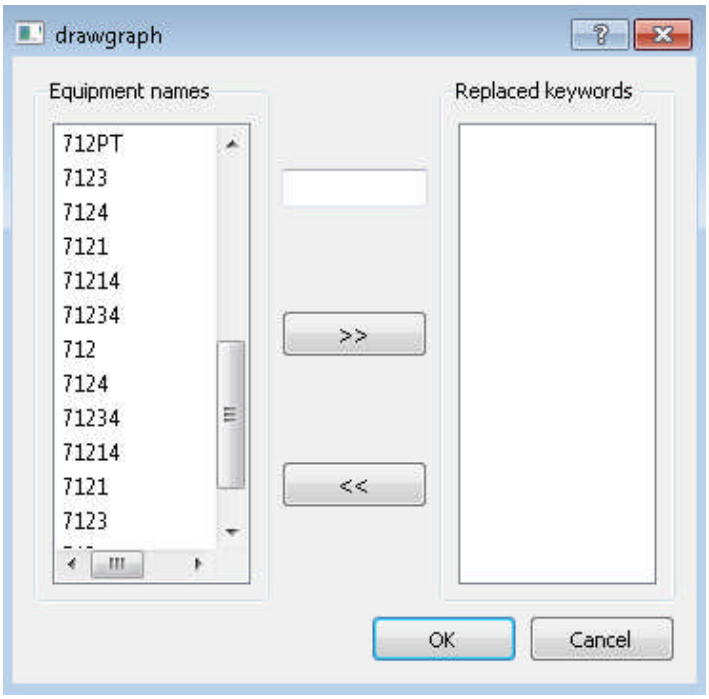


Figure 14.3-59 Replaced keywords

14.3.7.2 Use of Bay Template

To use a bay template, click “Template” tab in the Resource List. Select the template to be used in the Bay templates column, and drag it to the graph. At this time, if this template has used “Simple template” function, the following dialog box will pop up. Enter replacement string; all matching equipment names in the template will be changed. Finally, move the template to target position.

Click button  on the toolbar to ungroup objects; user can now edit equipment in the template like editing ordinary equipment.

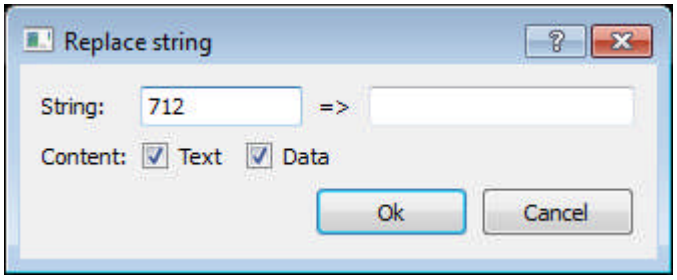


Figure 14.3-60 Replace string

14.3.7.3 Edit and Delete Template

To edit a template, first select this template in the interface shown in *Figure 14.3-58*. Right click mouse and select “Edit template” in the menu popped up, as shown below. At this time, a Graph Editor interface will be opened to display the template to be edited. In this interface, modify and save the template.

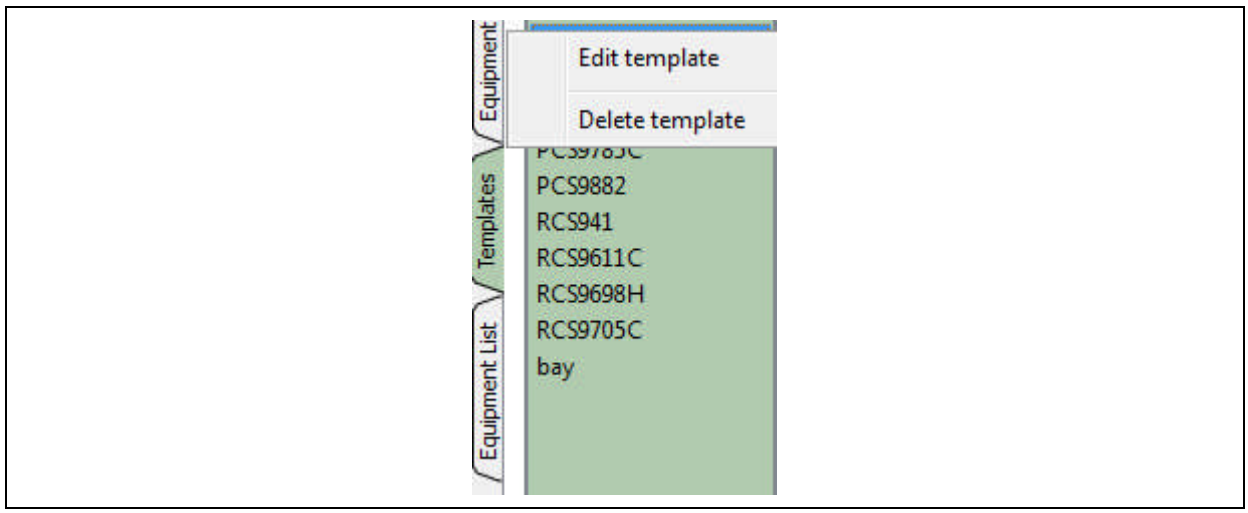


Figure 14.3-61 Edit, delete template

To delete a template, select “Delete template” in the menu above, and then select OK in the confirmation dialog box popped up; the template will be deleted.

14.3.7.4 Generation of Style Template

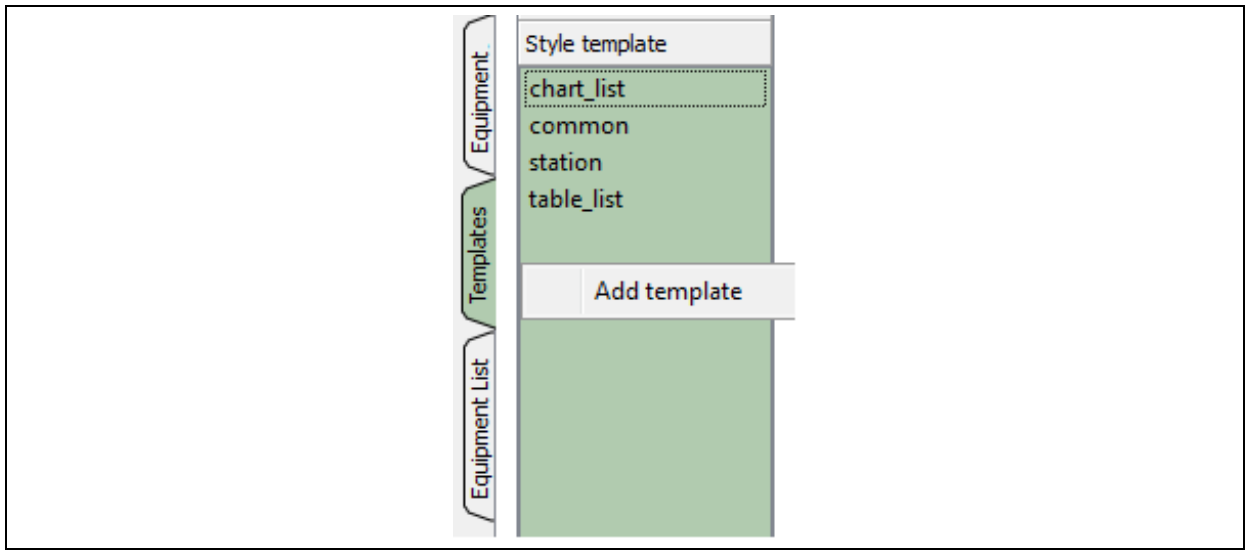


Figure 14.3-62 Add style template

Right click a blank place on Style template and select “Add template”.

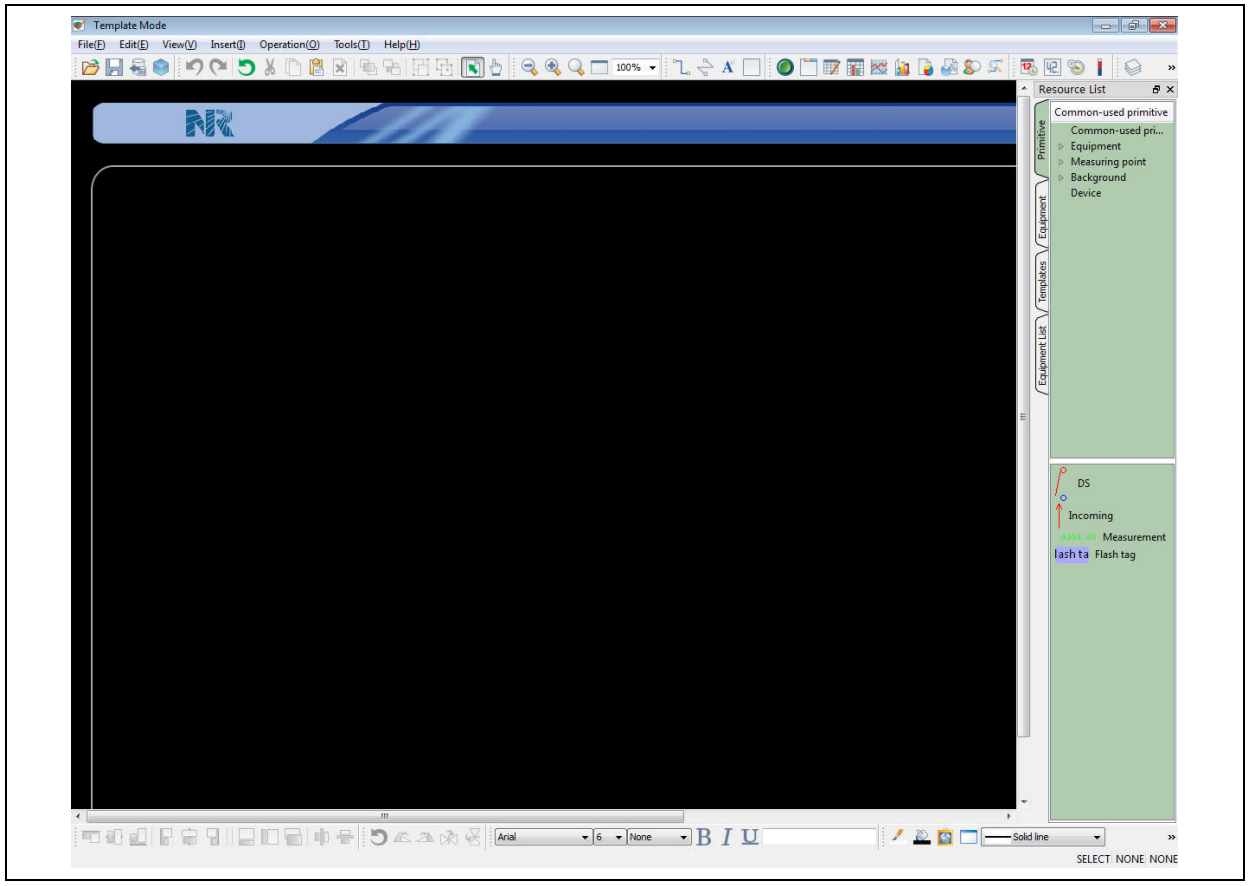


Figure 14.3-63 Create a style template

Create the style template in the Graph Editor window newly opened. After editing, save and exit.

14.3.7.5 Use of Style Template

To use a style template, click “Template” tab in the Resource List. Select the template to be used in the style template column and drag it to the graph. To view the template used by this graph or cancel use of the template, select “Graph attribute” in the menu shown in

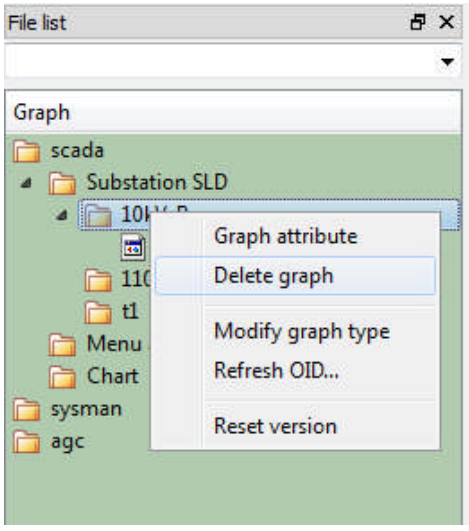


Figure 14.3-7. The following window will pop up.

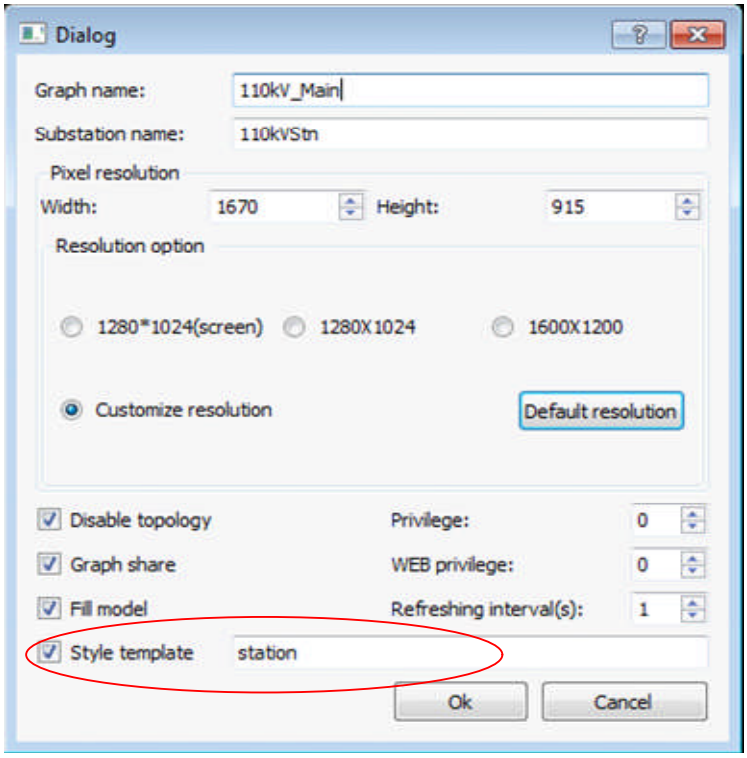


Figure 14.3-64 View the template used

14.3.8 Use of Equipment List

14.3.8.1 Find and Position an Item of Equipment on a Graph

Open a substation diagram and click “Equipment” tab of Resource List. User will see two tabs under it: “Equipment list” and “Search”, as shown below. In “Equipment list”, all equipment in current graph is listed according to voltage levels, with types of equipment shown. Unfold a voltage level and double click an item of equipment; this equipment will be selected and positioned at center of the graph.

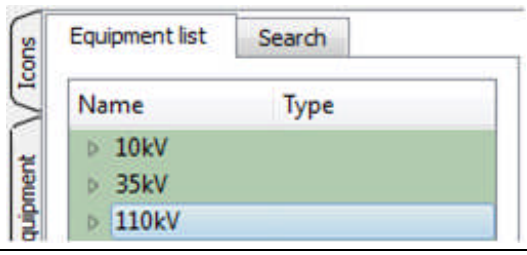


Figure 14.3-65 Equipment list

Click “Search” tab; the interface is shown as below. In “Find” editing box, enter name of the equipment to be found. In the list below, matching equipment will be displayed according to content entered. Double click an item of equipment to select it and position it at center of the graph.

Combining the Find function of equipment list and that of menu, you can very easily locate an item

of equipment in substation diagram, thus increasing speed and efficiency of editing.

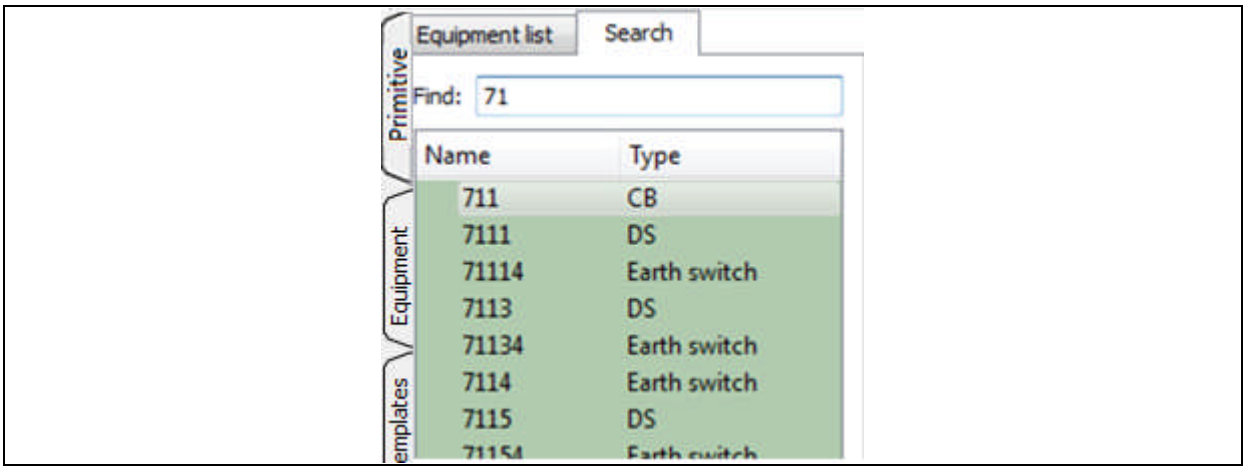


Figure 14.3-66 Search equipment

In default, in equipment list, equipment and bays are differentiated according to voltage levels. User can also change this to differentiation according to equipment types. Method: right click voltage level and select “Arrange by” in the menu popped up. Then select “Type”, as shown below:

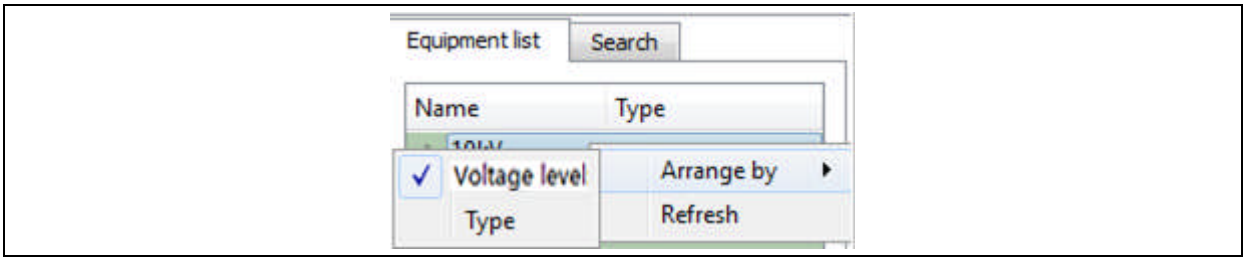


Figure 14.3-67 Arrange equipment

14.3.8.2 Select Bay Equipment and Delete Bay Equipment

Right click a bay name to pop up the following dialog box. The following operations can be performed:

Select bay: select all equipment in this bay.

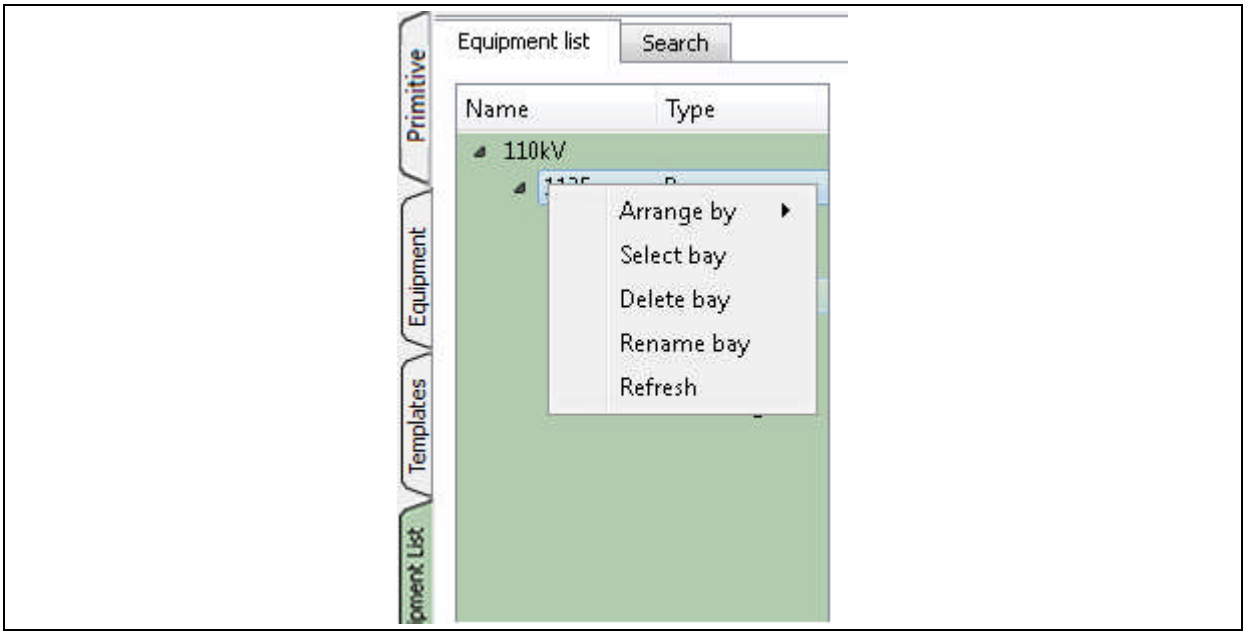


Figure 14.3-68 Select bay equipment and delete bay equipment

Delete bay: select this item to pop up a dialog box to confirm deletion. After confirmation, this bay will be deleted from the tree type list. At the same time, equipment originally belonging to this bay will no longer have bay attribute.

14.3.9 Bay Attribute of Equipment

Double click an item of equipment to pop up Attribute dialog box as shown below. “Bay” displayed is the bay to which this equipment belongs and cannot be directly modified.

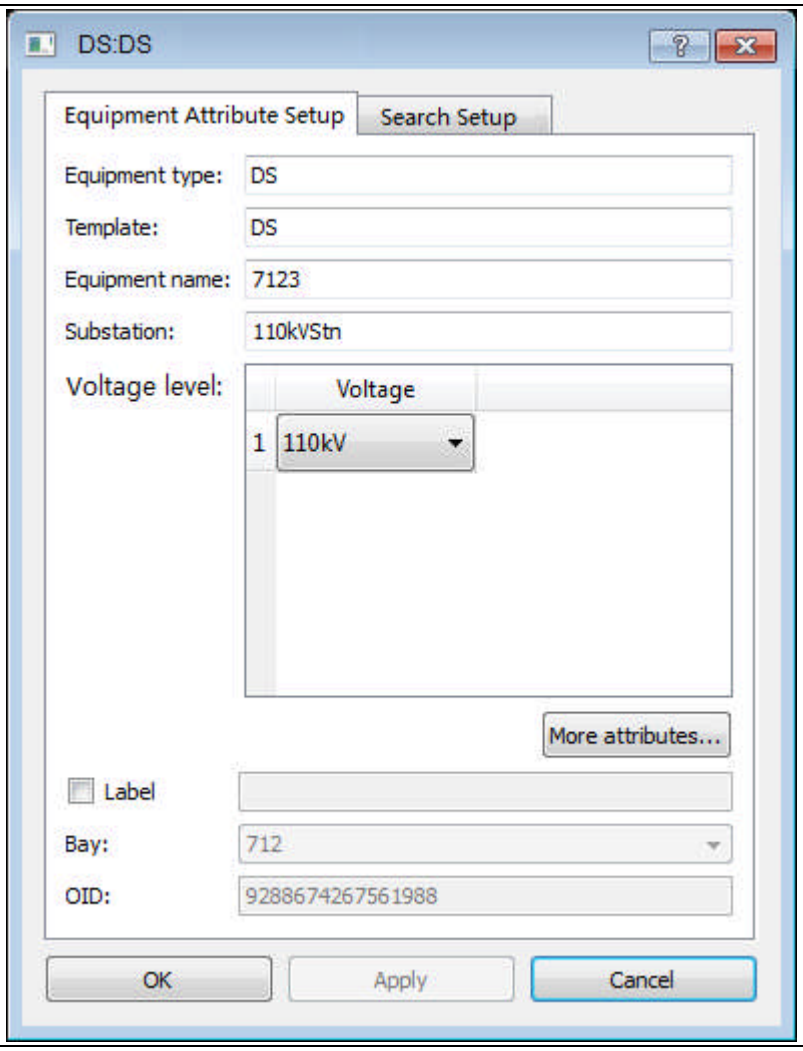


Figure 14.3-69 Equipment attribute setup

If model has been filled for current graph, user can change bay attribute of equipment while changing name of the equipment. Method: click “Search Setup” tab in above figure. In the following dialog box popped up, select voltage level and bay (bay in database) in sequence, and then select equipment in the list. After clicking OK, original equipment name will be changed to selected equipment name. At the same time, name of bay will be changed to name of selected bay, and OID will change accordingly.

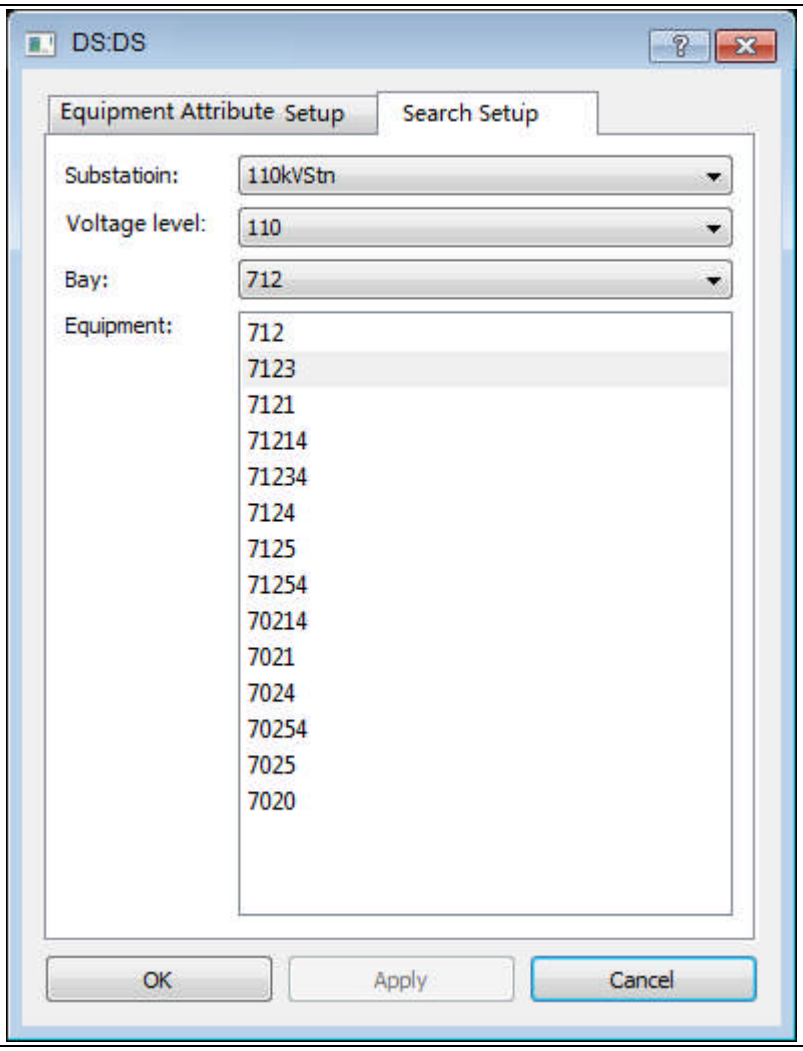


Figure 14.3-70 Search equipment

The following figure shows results of selection of KG5012. Compared with *Figure 14.3-69*, user can see that equipment name, bay name, and OID have all changed.

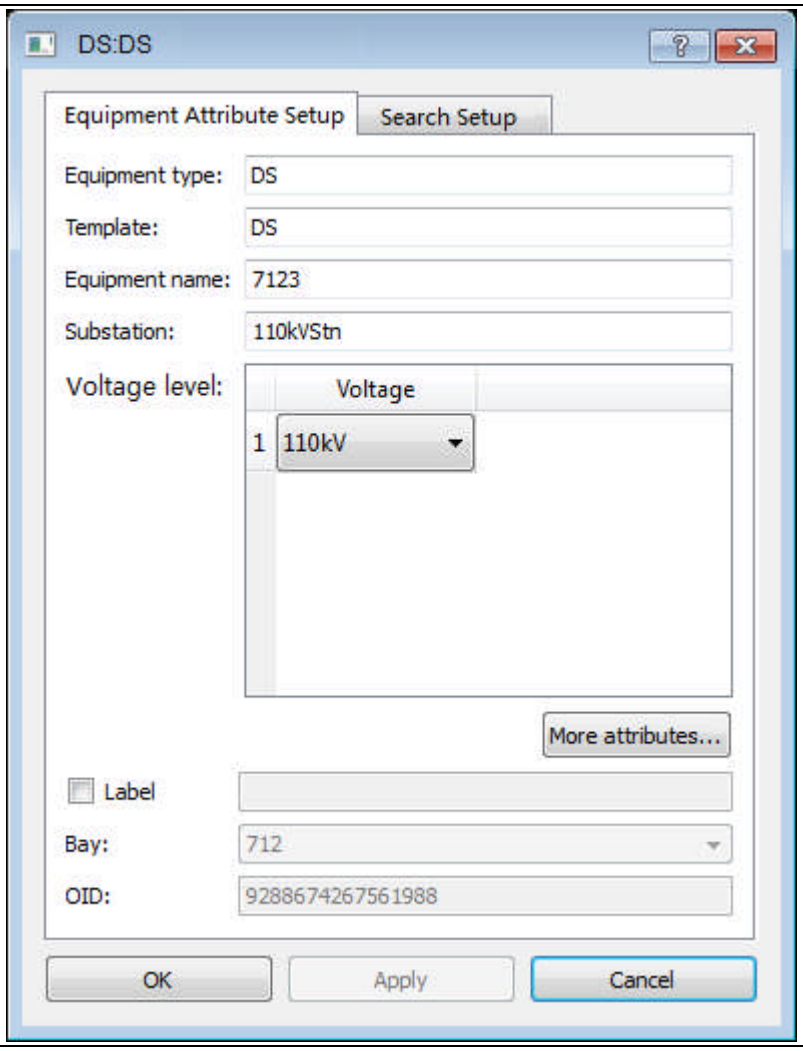


Figure 14.3-71 Equipment Attribute Setup

14.3.10 Modification of Topology Color and Voltage Level Color

To modify color corresponding to each voltage level, click “Edit color” in menu “Tools” to pop up the following dialog box:

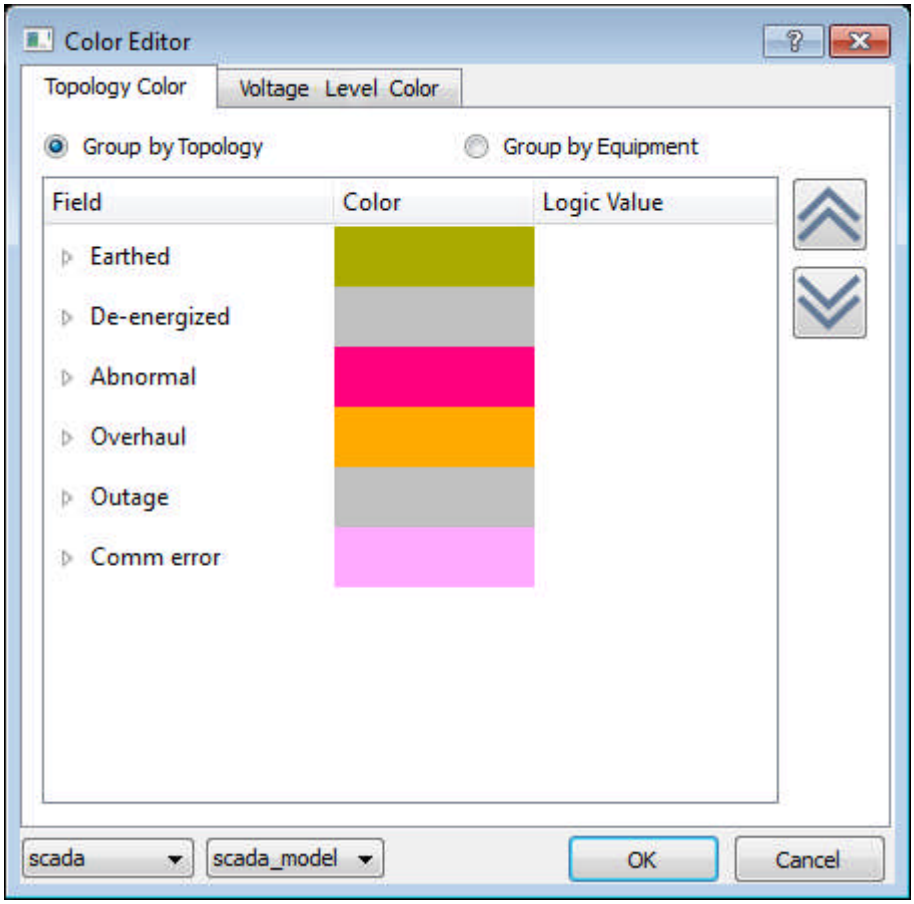


Figure 14.3-72 Topology color

The list above displays topology colors in current system. To modify a color, double click the color column and select suitable color in the Color dialog box popped up.

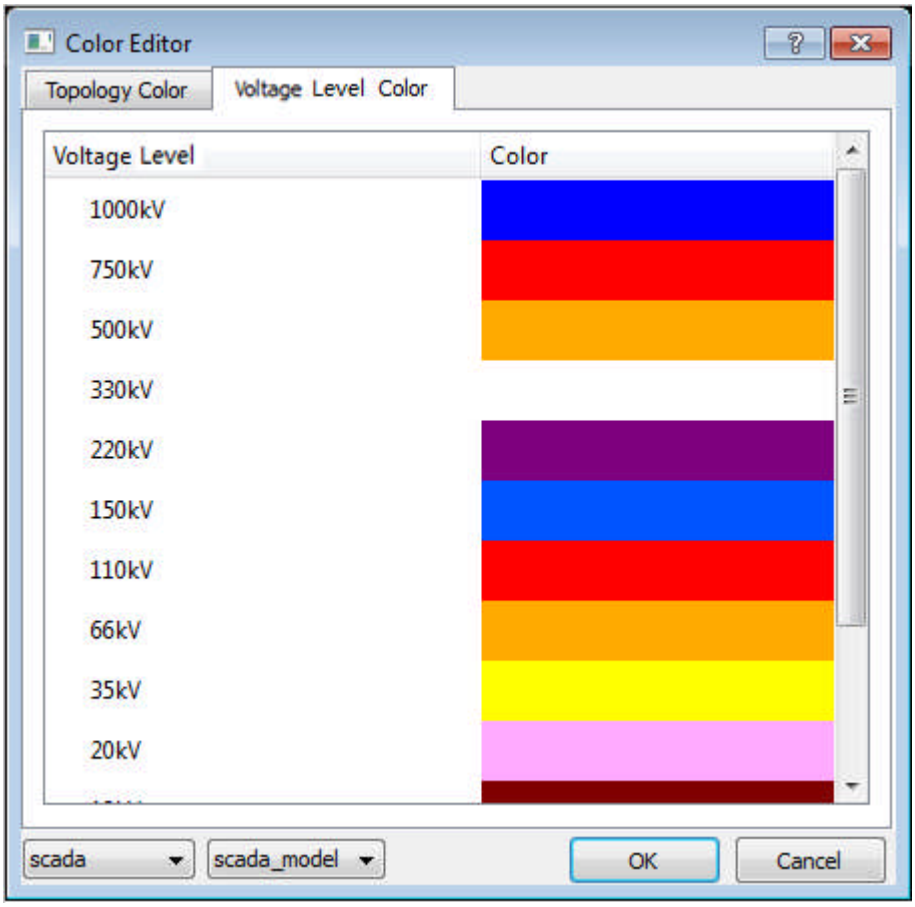


Figure 14.3-73 Voltage level color

This list displays color of each voltage level in current system. To modify color of a voltage level, double click the color column and select a suitable color in the Color dialog box popped up. After selection, click OK; color of all equipment of this voltage level in substation diagram will change.

14.3.11 Operations of Context Menu

14.3.11.1 Context Menu of Equipment Object

Select and right click an equipment object on the graph to pop up the following menu:

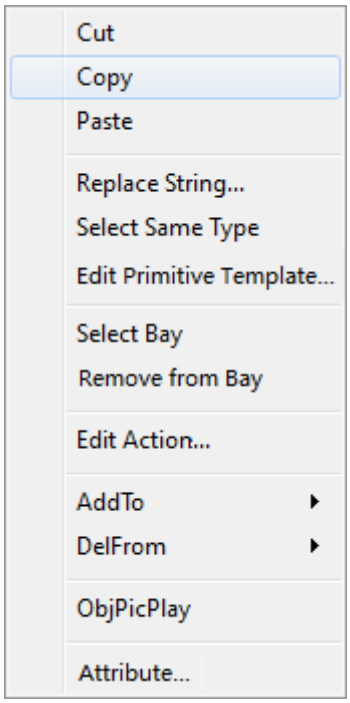


Figure 14.3-74 Context menu

Cut: cut currently selected primitive.

Copy: copy currently selected primitive.

Paste: paste current content of the clipboard.

Replace String: after clicking this menu item, the following Replace String dialog box will appear as shown below. User can enter original string and replacement string. Scope of replacement includes equipment name, text, hot point, and foreground path etc. User can select text or data to be replaced.

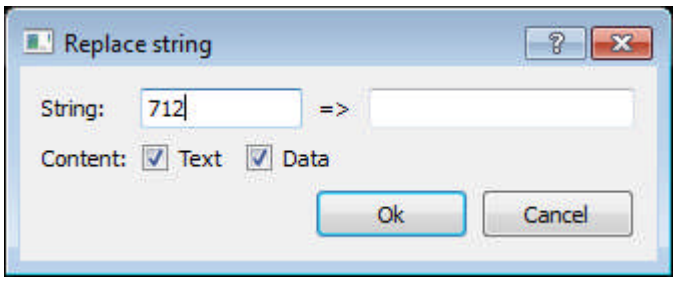


Figure 14.3-75 Replace string

Select Same Type: select all equipment in the graph of the same type as currently selected equipment

Edit Primitive Template: select this item to open primitive template of selected equipment in the Primitive Editor for editing.

Select Bay: select all equipment in the graph belonging to the same bay as currently selected equipment

Attribute: pop up equipment attributes dialog box.

14.3.11.2 Context Menu of Ordinary Object

Right click graphic object other than equipment to pop up the following menu:

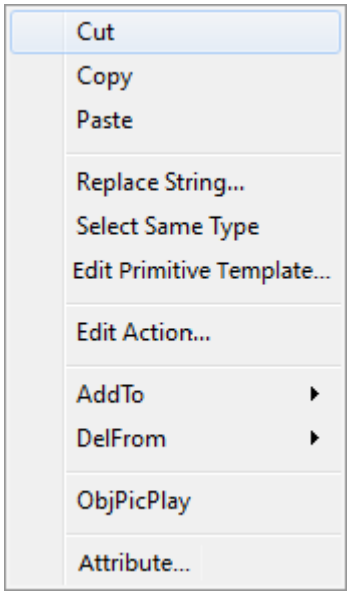


Figure 14.3-76 Context menu

It can be seen that this menu is the previous menu less equipment operations. Methods of use are basically consistent with the previous menu, only that attribute operations have different attribute boxes according to different objects selected.

14.4 Instantiated Description

14.4.1 Description of Substation Diagram

14.4.1.1 Drawing of Substation Diagram

To add a new substation diagram, user can create a blank graph and add equipment to it and draw connecting lines. User can also paste a similar graph and modify it to realize the new substation diagram.

14.4.1.2 Publish Substation Diagram

After drawing or modification of the whole graph, click button “  ” on toolbar to save the graph. Later, select name of this graph in the Graph List, right click mouse, and select “Publish graph”, as shown below:

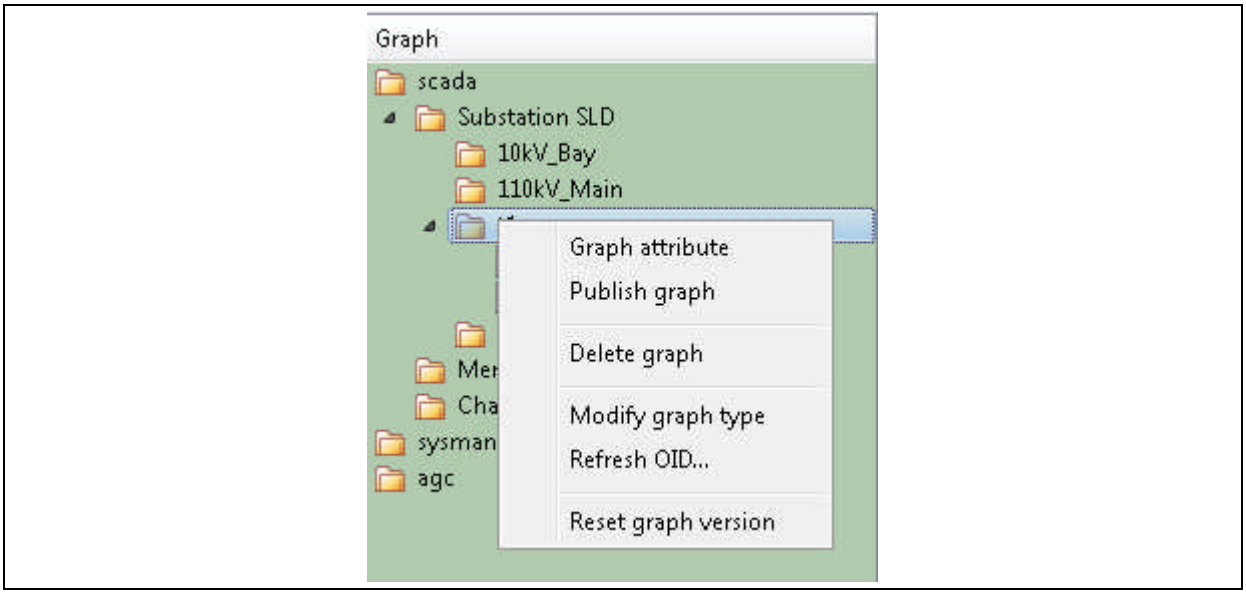


Figure 14.4-1 Publish graph

After successful publishing of graph, only latest version will be shown under graph name, as shown below:

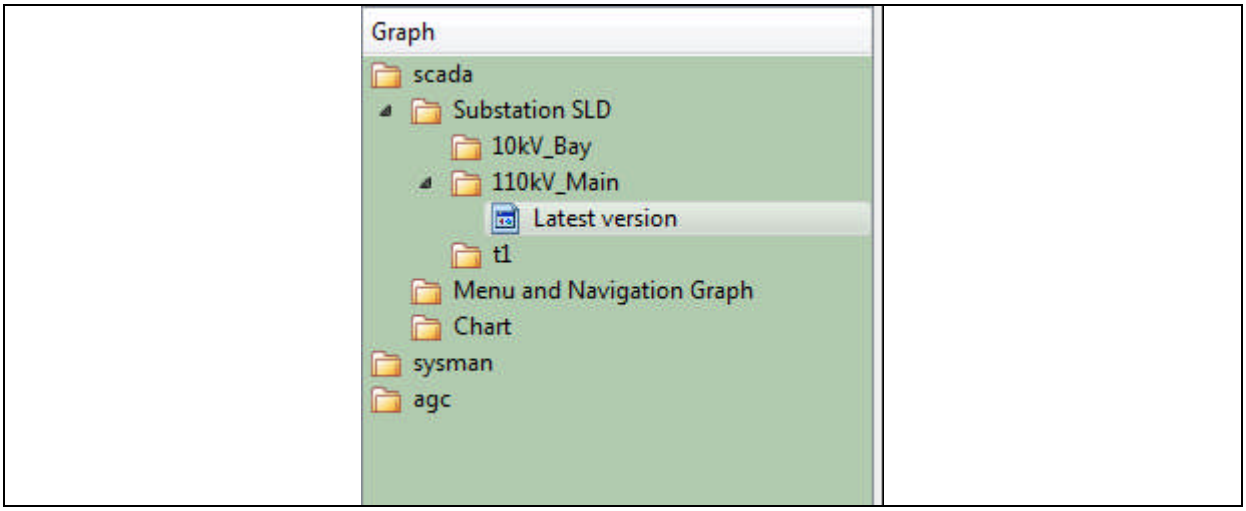


Figure 14.4-2 Latest version

14.4.1.3 Fill Model for Substation Diagram

On the toolbar, click button “ ” (Fill Model) to perform Fill Model operation. After the following dialog box appears, click “Yes” to fill model.

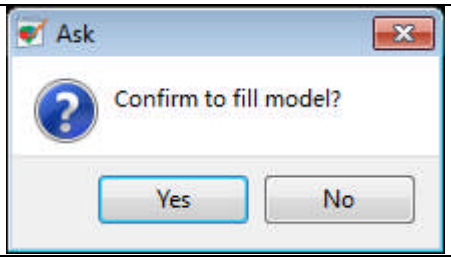


Figure 14.4-3Fill model

At end of Fill Model, the following dialog box will pop up for prompt; click “Yes” to publish database.

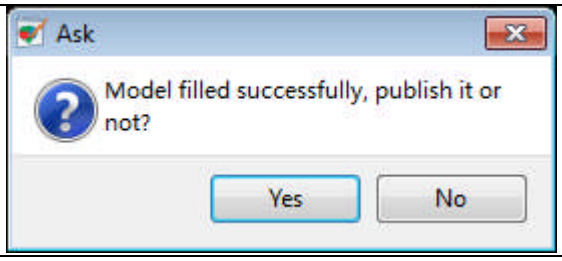


Figure 14.4-4 Publish database

After successful publishing, prompt “Published successfully” dialog box will appear.

14.4.1.4 Check of Online Viewing of Graph

Start Graph Editor and open substation graph drawn. Click Preview button “ ” on toolbar for online browsing of the graph. If all equipment and connecting lines are shown in pearl (color for non-live), and a cross is displayed on circuit breaker, switch, and ES (indicating that status of current position is invalid), then drawing of the graph is successful, as shown below:

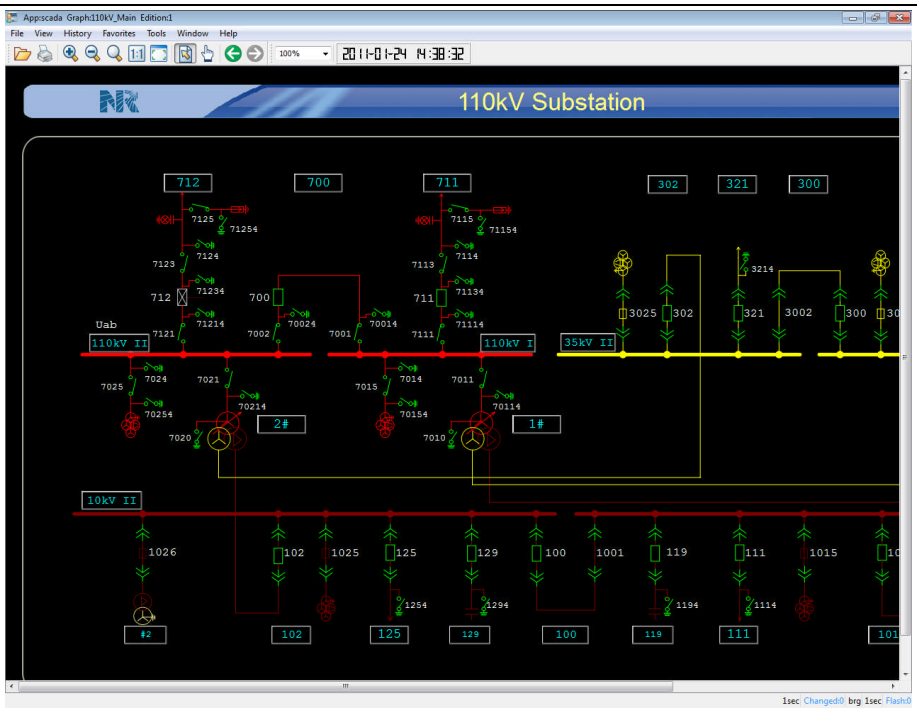


Figure 14.4-5 Preview graph

15 Manual Version History

In the current version of the instruction manual, several descriptions on existing features have been modified.

Manual version and modification history records

Manual Version		Software Version	Date	Description of change
Source	New			
	1.00	1.01	2011-06-14	Form the original manual.

PCS-9705

Bay Control Unit

Instruction Manual

NR Electric Co., Ltd.

Preface

Introduction

This guide and the relevant operating or service manual documentation for the equipment provide full information on safe handling, commissioning and testing of this equipment.

Documentation for equipment ordered from NR is dispatched separately from manufactured goods and may not be received at the same time. Therefore, this guide is provided to ensure that printed information normally present on equipment is fully understood by the recipient.

Before carrying out any work on the equipment, the user should be familiar with the contents of this manual, and read relevant chapter carefully.

This chapter describes the safety precautions recommended when using the equipment. Before installing and using the equipment, this chapter must be thoroughly read and understood.

Health and Safety

The information in this chapter of the equipment documentation is intended to ensure that equipment is properly installed and handled in order to maintain it in a safe condition.

When electrical equipment is in operation, dangerous voltages will be present in certain parts of the equipment. Failure to observe warning notices, incorrect use, or improper use may endanger personnel and equipment and cause personal injury or physical damage.

Before working in the terminal strip area, the equipment must be isolated.

Proper and safe operation of the equipment depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing. For this reason, only qualified personnel may work on or operate the equipment.

Qualified personnel are individuals who:

- Are familiar with the installation, commissioning, and operation of the equipment and of the system to which it is being connected;
- Are able to safely perform switching operations in accordance with accepted safety engineering practices and are authorized to energize and de-energize equipment and to isolate, ground, and label it;
- Are trained in the care and use of safety apparatus in accordance with safety engineering practices;
- Are trained in emergency procedures (first aid).

Instructions and Warnings

The following indicators and standard definitions are used:

DANGER!

It means that death, severe personal injury, or considerable equipment damage will occur if safety precautions are disregarded.

WARNING!

It means that death, severe personal, or considerable equipment damage could occur if safety precautions are disregarded.

CAUTION!

It means that light personal injury or equipment damage may occur if safety precautions are disregarded. This particularly applies to damage to the device and to resulting damage of the protected equipment.

WARNING!

The firmware may be upgraded to add new features or enhance/modify existing features, please make sure that the version of this manual is compatible with the product in your hand.

WARNING!

During operation of electrical equipment, certain parts of these devices are under high voltage. Severe personal injury or significant equipment damage could result from improper behavior.

Only qualified personnel should work on this equipment or in the vicinity of this equipment. These personnel must be familiar with all warnings and service procedures described in this manual, as well as safety regulations.

In particular, the general facility and safety regulations for work with high-voltage equipment must be observed. Noncompliance may result in death, injury, or significant equipment damage.

DANGER!

Never allow the current transformer (CT) secondary circuit connected to this equipment to be opened while the primary system is live. Opening the CT circuit will produce a dangerously high voltage.

WARNING!

- **Exposed terminals**

Do not touch the exposed terminals of this equipment while the power is on, as the high voltage generated is dangerous

- **Residual voltage**

Hazardous voltage can be present in the DC circuit just after switching off the DC power supply. It takes a few seconds for the voltage to discharge.

CAUTION!

- **Earth**

The earthing terminal of the equipment must be securely earthed.

- **Operating environment**

The equipment must only be used within the range of ambient environment detailed in the specification and in an environment free of abnormal vibration.

- **Ratings**

Before applying AC voltage and current or the DC power supply to the equipment, check that they conform to the equipment ratings.

- **Printed circuit board**

Do not attach and remove printed circuit boards when DC power to the equipment is on, as this may cause the equipment to malfunction.

- **External circuit**

When connecting the output contacts of the equipment to an external circuit, carefully check the supply voltage used in order to prevent the connected circuit from overheating.

- **Connection cable**

Carefully handle the connection cable without applying excessive force.

NR ELECTRIC CO., LTD. Tel: +86-25-87178888, Fax: +86-25-87178999

69 Suyuan Avenue. Jiangning, Nanjing 211102, China Website: www.nrelect.com, www.nari-relays.com

Version: R2.11

Documentation Structure

The manual provides a functional and technical description of this device and a comprehensive set of instructions for the device's use and application.

All contents provided by this manual are summarized as below.

1 Introduction

Brief introduction of the application, functions and features.

2 Technical Data

Lists of the technical data such as electrical specifications, mechanical specifications, ambient temperature and humidity range, communication port parameters, type tests and accuracy limits.

3 Operation Theory

Comprehensive and detailed functional description of all functional modules.

4 Supervision

Automatic self-supervision function of device.

5 Management

Management function (measurement and recording) of this device.

6 Hardware

Description of plug-in modules and definition of pins.

7 Settings

Setting lists including system settings, communication settings and etc.

8 Human Machine Interface

Description of the HMI module and a detailed guide to use the device through HMI.

9 Configurable Function

Brief introduction of configurable functions and configuration software.

10 Communication

Supported conmmunication protocol details.

11 Installation

Recommendation for unpacking, handling, inspection and storage with a guide to the mechanical and electrical installation. A typical wiring connection is also indicated.

12 Commissioning

Commissioning recommendation for comprising checks on the calibration and functionality of

device.

13 Maintenance

General maintenance policy.

14 Decommissioning and Disposal

General decommissioning and disposal policy.

15 Manual Version History

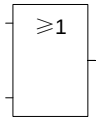
List of instruction manual version and history record of update.

Typographic and Graphical Conventions

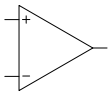
Deviations may be permitted in drawings and tables so that the type of designator can be obviously derived from the illustration.

The following symbols may be used in drawings:

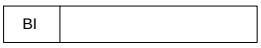
AND gate



OR gate

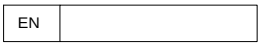


Comparator

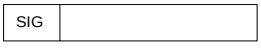


Binary signal via opto-coupler

Input signal from comparator with setting



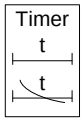
Input signal of logic setting for function enabling



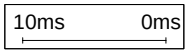
Input of binary signal except those signals via opto-coupler

XXX

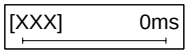
Output signal



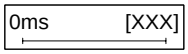
Time (optional definite-time or inverse-time characteristic)



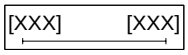
Timer [delay pickup (10ms), delay drop off (0ms), non-settable]



Timer (delay pickup, settable)



Timer (delay drop off, settable)



Timer (delay pickup, delay drop off, settable)

Timer (inverse-time characteristic)

---xxx is the symbol

Symbol Corresponding Relationship

Basic	
A, B, C	L1, L2, L3
AN, BN, CN	L1N, L2N, L3N
ABC	L123
U (voltage)	V

Example	
Ia, Ib, Ic, I0	IL1, IL2, IL3, IN
Ua, Ub, Uc	VL1, VL2, VL3
Uab, Ubc, Uca	VL12, VL23, VL31
U0, U1, U2	VN, V1, V2

1 Introduction

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1.1 Application

PCS-9705 series bay control units (abbreviated as BCUs) are used for controlling and monitoring bay (different types) in power grid. PCS-9705 series BCUs are especially suitable for applications in control systems with distributed control IEDs in all bays with high reliability.

PCS-9705 series BCUs are designed for controlling and monitoring circuit breaker, disconnector, and earthing switch in switchgear. Additionally, PCS-9705 series BCUs enable manual control of tap changer.

PCS-9705 series BCUs can be used to both single and multiple bay arrangements and the series of PCS-9705 have been defined for the following applications:

Table 1.1-1 Series of PCS-9705

Application	Description
Application 1: Single bay (4CT/5VT)	Single circuit breaker Each side of transformer.
Application 2: General (13VT)	Common signals in substation Busbars (up to 4 sections)
Application 3: Dual bays (7CT/8VT)	1½ CB arrangement Double branches for the low-voltage side of the main transformer 0.4kV station transformer
Application 4: Extended General (24VT)	Common signals in substation Busbars (up to 8 sections)
Application 5: Transformer Unit (12CT/12VT)	Transformer unit (3 or 4 windings)

Application diagrams of PCS-9705 are listed in the following figures:

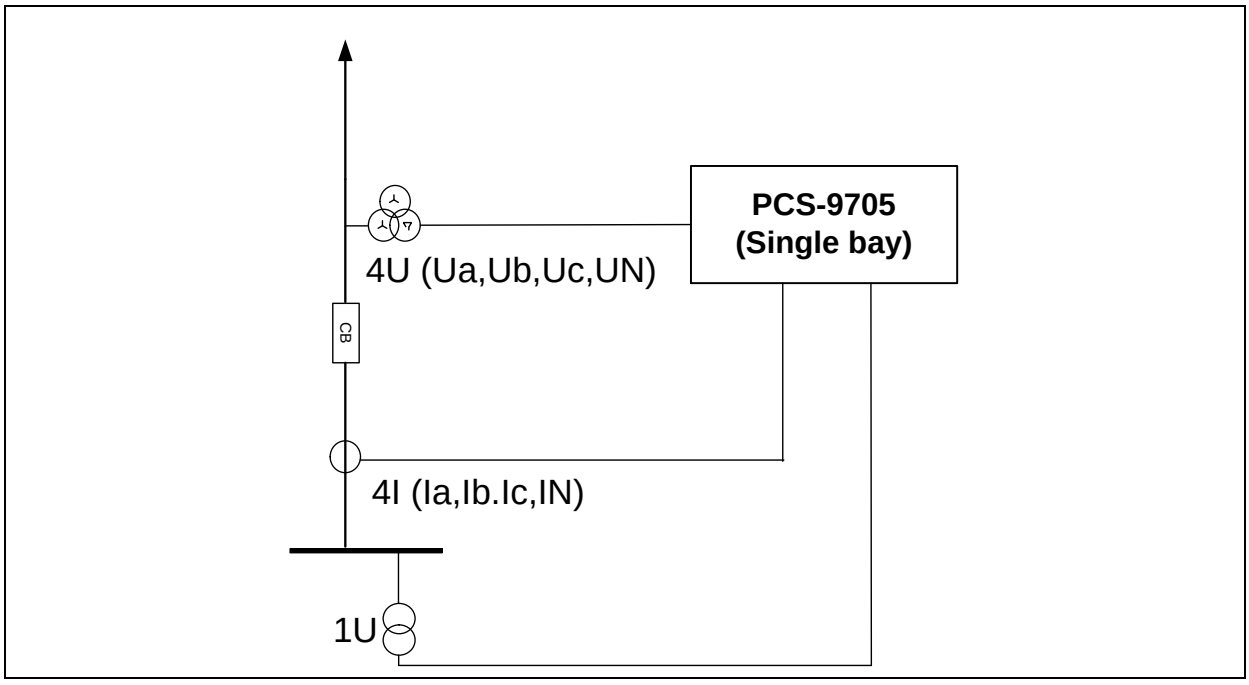

Figure 1.1-1 Typical application diagram of PCS-9705 (Single bay, 4CT/5VT)

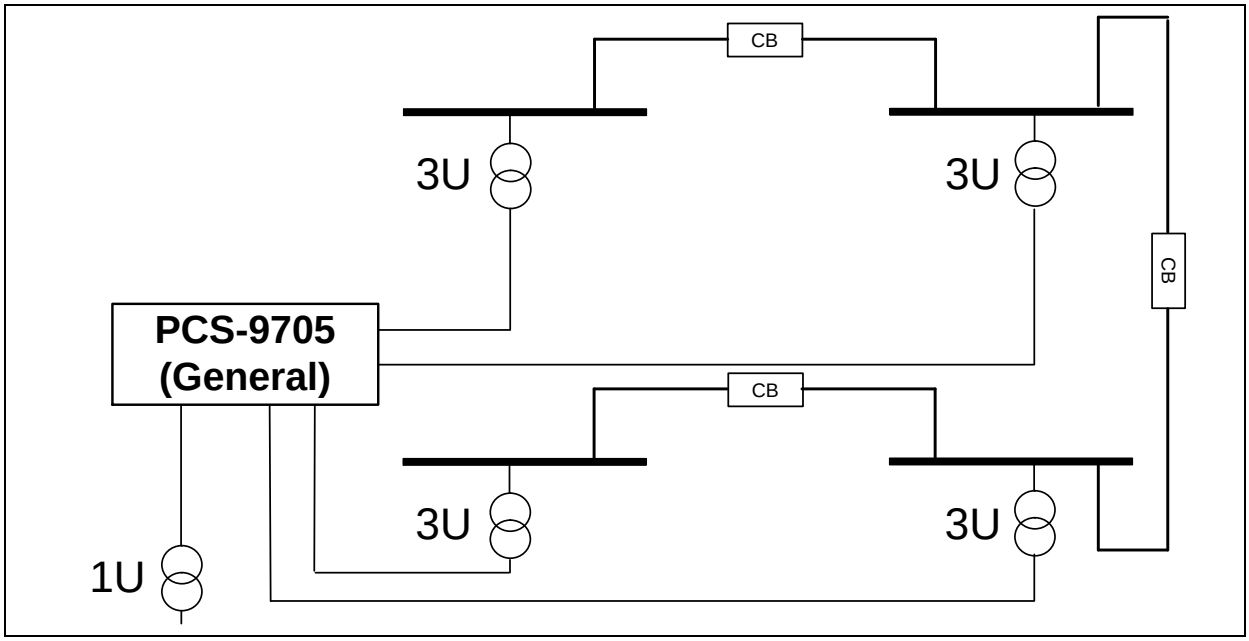

Figure 1.1-2 Typical application diagram 1 of PCS-9705 (General, 13VT)

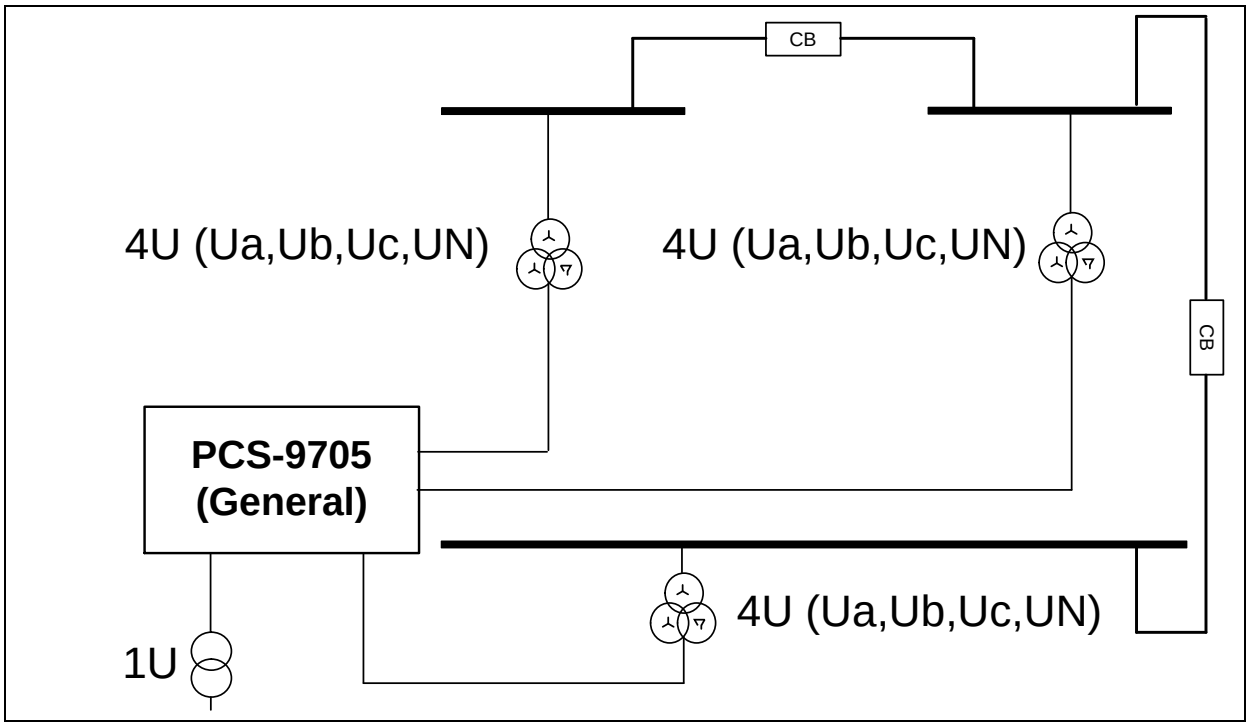

Figure 1.1-3 Typical application diagram 2 of PCS-9705 (General, 13VT)

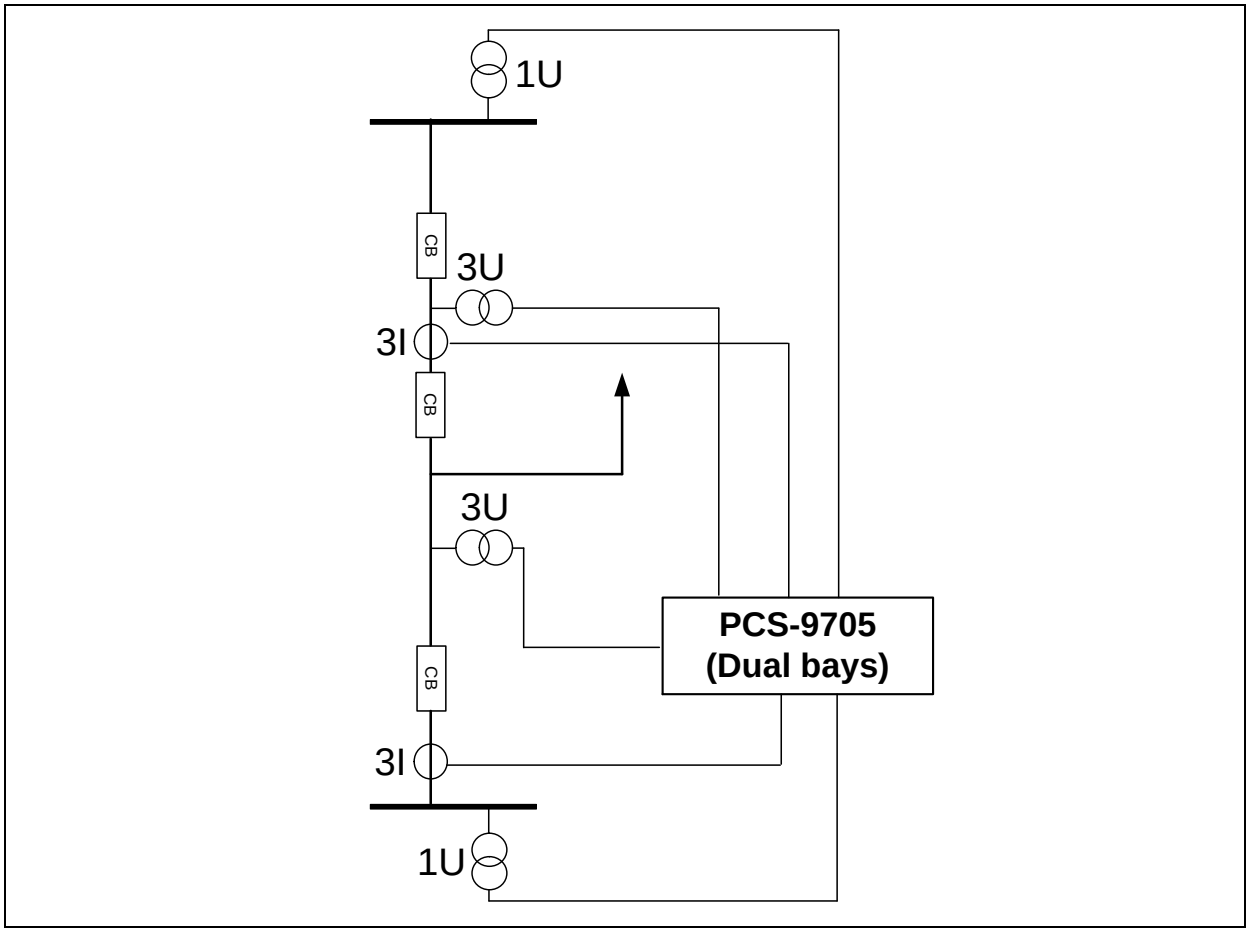

Figure 1.1-4 Typical application diagram of PCS-9705 (Dual bays, 7CT/8VT)

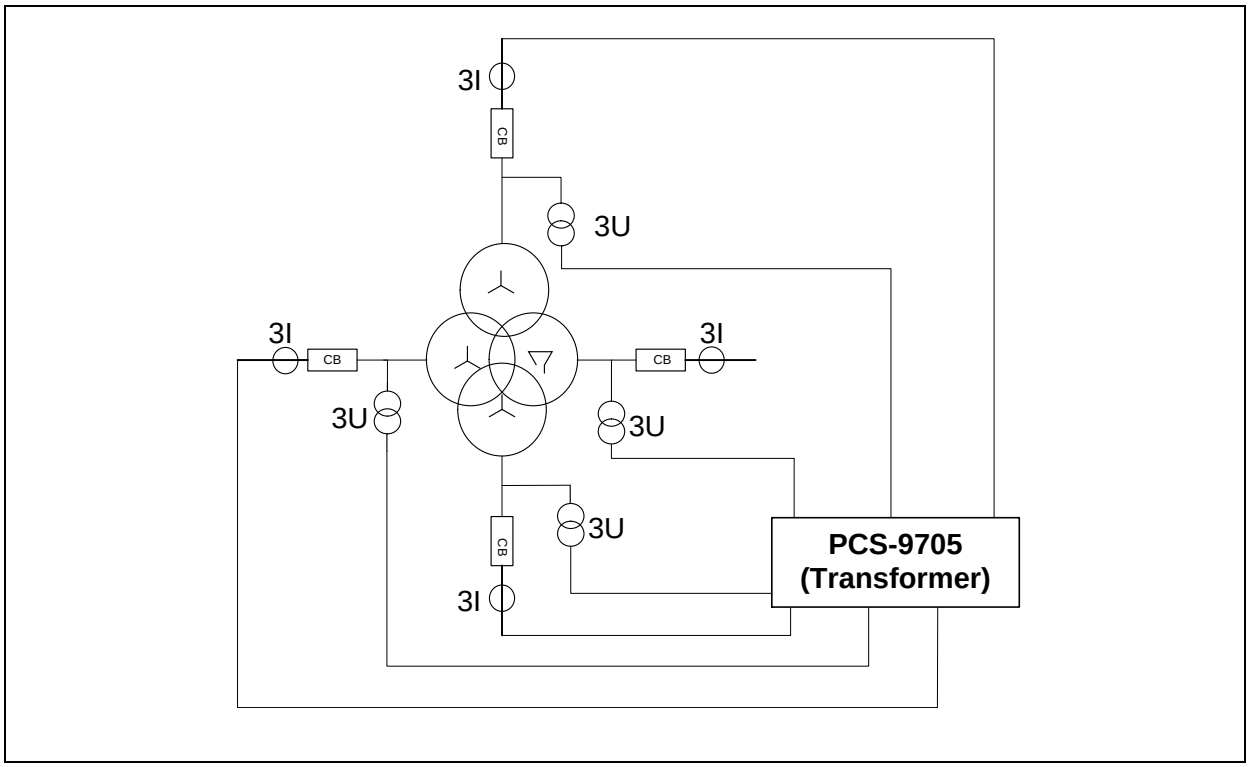

Figure 1.1-5 Typical application diagram of PCS-9705 (Transformer Unit, 12CT/12VT)

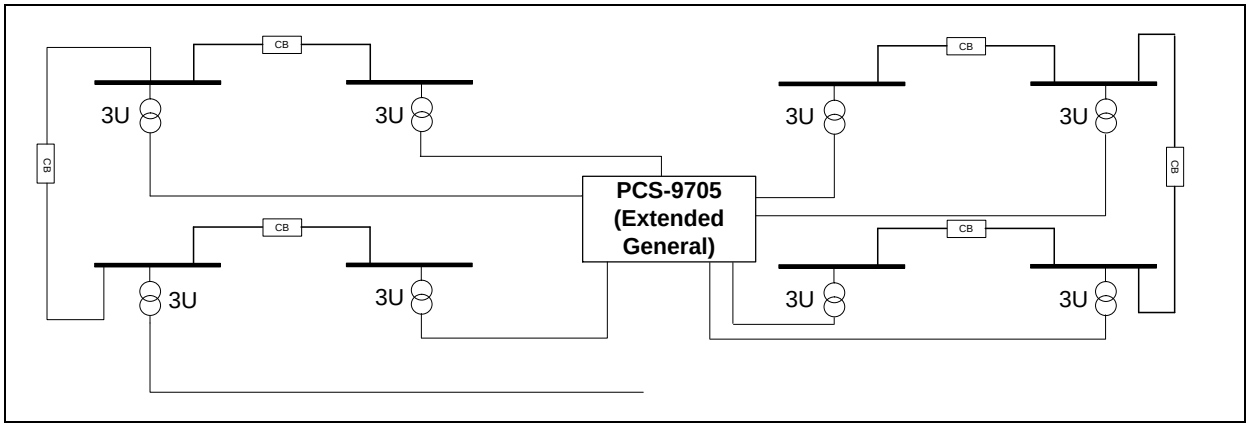

Figure 1.1-6 Typical application diagram 1 of PCS-9705 (Extended General, 24VT)

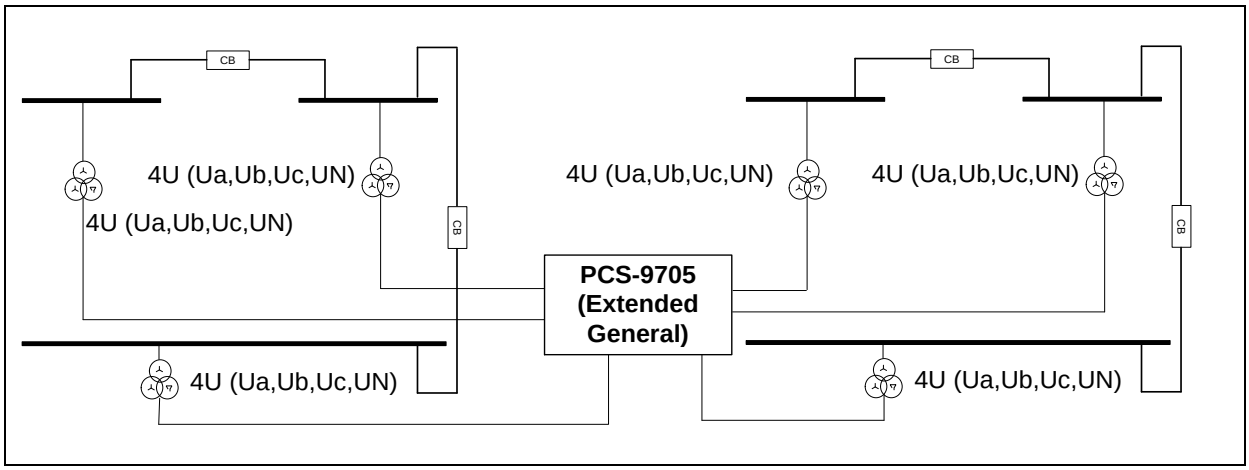

Figure 1.1-7 Typical application diagram 2 of PCS-9705 (Extended General, 24VT)

Note!

4U: Ua, Ub, Uc and external residual voltage input (UN);

4I: Ua, Ub, Uc and external residual current input (IN);

3U: Ua, Ub and Uc;

3I: Ia, Ib and Ic;

1U: One voltage input;

1.2 Functions

Main functions of PCS-9705 are listed in the following table:

Table 1.2-1 Main functions of PCS-9705

No.	Function	ANSI
1	Synchronism-check	25
2	Tap changer control and supervision	84

No.	Function	ANSI
3	Monitoring (Binary inputs, AC/DC analog inputs)	/
4	Regulation (DC analog outputs)	/
5	Control (Binary outputs)	/
6	Interlocking	/

Maximum configuration of PCS-9705 is listed in the following table:

Table 1.2-2 Application configurations of PCS-9705

Configuration	Full Width Chassis					Half Width Chassis		
	App 1	App 2	App 3	App 4	App 5	App 1	App 2	App 3
Conventional sampling method: AC analog inputs	4CT 5VT	13VT	7CT 8VT	24VT	12CT 12VT	4CT 5VT	13VT	7CT 8VT
DC analog inputs	0 or 8 or 16					/		
DC analog outputs	0 or 4			/				
Binary inputs	14 fixed + up to 106 configurable (common negative supply)			14 fixed + up to 126 configurable (common negative supply)		14 fixed + up to 46 configurable (common negative supply)		
Binary outputs	Up to 15 groups of normally open binary outputs in 3 BO modules Up to 10 groups of normally open duplicated binary outputs in 2 BO modules			Up to 25 groups normally open binary outputs in 5 BO modules		Up to 10 groups normally open binary outputs in 2 BO modules		
Number of CB for synchronism-check	0,1	0	0,1,2	0	0,1	0,1	0	0,1,2
Interlocking criteria status output contacts	Up to 15 groups of binary outputs(NO) in 3 BO modules for interlock logic			Up to 10 groups of binary outputs(NO) in 2 BO modules for interlock logic		/		

Note!

Only one of the following optional sampling methods can be chosen at one time:

1. Conventional sampling method via AI module.
2. IEC61850-9-2 digital sampling method via NET-DSP module.

Note!

GOOSE function (station level) can be realized without NET-DSP module.

Graphical representation of an electric single line diagram (abbreviated as SLD) is supplied to be shown on the LCD display of this device.

1.3 Features

1. PCS-9705 series BCUs adopt a fully closed chassis with a complete panel. Completely separated spaces for electronic and electrical systems are provided.
2. PCS-9705 series BCUs adopt new UAPC hardware platform, 16 bits parallel A/D converter, graphic dot matrix LCD, and real time multi-task operating system for industrial purpose so as to realize high-capacity, high-precision, fast, real time information processing. With high-precision parallel A/D converter, synchronization sampling can be conducted for all the AC signals to ensure the accuracy of analog quantity measurement which is up to the 15th harmonic component.
3. Software and hardware clock synchronization are both adopted with 1ms timing accuracy to ensure the resolution of Sequence Of Events (abbreviated as SOE).
4. Large scale LCD provides graph and text HMI which makes operation convenient.
5. Duplex Ethernet ports with 100M optical fiber or twisted-pair cable are provided.
6. Back plug-in module structure is adopted. Electrical and electronic circuits are strictly separated, which enhances EMC immunity performance.
7. Low power consumption and wide ambient temperature range.
8. PCS-9705 series BCUs support IEC61850 and IEC60870-5-103 protocols. Please refer to the *Chapter "Communication"* for more details of these communication protocols.

1.4 Glossary

No.	Abbreviation	Description
1	ADisc	Disconnection of network A
2	ANSI	American National Standards Institute
3	AStorm	Storm of network A
4	BCD	Binary-Coded Decimal
5	BCU	Bay Control Unit
6	BDisc	Disconnection of network B
7	BStorm	Storm of network B
8	CB	Circuit Breaker
9	CC	Control Center

No.	Abbreviation	Description
10	CT	Current Transformer
11	CMMI	Capability Maturity Model Integration
12	DS	Disconnector Switch
13	DSP	A Digital Signal Processor (DSP) is a specialized microprocessor with an architecture optimized for the fast operational needs of digital signal processing.
14	e.g.	Exempli gratia: Usually shortened in English to "for example" (see citation signal). Exempli gratia, "for example", is commonly abbreviated as "e.g."; in this usage it is sometimes followed by a comma, depending on style.
15	E^2PROM	Electrically Erasable Programmable Read-Only Memory
16	EIA	Electronic Industries Alliance
17	ELV	Extra-Low Voltage
18	ES	Earthing Switch
19	etc.	Et cētera (etc.) is a Latin expression that means "and other things", or "and so forth". It is taken directly from the Latin expression which literally means "and the rest (of such things)". "Et" means "and"; "cētera" means "the rest".
20	GAlm	Alarm signal for Generic Object Oriented Substation Event
21	GI	General Interrogation
22	GMT	Greenwich Mean Time (GMT) is a term originally referring to mean solar time at the Royal Observatory in Greenwich, London. It is arguably the same as Coordinated Universal Time (UTC).
23	GOOSE	Generic Object Oriented Substation Event
24	GPS	Global Positioning System
25	HMI	Human-Machine Interface
26	i.e.	Id est: "That is (to say)" in the sense of "that means" and "which means", or "in other words", or sometimes "in this case".
27	IEC	International Electro-technical Commission
28	IED	Intelligent Electronic Device
29	IRIG	Inter-Range Instrumentation Group time code
30	ISO	International Organization for Standardization
31	LCD	Liquid Crystal Display
32	LED	Light-Emitting Diode
33	MMS	Manufacturing Message Specification
34	NC	Normally Closed
35	NO	Normally Open
36	OHSAS	Occupational Health and Safety Assessment Series
37	PCB	Printed Circuit Board
38	PL	Process Level
39	PPS	A Pulse Per Second (PPS) is an electrical signal that very accurately repeats once per second (i.e. with a frequency of 1 Hertz).
40	PPM	Pulse per minute
41	PWR module	Power supply module

No.	Abbreviation	Description
42	RAM	Random-Access Memory
43	RMS	In mathematics, the root mean square (abbreviated RMS or rms), also known as the quadratic mean, is a statistical measure of the magnitude of a varying quantity. RMS is used in various fields, including electrical engineering.
44	ROV	Residual Over-voltage
45	SAS	Substation Automation System
46	SBO	Select-Before-Operate
47	SCADA	Supervisory Control And Data Acquisition
48	SCSM	Specific Communication Service Mapping
49	SL	Station Level
50	SLD	Single Line Diagram
51	SOE	Sequence Of Events
52	SNTP	Simple Network Time Protocol
53	SV	Sampled Values
54	SVAlm	Alarm signal for Sampled Values
55	TAL	Time Allowed to Live
56	TPI	Tap Position Indication
57	UTC	Coordinated Universal Time (UTC) is the primary time standard by which the world regulates clocks and time.
58	VT	Voltage Transformer
59	VTS	Voltage Transformer Supervision

2 Technical Data

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2.1 Electrical Specifications

2.1.1 AC Current Input

Phase rotation	ABC	
Rated frequency (fn)	50Hz, 60Hz	
Nominal frequency range	fn ± 5Hz	
Rated current (In)	1A	5A
Linear to	0.05In~2In	
Thermal withstand capability -continuously -for 10s -for 1s -for half a cycle	 2In 12In 30In 75In	
Burden	< 0.2VA/phase @In	< 0.4VA/phase @In

2.1.2 AC Voltage Input

Phase rotation	ABC
Rated frequency (fn)	50Hz, 60Hz
Nominal frequency range	fn ± 5Hz
Rated voltage (Un)	100V~120V (phase-to-phase voltage)
Linear to	1V~130V
Thermal withstand capability -continuously -10s -1s	 130V 200V 250V
Burden at rated	< 0.10VA/phase @Un

2.1.3 Power Supply

Standard	IEC 60255-11:2008
Rated voltage	110Vdc/125Vdc, 220Vdc/250Vdc
Operating range	88~300Vdc
Permissible AC ripple voltage	≤15% of the nominal auxiliary voltage

2.1.4 Transducer Input

Standard	IEC 60255-1:2009			
Input range	4-20mA	0-5V	0-48V	0-250V
Input resistance	235Ω	4.4kΩ	54.2kΩ	248kΩ
Accuracy	class 0.5	class 0.5	class 0.5	class 0.5

2.1.5 DC Analog Output

Standard	IEC 60255-1:2009	
Output range	4-20mA	0-10V

Max load	<500Ω	<5mA
Dielectric tests	2000VAC	2000VAC
Accuracy	class 0.5	class 0.5

2.1.6 Binary Input

Rated voltage	24V	30V	48V	110V	125V	220V
Rated current drain	1.20mA	1.50mA	2.40mA	1.10mA	1.25mA	2.20mA
Pickup voltage	55% ~ 70% rated voltage					
Drop-off voltage	55% rated voltage					
Maximum permissible voltage	120% rated voltage					
Withstand voltage	2000Vac, 2800Vdc					
Response time for logic input	< 1ms					

2.1.7 Binary Output

Contact type	Tripping/signaling contact
Output mode	Potential free contact
Continuous carry	5A@380Vac 5A@250Vdc
Pickup time	<8ms (typical 3~5ms)
Drop off time	<5ms
Breaking capacity (L/R=40ms)	0.65A@48Vdc 0.30A@110Vdc 0.15A@220Vdc
Burden	300mW
Maximal system voltage	380Vac 250Vdc
Test voltage across open contact	1000V RMS for 1min
Short duration current	6A@3s 15A@0.5s 30A@0.2s
Durability	10,000 operations minimum

2.2 Mechanical Specifications

Mounting Way	Flush mounted
Chassis color	Silver grey
Weight per device	Approx. 8kg
Chassis material	Aluminum alloy
Location of terminal	Rear panel of the device
Device structure	Plug-in modular type @ rear side, integrated front plate
Protection class	
Standard	IEC 60225-1:2009
Front side	IP40

Other sides	IP30
Rear side, connection terminals	IP20

2.3 Ambient Temperature and Humidity Range

Standard	IEC 60255-1:2009
Operating temperature	-40°C to +70°C (Readability of display may be impaired below -20°C)
Transport and storage temperature range	-40°C to +70°C
Permissible humidity	5%-95%, without condensation
Pollution degree	2
Altitude	<3000m

2.4 Communication Port

2.4.1 EIA-485 Port

Baud rate	4.8kbit/s, 9.6kbit/s, 19.2kbit/s, 38.4kbit/s, 57.6kbit/s, 115.2kbit/s
Protocol	IEC 60870-5-103:1997
Maximal capacity	32
Transmission distance	<500m
Safety level	Isolation to ELV level
Twisted pair	Screened twisted pair cable

2.4.2 Ethernet Port

Connector type	RJ-45	ST (Multi mode)
Transmission rate	100Mbits/s	
Transmission standard	10Base-T/100Base-TX	100Base-FX
Transmission distance	<100m	<2km (1310nm)
Protocol	IEC 60870-5-103:1997 or IEC 61850	
Safety level	Isolation to ELV level	

2.4.3 Optical Fiber Port

2.4.3.1 For Station Level

Characteristic	Glass optical fiber
Connector type	ST
Fiber type	Multi-mode
Transmission distance	<2km
Wave length	1310nm
Transmission power	Min. -20.0dBm
Minimum receiving power	Min. -30.0dBm
Margin	Min. +3.0dB

2.4.3.2 For Process Level

Characteristic	Glass optical fiber
Connector type	LC
Fiber type	Multi-mode
Transmission distance	<2km
Wave length	1310nm
Transmission power	Min. -20.0dBm
Minimum receiving power	Min. -30.0dBm
Margin	Min. +3.0dB

2.4.3.3 For Synchronization Port

Characteristic	Glass optical fiber
Connector type	ST
Fiber type	Multi-mode
Wave length	820nm
Minimum receiving power	Min. -25.0dBm
Margin	Min. +3.0dB

2.4.4 Clock Synchronization Port

Type	RS-485
Transmission distance	<500m
Maximal capacity	32
Timing standard	PPS, PPM, IRIG-B
Safety level	Isolation to ELV level

2.5 Type Tests

2.5.1 Environmental Tests

Dry cold test	IEC60068-2-1:2007
Dry heat test	IEC60068-2-2:2007
Damp heat test, cyclic	IEC60068-2-30:2005

2.5.2 Mechanical Tests

Vibration	IEC 60255-21-1:1988 Class I
Shock and bump	IEC 60255-21-2:1988 Class I

2.5.3 Electrical Tests

Standard	IEC 60255-27:2005
Dielectric tests	Test voltage 2kV, 50Hz, 1min
Standard	IEC 60255-5:2000
Impulse voltage tests	Test voltage 5kV
Overvoltage category	III

Insulation resistance measurements	Isolation resistance >100MΩ@500VDC

2.5.4 Electromagnetic Compatibility

1MHz burst disturbance test	IEC 60255-22-1:2007
	Common mode: class III 2.5kV
	Differential mode: class III 1.0kV
Electrostatic discharge test	IEC60255-22-2:2008 class IV
	For contact discharge: 8kV
	For air discharge: 15kV
Radio frequency interference tests	IEC 60255-22-3:2007 class III
	Frequency sweep Radiated amplitude-modulated 10V/m (rms), f=80~1000MHz
	Spot frequency Radiated amplitude-modulated 10V/m (rms), f=80MHz/160MHz/450MHz/900MHz Radiated pulse-modulated 10V/m (rms), f=900MHz
Fast transient disturbance tests	IEC 60255-22-4:2008
	Power supply, I/O, Earth: class IV, 4kV, 2.5kHz, 5/50ns
	Communication terminals: class IV, 2kV, 5kHz, 5/50ns
Surge immunity test	IEC 60255-22-5:2008
	Power supply, AC input, I/O port: class IV, 1.2/50μs Common mode: 4kV Differential mode: 2kV
Conducted RF electromagnetic disturbance	IEC 60255-22-6:2001
	Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Power frequency magnetic field immunity	IEC 61000-4-8:2001
	class V, 100A/m for 1min, 1000A/m for 3s
Pulse magnetic field immunity	IEC 61000-4-9:2001
	class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10:2001
	class V, 100kHz & 1MHz–100A/m
Auxiliary power supply performance - Voltage dips -Voltage short interruptions	IEC60255-11: 2008 Up to 200ms for dips to 40% of rated voltage without reset 30ms for interruption without rebooting

2.6 Management Functions

2.6.1 Measurement Scope and Accuracy

Item	Range	Accuracy
Phase range	0Deg ~ 360Deg	≤ 0.5% or ±1Deg
Frequency	90%～110%fn fn=50Hz or 60Hz	≤ 0.005Hz
Current	0.05In~2.00In	≤ 0.2% of rating
Voltage	0.05Un~1.20Un	≤ 0.2% of rating
Active power (W)	0.05Un~1.20Un, 0.05In~2.00In	≤ 0.5% of rating at unity power factor
Reactive power (VAr)	0.05Un~1.20Un, 0.05In~2.00In	≤ 0.5% of rating at zero power factor
Apparent power (VA)	0.05Un~1.20Un, 0.05In~2.00In	≤ 0.5% of rating

2.6.2 Control Performance

Control mode	Local or remote
Accuracy of local control	≤ 1s
Accuracy of remote control	≤ 3s

2.6.3 Clock Performance

Real time clock accuracy	≤ 3s/day
Accuracy of GPS synchronization	≤ 1ms
External time synchronization	IRIG-B (200-98), PPS, PPM or SNTP protocol

2.6.4 Binary Input Signal

Resolution of binary input signal	≤ 1ms
Binary input mode	Potential-free contact
Resolution of SOE	≤ 2ms

2.7 Certifications

1. ISO9001:2008
2. ISO14001:2004
3. OHSAS18001:2007
4. ISO10012:2003
5. CMMI L5
6. EMC: 2004/108/EC, EN50263:1999
7. Products safety (PS): 2006/95/EC, EN61010-1:2001

3 Operation Theory

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3.1 System Parameters

The device performs various functions by respective algorithms with the information (currents and voltages) acquired from primary system through instrument transformers, so it is important to configure the analog input channels correctly.

Please refer to "*System Settings*" in Chapter 7 for the details of these settings.

3.2 AC Analog Input (ACAI)

3.2.1 General Application

The AI plug-in module completes the acquisition of incoming secondary AI AC voltage and current.

3.2.2 Function Description

The sampling rate of the measurement is 80 points per cycle (0.02s), and these measurements displayed on LCD will be refreshed every 0.1s.

Besides observing from the LCD of device, user can also use the auxiliary software PCS-Explorer or SAS system to supervise these measurements (via communication protocol).

Here is the calculation theory of measurements:

$$U = \sqrt{\frac{1}{N}\sum_{n=1}^{N} U^2(n)}$$

$$I = \sqrt{\frac{1}{N}\sum_{n=1}^{N} I^2(n)}$$

$$P = \frac{1}{N}\sum_{n=1}^{N} [U_a(n)I_a(n) + U_b(n)I_b(n) + U_c(n)I_c(n)]$$

$$Q = \frac{1}{N}\sum_{n=1}^{N} [U_a(n)I_a(n-\frac{3}{4}N) + U_b(n)I_b(n-\frac{3}{4}N) + U_c(n)I_c(n-\frac{3}{4}N)]$$

$$Cos\Phi = \frac{P}{\sqrt{P^2+Q^2}}$$

N : The sampling rate of the measurement.

P, Q are calculated by the three-meter method.

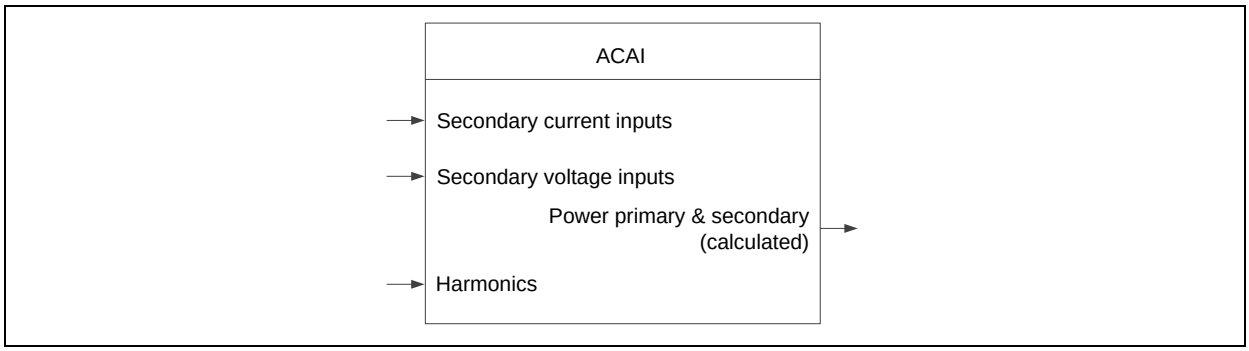
Note!

Different types of PCS-9705 BCU adopt different types of AI plug-in module, please refer

to "*AI Plug-in Module (AC Analog Input)*" in Chapter 6 for more details and declare the type when ordering.

PCS-9705 can detect the effective value of voltage up to the 15th harmonic.

3.2.3 Function Block Diagram



3.2.4 I/O Signals

Measurements for AC analog inputs are listed in "**MainMenu**" -> "**Measurements**" -> "**Measurements3**". Please refer to "*Measurements*" in Chapter 8 for more details.

3.2.5 Settings

Settings for AC calibration are listed in "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**AC Calbr Settings**". Please refer to "*AC Calbr Settings*" in Chapter 7 for the details of these settings.

3.3 DC Analog Input (DCAI)

3.3.1 General Application

The DI plug-in module completes the acquisition of incoming AI DC voltage or current.

3.3.2 Function Description

The sampling rate of the measurement is 80 points per cycle (0.02s), and these measurements displayed on LCD will be refreshed every 0.1s.

Besides observing from the LCD of device, user can also use the auxiliary software PCS-Explorer or SAS system to supervise these measurements (via communication protocol).

Here is the calculation theory of measurements:

$$U = \sqrt{\frac{1}{N}\sum_{n=1}^{N} U^2(n)}$$

$$I = \sqrt{\frac{1}{N}\sum_{n=1}^{N} I^2(n)}$$

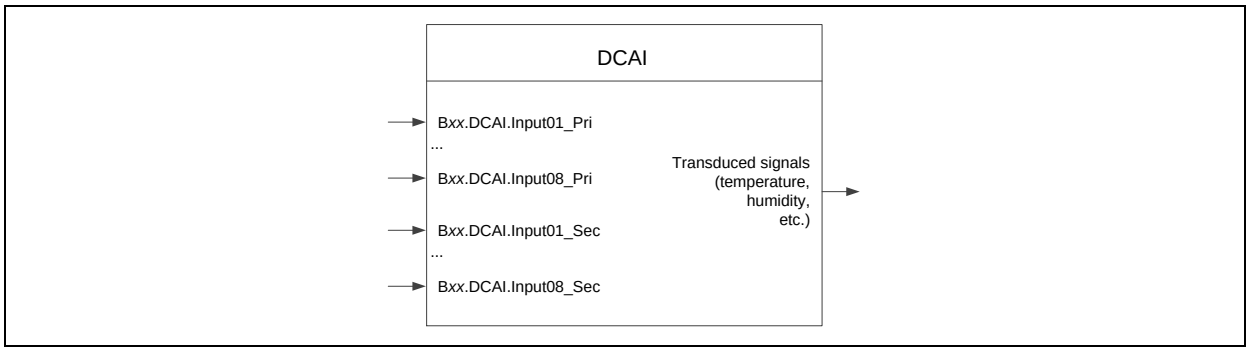
N : The sampling rate of the measurement.

Note!

Different measurement range of DC input can be selected according to the right configuration of jumper links in the DI plug-in module. Please refer to "*DI Plug-in Module (DC Analog Input)*" in Chapter 6 for the jumpers' configuration.

The measurements via transducers in the DI module usually represent temperature or humidity.

3.3.3 Function Block Diagram



3.3.4 I/O Signals

Measurements for DC analog inputs are listed in "**MainMenu**" -> "**Measurements**" -> "**Measurements3**". Please refer to "*Measurements*" in Chapter 8 for more details.

3.3.5 Settings

Settings for AC calibration are listed in "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**Transducer Settings**". Please refer to "*Transducer Settings*" in Chapter 7 for the details of these settings.

3.4 Binary Input (BI)

3.4.1 General Application

Electrical signals are introduced into the device via optical isolation in the BI plug-in module and then be converted into digital signals. These signals' description can be freely configured (by the auxiliary software PCS-Explorer).

GOOSE signals are introduced into the device via the MON plug-in module (station layer) or the NET-DSP plug-in module (process layer). Along with the contact signals, these two kinds signal can form double position signal for further use.

Pulse IO signals are introduced into the device via the MON plug-in module and are prolonged to a fixed width output for further use of control.

3.4.2 Function Description

After the filter circuit and debouncing algorithm processing, external interference can be filtered effectively. As shown in the following figure, a well-designed debouncing technique is adopted in this device. Binary input state change within "Debouncing time" (t0-t1 can be set 0~30s) will be ignored, in order to ensure the accuracy of the signal status.

Once there is a confirmation of change status of signal (start from t1), a SOE record will be noted in the device.

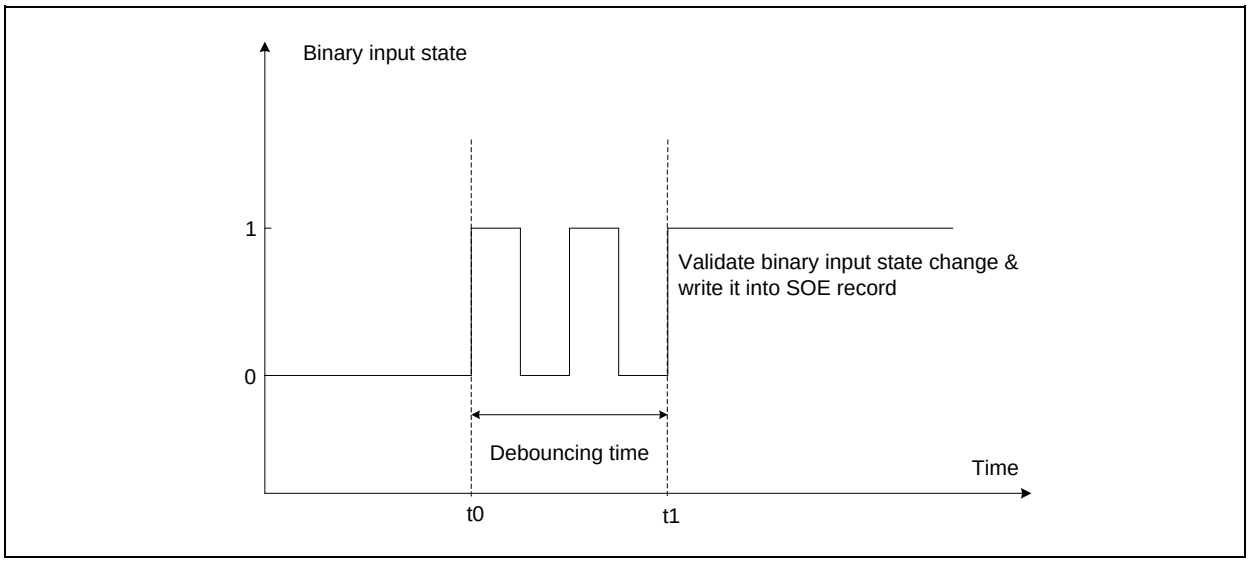
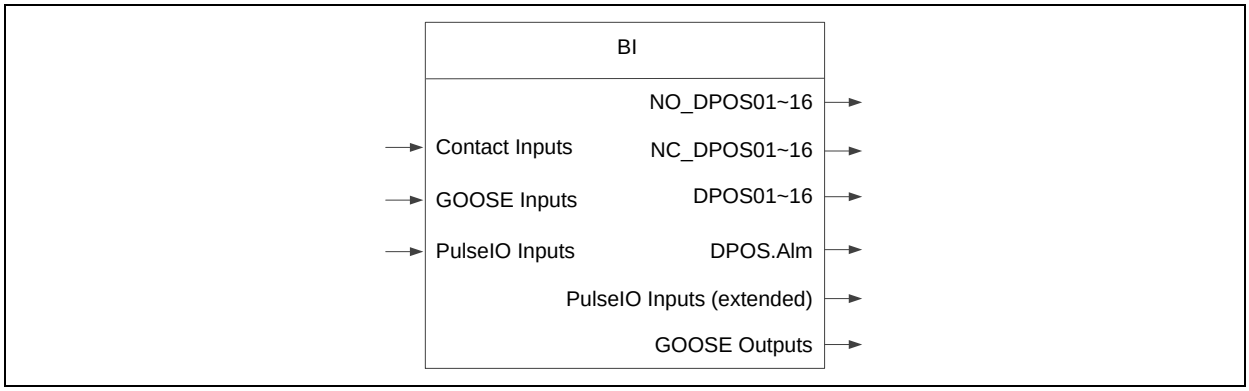


Figure 3.4-1 Debouncing technique

3.4.3 Function Block Diagram



3.4.4 I/O Signals

No.	Input Signal	Description
1	Contact Inputs	Optically isolated binary inputs (electrical) get from BI module. Please refer to "*BI Plug-in Module (Binary Input)*" in Chapter 6 for more details.
2	GOOSE Inputs	Digital binary inputs of GOOSE.
3	PulseIO Inputs	Short-time (pulse) binary inputs that are sent by station control. Please refer to "*Status*" in Chapter 8 for more details.

No.	Output Signal	Description
1	NO_DPOS01~16	It indicates normally open (abbreviated as NO) contact status of No.1~16 double point.
2	NC_DPOS01~16	It indicates normally closed (abbreviated as NC) contact status of No.1~16 double point.
3	DPOS01~16	It indicates status of No.1~16 double point. "DPS_INT": Intermediate-state; "DPS_OFF": Open; "DPS_ON": Close; "DPS_BAD": Bad state.
4	DPOS.Alm	For any one of [DPOS*XX*] (*XX*=01~16) (corresponds to a CB, a DS or an ES), both the normally open (abbreviated as NO) contact and the normally closed (abbreviated as NC) contact are open or closed. This signal will pick up with a time delay of "[DPOS.t_DPU_XX] + [DPOS.t_Alm]" and will drop off with a time delay of [DPOS.t_Alm].
5	PulseIO Inputs (extended)	PulseIO inputs prolonged to a fixed width output
6	GOOSE Outputs	Digital binary outputs of GOOSE

3.4.5 Settings

General settings for binary inputs are listed in "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**BI Settings**". Please refer to "*BI Settings*" in Chapter 7 for the details of these settings.

3.5 Binary Output (CSWI)

3.5.1 General Application

Binary output function (i.e.: control function) is abbreviated as "CSWI". It will perform execution like open/close of CB/DS/ES, rise/drop of tap position, etc.

3.5.2 Function Description

To ensure more security of this function, each command objet has three control relays and each execution is controlled by two CPU chips. Furthermore, the circuit to block control is also available to prevent output by mistake during breakdown of hardware.

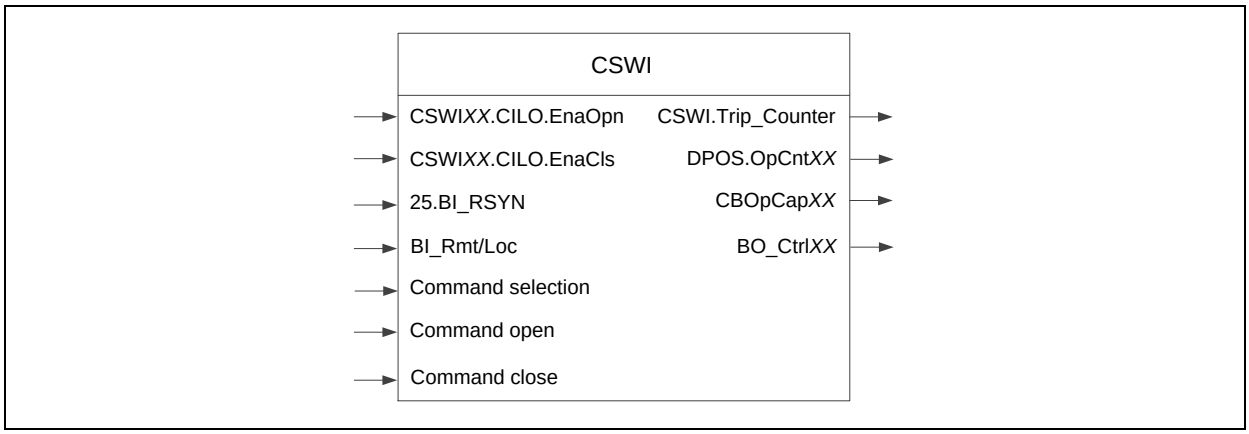
CSWI function, which is based on the principle "Select Before Operate (abbreviated as SBO)", can be performed from device LCD (Mode local), local HMI (Mode remote) or dispatching center (Mode remote) with the use of suitable communication protocol (103, 61850, etc.). One integrated procedure of control contains:

1. Send the selection command from device LCD (Mode local), local HMI (Mode remote) or dispatching center (Mode remote);
2. After the judgment of device logic function, return "selection success" or "fail reason";
3. Send the execution command from device LCD (Mode local), local HMI (Mode remote) or dispatching center (Mode remote) if the "selection success" result is received;
4. After the judgment of device logic function, return "execution success" or "fail reason";
5. Do the execution;

Synchronism control function is available to fulfill the need of synchrocheck during the bay combination to the grid. Please refer to "*RSYN Check (25)*" in Chapter 3 for more details.

Interlocking control function is also available and configurable logically to accomplish different open/close arrangements of engineering practice. Please refer to "*Interlock*" in Chapter 3 for more details.

3.5.3 Function Block Diagram



3.5.4 I/O Signals

No	Input Signal	.Description
1	CSWI*XX*.CILO.EnaOpn	If the interlock criterias for No.*XX* open control are met, CSWI*XX*.CILO.EnaOpn will be displayed as "1". Otherwise, it will be displayed as "0".
2	CSWI*XX*.CILO.EnaCls	If the interlock criterias for No.*XX* close control are met, CSWI*XX*.CILO.EnaCls will be displayed as "1". Otherwise, it will be displayed as "0".
3	25.BI_RSYN	Result of synchronism check: "1" succeeded, "0" failed
4	BI_Rmt/Loc	Selection of control mode: "1" remote, "0" local
No.	**Output Signal**	**Description**
1	CSWI.Trip_Counter	Counter for trip times
2	DPOS.OpCnt*XX*	Counter of status change for No.*XX* double position
3	CBOpCap*XX*	Operation capability for No.*XX* CB
4	BO_Ctrl*XX*	No.*XX* binary output
5	CSWI.ExecInProg	Control operation is executing
6	CSWI.Fail_Execute	Control operation fails
7	CSWI.Succ_Execute	Control operation succeeds
8	CSWI.25.ChkInProg	Close operation via synchronism check is in progress
9	CSWI.25.Fail	Close operation via synchronism check fails
10	CSWI.Interlock_Fail	Control operation is disabled because corresponding interlock criteria are not met.

3.5.5 Settings

Control settings are listed in "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**Control Settings**".

Please refer to "*Control Settings*" in Chapter 7 for more details.

3.6 Tap Changer Control and Supervision (84)

3.6.1 General Application

A tap changer is a connection point selection mechanism along a power transformer winding that allows a variable number of turns to be selected in discrete steps. A transformer with a variable turn's ratio is produced, enabling stepped voltage regulation of the output. The tap selection may be made via an automatic or manual tap changer mechanism.

If only one tap changer is required, manually operated tap points are usually made on the high voltage (primary) or lower current winding of the transformer to minimize the current handling requirements of the contacts. However, a transformer may include a tap changer on each winding if there are advantages to do so. For example, in power distribution networks, a large step-down transformer may have an off-load tap changer on the primary winding and an on-load automatic tap changer on the secondary winding or windings. The high voltage tap is set to match long-term system profile on the high voltage network (typically supply voltage averages) and is rarely changed. The low voltage tap may be requested to change positions multiple times each day, without interrupting the power delivery, to follow loading conditions on the low-voltage (secondary winding) network.

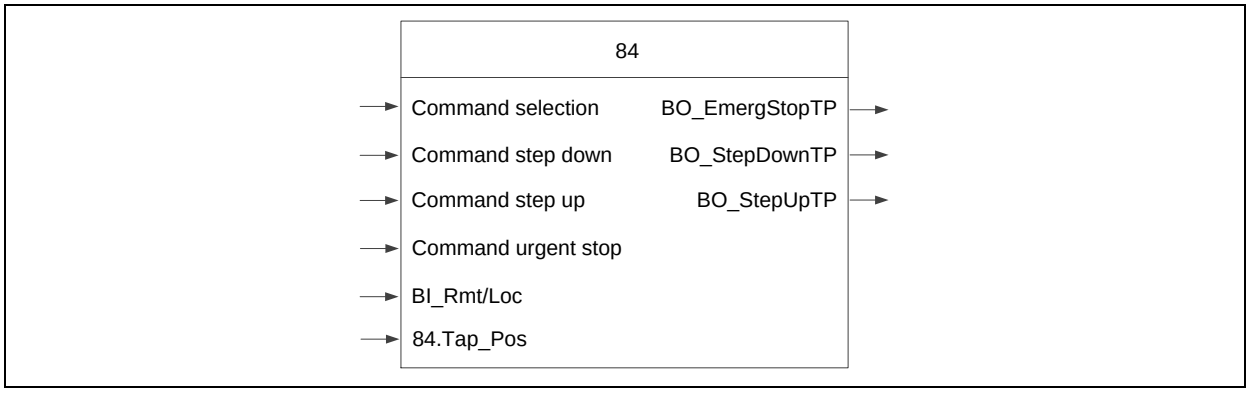
3.6.2 Function Description

On-load design is also called on circuit tap changer or On Load Tap Changer (OLTC). For many power transformer applications, a supply interruption during a tap change is unacceptable, and the transformer is often fitted with a more expensive and complex OLTC mechanism electronic.

The control and supervision of OLTC is another special kind of binary output in this BCU.

One exception is that, during tap changer control process, if "running tap" occurs, transformer tap position will be out of control (step up or down continuously). An output contact "BO_EmergStopTP" is provided to issue an emergency stop command for transformer tap position control. Therefore, "running tap" can be avoided. The output contact "BO_EmergStopTP" locates in one of the BO module, please refer to "*BO Module Plug-in Module (Binary Output)*" in Chapter 6 for more details.

3.6.3 Function Block Diagram



3.6.4 I/O Signals

No.	Input Signal	Description
1	BI_Rmt/Loc	Mode selection of control
2	84.Tap_Pos	Indication of transduced transformer tap position.
No.	**Output Signal**	**Description**
1	CSWI.ExecInProg	Control operation is executing
2	CSWI.Fail_Execute	Control operation fails
3	CSWI.Succ_Execute	Control operation succeeds
4	BO_EmergStopTP	Specially defined binary outputs, please refer to "*BO Plug-in Module (Binary Output)*" in Chapter 6 for more details. Output contact "BO_EmergStopTP" to issue an emergency stop command for transformer tap position control. Therefore, "running tap" can be avoided. Select Before Operate (abbreviated as SBO) process is cancelled here to stop "running tap" immediately.
5	BO_StepDownTP	Specially defined binary outputs, please refer to "*BO Plug-in Module (Binary Output)*" in Chapter 6 for more details.
6	BO_StepUpTP	

3.6.5 Settings

Settings for tap changer control and supervision are listed in "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**TP Settings**". Please refer to "*TP Settings*" in Chapter 7 for more details.

3.7 DC Analog Output (DCAO)

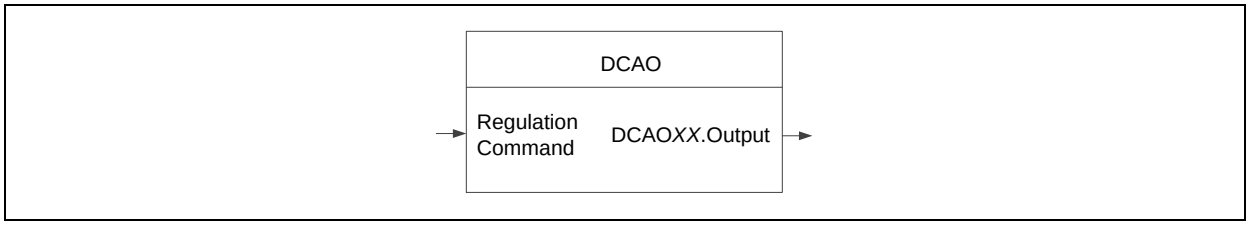
3.7.1 General Application

PCS-9705 can receive regulation messages from station control or control center, and then send DC output 4~20mA or 0~10V (for example to DCS system). The purpose to regulate the active/reactive power output of generator (AGC, AVC).

3.7.2 Function Description

There are 4 DC analog outputs (DO module is optional) in this BCU. With the use of [DCAO*XX*.Opt_Type_Regu], user can select the output mode and with the use of [DCAO*XX*.Min_Regu] and [DCAO*XX*.Max_Regu], user can define the values maximal and minimal of their physical implication. Please refer to "*Regulation Settings*" in Chapter 7 for more details.

3.7.3 Function Block Diagram



3.7.4 I/O Signals

No.	Output Signal	Description
1	DCAO*XX*.Output	No.*XX* DC analog output.

3.7.5 Settings

Regulation settings are listed in "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**Regulation Settings**". Please refer to "*Regulation Settings*" in Chapter 7 for more details.

3.8 Interlock (LOCK)

3.8.1 General Application

The interlocking function can block the possibility to operate primary equipment. The interlocking function is distributed to each IED. For station-wide interlock, IEDs communicate via the system-wide inter-bay bus (IEC 61850-8-1) and interlock criteria depends on the circuit configuration and primary equipment position status.

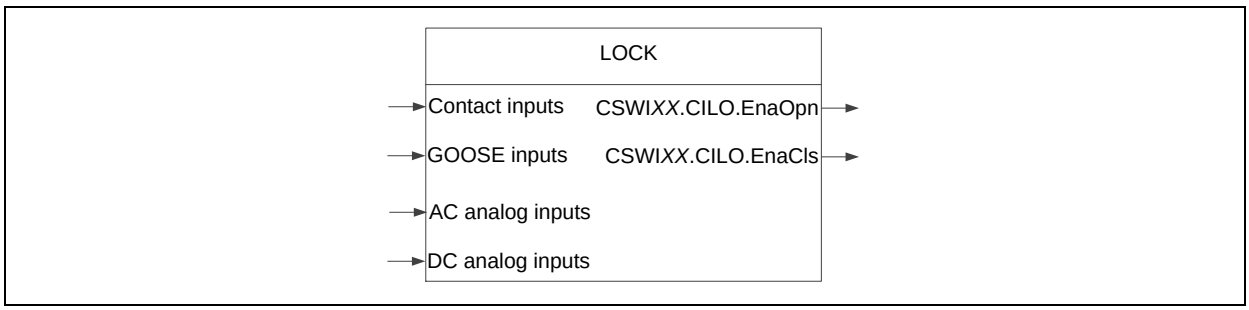
For easy and safe implementation of the interlocking function, the interlock criteria are configurable to meet the specific requirements of the customer.

3.8.2 Function Description

The logic interlocking function is enabled by setting the parameter [CSWI*XX*.En_Opn_Blk] and/or [CSWI*XX*.En_Cls_Blk] to "1". (*XX*=01~15)

When executing a switching command output, if the interlocking logic conditions are met, besides internal software interlocking, this device also provides hardware interlocking (additional normally open contact for remotely controlled apparatus via IL module). Please refer to "*IL Plug-in Module (Binary Output for Interlock Logic)*" in Chapter 6 for more details.

3.8.3 Function Block Diagram



3.8.4 I/O Signals

No.	Output Signal	Description
1	CSWI*XX*.CILO.EnaOpn	If the interlock criteria for No.*XX* open control are met, [CSWI01~15.CILO.EnaOpn] will be displayed as "1". Otherwise, it will be displayed as "0".
2	CSWI*XX*.CILO.EnaCls	If the interlock criteria for No.*XX* close control are met,

No.	Output Signal	Description
		[CSWI01~15.CILO.EnaCls] will be displayed as "1". Otherwise, it will be displayed as "0".

3.8.5 Settings

Interlock settings are listed in "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**Interlock Settings**". Please refer to "*Interlock Settings*" in Chapter 7 for more details.

3.9 RSYN Check (25)

3.9.1 General Application

The purpose of synchrocheck (abbreviated as RSYN check) is to synchronize the bay combination to the grid.

Note!

This function is inapplicable in PCS-9705 (General / Extended General).

3.9.2 Function Description

The synchrocheck function measures the conditions across the circuit breaker and compares them with corresponding settings. Output command is only given if all measured quantities are simultaneously within their set limits.

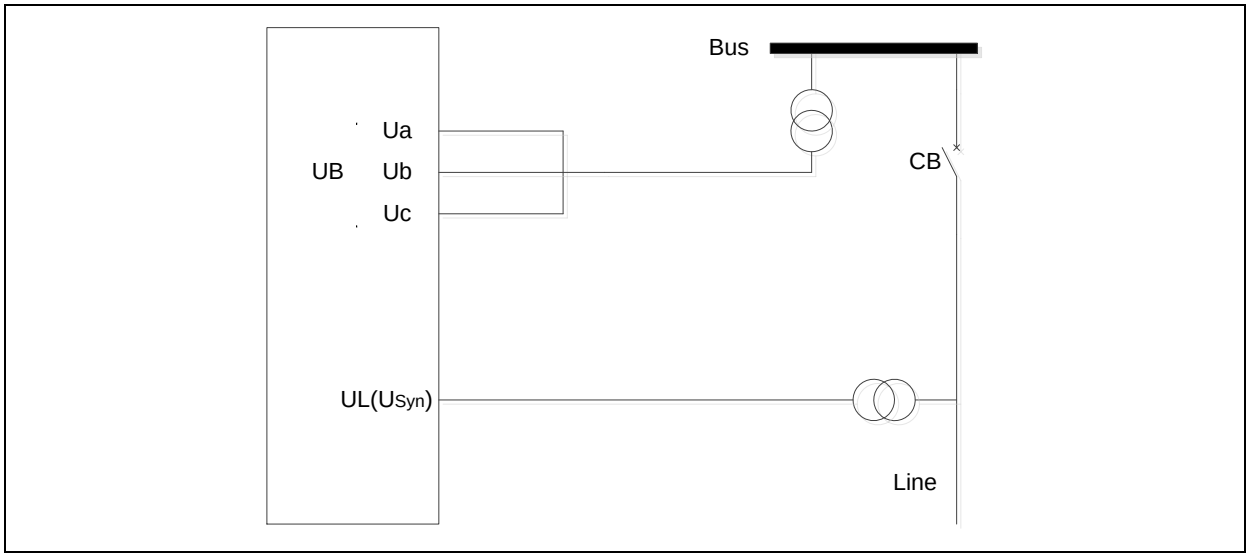
Synchrocheck in this device can be used for remote closing and manual closing. Four modes of check are available: non-check mode, synchronism check mode, loop check mode and dead check mode.

Note!

The following VT connection mode of three-phase voltage and reference voltage can be different according to different engineering requirement.

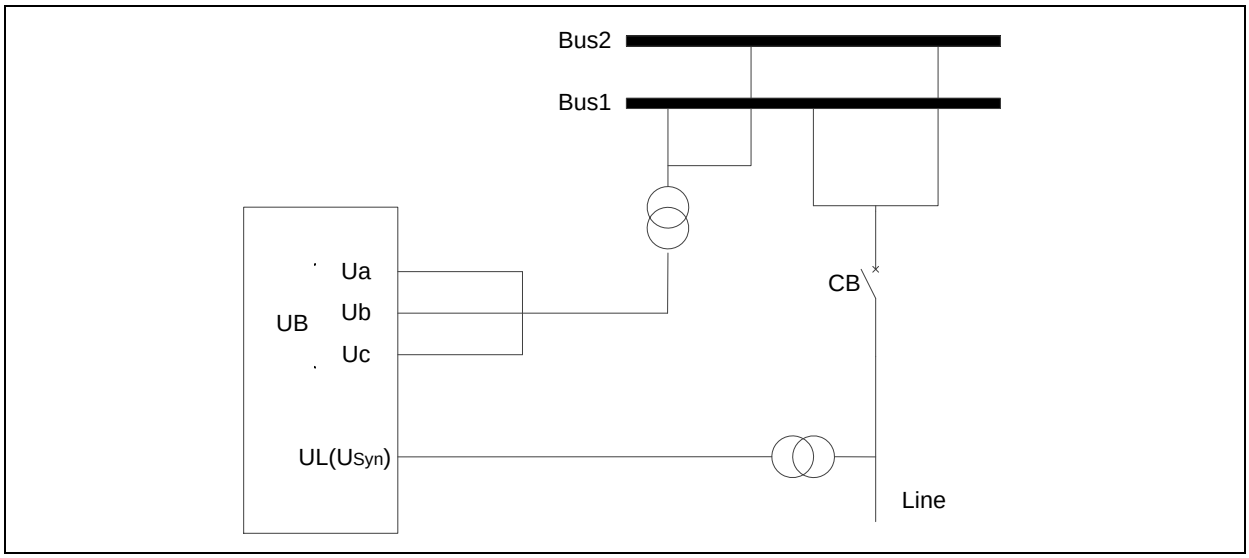
3.9.2.1 Single Busbar Arrangement (with PCS-9705 Single Bay)

Voltage selection function is not required for this busbar arrangement.



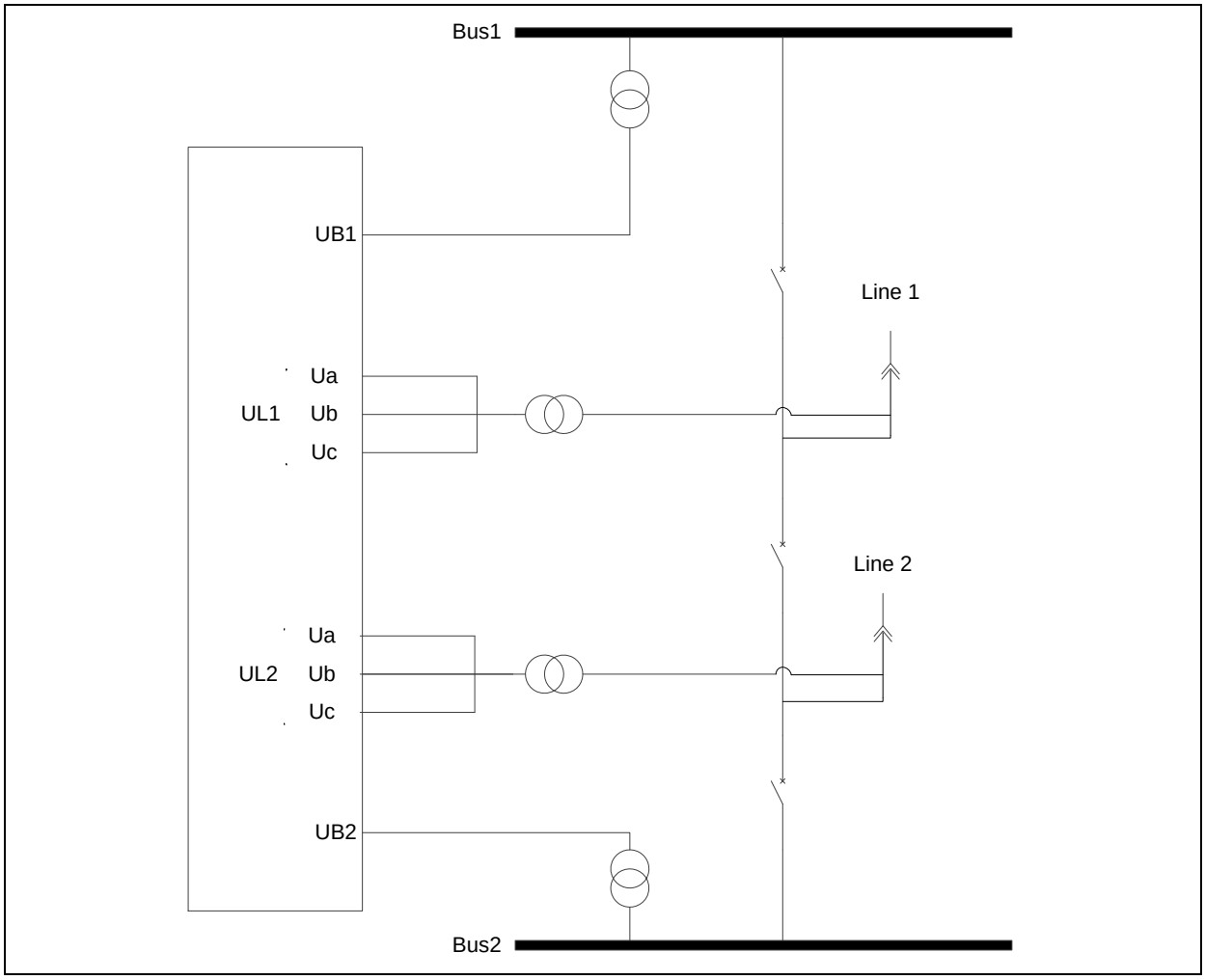
3.9.2.2 Double Busbars Arrangement (with PCS-9705 Single Bay)

For double busbars arrangement, selection of appropriate voltage from Bus 1 and Bus 2 for synchronism is required to be done by external circuit. After that, BCU will take line VT signal as reference to check synchronism with the bus voltage after voltage selection.



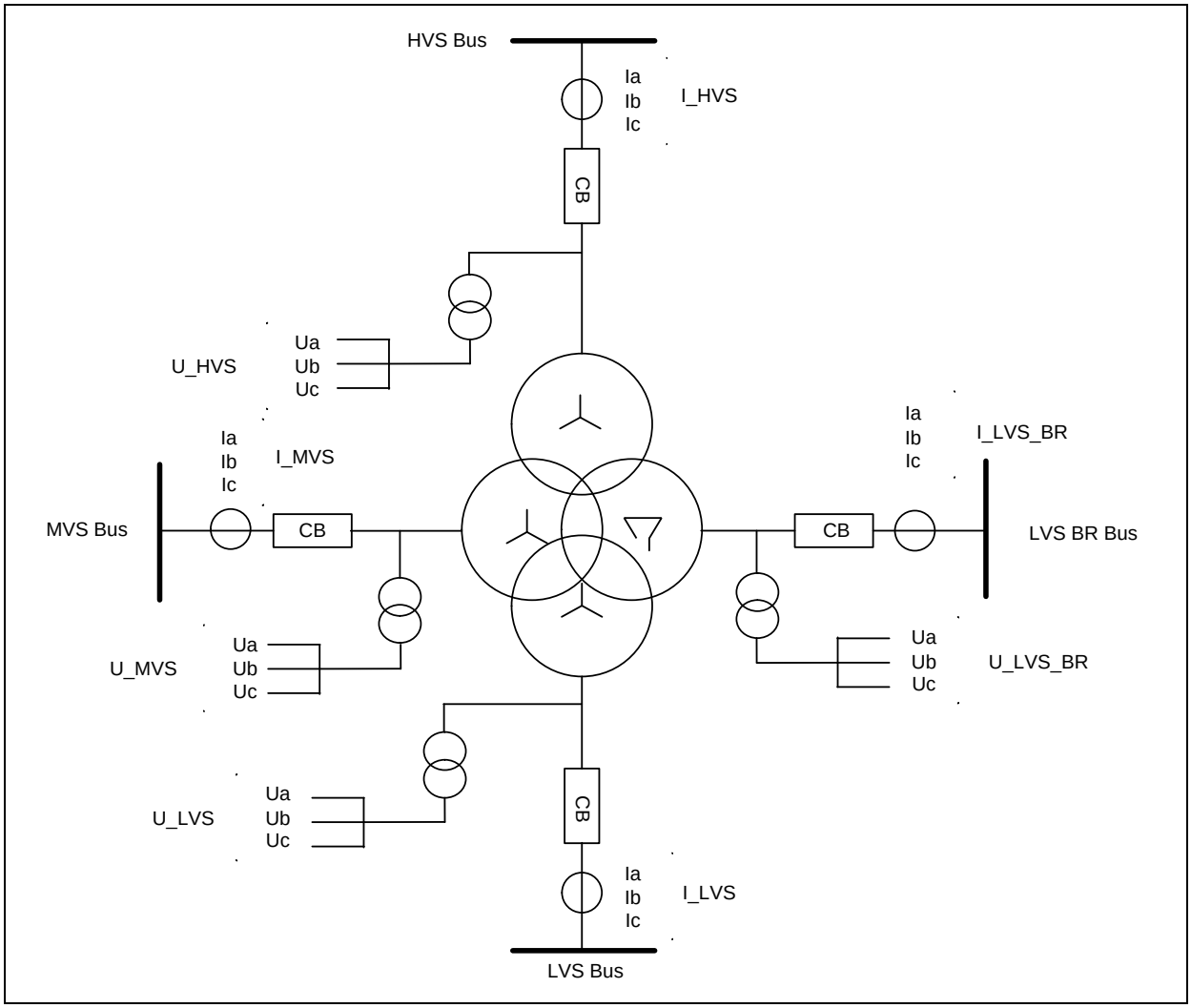
3.9.2.3 One and a Half Breakers Arrangement (with PCS-9705 Dual Bays)

For one and a half breakers arrangement, the reference voltage will synchronize with Bus 1 voltage signal for closing the circuit breaker at Bus 1 side.

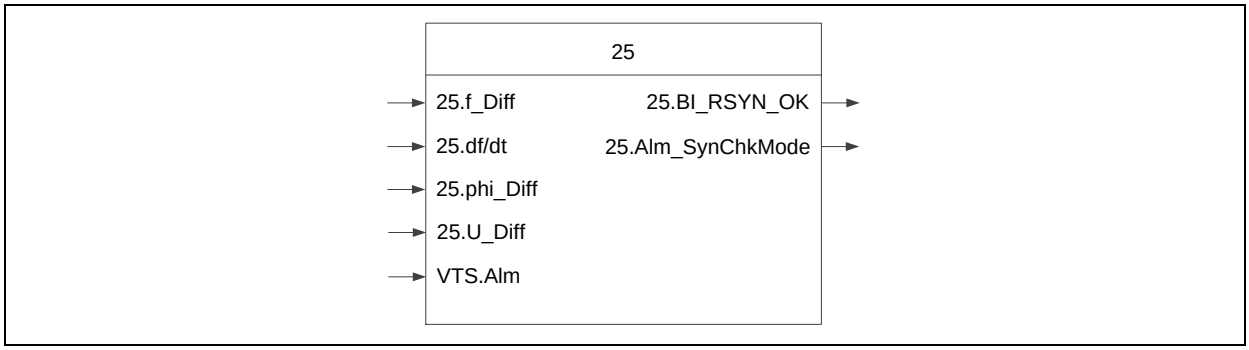


3.9.2.4 Transformer Unit Arrangement (with PCS-9705 Transformer Unit)

For transformer unit (3 or 4 windings), the reference side and the synchronization side can be selected in using 2 special settings. Please refer to "*Syn Settings*" in Chapter 7 for more details about these settings.



3.9.3 Function Block Diagram



3.9.4 I/O Signals

Calculated AC analog inputs for interlock logic are listed in "**MainMenu**" -> "**Measurements**" -> "**Measurements3**" -> "**Synchrocheck**". Please refer to "*Synchrocheck*" in Chapter 8 for more details.

No.	Output Signal	Description
1	25.BI_RSYN_OK	"1" indicates the satisfaction of interlock logic
2	25.Alm_SynChkMode	Alarm indicates error in the mode selection of synchrocheck

3.9.5 Logic

Logic links for RSYN check are listed in "**MainMenu**"->"**Settings**"->"**Logic Links**"->"**Function Links**". There are 4 modes of RSYN check in using of 3 logic links: [25.Link_DeadChk], [25.Link_SynChk] and [25.Link_LoopChk].

When BCU is in local control mode, these 3 logic links will determine the RSYN check mode. While BCU is in remote control mode, all the 3 logic links are invalid and the RSYN check mode will be determined by SCADA system.

Note!

[25.Link_DeadChk] and [25.Link_SynChk] can be enabled independently or together.

[25.Link_LoopChk] should be enabled uniquely, else (i.e. is enabled with either of [25.Link_DeadChk] or [25.Link_SynChk] at the same time), there will be an alarm "25.Alm_SynChkMode" after 1s.

Note!

Please refer to "*25.HMI_Mode*" in Chapter 7 for more details about the coordination between these logic links and the selection of remote/local control mode.

3.9.5.1 Non-Check Logic

All the 3 logic links are disabled (i.e. "0"), and BCU will send out the closing command without any block from RSYN check logic.

3.9.5.2 Synchronism Check Logic

Comparative relationship between reference voltage and incoming voltage for synchronism is as follows.

UL Line voltage

UB Bus voltage

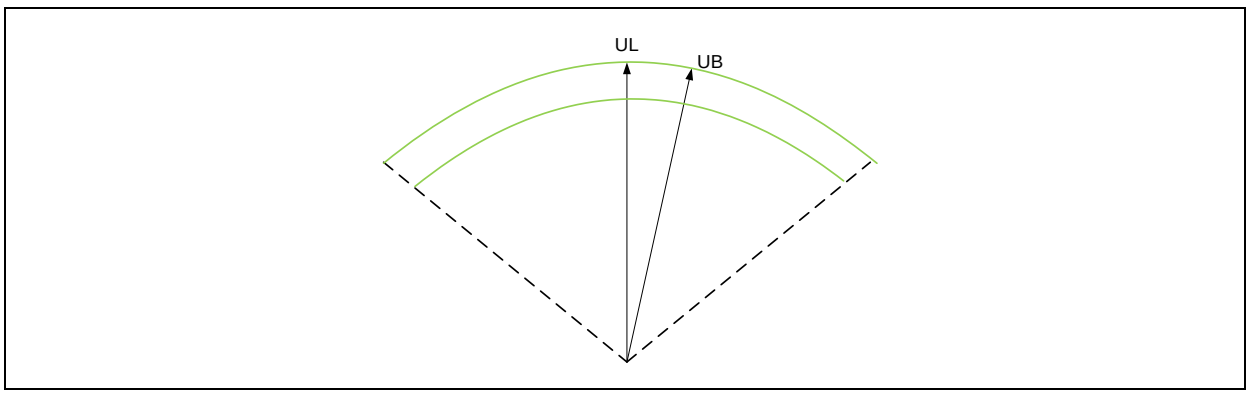


Figure 3.9-1 Relationship between reference voltage and synchronous voltage

Figure 3.9-1 shows the characteristics of synchrocheck element used for tele-closing or manual closing if both line and busbar are live. The synchrocheck element operates if voltage difference, frequency difference, slip frequency difference and phase angle difference are all within their setting values.

1. The slip frequency difference is checked by the following equations.

   df/dt≤[25.df/dt_SynChk]

2. The voltage difference is checked by the following equations.

   [25.U_LiveChk]≤UB

   [25.U_LiveChk] ≤UL

   [25.U_Diff_SynChk]≤|UB- UL|

3. The frequency difference is checked by the following equations.

   |f(UB)-f(UL)|≤[25.f_Diff_SynChk]

4. The phase difference is fixed at one (i.e. criterion is always satisfied).

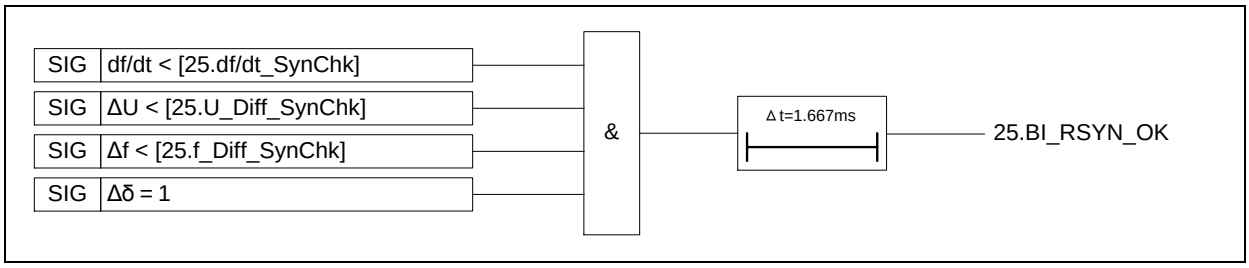


Figure 3.9-2 Synchronism check logic diagram

3.9.5.3 Loop Check Logic

The principle of loop check logic is similar to the one of synchronism check logic except the criterions will be:

1. The slip frequency difference is checked by the following equations.

   df/dt≤[25.df/dt_SynChk]

2. The voltage difference is checked by the following equations.

   [25.U_LiveChk]≤UB

   [25.U_LiveChk] ≤UL

   [25.U_Diff_SynChk]≤|UB- UL|

3. The phase difference is checked by the following equations.

   |phi(UB)-phi(UL)| ≤ [25.phi_Diff_SynChk]

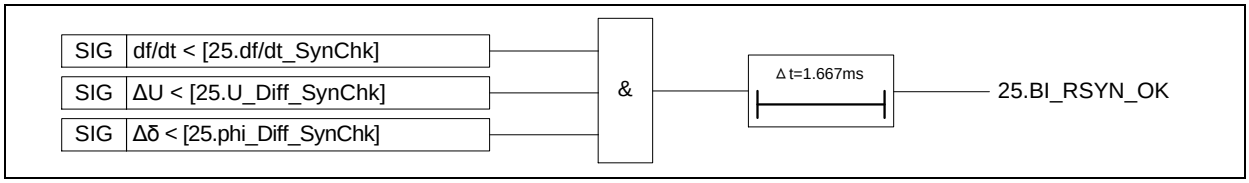


Figure 3.9-3 Loop check logic diagram

3.9.5.4 Dead Check Logic

The dead check mode checks only the synchronism check voltage. Several dead check modes are supported, please refer to "*Syn Settings*" in Chapter 7 for more details about these modes. The device will calculate measured bus voltage and line voltage at both sides of circuit breaker and compare them with the settings [25.U_LiveChk] and [25.U_DeadChk]. When the voltage is higher than [25.U_LiveChk], the bus/line is regarded as live. When the voltage is lower than [25.U_DeadChk], the bus/line is regarded as dead.

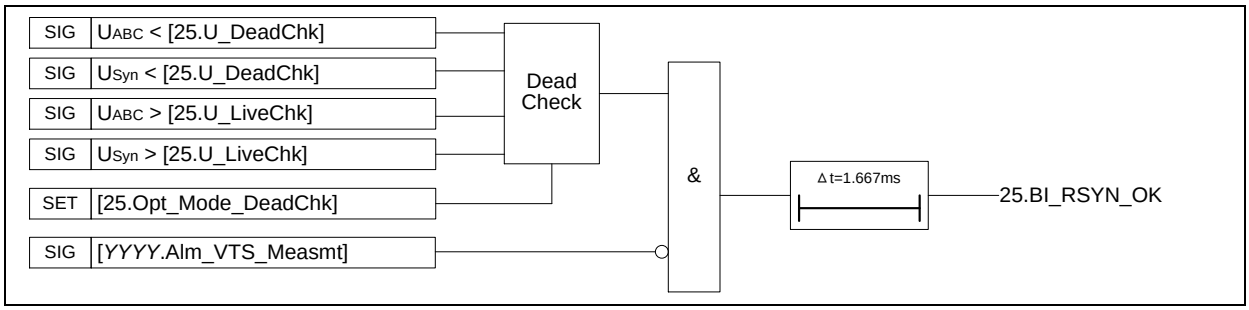


Figure 3.9-4 Dead check logic diagram

3.9.6 Settings

For PCS-9705, settings for RSYN check are listed in "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**Syn Settings**". Please refer to "*Syn Settings*" in Chapter 7 for more details about these settings.

3.10 VT Circuit Supervision (VTS)

Note!

"*YYYY*" is the function name substitution of different bays that can be "BayMMXU", "Bus1_MMXU", "Bay1_MMXU", "BayMHAN", etc.

3.10.1 General Application

The purpose of VT circuit supervision is to detect whether VT circuit is normal. Because some functions, such as synchronism check function and so on, will be influenced by VT circuit failure, these functions can be enabled/disabled by logic links (such as [25.En_VTS_Blk_DeadChk]) when VT circuit fails.

VT circuit failure can be caused by many reasons, such as fuse blown due to short-circuit fault, poor contact of VT circuit, VT maintenance and so on. The device can detect them and issue

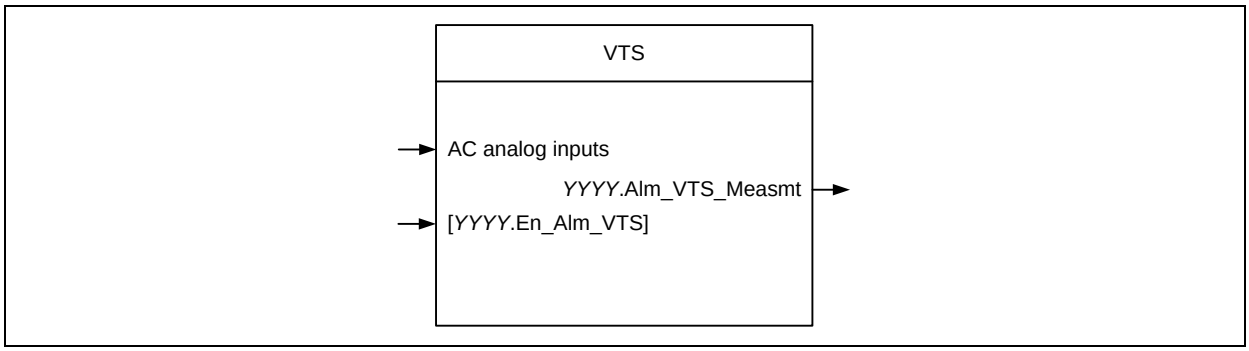
alarm signal or block relevant function.

3.10.2 Function Description

VT circuit supervision can detect failure of single-phase, two-phases and three-phases VT. Under normal condition, the device continuously supervises input voltage from VT. If the device is under abnormality, VT circuit supervision will be disabled.

VT circuit failure signal will be activated if positive-sequence voltage is lower than 30V or negative-sequence voltage exceeds 8V. This signal will pick up with a time delay of 1.25s and will drop off with a time delay of 10s.

3.10.3 Function Block Diagram



3.10.4 I/O Signals

No.	Output Signal	Description
1	*YYYY*.Alm_VTS_Measmt	Alarm for VT circuit fails.

3.10.5 Logic

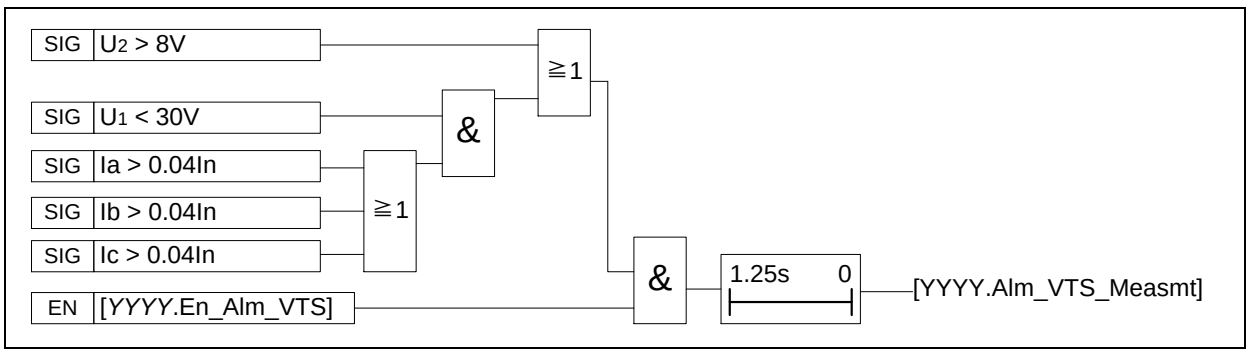


Figure 3.10-1 VT circuit supervision logic diagram

3.10.6 Settings

There is one logic link [*YYYY*.En_Alm_VTS] to enable or disable the alarm function of VT circuit supervision, please refer to "*FUN Settings*" in Chapter 7 for more details.

3.11 CT Circuit Supervision (CTS)

Note!

"*YYYY*" is the function name substitution of different bays that can be "BayMMXU", "Bus1_MMXU", "Bay1_MMXU", "BayMHAN", etc.

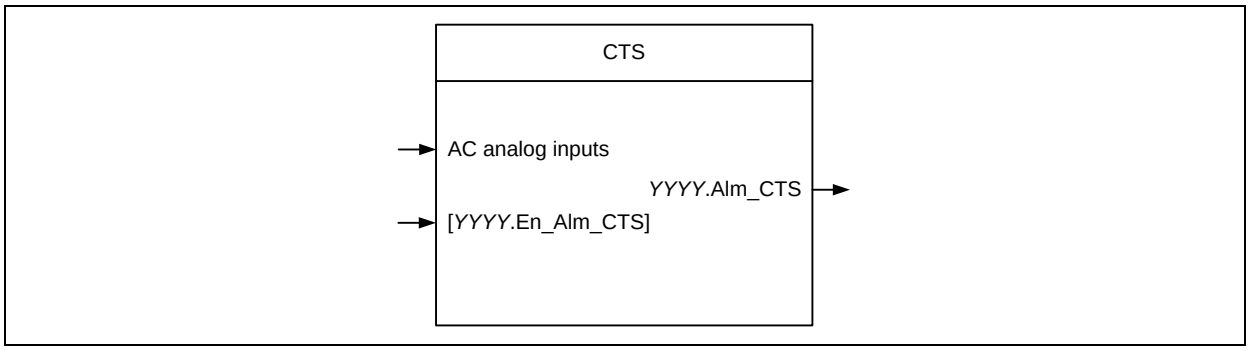
3.11.1 General Application

The purpose of the CT circuit supervision is to detect abnormality on CT secondary circuit.

3.11.2 Function Description

Under normal conditions, CT secondary signal is continuously supervised by detecting the residual and negative-sequence current. If residual current is larger than 0.06A or the negative-sequence current is greater than 0.10A, an error in CT circuit is considered, the concerned functions are going to be blocked and an alarm will be issued with a time delay of 1.25s and drop off with a time delay of 10s after CT circuit is restored to normal condition.

3.11.3 Function Block Diagram



3.11.4 I/O Signals

No.	Output Signal	Description
1	*YYYY*.Alm_CTS	Alarm for CT circuit fails.

3.11.5 Logic

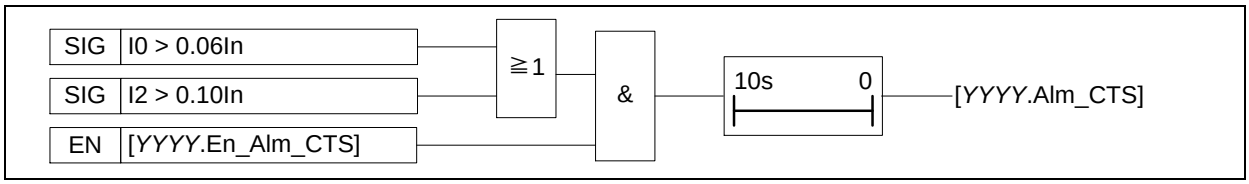


Figure 3.11-1 CT circuit supervision logic diagram

3.11.6 Settings

There is one logic link [*YYYY*.En_Alm_CTS] to enable or disable the alarm function of CT circuit supervision, please refer to "*FUN Settings*" in Chapter 7 for more details.

3.12 Clock Management

3.12.1 Real Time Clock

The MON module of PCS-9705 has a real time clock with high precision. The clock inside can last for about one month after the device is switched off.

3.12.2 Clock Synchronization

PCS-9705 can realize clock synchronization through various sources of clock including IRIG-B, PPS, PPM, SNTP broadcast from external timing device(e.g.: PCS-9785). Please refer to "*Communication Settings*" in Chapter 7 for more details about clock synchronization.

4 Supervision

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4.1 BCU Supervision Alarm Signals

4.1.1 Access Path

"**MainMenu**" -> "**Status**" -> "**Superv State**" -> "**BCU Superv**"

4.1.2 Description for BCU Supervision Alarm Signals

Hardware circuit and operation status of the device are self-supervised continuously. If any abnormal condition is detected, information or report will be displayed and corresponding alarm signal will be issued.

A minor abnormality may block a certain number of functions while the other functions can still work. However, if severe hardware failures or abnormalities are detected, all functions will be blocked, the LED "HEALTHY" will be extinguished, and blocking output contacts "BO_FAIL" will be enabled. Therefore, this device cannot work normally and maintenance is required to eliminate the failure. All the alarm signals and corresponding handling suggestions are listed below.

Note!

If the device is blocked or an alarm signal is sent during operation, please do find out its reason with the help of self-diagnostic record. If the reason cannot be found at site, please inform the manufacturer (NR) or the agent.

"*YYYY*" is the function name substitution of different bays that can be "BayMMXU", "Bus1_MMXU", "Bay1_MMXU", "BayMHAN", etc.

No.	Item	Description
Failure Signals (Device is blocked, "HEALTHY" LED is lit off, "ALARM" LED is lit on)		
1	Fail_Device	The device fails. This signal will pick up if any fail signal picks up and it will drop off when all fail signals drop off.
2	Fail_Sample_AD	Error is found during AD sampling. This signal will pick up instantaneously and will be latched unless corresponding error is eliminated.
3	Fail_Settings	Error is found during checking settings. This signal will pick up instantaneously and will be latched unless corresponding error is eliminated.
4	Fail_Initialization	Error is found during initialization process of this device. This signal will pick up instantaneously and will be latched unless corresponding error is eliminated.
5	Fail_FPGA	FPGA chip is damaged. This signal will pick up instantaneously and will be latched unless FPGA chip is OK.
6	Fail_Overflow_AD	Receiving buffer overflow is found during AD sampling. This signal will pick up instantaneously and will be latched unless receiving buffer overflow is eliminated.

No.	Item	Description
7	Fail_SampleSyn_AD	Receiving buffer error is found during AD sampling. This signal will pick up instantaneously and will be latched unless corresponding error is eliminated.
8	Alm_Self-Check	Error is found in device setting, or the device is abnormal.
Alarm Signals (Device is not blocked, "HEALTHY" LED keeps being lit on and "ALARM" LED is lit on)		
1	B*XX*.Alm_OptoDC, *XX*: 05 or 07	The power supply of BI plug-in module at slot *XX* is abnormal. This signal will pick up with a time delay of 10s and will drop off with a time delay of 10s.
2	*YYYY*.Alm_ROV	Residual voltage [*YYYY*.UN_Pri] is greater than [*YYYY*.UN_Alm_ROV]*[*YYYY*.U1n_VT_Measmt]. This signal will pick up with a time delay of 10s and will drop off with a time delay of 1s
3	*YYYY*.Alm_VTS_Measmt	VT circuit fails. This signal will pick up with a time delay of 1.25s and will drop off with a time delay of 10s.
4	*YYYY*.Alm_CTS	CT circuit fails. This signal will pick up with a time delay of 10s and will drop off with a time delay of 10s.
5	*YYYY*.Alm_UV	Primary value of any phase voltage is less than [*YYYY*.U_Alm_UV]*[*YYYY*.U1n_VT_Measmt]. This signal will pick up with a time delay of 10s and will drop off with a time delay of 1s.
6	Alm_Version	Error or inconsistence of program version is detected.
7	Alm_Device	The device is abnormal. This signal will pick up if any alarm signal picks up and it will drop off when all alarm signals drop off.
8	Alm_TimeSyn	Time synchronization abnormality alarm. This signal will pick up with a time delay of 60s and will drop off instantaneously.
9	Alm_SamplSyn_FO	Reserved for digital substation.
10	Alm_Overflow_FO	
11	Alm_SmplCRC_FO	
12	Alm_SmplCounter_FO	
13	Alm_RecvTimeout_FO	
14	Alm_Quality_FO	
15	B*XX*.Alm_Output	Hardware error is found in BO module at slot *XX*. This signal will pick up instantaneously and will be latched unless corresponding error is eliminated.
16	DPOS.Alm	For any one of [DPOS*XX*] (*XX*=01~16) (corresponds to a CB, a DS or an ES), both the normally open (abbreviated as NO) contact and the normally closed (abbreviated as NC) contact are open or closed. This signal will pick up with a time delay of "[DPOS.t_DPU_XX] + [DPOS.t_Alm]" and will drop off with a time delay of [DPOS.t_Alm].

No.	Item	Description
17	Alm_Settings_RSYN	Incompatibility of settings [25.Opt_Side_Measmt] and [25.Opt_Side_Syn] is found. This signal will pick up and drop off immediately after modification and save of settings.
Misc Signals (Device is not blocked, "HEALTHY" LED keeps being lit on and "ALARM" LED is lit off)		
1	CSWI.ExecInProg	Control operation is executing.
2	CSWI.Fail_Execute	Control operation fails.
3	CSWI.Succ_Execute	Control operation succeeds.
4	CSWI.25.ChkInProg	This device is checking synchronism-check criterion or dead check criterion during CB closing.
5	CSWI.25_Fail	This device fails to close CB because synchronism-check criterion or dead check criterion is not met.
6	CSWI.Interlock_Fail	This device fails to perform control operation because corresponding interlock criteria are not met.

4.1.3 Troubleshooting for BCU Supervision Alarm Signals

No.	Item	Handling suggestion
Failure Signals (Device is blocked, "HEALTHY" LED is lit off, "ALARM" LED is lit on)		
1	Fail_Device	The signal is issued if any other specific failure signal is issued, please refer to the handling suggestion of the specific failure signal.
2	Fail_Sample_AD	1. Put the device out of service. 2. Check that the analog input modules and corresponding wiring connectors are installed at correct position. 3. Reboot the device and the device will return to normal operation state.
3	Fail_Settings	Please inform the manufacturer (NR) or the agent for technical support.
4	Fail_Initialization	1. Check that software version in LCD display is consistent with software version in corresponding configuration file. 2. Please inform the manufacturer (NR) or the agent for technical support.
5	Fail_FPGA	FPGA chips are damaged and please inform the manufacturer (NR) or the agent.
6	Fail_Overflow_AD	1. Check that software version in LCD display is consistent with software version in corresponding configuration file. 2. Please inform the manufacturer (NR) or the agent for technical support.
7	Fail_SampleSyn_AD	1. Check that software version in LCD display is consistent with software version in corresponding configuration file. 2. Please inform the manufacturer (NR) or the agent for technical support.
8	Alm_Self-Check	1. Check that software version in LCD display is consistent with software version in corresponding configuration file. 2. Check whether there is fatal error in this device.

No.	Item	Handling suggestion
Alarm Signals (Device is not blocked, "HEALTHY" LED keeps being lit on and "ALARM" LED is lit on)		
1	B*XX*.Alm_OptoDC, *XX*: 05 or 07	1. Check whether the binary input module is connected to the power supply. 2. Check whether the voltage of power supply is in the required range. 3. After the voltage for binary input module restores to normal range, the "**ALARM**" LED will be extinguished and the corresponding alarm message will disappear and the device will return to normal operation state.
2	*YYYY*.Alm_ROV	Please check residual voltage input or calculated residual voltage.
3	*YYYY*.Alm_VTS_Measmt	Please check the corresponding VT secondary circuit.
4	*YYYY*.Alm_CTS	Please check the corresponding CT secondary circuit.
5	*YYYY*.Alm_UV	Please check three phase voltages.
6	Alm_Version	If there is none usage of moveable disk, please make sure that [En_MDisk]=0 (Access path: "**MainMenu**" -> "**Settings**" -> "**Device Setup**"). Users may pay no attention to this alarm in commissioning stage, but the latest package file (including correct version checksum file) ought to be downloaded to make the alarm disappear before put device into service. Please contact the provider to update the software.
7	Alm_Device	The signal is issued if any other specific alarm signal is issued, please refer to the handling suggestion of the specific alarm signal.
8	Alm_TimeSyn	1. Check whether the selected clock synchronization mode matches the clock synchronization source. 2. Check whether the wiring connection between the device and the clock synchronization source is correct. 3. Check whether the setting for selecting clock synchronization (i.e. [Opt_TimeSyn]) is set correctly. If there is no clock synchronization, please set the setting [Opt_TimeSyn] as "No TimeSyn". 4. After the abnormality is removed, the "**ALARM**" LED will be extinguished and the corresponding alarm message will disappear and the device will return to normal operation state.
9	Alm_SamplSyn_FO	Reserved for digital substation.
10	Alm_Overflow_FO	
11	Alm_SmplCRC_FO	
12	Alm_SmplCounter_FO	
13	Alm_RecvTimeout_FO	
14	Alm_Quality_FO	
15	B*XX*.Alm_Output	1. Check corresponding BO module or IL module. 2. Inform the manufacturer (NR) or the agent for technical support.
16	DPOS.Alm	1. Access the submenu "**MainMenu**" -> "**Status**" -> "**Inputs**" -> "**DPS Inputs**" to check the states of [DPOS*XX*] (*XX*=01~16). [DPOS*XX*] indicates state of double point *XX*: [DPOS*XX*]="DPS_INT": Intermediate-state;

No.	Item	Handling suggestion
		[DPOS*XX*]="DPS_OFF": Open; [DPOS*XX*]="DPS_ON": Close; [DPOS*XX*]="DPS_BAD": Bad state. 2. If [DPOS*XX*]="DPS_INT" or "DPS_BAD", it indicates that state of corresponding CB/DS/ES remains "Intermediate-state" or "Bad-state". Please check the state of corresponding CB/DS/ES. [DPOS.Alm] will drop off instantaneously if the state of corresponding CB/DS/ES returns to normal state ("Open" or "Close").
17	Alm_Settings_RSYN	Access the submenu "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**Syn Settings**" to change the values of [25.Opt_Side_Measmt] and [25.Opt_Side_Syn] (should be different) and save the modification.
Misc Signals (Device is not blocked, "HEALTHY" LED keeps being lit on and "ALARM" LED is lit off)		
1	CSWI.ExecInProg	This is only a prompt signal, no treatment is required.
2	CSWI.Fail_Execute	This is only a prompt signal, no treatment is required.
3	CSWI.Succ_Execute	This is only a prompt signal, no treatment is required.
4	CSWI.25.ChkInProg	This is only a prompt signal, no treatment is required.
5	CSWI.25_Fail	Please check the synchronism settings in: "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**Syn Settings**" or "**Bay1 Syn Settings**" or "**Bay2 Syn Settings**".
6	CSWI.Interlock_Fail	Please check the interlock configuration file.

4.2 GOOSE Supervision Alarm Signals

4.2.1 Access Path

"**MainMenu**" -> "**Status**" -> "**Superv State**" -> "**GOOSE Superv**"

4.2.2 Description for GOOSE Supervision Alarm Signals

If any GOOSE alarm signal is issued, the "**ALARM**" LED will be lit on, but the "**HEALTHY**" LED is still lit on. This device will not be blocked. When the GOOSE alarm signal disappears, the device will return to normal state, and the "**ALARM**" LED will be lit off automatically.

No.	Item	Description
1	GAlm_Overall_PL	[GAlm_Overall_PL] will be issued if any one of the following alarm signals is generated: [GAlm_AStorm_PL], [GAlm_BStorm_PL], [GAlm_CfgFile_PL], [*XX*.GAlm_ADisc_PL_*YY*], [*XX*.GAlm_BDisc_PL_*YY*], [*XX*.GAlm_Cfg_PL_*YY*].
2	GAlm_AStorm_SL	GOOSE alarm signal indicating that a network storm exists in the station level GOOSE network A.
3	GAlm_BStorm_SL	GOOSE alarm signal indicating that a network storm exists in the station

No.	Item	Description
		level GOOSE network B.
4	GAlm_CfgFile_SL	GOOSE alarm signal indicating that at least an error exists in the GOOSE configuration file for station level GOOSE.
5	*XX*.GAlm_ADisc_SL_*YY*	GOOSE alarm signal indicating that network A of station level GOOSE connection *YY* is disconnected. *YY* refers to the No. of GOOSE receiving link (*YY*=01…17). *XX* refers to the GOOSE receiving link name, and it can be configured by the value of the settings [B01_GOOSE_Link0],… [B01_GOOSE_Link16]. (Access path: "**MainMenu**" -> "**Settings**" -> "**Device Setup**" -> "**Label Settings**". Please refer to "*Label Settings*" in Chapter 7 for more details.) E.g., if default value of [B01_GOOSE_Link0] is "SL_0", and then corresponding default name will be "SL_0.GAlm_ADisc_SL_01".
6	*XX*.GAlm_BDisc_SL_*YY*	GOOSE alarm signal indicating that network B of station level GOOSE connection *YY* is disconnected. *YY* refers to the No. of GOOSE receiving link (*YY*=01…17). *XX* refers to the GOOSE receiving link name, and it can be configured by the value of the settings [B01_GOOSE_Link0],… [B01_GOOSE_Link16]. (Access path: "**MainMenu**" -> "**Settings**" -> "**Device Setup**" -> "**Label Settings**". Please refer to "*Label Settings*" in Chapter 7 for more details.) E.g., if default value of [B01_GOOSE_Link0] is "SL_0", and then corresponding default name will be "SL_0.GAlm_ADisc_SL_01".
7	*XX*.GAlm_Cfg_SL_*YY*	Between GOOSE control blocks received on network and GOOSE control blocks defined in GOOSE configuration file are unmatched for station level GOOSE connection *YY*. *YY* refers to the No. of GOOSE receiving link (*YY*=01…17). *XX* refers to the GOOSE receiving link name, and it can be configured by the value of the setting [B01_GOOSE_Link0],… [B01_GOOSE_Link16]. (Access path: "**MainMenu**" -> "**Settings**" -> "**Device Setup**" -> "**Label Settings**". Please refer to "*Label Settings*" in Chapter 7 for more details.) E.g.: if default value of [B01_GOOSE_Link0] is "SL_0", and then corresponding default name will be "SL_0.GAlm_Cfg_SL_01".
8	GAlm_AStorm_PL	GOOSE alarm signal indicating that a network storm exists in the process level GOOSE network A.
9	GAlm_BStorm_PL	GOOSE alarm signal indicating that a network storm exists in the process level GOOSE network B.
10	GAlm_CfgFile_PL	GOOSE alarm signal indicating that at least an error exists in the GOOSE configuration file for process level GOOSE.
11	*XX*.GAlm_ADisc_PL_*YY*	GOOSE alarm signal indicating that network A of process level GOOSE connection *YY* is disconnected. *YY* refers to the No. of GOOSE receiving link. *YY*=01…16. *XX* refers to

No.	Item	Description
		the GOOSE receiving link name, and it can be configured by the value of the setting [B01_GOOSE_Link0],… [B01_GOOSE_Link15]. (Access path: "**MainMenu**" -> "**Settings**" -> "**Device Setup**" -> "**Label Settings**". Please refer to "*Label Settings*" in Chapter 7 for more details.) E.g.: if default value of [B01_GOOSE_Link0] is "PL_0", and then corresponding default name will be "PL_0.GAlm_ADisc_PL_01".
12	*XX*.GAlm_BDisc_PL_*YY*	GOOSE alarm signal indicating that network B of process level GOOSE connection *YY* is disconnected. *YY* refers to the No. of GOOSE receiving link. *YY*=01…16. *XX* refers to the GOOSE receiving link name, and it can be configured by the value of the setting [B01_GOOSE_Link0],… [B01_GOOSE_Link15]. (Access path: "**MainMenu**" -> "**Settings**" -> "**Device Setup**" -> "**Label Settings**". Please refer to "*Label Settings*" in Chapter 7 for more details.) E.g.: if default value of [B01_GOOSE_Link0] is "PL_0", and then corresponding default name will be "PL_0.GAlm_BDisc_PL_01".
13	*XX*.GAlm_Cfg_PL_*YY*	Between GOOSE control blocks received on network and GOOSE control blocks defined in GOOSE configuration file are unmatched for process level GOOSE connection *YY*. *YY* refers to the No. of GOOSE receiving link. *YY*=01…16. *XX* refers to the GOOSE receiving link name, and it can be configured by the value of the setting [B01_GOOSE_Link0],… [B01_GOOSE_Link15]. (Access path: "**MainMenu**" -> "**Settings**" -> "**Device Setup**" -> "**Label Settings**". Please refer to "*Label Settings*" in Chapter 7 for more details.) E.g.: if default value of [B01_GOOSE_Link0] is "PL_0", and then corresponding default name will be "PL_0.GAlm_Cfg_PL_01".

4.2.3 Troubleshooting for GOOSE Supervision Alarm Signals

No.	Item	Handling suggestion
1	GAlm_Overall_PL	Please check Ethernet switch of process level GOOSE network, GOOSE configuration file and process level GOOSE network.
2	GAlm_AStorm_SL	Please check Ethernet switch of station level GOOSE network.
3	GAlm_BStorm_SL	Please check Ethernet switch of station level GOOSE network.
4	GAlm_CfgFile_SL	Please check GOOSE configuration file.
5	*XX*.GAlm_ADisc_SL_*YY*	Please check station level GOOSE network.
6	*XX*.GAlm_BDisc_SL_*YY*	Please check station level GOOSE network.
7	*XX*.GAlm_Cfg_SL_*YY*	Please check GOOSE configuration file.
8	GAlm_AStorm_PL	Please check Ethernet switch of process level GOOSE network.
9	GAlm_BStorm_PL	Please check Ethernet switch of process level GOOSE network.
10	GAlm_CfgFile_PL	Please check GOOSE configuration file.
11	*XX*.GAlm_ADisc_PL_*YY*	Please check process level GOOSE network.

No.	Item	Handling suggestion
12	*XX*.GAlm_BDisc_PL_*YY*	Please check process level GOOSE network.
13	*XX*.GAlm_Cfg_PL_*YY*	Please check GOOSE configuration file.

5 Management

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5.1 Measurement

PCS-9705 performs continuous measurement of analogue inputs. The device samples 80 points per cycle, calculates the RMS value in each interval, and updates the LCD display in every 0.5 second. The measurement data can be displayed on the LCD of the device front panel or on local/remote PC via software tool.

5.2 Event Recording

5.2.1 Overview

The device can store the latest 1024 supervision events, 1024 IO events, 1024 device logs, 256 control logs and 256 regulation logs. All the records are stored in non-volatile memory, and when the available space is exhausted, the oldest record will be automatically overwritten by the latest one.

5.2.2 Disturbance Records

Access path: "**MainMenu**"-> "**Records**"->"**Disturb Records**".

When any protection element operates or drops off, such as fault detector, distance protection etc., they will be logged in disturbance records.

Note!

This function is invalid in BCU.

5.2.3 Supervision Events

Access path: "**MainMenu**"-> "**Records**"->"**Superv Events**".

The device is under automatic supervision all the time. If there is any failure or abnormal condition detected (e.g. VT circuit failure), it will be stored and displayed.

5.2.4 IO Events

Access path: "**MainMenu**"-> "**Records**"->"**IO Events**".

When a binary input is energized or de-energized, i.e., its state has changed from "0" to "1" or from "1" to "0", it will be stored and displayed.

5.2.5 Device Logs

Access path: "**MainMenu**"-> "**Records**"->"**Device Logs**".

If an operator implements some operations on the device, such as reboot device, modify setting, etc., they will be stored and displayed.

5.2.6 Control Logs

Access path: "**MainMenu**"-> "**Records**"->"**Control Logs**".

The total sequence of each attempt of control command will be stored and displayed, including

object, source, remote/local mode, interlock condition, command (selection/execution, open/close, up/down) and result.

5.2.7 Regulation Logs

Access path: "**MainMenu**"-> "**Records**"->"**Regulation Logs**".

The total sequence of each attempt of regulation command will be stored and displayed, including object, source, remote/local mode, command (selection/execution), value and result.

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6.1 Overview

PCS-9705 adopts 32-bit microchip processor MON as control core for management and monitoring function, meanwhile, adopts high-speed digital signal processor DSP for all calculation. 80 points are sampled in every cycle and parallel processing of sampled data can be realized in each sampling interval to ensure ultrahigh reliability and safety of the device.

This device is developed on the basis of our latest software and hardware platform, and this new platform provides high reliability, networking and great capability in anti-interference. See the following figure for hardware diagram.

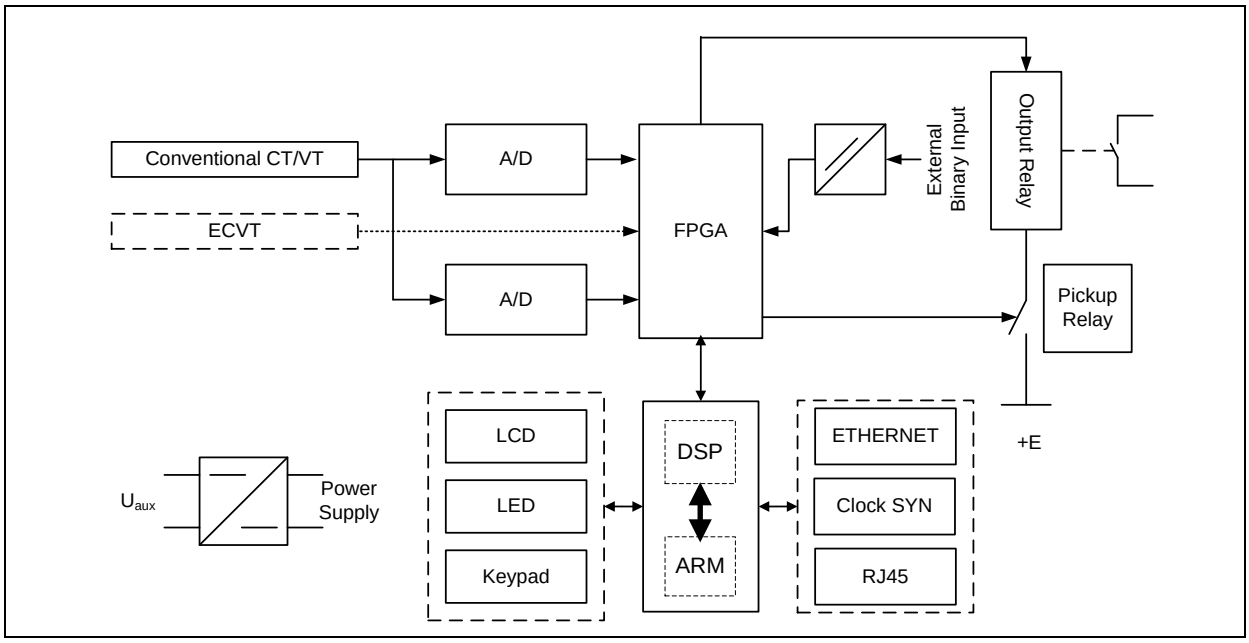


Figure 6.1-1 Hardware diagram

The working process of the device is shown in above figure: current and voltage from conventional CT/VT are converted into small voltage signal and sent to FPGA module after filtered and A/D conversion for calculation (ECVT signal is sent to the device without small signal and A/D conversion). MON module performs SOE (sequence of event) record, communication between device and SAS and communication between HMI and MON module.

The items can be flexibly configured depending on the situations like sampling method of the device (conventional CT/VT or ECT/EVT), and the mode of binary output (conventional binary output or GOOSE binary output). The configurations for PCS-9705 based on microcomputer are classified into standard and optional modules.

PCS-9705 is comprised of intelligent plug-in modules (maximum 20 slots for full width chassis or 9 slots for half width).

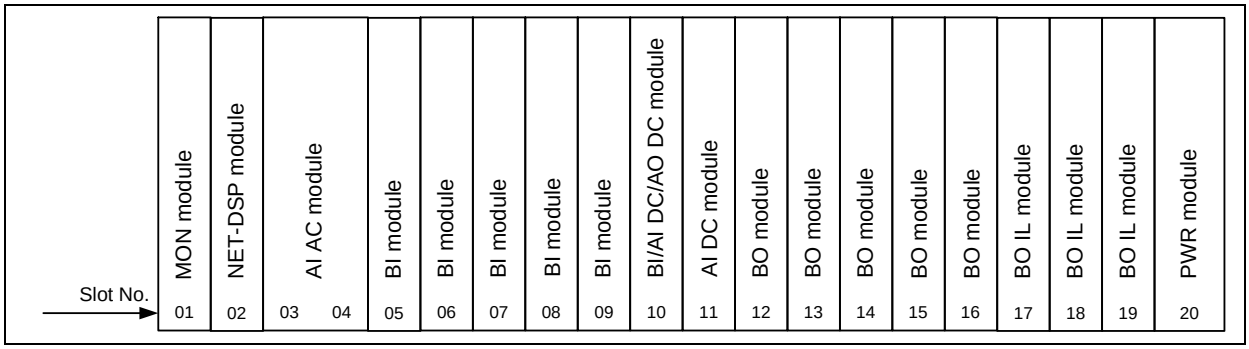


Figure 6.1-2 Example rear view of device slot (App 1, 2, 3, Full Width)

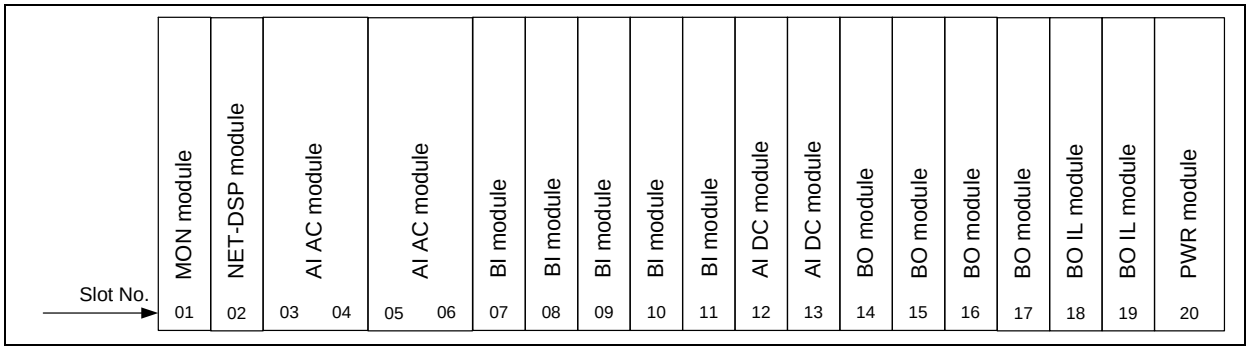


Figure 6.1-3 Example rear view of device slot (App 4, 5, Full Width)

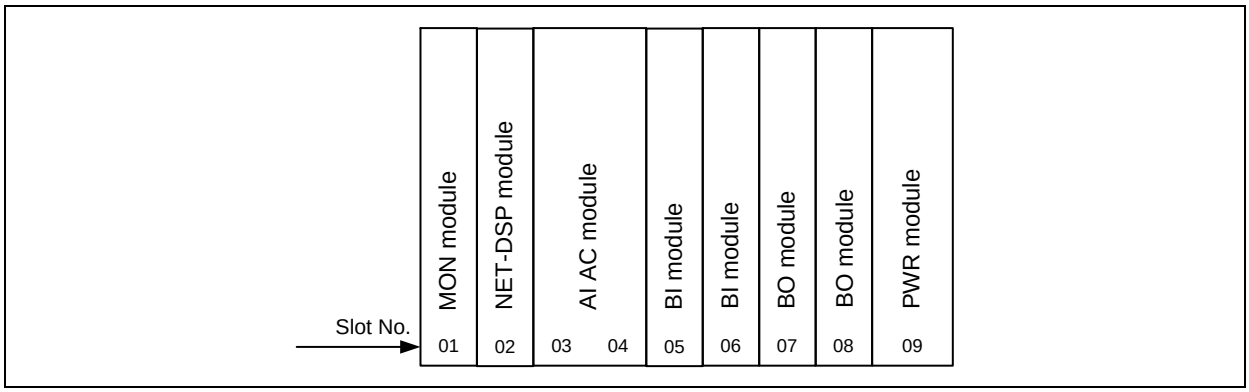


Figure 6.1-4 Example rear view of device slot (App 1, 2, 3, Half Width)

Table 6.1-1 Hardware configuration

No.	Module Type	Brief
1	NR4106M	Management and monitor module (MON module); Receive GOOSE message from station layer;
2	NR4138	NET-DSP module; Receive SV data from merging unit via IEC61850-9-2; Transmit/Receive GOOSE message of process layer;
3	NR4402	Analog input module (AI module)
4	NR4501/NR4504	Binary input module (BI module)
5	NR4410	DC analog input module (DI module)
6	NR4411	DC analog output module (DO module)

No.	Module Type	Brief
7	NR4522	Binary output module (BO module)
8	NR4522	Binary outputs for interlock logic (IL module)
9	NR4304	Power supply module (PWR module)
10	NR1854	HMI module

Note!

Please declare the hardware configuration of device when placing order.

1. **MON module** provides functions like communication with SAS, event record, setting management etc. The medium of the Ethernet interface of the MON module is optional. Different subtypes of the MON module correspond to different Ethernet interface medium. GOOSE messages of station level can also be received by MON module.
2. **NET-DSP module** can receive SV data from merging unit via IEC61850-9-2. GOOSE message of process layer can also be received by NET-DSP module.
3. **AI module** converts AC current and voltage from current transformers and voltage transformers respectively to small voltage signal.
4. **BI module** provides binary inputs via opto-couplers with rated voltage (configurable).
5. **DI module** can receive DC analog inputs from transducers (e.g. temperature or humidity transducers).
6. **DO module** can send out up to 4 channels of 0~10V or 4~20mA output to DCS system to regulate the active power output of the specified generator.
7. **BO module** provides output contacts, and the output contact assigned to operate when remote control in progress.
8. **IL module** provides output contacts, and the output contact assigned to operate when interlock logic is satisfied.
9. **PWR module** converts DC 110~250V into various DC voltage levels for modules of the device.
10. **HMI module** human-machine interface is comprised of LCD, keypad, LED indicators and multiplex RJ45 ports.

Note!

In engineering applications, the number of the modules equipped may be different according to the actual requirements.

Examples of front and rear panel of PCS-9705 are shown in the following figures.

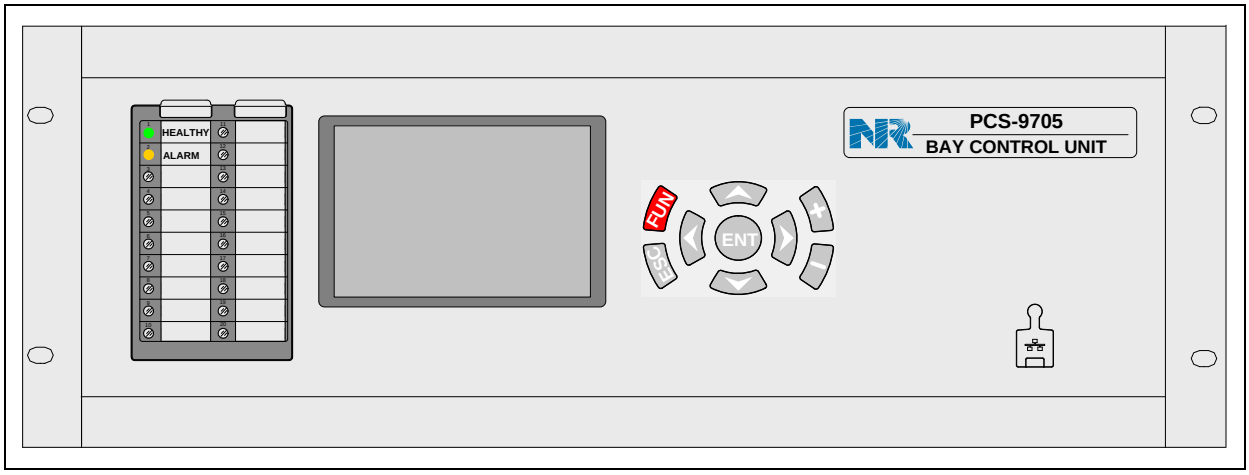


Figure 6.1-5 Front panel (Full Width, Normal)

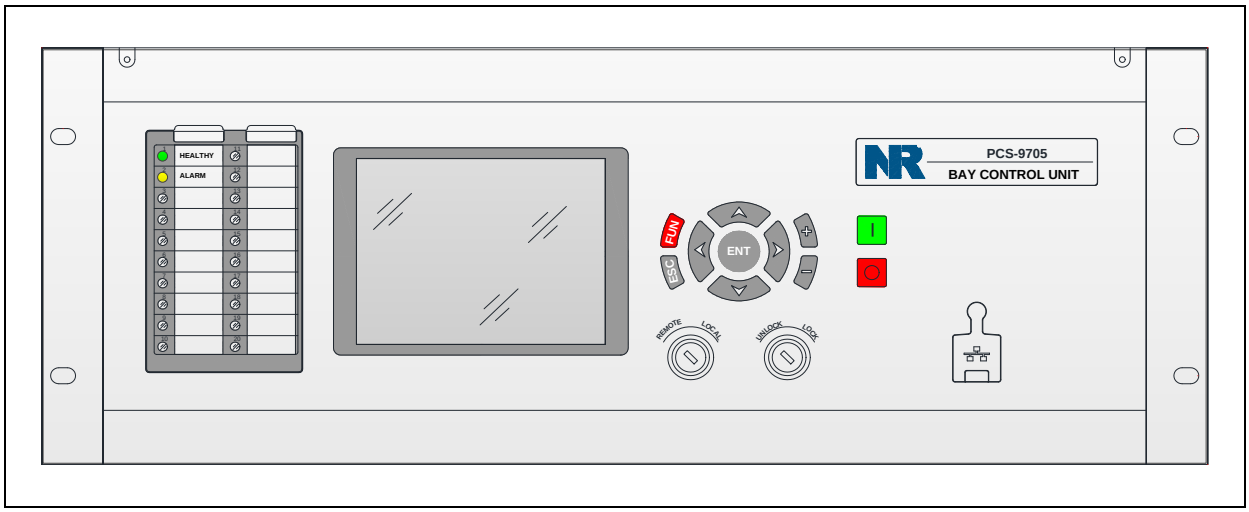


Figure 6.1-6 Front panel (Full Width, with Control Buttons)

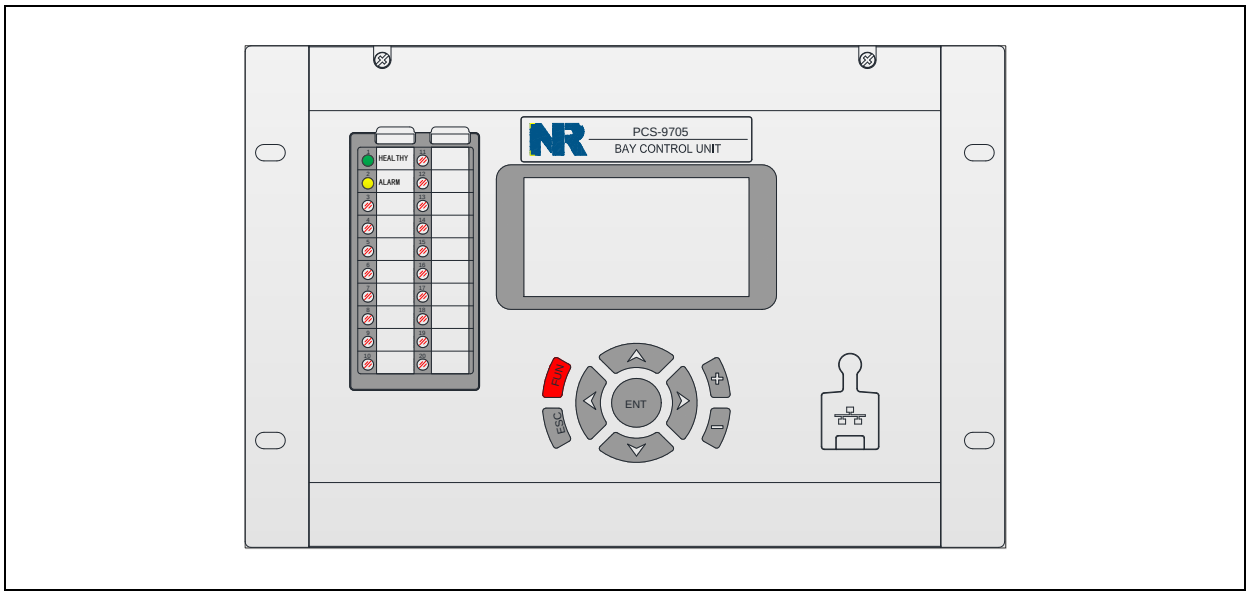


Figure 6.1-7 Front panel (Half Width, Normal)

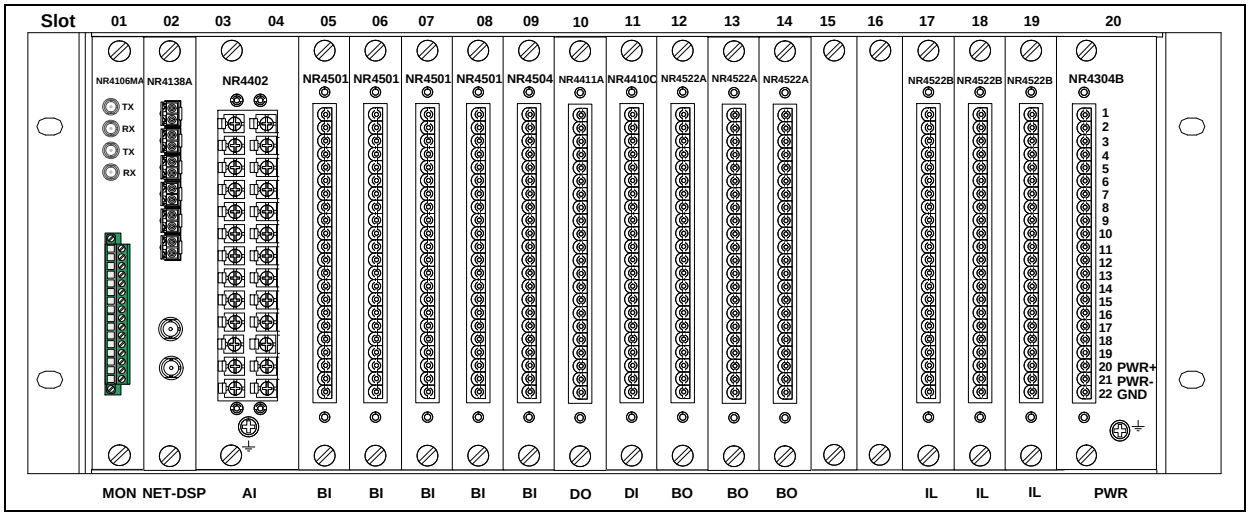


Figure 6.1-8 Example of rear panel (Full Width, App 1, 2, 3)

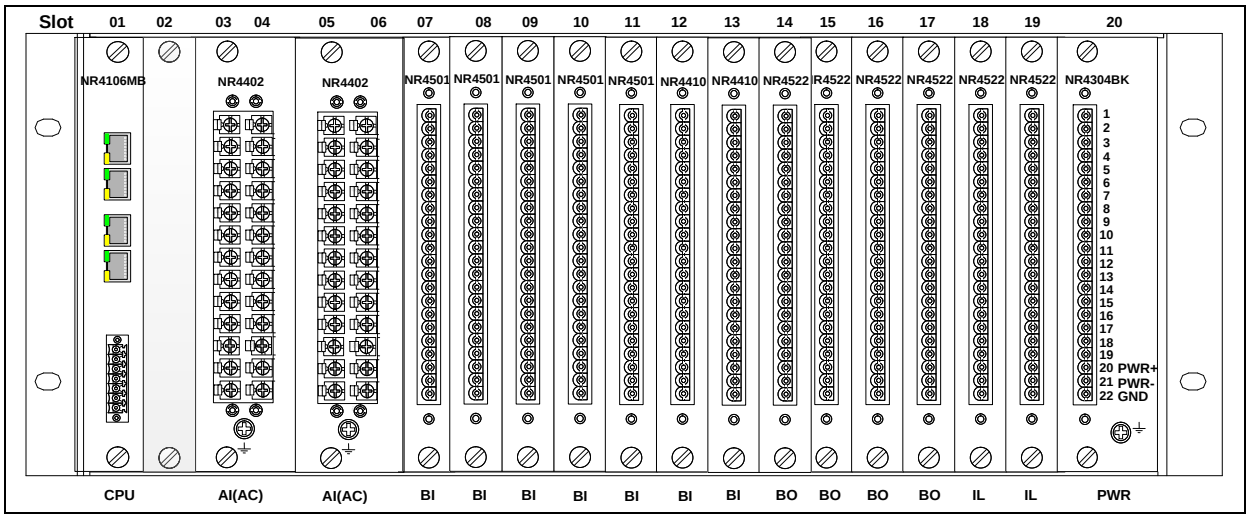


Figure 6.1-9 Example of rear panel (Full Width, App 4, 5)

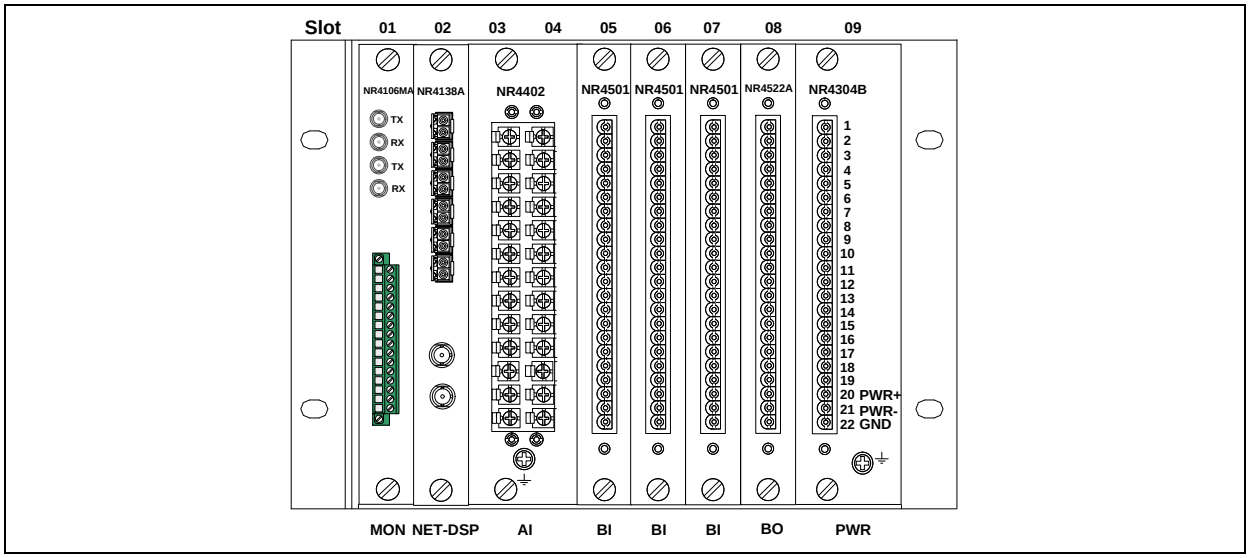


Figure 6.1-10 Example of rear panel (Half Width, App 1, 2, 3)

6.2 Typical Wiring

6.2.1 Conventional CT/VT (For Reference Only)

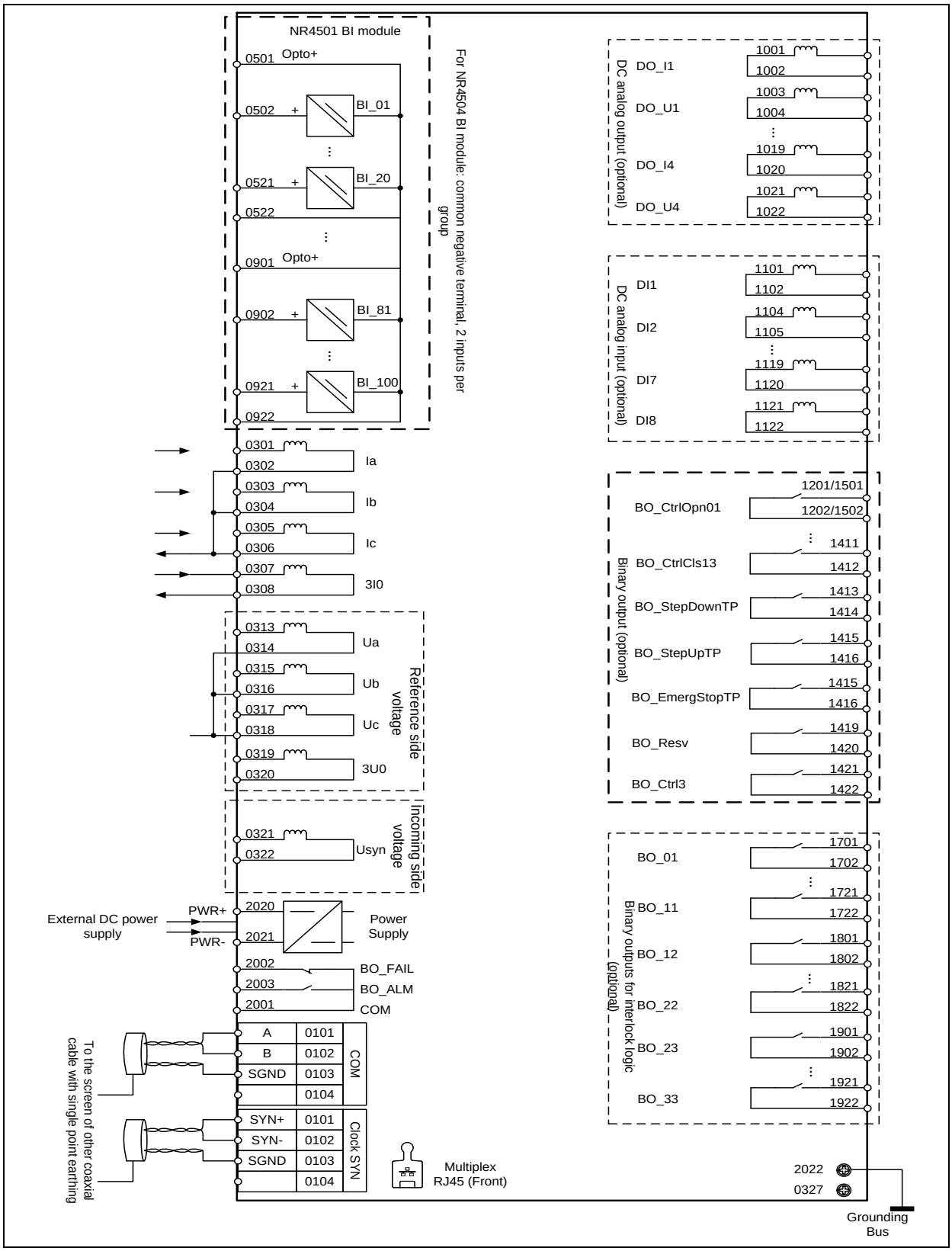


Figure 6.2-1 Typical wiring diagram (conventional CT/VT)

PCS-9705 hardware configuration corresponds to conventional CT/VT is displayed in the following figure.

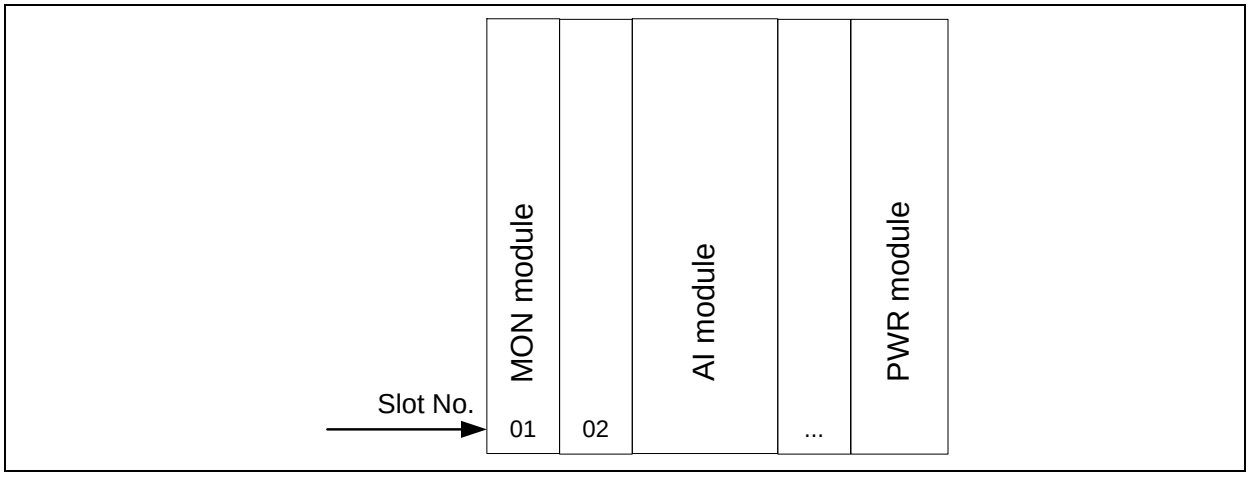


Figure 6.2-2 Hardware configuration (conventional CT/VT)

6.2.2 ECT/EVT (For Reference Only)

If electronic current and voltage transformer (ECT/EVT) are adopted, the merging unit will merge the sample data from ECT/EVT, and then send it to the device through multi-mode optical fiber. NET-DSP module receives the data from merging unit through the optical-fiber interface.

The difference between the hardware platform based on ECT/EVT and the hardware platform based on conventional CT/VT lies in the receiving module of sampled values only, and the device receives the sampled value from merging unit through multi-mode optical fiber.

PCS-9705 hardware configuration corresponds to conventional CT/VT is displayed in the following figure.

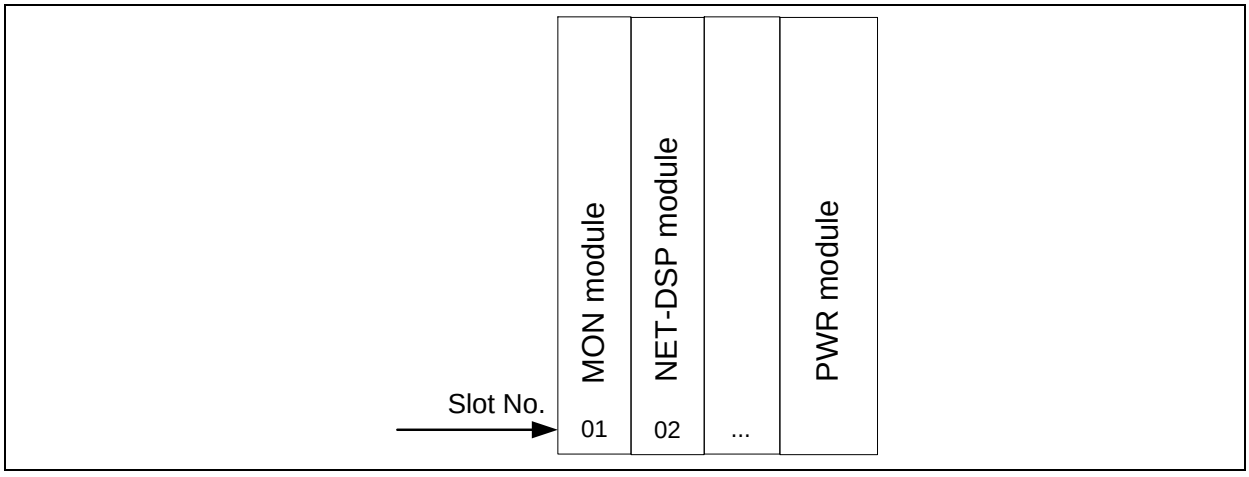


Figure 6.2-3 Hardware configuration (ECT/EVT)

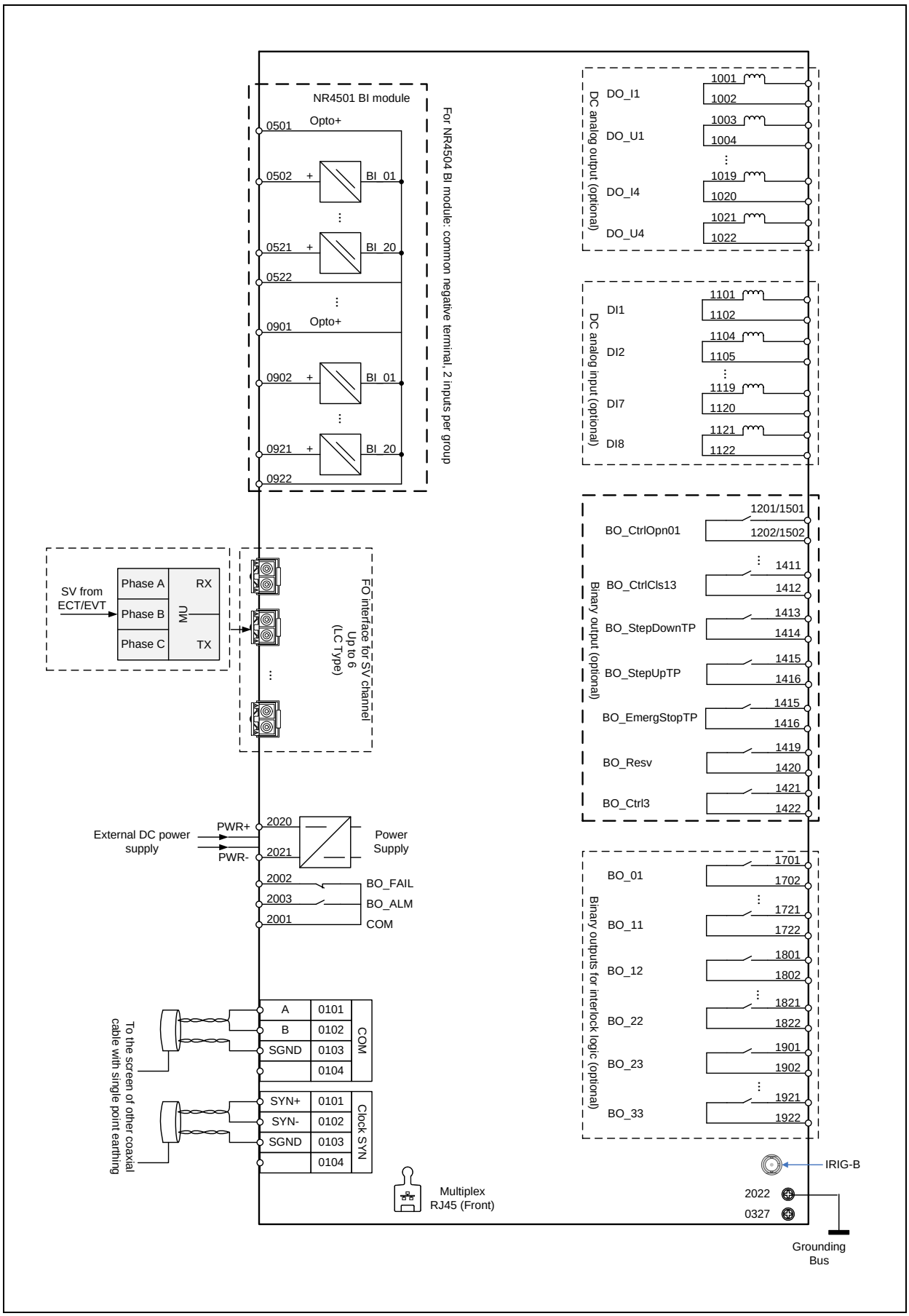


Figure 6.2-4 Typical wiring diagram (ECT/EVT)

6.3 Plug-in Module Description

6.3.1 MON Plug-in Module (Monitor)

The MON module must be configured in this device.

MON module consists of high-performance built-in processor, FLASH, SRAM, SDRAM, Ethernet controller and other peripherals. Its functions include management of the complete device, human machine interface, communication and waveform recording, etc.

MON module uses the internal bus to receive the data from other modules of the device. It communicates with the LCD module by RS-485 bus. This module comprises 10Base-T/100Base-TX or 100Base-FX (ST) Ethernet interfaces, RS-485 communication interfaces, PPS/PPM/IRIG-B differential clock synchronization interface.

Modules with various combinations of memory and interface are available as shown in the table below.

Note!

MON module is applied for station level GOOSE, while NET-DSP module is applied for process level GOOSE.

The subtypes optional of MON module are shown in the following figure.

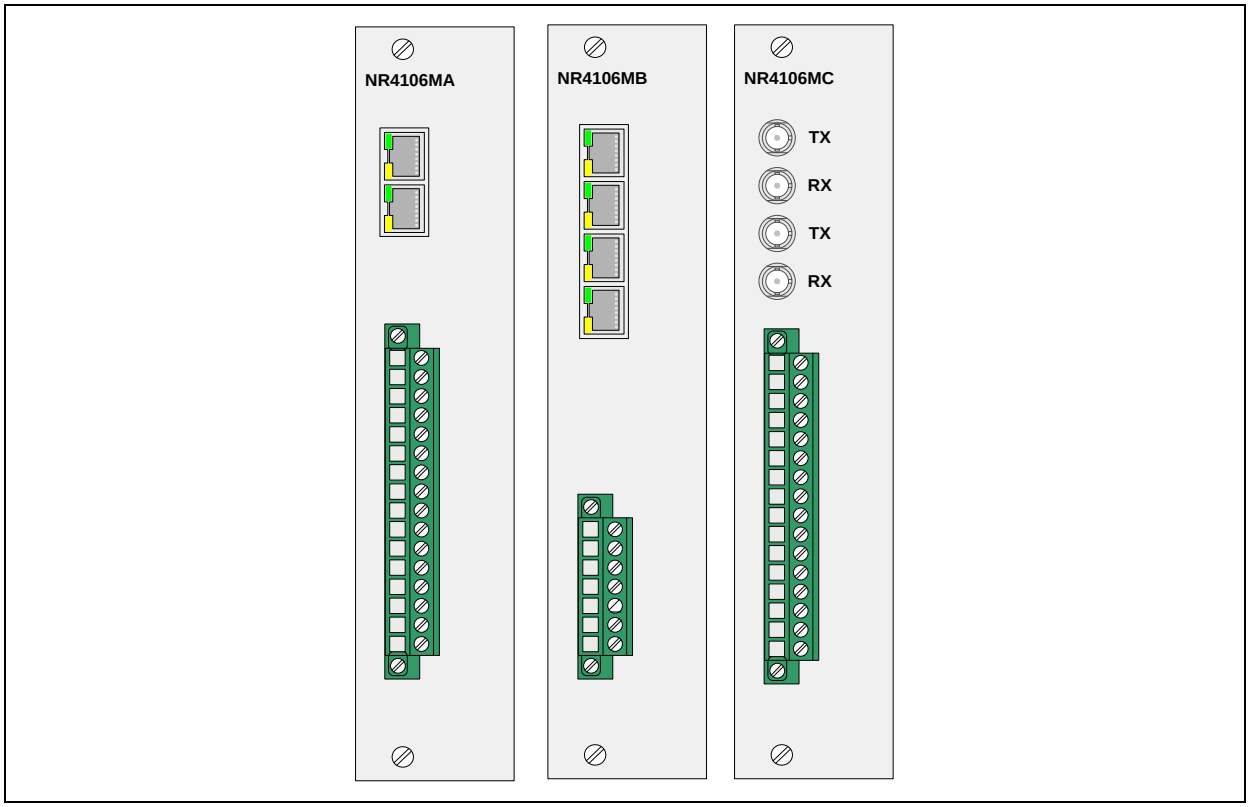


Figure 6.3-1 View of MON module

A 16-pin or 7-pin connector is fixed on the front side of the module.

Terminal description of the MON modules is listed in the following table:

Table 6.3-1 Terminal description of MON modules

Module ID	Memory	Interface	Terminal No.		Usage	Physical Layer
NR4106MA	128MB DDR	2 RJ45 Ethernet			To SCADA	Network wire
		RS-485	01	A	Reserved	Twisted-pair wire
			02	B		
			03	SGND		
			04			
		RS-485	05	A	Reserved	
			06	B		
			07	SGND		
			08			
			09			
		RS-485	10	SYN+	To clock synchronization	
			11	SYN-		
			12	SGND		
			13			
		RS-232	14	RTS	Reserved	Cable
			15	TXD		
			16	SGND		
NR4106MB		4 RJ45 Ethernet			To SCADA	Network wire
		RS-485	01	SYN+	To clock synchronization	Twisted-pair wire
			02	SYN-		
			03	SGND		
			04			
		RS-232	05	RTS	Reserved	Cable
			06	TXD		
			07	SGND		
NR4106MC		2 FO Ethernet			To SCADA	Optical fiber ST
		RS-485	01	A	Reserved	Twisted-pair wire
			02	B		
			03	SGND		
			04			
		RS-485	05	A	Reserved	
			06	B		
			07	SGND		
			08			
			09			
		RS-485	10	SYN+	To clock synchronization	
			11	SYN-		

Module ID	Memory	Interface	Terminal No.		Usage	Physical Layer
			12	SGND		
			13			
		RS-232	14	RTS	Reserved	Cable
			15	TXD		
			16	SGND		

The correct connection is shown in the following figure. Generally, the shielded cable with two pairs of twisted pairs inside shall be applied. One pair of the twisted pairs are respectively used to connect the "+" and "–" terminals of difference signal. The other pair of twisted pairs is used to connect the signal ground of the communication interface. The module reserves a free terminal for all the communication ports. The free terminal has no connection with any signal of the device, and it is used to connect the external shields of the cable when connecting multiple devices in series. The external shield of the cable shall be grounded at one of the ends only.

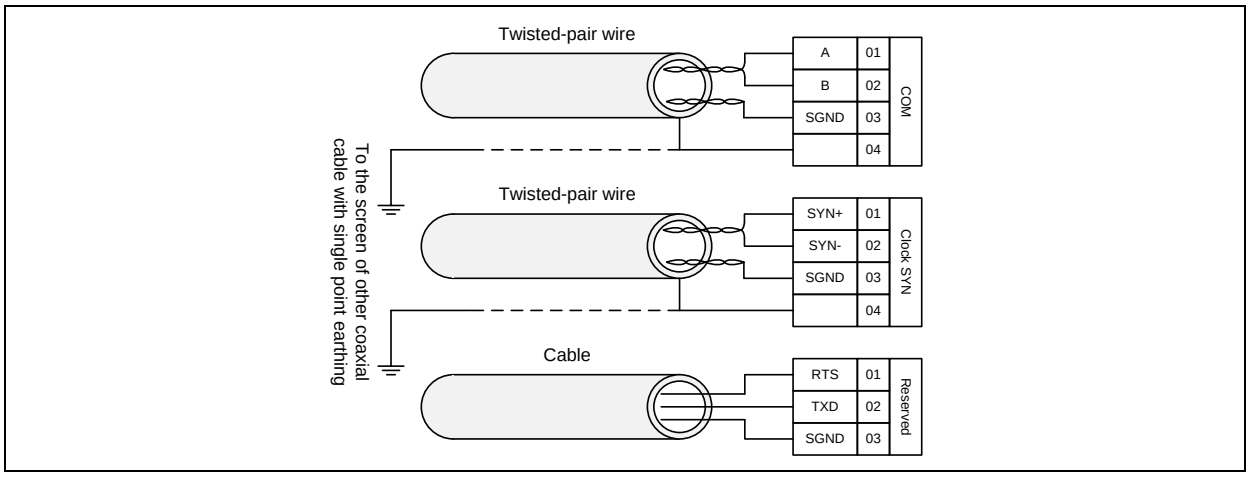


Figure 6.3-2 Connection of communication terminal

6.3.2 NET-DSP Plug-in Module (GOOSE and SV, Optional)

The NET-DSP module is a digital sampling module applied in a digital substation for sampling the current and voltage from electronic transformer through merging units. The communication protocol is abided by the IEC61850-9-2 standard protocol strictly.

The NET-DSP module of PCS-9705 will transfer these digital inputs to the MON module for further treatment.

The NET-DSP module can also be used to transmit or receive the binary inputs via GOOSE network. It can also trip or close the corresponding CB according to the control command from manual operation on PCS-9705, or from station control or control center.

Note!

MON module is applied for station layer GOOSE, while NET-DSP module is applied for process layer GOOSE.

As shown in the following figure, the NET-DSP module (NR4138A) has 6 LC type optical Ethernet ports (TX1/RX1, TX2/RX2, TX3/RX3, TX4/RX4, TX5/RX5, TX6/RX6) for receiving or transmitting sampled values or GOOSE command.

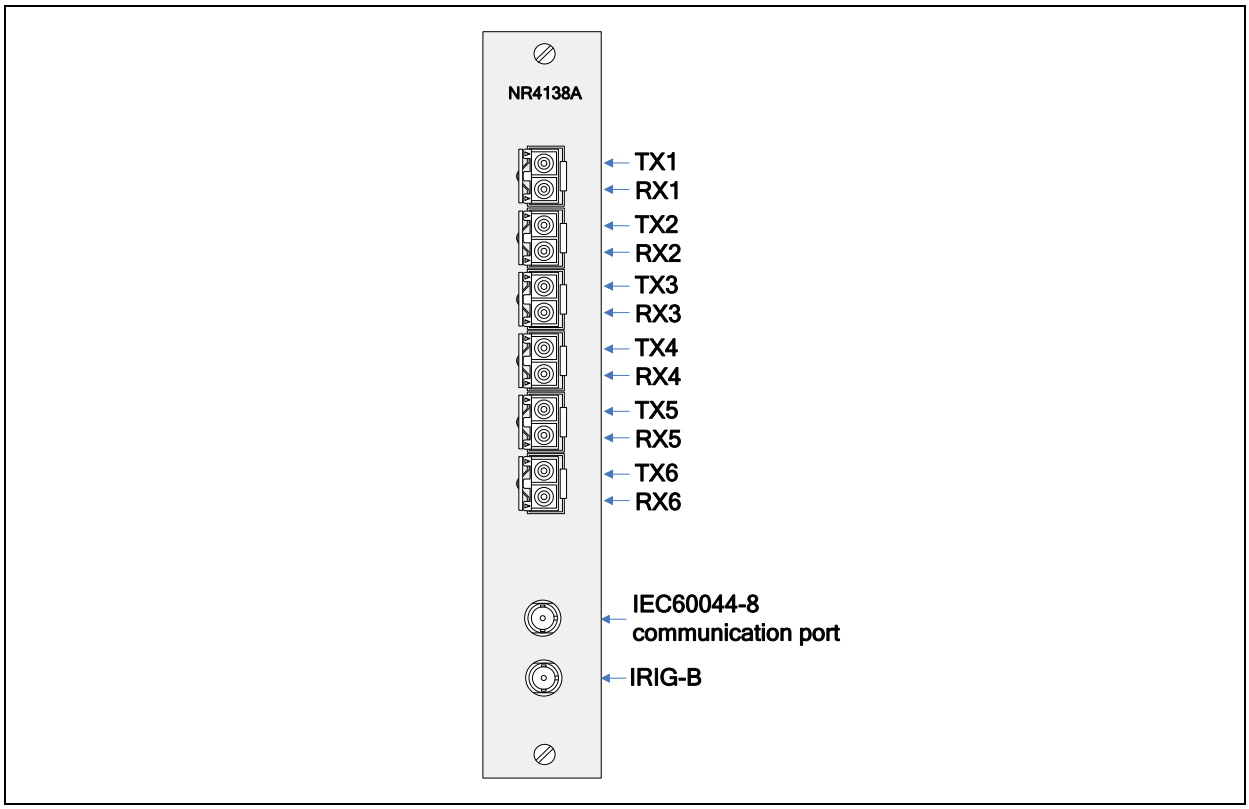


Figure 6.3-3 NET-DSP module

As shown in the following figure, there are also 2 ST type optical Ethernet ports:

1. IEC60044-8 communication port: reserved.
2. IRIG-B: applied to receive the clock synchronization input signals. It corresponds to the clock synchronization method "IRIG-B (Fiber optic)".

Note!

NR 4138A is only applicable for App 1 (Single Bay), App 2 (General) and App 3 (Dual Bays).

6.3.3 AI Plug-in Module (AC Analog Input)

The AI module is an analog input unit. It contains voltage transformers and current transformers that can transform high AC input values into relevant low AC output value. These values are suited to the analog inputs of the MON module. So it can be thought as a bridge between the MON module and the external analog signals that come into the device. The transformers are used to step-down currents and voltages to levels appropriate for this device's electronic circuit and to provide effective isolation between the device and the power system. A low pass filter circuit is connected to each transformer (CT and VT) secondary circuit for reducing the noise of each

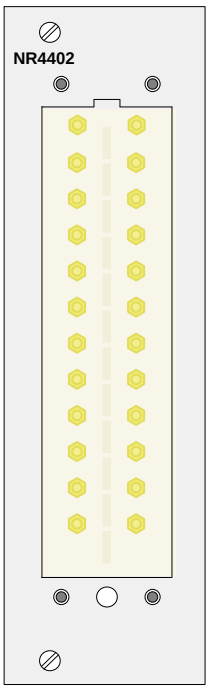
analog AC input signal.

Note!

1. The rated value of the input current transformer is optional: 1A or 5A. Please declare the rated value of the CT when place order.
2. Because the rated value of the input current transformer is optional, it is necessary to check that whether the rated values of the current transformer inputs are in accordance with the demand of the practical engineering before putting the device into operation.
3. The width of AI module is double of other modules. One AI module occupies 2 slots.

There are several subtypes of AI modules providing various numbers of CT and VT separately applicable to different types of BCUs.

The following figure shows the AI module 4CT/5VT.



Ia	01	**Ian**	02
Ib	03	**Ibn**	04
Ic	05	**Icn**	06
IN	07	**INn**	08
	09		10
	11		12
Ua	13	**Uan**	14
Ub	15	**Ubn**	16
Uc	17	**Ucn**	18
UN	19	**UNn**	20
Usyn	21	**Un_syn**	22
	23		24

Figure 6.3-4 AI module 4CT/5VT

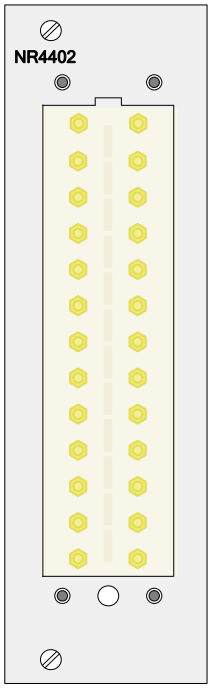
The following table shows terminal description of AI module 4CT/5VT.

Table 6.3-2 Terminal description of AI module 4CT/5VT

Terminal No.	Sign	Description
01	Ia	Current input of phase A.
02	Ian	
03	Ib	Current input of phase B.

Terminal No.	Sign	Description
04	Ibn	
05	Ic	Current input of phase C.
06	Icn	
07	IN	Residual current input.
08	INn	
09		Not used.
10		Not used.
11		Not used.
12		Not used.
13	Ua	Voltage inputs of reference side for synchronism-check when closing CB, phase sequence is (A, B, C), star connection (Y).
14	Uan	
15	Ub	
16	Ubn	
17	Uc	
18	Ucn	
19	UN	Residual voltage input.
20	UNn	
21	Usyn	Voltage input of incoming side for synchronism-check when closing CB.
22	Un_syn	
23		Not used.
24		Not used.

The following figure shows the AI module 13VT.



U1	01	**Un1**	02
U2	03	**Un2**	04
U3	05	**Un3**	06
U4	07	**Un4**	08
U5	09	**Un5**	10
U6	11	**Un6**	12
U7	13	**Un7**	14
U8	15	**Un8**	16
U9	17	**Un9**	18
U10	19	**Un10**	20
U11	21	**Un11**	22
U12	23	**Un12**	24
U13	25	**Un13**	26

Figure 6.3-5 AI module 13VT

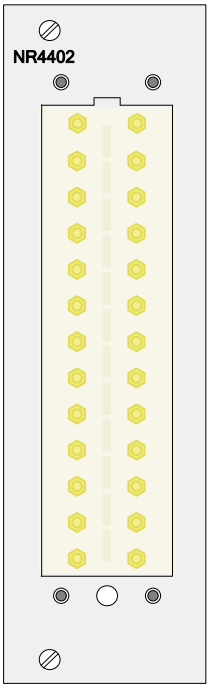
The following table shows terminal description of AI module 13VT.

Table 6.3-3 Terminal description of AI module 13VT

Terminal No.	Sign		Description
01	U1	Group 1	Voltage input of phase A.
02	Un1		
03	U2		Voltage input of phase B.
04	Un2		
05	U3		Voltage input of phase C.
06	Un3		
07	U4	Group 2	Voltage input of phase A.
08	Un4		
09	U5		Voltage input of phase B.
10	Un5		
11	U6		Voltage input of phase C.
12	Un6		
13	U7	Group 3	Voltage input of phase A.
14	Un7		
15	U8		Voltage input of phase B.

Terminal No.	Sign		Description
16	Un8		
17	U9		Voltage input of phase C.
18	Un9		
19	U10	Group 4	Voltage input of phase A.
20	Un10		
21	U11		Voltage input of phase B.
22	Un11		
23	U12		Voltage input of phase C.
24	Un12		
25	U13		Residual voltage input.
26	Un13		

The following figure shows the AI module 7CT/8VT.



Ia1	01	**Ia1n**	02
Ib1	03	**Ib1n**	04
Ic1	05	**Ic1n**	06
Ia2	07	**Ia2n**	08
Ib2	09	**Ib2n**	10
Ic2	11	**Ic2n**	12
Iext	13	**Iextn**	14
Ua1	15	**Ub1**	16
Uc1	17	**Un1**	18
Usyn1	19	**Un_syn1**	20
Ua2	21	**Ub2**	22
Uc2	23	**Un2**	24
Usyn2	25	**Un_syn2**	26

Figure 6.3-6 AI module 7CT/8VT

Note!

In 1½ CB arrangement, there are 2 circuit breakers related to this device.

1. Side CB;
2. Center CB.

The following table shows terminal description of AI module 7CT/8VT. In the following table:

"1st CB" mainly refers to the first CB in 1½ CB arrangement that can be either the Side CB or the Center CB.

"2nd CB" mainly refers to the second CB in 1½ CB arrangement that can be either the Center CB or the Side CB.

Table 6.3-4 Terminal description of AI module 7CT/8VT

Terminal No.	Sign		Description
01	Ia1	Group 1 (E.g.: for the 1st bay)	Current input of phase A.
02	Ia1n		
03	Ib1		Current input of phase B. When the setting [Cur3P.Opt_CT_Measmt] is set as "0", only Ia and Ic inputs are enough for current measurement (i.e.: Ib is unnecessary), terminal "03" and "04" will be useless. When the setting [Cur3P.Opt_CT_Measmt] is set as "1", Ia, Ib & Ic inputs are all necessary for current measurement, terminal "03" and "04" will be used to receive the input of the 1st group current of the phase B.
04	Ib1n		
05	Ic1		Current input of phase C.
06	Ic1n		
07	Ia2	Group 2 (E.g.: for the 2nd bay)	Current input of phase A.
08	Ia2n		
09	Ib2		Current input of phase B. When the setting [Cur3P.Opt_CT_Measmt] is set as "0", only Ia and Ic inputs are enough for current measurement (i.e.: Ib is unnecessary), terminal "09" and "10" will be useless. When the setting [Cur3P.Opt_CT_Measmt] is set as "1", Ia, Ib & Ic inputs are all necessary for current measurement, terminal "09" and "10" will be used to receive the input of the 2nd group current of the phase B.
10	Ib2n		
11	Ic2		Current input of phase C.
12	Ic2n		
13	Iext		Terminal "13" and "14" on the AI module of PCS-9705 (Dual bays) are used to receive independent external current input. The primary value of the independent external current is displayed as "Sum_MMXU.Iext_Pri" in the submenu "**Measurements**"->"**Measurements3**"->"**Primary Values**" of PCS-9705 (Dual bays). The secondary value of the independent external current is displayed as "Sum_MMXU.Iext_Sec" in the submenu "**Measurements**"->"**Measurements3**"->"**Secondary Values**" of PCS-9705 (Dual bays).
14	Iextn		

Terminal No.	Sign		Description
15	Ua1	Group 1 (for the 1st bay)	Voltage inputs of reference side for synchronism-check when closing the 1st CB, phase sequence is (A, B, C), star connection (Y).
16	Ub1		
17	Uc1		
18	Un1		
19	Usyn1		Voltage input of incoming side for synchronism-check when closing the 1st CB.
20	Un_syn1		
21	Ua2	Group 2 (for the 2nd bay)	Voltage inputs of reference side for synchronism-check when closing the 2nd CB, phase sequence is (A, B, C), star connection (Y).
22	Ub2		
23	Uc2		
24	Un2		
25	Usyn2		Voltage input of incoming side for synchronism-check when closing the 2nd CB.
26	Un_syn2		

The following figure shows the AI module 12CT.

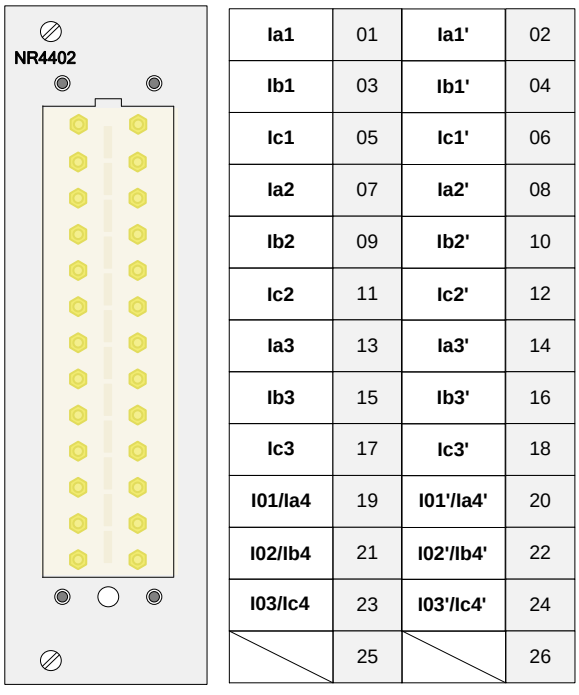


Figure 6.3-7 AI module 12CT

Table 6.3-5 Terminal description of AI module 12CT

Terminal No.	Sign		Description
01	Ia1	Group 1	Current input of phase A.
02	Ia1'		
03	Ib1		Current input of phase B.
04	Ib1'		

Terminal No.	Sign		Description
05	Ic1		Current input of phase C.
06	Ic1'		
07	Ia2	Group 2	Current input of phase A.
08	Ia2'		
09	Ib2		Current input of phase B.
10	Ib2'		
11	Ic2		Current input of phase C.
12	Ic2'		
13	Ia3	Group 3	Current input of phase A.
14	Ia3'		
15	Ib3		Current input of phase B.
16	Ib3'		
17	Ic3		Current input of phase C.
18	Ic3'		
19	I01/Ia4	Group 4	Residual 1 or phase A current input.
20	I01'/Ia4'		
21	I02/Ib4		Residual 2 or phase B current input.
22	I02'/Ib4'		
23	I03/Ic4		Residual 3 or phase C current input.
24	I03'/Ic4'		
25			Not used.
26			

6.3.4 BI Plug-in Module (Binary Input)

At least one binary input module (abbreviated as BI module) must be configured in this device. Each binary input is processed by a well-designed debouncing technique to avoid any hazardous behavior (multiple state changes during a given duration). A separate debounce and chatter time (please refer to *"BI Settings"* in Chapter 7 for more details) may be set for each of the binary input.

The auxiliary power supervision input terminal should be connected to the positive pole of an auxiliary power.

If the Opto+ terminal of the BI module on slot xx (xx: 05~13) is not connected to positive pole of binary power, [Bxx.Alm_OptoDC] will be issued and sent to SCADA.

6.3.4.1 NR 4501

Each NR4501 BI module has 21 optically isolated binary inputs and 1 common negative connection of all the binary inputs of this module (i.e.: the 22nd terminal Opto-_X).

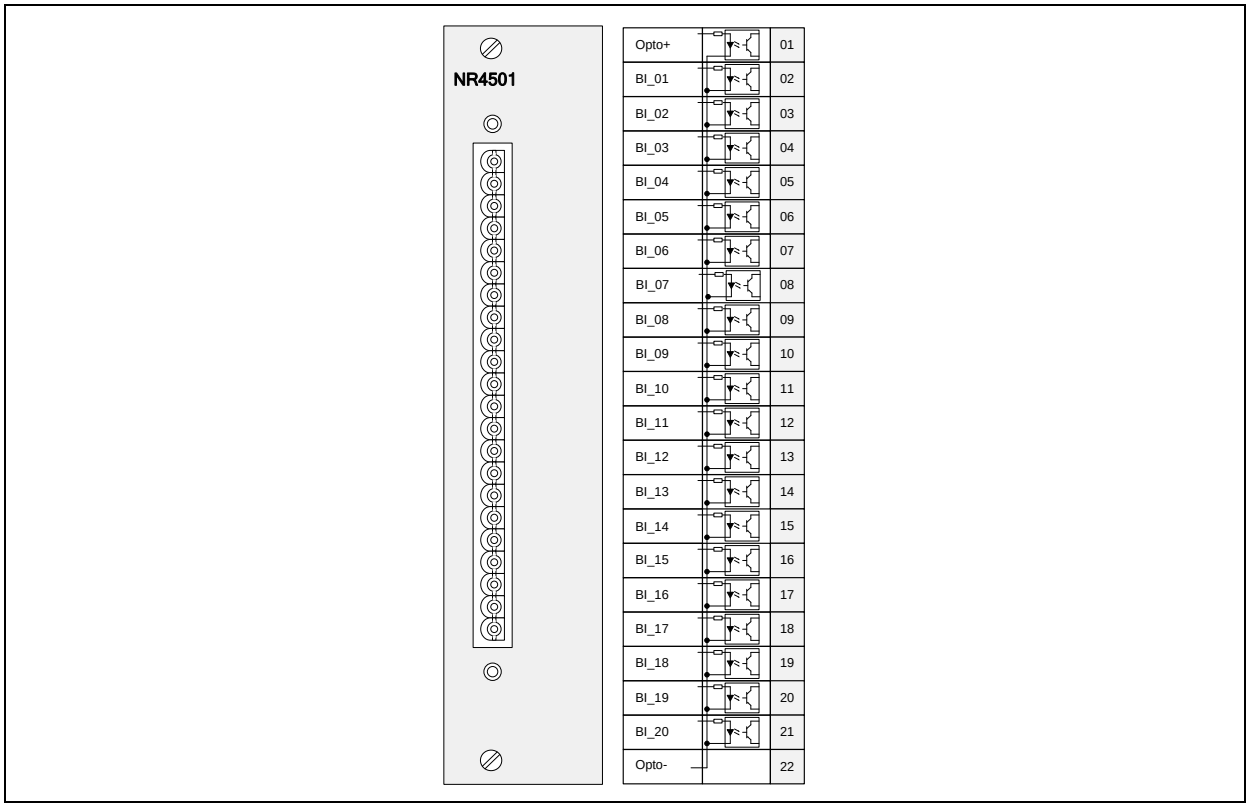


Figure 6.3-8 NR4501 BI module

Note!

Several rated voltages of binary input are optional, please declare the option when place order. It is necessary to check whether the rated voltage of BI module meets the demand of the engineering before putting the device into operation.

Note!

If more than one BI modules are equipped, the first one must be NR4501, while the others can be NR4501 or NR4504.

The arrangement of the 21 binary inputs for the first NR4501 BI module is always: 14 reserved, 6 configurable and 1 for supervision.

Note!

If chassis with control buttons and switches is adopted, the fonction of the No.3 terminal (i.e. "CILO.BI_Disable") and the No.4 terminal (i.e. "BI_Rmt/Loc") on the first BI module (NR4501) will be replaced respectively by the switches ("**UNLOCK/LOCK**" and "**REMOTE/LOCAL**") on the front panel. These 2 terminals will be invalid.

1. The following table shows the terminal description of the first NR4501 of PCS-9705 (Single bay).

Table 6.3-6 Terminal description of the first NR4501 of PCS-9705 (Single bay)

Terminal No.	Sign	Description
01	Opto+_1	Positive terminal of power supply in the module
02	BI_Maintenance	Binary input of indicating the equipment is in maintenance state. (1: The device is in the maintenance mode, 0: The device is not in the maintenance mode.)
03	CILO.BI_Disable	A binary input used to disable the interlock blocking function for control output. (1: all binary outputs of this device will not be blocked by interlock conditions, 0: the interlock blocking function for all binary outputs is disabled.)
04	BI_Rmt/Loc	A binary input for enabling the remote control. (1: enable remote control, 0: enable local control.)
05	BI_Manual_Synchro	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Synchro] is 1, the synchronism-check function for closing CB will be enabled. When all the synchronism conditions are met, a manual control command will be issued to close CB.
06	BI_Manual_Open	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Open] is 1, a manual control command will be issued to open CB.
07	BI_Reserved1	Reserved binary input for possible special purpose in the future.
08	BI_Reserved2	
09	BI_Reserved3	
10	BI_Reserved4	
11	BI_Reserved5	
12	BI_Reserved6	
13	BI_Reserved7	
14	BI_Reserved8	
15	BI_Reserved9	
16	BI_15(BCD1)	If [84.Code_Tap_Pos] is configured as "1", binary inputs 15 to 20 will be used as Binary-Coded Decimal (abbreviated as BCD) codes for transformer tap position indication. (Access menu of [84.Code_Tap_Pos]: "MainMenu"->"Settings"->"BCU Settings" ->"TP Settings".)
17	BI_16(BCD2)	
18	BI_17(BCD3)	
19	BI_18(BCD4)	
20	BI_19(BCD5)	
21	BI_20(BCD6)	

Terminal No.	Sign	Description
22	Opto-_1	Common terminal of negative supply of all the binary inputs of this module.

2. The following table shows the terminal description of the first NR4501 of PCS-9705 (General / Extended General).

Table 6.3-7 Terminal description of the first NR4501 of PCS-9705 (General / Extended General)

Terminal No.	Sign	Description
01	Opto+_1	Positive terminal of power supply in the module
02	BI_Maintenance	Binary input of indicating the equipment is in maintenance state. 1: The device is in the maintenance mode, 0: The device is not in the maintenance mode.
03	CILO.BI_Disable	A binary input used to disable the interlock blocking function for control output. (1: all binary outputs of this device will not be blocked by interlock conditions, 0: the interlock blocking function for all binary outputs is disabled.)
04	BI_Rmt/Loc	A binary input for enabling the remote control. (1: enable remote control, 0:enable local control)
05	BI_Reserved1	Reserved binary input for possible special purpose in the future.
06	BI_Reserved2	
07	BI_Reserved3	
08	BI_Reserved4	
09	BI_Reserved5	
10	BI_Reserved6	
11	BI_Reserved7	
12	BI_Reserved8	
13	BI_Reserved9	
14	BI_Reserved10	
15	BI_Reserved11	
16	BI_15(BCD1)	If [84.Code_Tap_Pos] is configured as "1", binary inputs 15 to 20 will be used as Binary-Coded Decimal (abbreviated as BCD) codes for transformer tap position indication. (Access menu of [84.Code_Tap_Pos]: "MainMenu"->"Settings"->"BCU Settings" ->"TP Settings".)
17	BI_16(BCD2)	
18	BI_17(BCD3)	
19	BI_18(BCD4)	
20	BI_19(BCD5)	
21	BI_20(BCD6)	
22	Opto-_1	Common terminal of negative supply of all the binary inputs of this

Terminal No.	Sign	Description
		module.

3. The following table shows the terminal description of the first NR4501 of PCS-9705 (Dual bays).

Table 6.3-8 Terminal description of the first NR4501 of PCS-9705 (Dual bays)

Terminal No.	Sign	Description
01	Opto+_1	Positive terminal of power supply in the module
02	BI_Maintenance	Binary input of indicating the equipment is in maintenance state. 1: The device is in the maintenance mode, 0: The device is not in the maintenance mode.
03	CILO.BI_Disable	A binary input used to disable the interlock blocking function for control output. (1: all binary outputs of this device will not be blocked by interlock conditions, 0: the interlock blocking function for all binary outputs is disabled.)
04	BI_Rmt/Loc	A binary input for enabling the remote control. (1: enable remote control, 0:enable local control)
05	BI_Manual_Synchro1	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Synchro1] is 1, the synchronism-check function for closing the 1st CB will be enabled. When all the synchronism conditions are met, a manual control command will be issued to close the 1st CB.
06	BI_Manual_Open1	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Open1] is 1, a manual control command will be issued to open the 1st CB.
07	BI_Manual_Synchro2	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Synchro2] is 1, the synchronism-check function for closing the 2nd CB will be enabled. When all the synchronism conditions are met, a manual control command will be issued to close the 2nd CB.
08	BI_Manual_Open2	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Open2] is 1, a manual control command will be issued to open the 2nd CB.
09	BI_Reserved3	Reserved binary input for possible special purpose in the future.
10	BI_Reserved4	
11	BI_Reserved5	
12	BI_Reserved6	
13	BI_Reserved7	

Terminal No.	Sign	Description
14	BI_Reserved8	
15	BI_Reserved9	
16	BI_15(BCD1)	If [84.Code_Tap_Pos] is configured as "1", binary inputs 15 to 20 will be used as Binary-Coded Decimal (abbreviated as BCD) codes for transformer tap position indication. (Access menu of [84.Code_Tap_Pos]: "MainMenu"->"Settings"->"BCU Settings" ->"TP Settings".)
17	BI_16(BCD2)	
18	BI_17(BCD3)	
19	BI_18(BCD4)	
20	BI_19(BCD5)	
21	BI_20(BCD6)	
22	Opto-_1	Common terminal of negative supply of all the binary inputs of this module.

4. The following table shows the terminal description of the first NR4501 of PCS-9705 (Transformer).

Table 6.3-9 Terminal description of the first NR4501 of PCS-9705 (Transformer)

Terminal No.	Sign	Description
01	Opto+_1	Positive terminal of power supply in the module
02	BI_Maintenance	Binary input of indicating the equipment is in maintenance state. (1: The device is in the maintenance mode, 0: The device is not in the maintenance mode.)
03	CILO.BI_Disable	A binary input used to disable the interlock blocking function for control output. (1: all binary outputs of this device will not be blocked by interlock conditions, 0: the interlock blocking function for all binary outputs is disabled.)
04	BI_Rmt/Loc	A binary input for enabling the remote control. (1: enable remote control, 0: enable local control.)
05	BI_Manual_Synchro	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Synchro] is 1, the synchronism-check function for closing CB will be enabled. When all the synchronism conditions are met, a manual control command will be issued to close CB.
06	BI_Manual_Open	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Open] is 1, a manual control command will be issued to open CB.
07	BI_Manual_Synchro2	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Synchro2] is 1, the synchronism-check function for closing the 2nd CB will be enabled. When all the synchronism conditions are met, a manual control command

Terminal No.	Sign	Description
		will be issued to close the 2nd CB.
08	BI_Manual_Open2	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Open2] is 1, a manual control command will be issued to open the 2nd CB.
09	BI_Manual_Synchro3	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Synchro3] is 1, the synchronism-check function for closing the 3rd CB will be enabled. When all the synchronism conditions are met, a manual control command will be issued to close the 3rd CB.
10	BI_Manual_Open3	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Open3] is 1, a manual control command will be issued to open the 3rd CB.
11	BI_Manual_Synchro4	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Synchro4] is 1, the synchronism-check function for closing the 4th CB will be enabled. When all the synchronism conditions are met, a manual control command will be issued to close the 4th CB.
12	BI_Manual_Open4	If [BI_Rmt/Loc] is 0, i.e.: this device works in local control mode, when the [BI_Manual_Open4] is 1, a manual control command will be issued to open the 4th CB.
13	BI_Reserved7	The 7th reserved binary input for possible special purpose in the future.
14	BI_Reserved8	The 8th reserved binary input for possible special purpose in the future.
15	BI_Reserved9	The 9th reserved binary input for possible special purpose in the future.
16	BI_15(BCD1)	If [84.Code_Tap_Pos] is configured as "1", binary inputs 15 to 20 will be used as Binary-Coded Decimal (abbreviated as BCD) codes for transformer tap position indication. (Access menu of [84.Code_Tap_Pos]: "MainMenu"->"Settings"->"BCU Settings" ->"TP Settings".)
17	BI_16(BCD2)	
18	BI_17(BCD3)	
19	BI_18(BCD4)	
20	BI_19(BCD5)	
21	BI_20(BCD6)	
22	Opto-_1	Common terminal of negative supply of all the binary inputs of this module.

6.3.4.2 NR 4504

Every NR4504 BI module has 14 optically isolated binary inputs and 7 groups of common negative connection (every 2 have 1 common group).

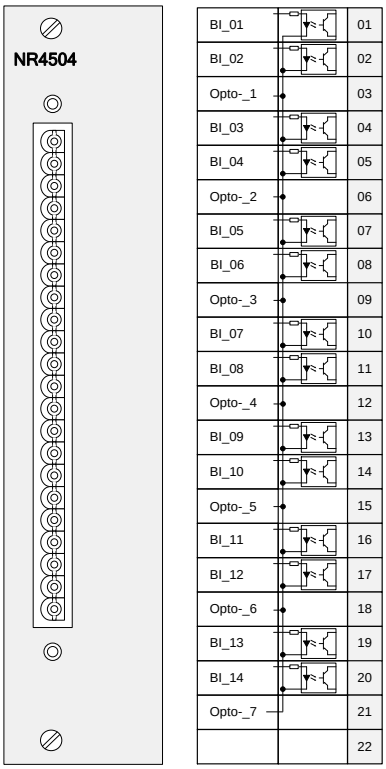


Figure 6.3-9 NR4504 BI module

The following table shows the terminal description of the NR4504 BI module.

Table 6.3-10 Terminal description of NR4504 BI module

Terminal No.	Sign	Description
01	BI_01	Binary input 01
02	BI_02	Binary input 02
03	BI_Opto1-	Common terminal of negative supply of the terminal 1 and 2 of this module.
04	BI_03	Binary input 03
05	BI_04	Binary input 04
06	BI_Opto2-	Common terminal of negative supply of the terminal 3 and 4 of this module.
07	BI_05	Binary input 05
08	BI_06	Binary input 06
09	BI_Opto3-	Common terminal of negative supply of the terminal 5 and 6 of this module.
10	BI_07	Binary input 07
11	BI_08	Binary input 08
12	BI_Opto4-	Common terminal of negative supply of the terminal 7 and 8 of this module.

Terminal No.	Sign	Description
13	BI_09	Binary input 09
14	BI_10	Binary input 10
15	BI_Opto5-	Common terminal of negative supply of the terminal 9 and 10 of this module.
16	BI_11	Binary input 11
17	BI_12	Binary input 12
18	BI_Opto6-	Common terminal of negative supply of the terminal 11 and 12 of this module.
19	BI_13	Binary input 13
20	BI_14	Binary input 14
21	BI_Opto7-	Common terminal of negative supply of the terminal 13 and 14 of this module.
22		Reserved.

6.3.5 DO Plug-in Module (DC Analog Output)

DO module can send out up to 4 channels of 0~10V or 4~20mA output to DCS system to regulate the active power output of the specified generator. Each output can be configured as 0~10V or 4~20mA by corresponding settings.

The following figure shows the DO module of PCS-9705.

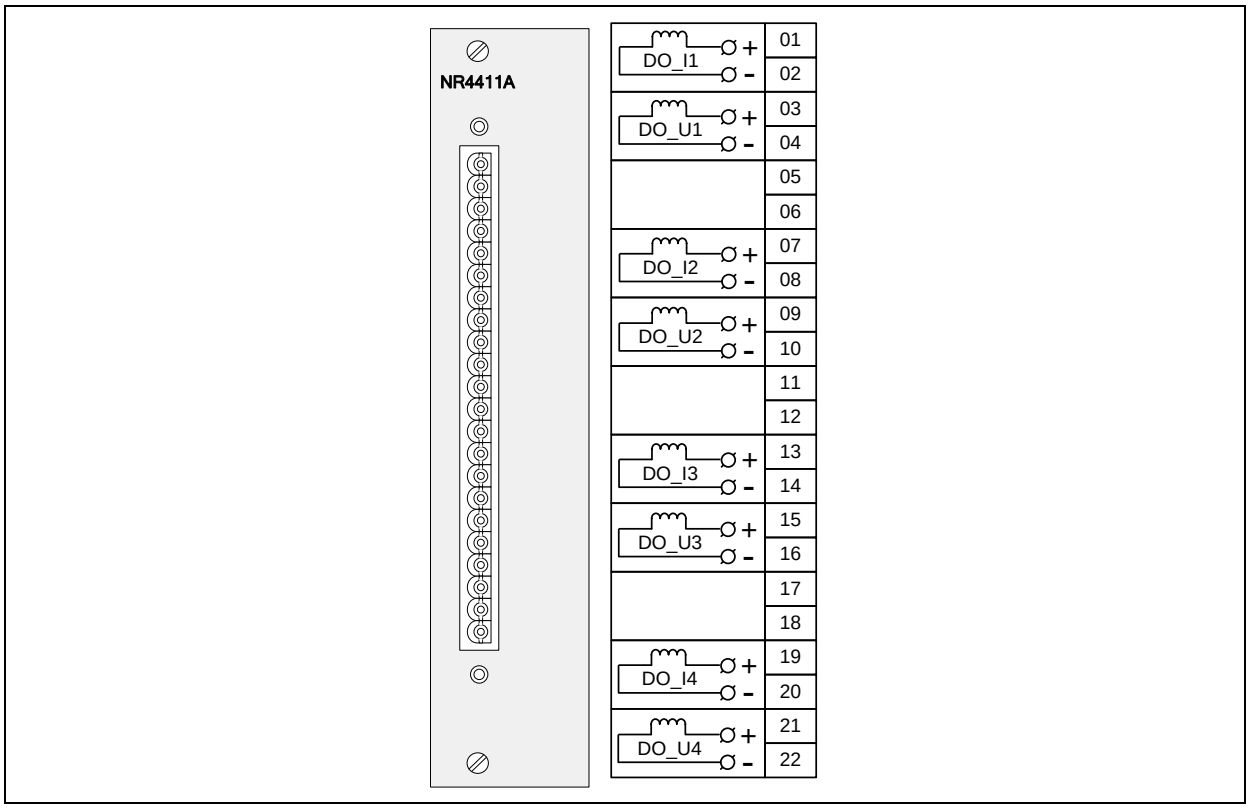


Figure 6.3-10 DO module

Table 6.3-11 Terminal description of DO module of this device

Terminal No.	Sign	Description
01	DO_I1+	4~20mA current output 1+
02	DO_I1-	4~20mA current output 1-
03	DO_U1+	0~10V voltage output 1+
04	DO_U1-	0~10V voltage output 1-
05		Reserved.
06		Reserved.
07	DO_I2+	4~20mA current output 2+
08	DO_I2-	4~20mA current output 2-
09	DO_U2+	0~10V voltage output 2+
10	DO_U2-	0~10V voltage output 2-
11		Reserved.
12		Reserved.
13	DO_I3+	4~20mA current output 3+
14	DO_I3-	4~20mA current output 3-
15	DO_U3+	0~10V voltage output 3+
16	DO_U3-	0~10V voltage output 3-
17		Reserved.
18		Reserved.
19	DO_I4+	4~20mA current output 4+
20	DO_I4-	4~20mA current output 4-
21	DO_U4+	0~10V voltage output 4+
22	DO_U4-	0~10V voltage output 4-

6.3.6 DI Plug-in Module (DC Analog Input)

DI module is a transducer input module used to receive DC analog inputs from transducers (e.g. temperature or humidity transducers).

Several types of DC signals can be acquired by configuring 3 groups of jumpers on the DI module.

Description of jumpers of DI module is introduced in the following table.

Table 6.3-12 Description of jumpers of DI module

Signal Input Range	S*X*	JP*X*-1	JP*X*-2
4~20mA DC (NR4410C/NR4410D)	ON	OFF	ON
0~5V DC(NR4410C/NR4410D)	OFF	OFF	ON
0~250V DC (NR4410C)	OFF	ON	OFF

Signal Input Range	S*X*	JP*X*-1	JP*X*-2
0~48V DC (NR4410D)	OFF	ON	OFF

Note!

In the above table, *X*=1, 2, 3, 4, 5, 6, 7, 8.

The following figure shows the DI module of PCS-9705.

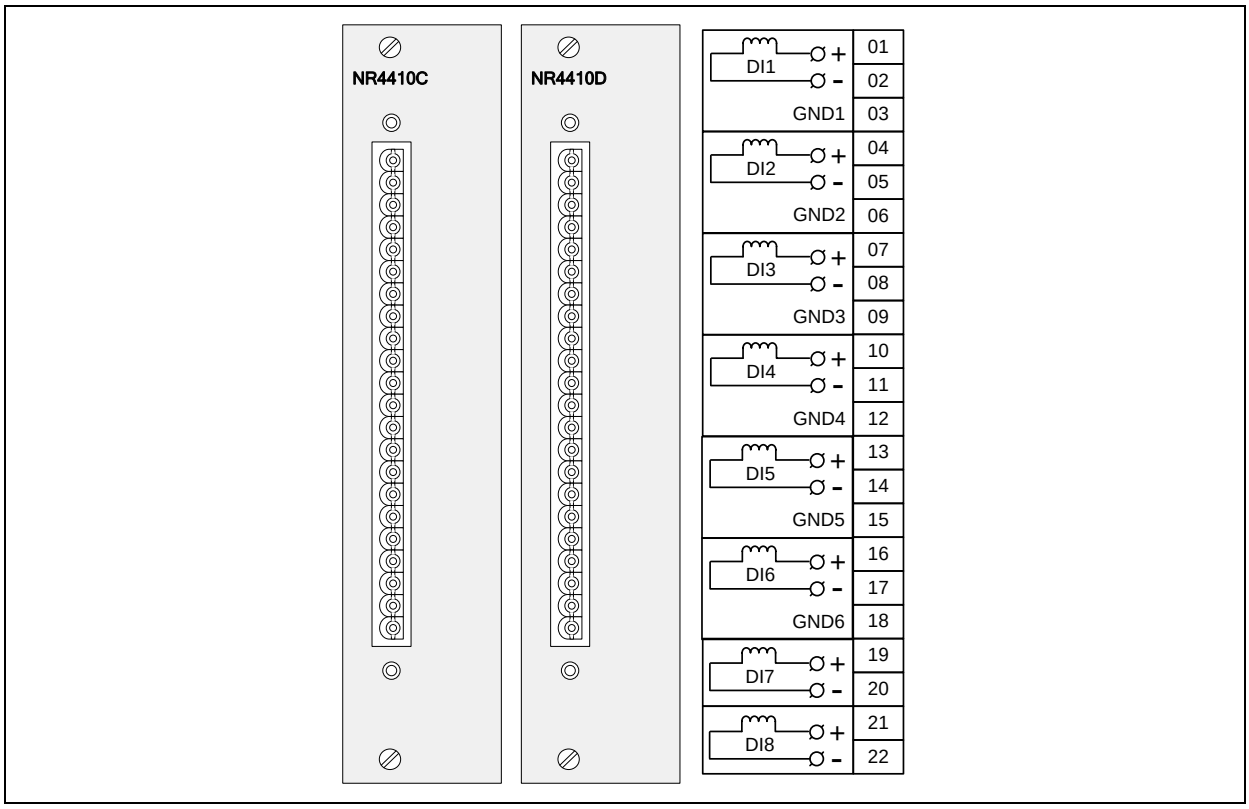


Figure 6.3-11 DI module

Terminal description on the connector of the DI module is introduced in the following table.

Table 6.3-13 Terminal description of DI module

Terminal No.	Sign	Description
01	DI1+	Transducer input 1
02	DI1-	
03	GND1	
04	DI2+	Transducer input 2
05	DI2-	
06	GND2	
07	DI3+	Transducer input 3
08	DI3-	

Terminal No.	Sign	Description
09	GND3	
10	DI4+	Transducer input 4
11	DI4-	
12	GND4	
13	DI5+	Transducer input 5
14	DI5-	
15	GND5	
16	DI6+	Transducer input 6
17	DI6-	
18	GND6	
19	DI7+	Transducer input 7
20	DI7-	
21	DI8+	Transducer input 8
22	DI8-	

6.3.7 BO Plug-in Module (Binary Output)

The BO module is a binary output module used for opening and closing output or for any signaling purpose.

The contacts provided by BO module (NR4522) are all normally open (abbreviated as NO) contacts.

Up to 10 binary outputs are provided on each BO module for controlling up to 5 CB/DS/ES or transformer tap changer position. By setting the closing time of NO contact of the binary output (please refer to the "*Control Settings*" in Chapter 7 for more details), the user can adopt individual switchgear's operating time.

An NO contact is presented via terminal 21-22 (i.e. BO_Ctrl*X*, *X*=1, 2, 3, 4, 5) designated as ROS (remote operation signal). Whenever any of the NO contacts of the binary output relay is closed, the NO contact ROS will close to issue a signal indicating a remote control operation in progress. If none of the NO contacts of the binary output relay is closed, the NO contact ROS keeps open state.

The following figure shows the BO module of PCS-9705.

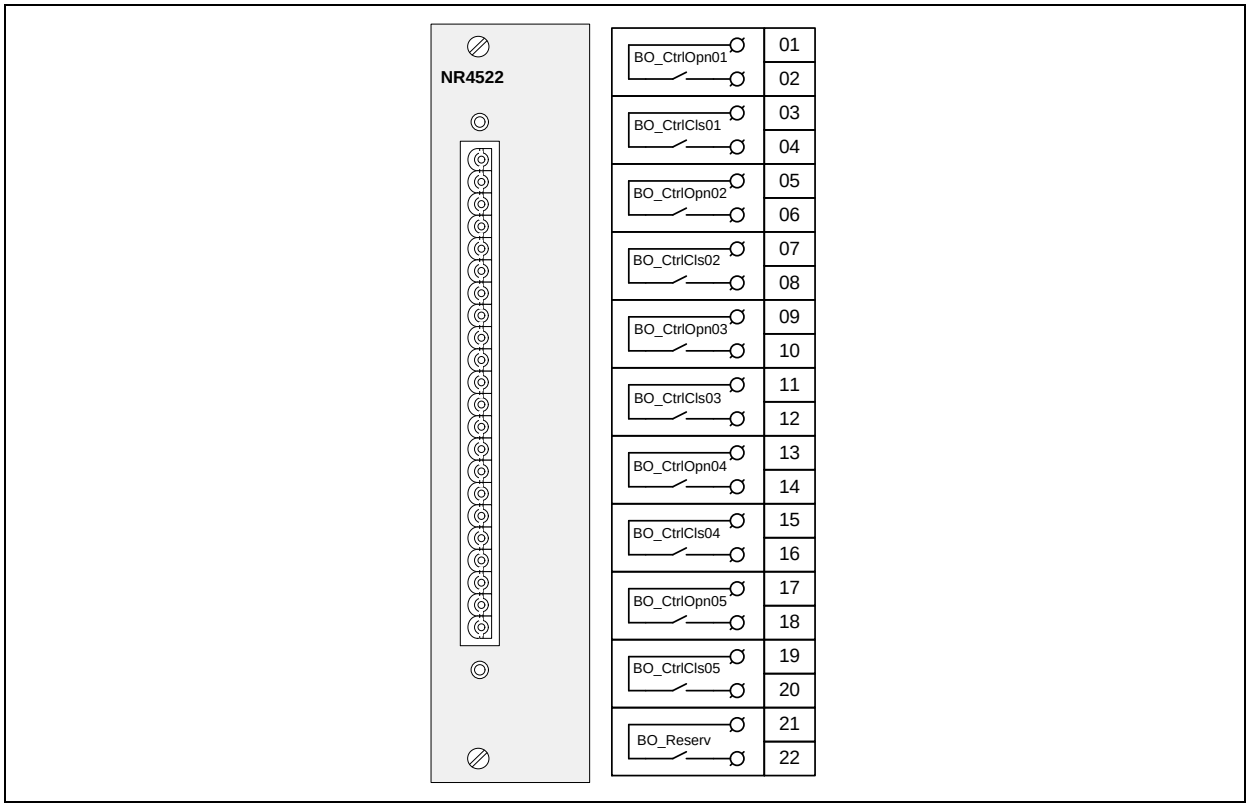


Figure 6.3-12 BO modules

Terminal descriptions of BO module is shown in the following table.

Table 6.3-14 Terminal description of BO module

Terminal No.	Sign		Description
01	BO_CtrlOpn01	\	Open output 01
02			
03	BO_CtrlCls01	\	Closing output 01
04			
05	BO_CtrlOpn02	\	Open output 02
06			
07	BO_CtrlCls02	\	Closing output 02
08			
09	BO_CtrlOpn03	\	Open output 03
10			
11	BO_CtrlCls03	\	Closing output 03
12			
13	BO_CtrlOpn04	\	Open output 04
14			
15	BO_CtrlCls04	\	Closing output 04

Terminal No.	Sign		Description
16			
17	BO_CtrlOpn05	\	Open output 05
18			
19	BO_CtrlCls05	\	Closing output 05
20			
21	BO_Reserv		Reserved
22			

Note!

The binary outputs for the control of tap position changer are special and fixed.

Table 6.3-15 Binary outputs for the control of tap position changer

Application	Slot	Terminal No.		
		Down	Up	Urgent stop
App 1,2,3 Full Width	B14	13~14	15~16	17~18
App 4,5 Full Width	B16	13~14	15~16	17~18
App 1,2,3 Half Width	B08	05~06	07~08	09~10

Note!

For the applications of "App 1, 2, 3 full widths", the slot "Binary Outputs (Duplicated)" in the MOT signifies a copy of BO module that has been configured at the corresponding slot before. The allocation of the binary outputs on the BO module (Duplicated) is the same as the one before.

Table 6.3-16 Matchup of BO module (Duplicated)

Slot No. of BO module	Slot No. of BO module (Duplicated)
12	15
13	16
14	17

6.3.8 IL Plug-in Module (Binary Output for Interlock Logic)

Interlock logic module (abbreviated as IL module) provides configurable normally open (abbreviated as NO) contacts for remotely controlled objects.

The device provides additional NO contacts for remotely controlled apparatus via IL module when executing a switching command output (besides internal software interlocking corresponds remote trip or remote closing contact).

If a contact is closed, the interlocking criterion of corresponding binary output is met.

If a contact is opened, the interlocking criterion of corresponding binary output is not met.

Interlocking criteria can be configured by corresponding interlocking configuration tool (PCS-Explorer).

The following figure shows the IL module.

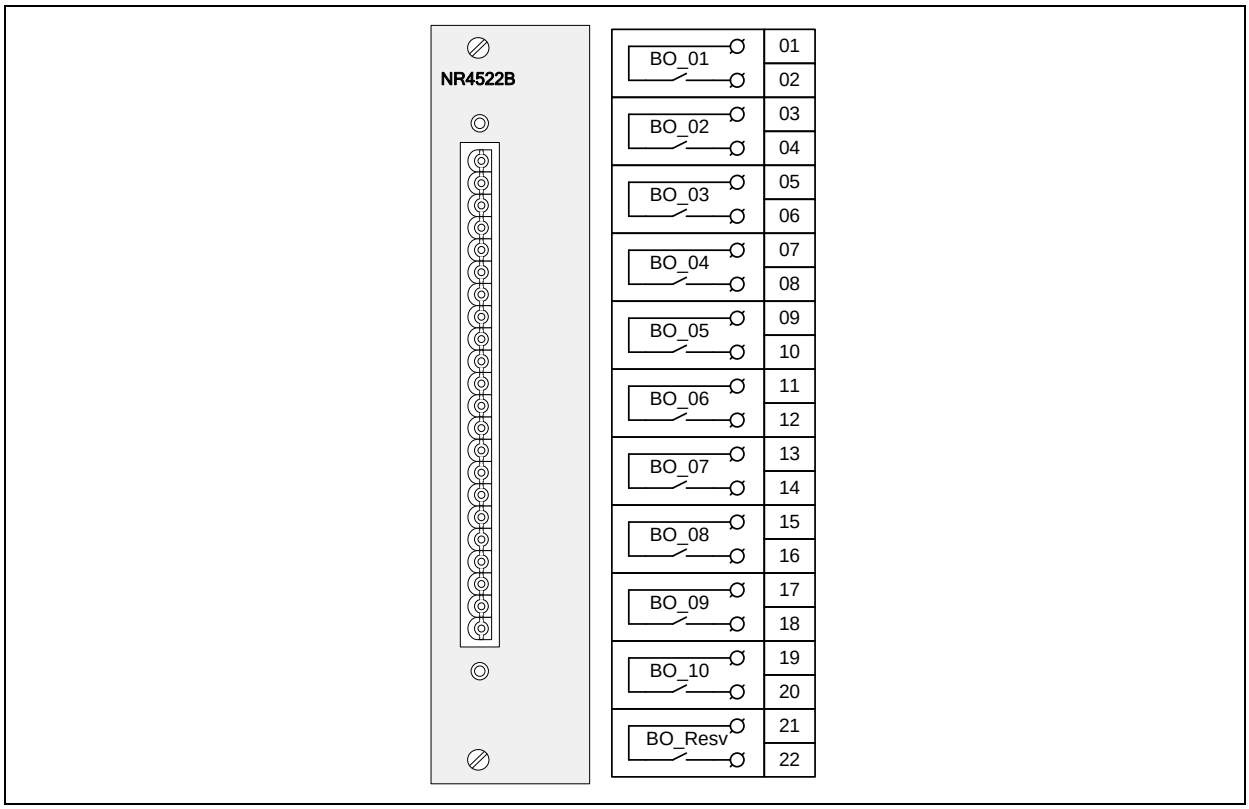


Figure 6.3-13 IL module

Note!

Binary output contacts of IL module can also be configured (with the use of PCS-Explorer) as outputs for [PulseIO.Sig_*XX*] (Access path: "**Status**"->"**Inputs**"->"**PulseIO Inputs**", please refers to "*Status*" in Chapter 8 for more details).

6.3.9 PWR Plug-in Module (Power Supply)

The power supply module (abbreviated as PWR module) is a DC/DC converter with electrical insulation between input and output. It provides +5V DC output for other modules of this device.

Note!

1. The width of PWR module is double of other modules. A PWR module occupies 2 slots.

2. It is only permitted to withdraw or insert the PWR module or modules when the auxiliary power has been switched off.

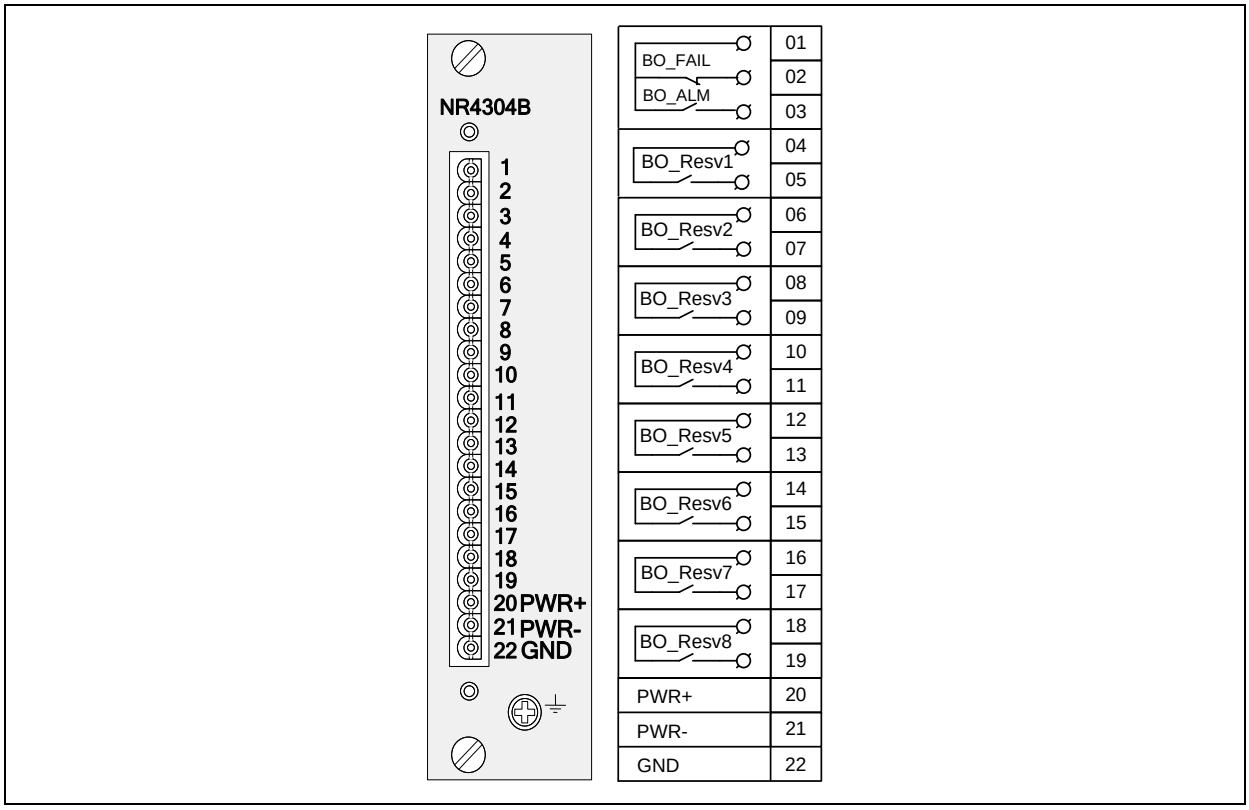


Figure 6.3-14 PWR module

Terminal description is shown in the following table.

Table 6.3-17 Terminal description of PWR module

Terminal No.	Sign		Description
01	BO_COM		Common of the binary outputs.
02	BO_FAIL		Equipment failure output.
03	BO_ALM		Equipment alarm output.
04	BO_Resv1	\	Reserved binary output 1
05			
06	BO_Resv2	\	Reserved binary output 2
07			
08	BO_Resv3	\	Reserved binary output 3
09			
10	BO_Resv4	\	Reserved binary output 4
11			
12	BO_Resv5	\	Reserved binary output 5
13			

Terminal No.	Sign		Description
14	BO_Resv6	\	Reserved binary output 6
15			
16	BO_Resv7	\	Reserved binary output 7
17			
18	BO_Resv8	\	Reserved binary output 8
19			
20	PWR+		DC power supply positive input.
21	PWR-		DC power supply negative input.
22	GND		Ground connection.

6.3.10 HMI Module

The human-machine interface module (abbreviated as HMI module) consists of liquid crystal display screen, keyboard, LED and ARM processor. The functions of ARM processor include display controlling of LCD, keyboard processing, and exchanging data with MON through LAN port etc. The LCD screen is a high-performance grand liquid crystal panel with back lighting, which has a user-friendly interface and an extensive display range.

7 Settings

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Note!

According to different applications in different engineering requirements, settings and menus in HMI may be different.

"*YYYY*" in the following tables is the wildcard that can be set by via the software PCS-Explorer.

7.1 System Settings

"**MainMenu**" -> "**Settings**" -> "**System Settings**"

No.	Item	Description	Range	Step(Unit)
1	Opt_SysFreq	Option of system frequency.	50Hz or 60Hz	
2	*YYYY*.I1n_CT_Measmt	Rated primary current of three-phase CT.	10~8000	1(A)
3	*YYYY*.I2n_CT_Measmt	Rated secondary current of three-phase CT.	1~5	1(A)
4	*YYYY*.I1n_RCT	Rated primary current of residual CT.	10~8000	1(A)
5	*YYYY*.I2n_RCT	Rated secondary current of residual CT.	1~5	1(A)
6	*YYYY*.U1n_VT_Measmt	Rated primary voltage of reference side VT.	0.10~1000.00	0.01(kV)
7	*YYYY*.U2n_VT_Measmt	Rated secondary voltage of reference side VT.	1.000~120.000	0.001(V)
8	*YYYY*.U1n_VT_Syn	Rated primary voltage of incoming side VT.	0.10~1000.00	0.01(kV)
9	*YYYY*.U2n_VT_Syn	Rated secondary voltage of incoming side VT.	1.000~120.000	0.001(V)
10	Sum_MMXU.I1n	Rated primary current of current vector summations of dual bays.	10~8000	1(A)
11	Sum_MMXU.I2n	Rated secondary current of current vector summations of dual bays.	1~5	1(A)

7.2 Measurement and Control Settings

"**MainMenu**" -> "**Settings**" -> "**BCU Settings**"

7.2.1 FUN Settings

No.	Name	Range	Step(Unit)
1	Th_ZeroDrift	0.0% ~100.0%	0.1%
2	*YYYY*.En_Alm_ROV	0 or 1	1
3	*YYYY*.UN_Alm_ROV	0%Un~100%Un	1%(Un)
4	*YYYY*.En_Alm_UV	0 or 1	1
5	*YYYY*.U_Alm_UV	0%Un~100%Un	1%(Un)
6	25.HMI_Mode	0 or 1 (0: Bit2;1: Bit4)	1
7	Cur3P.Opt_CT_Measmt	0 or 1	1

No.	Name	Range	Step(Unit)
8	Vol3P.Opt_UN	0 or 1	1
9	Cur3P.Opt_IN	0 or 1	1
10	*YYYY*.En_CT(1, 2)RevPolarity	0 or 1 (0: +;1: -)	1
11	*YYYY*.En_Alm_VTS	0 or 1	1
12	*YYYY*.En_Alm_CTS	0 or 1	1
13	DPOS.Map	0000~FFFF	N/A
14	DPOS.t_Alm	0~60000	1(ms)
15	Sum_MMXU.Opt_VoltGrp	0 or 1	1

1. Th_ZeroDrift

Threshold of zero drift to limit the variation influence (of voltage and current) due to temperature or other environment factor. Variation less than this setting will be regarded as a zero drift and be ignored.

2. *YYYY*.En_Alm_ROV

Logic link for the supervision of residual voltage, "1/0": Enable/Disable the alarm function to issue [*YYYY*.Alm_ROV].

3. *YYYY*.UN_Alm_ROV

This setting is expressed as a percentage for the emission threshold of the alarm [*YYYY*.Alm_ROV].

If (

[*YYYY*.En_Alm_ROV] = 1,

[*YYYY*.UN_Pri] > [*YYYY*.UN_Alm_ROV] * [*YYYY*.U1n_VT_Measmt],

Hold time > 10s)

[*YYYY*.Alm_ROV] = 1; /* To issue [*YYYY*.Alm_ROV] */

If (

[*YYYY*.Alm_ROV] = 1,

[*YYYY*.UN_Pri] < [*YYYY*.UN_Alm_ROV] * [*YYYY*.U1n_VT_Measmt],

Hold time > 1s)

[*YYYY*.Alm_ROV] = 0; /* To return [*YYYY*.Alm_ROV] */

Note!

The logic is the same for both primary and secondary residual voltage.

4. *YYYY*.En_Alm_UV

Logic link for the supervision of under voltage, "1/0": Enable/Disable the alarm function to issue [*YYYY*.Alm_UV].

5. *YYYY*.U_Alm_UV

This setting is expressed as a percentage for the emission threshold of the alarm [*YYYY*.Alm_UV].

If (

[*YYYY*.En_Alm_UV] = 1,

Ua or Ub or Uc < [*YYYY*.U_Alm_UV] * [*YYYY*.U1n_VT_Measmt],

Hold time > 10s,

)

[*YYYY*.Alm_UV] = 1; /* To issue [*YYYY*.Alm_UV] */

If (

[*YYYY*.Alm_UV] = 1,

All Ua&Ub&Uc > [*YYYY*.U_Alm_UV] * [*YYYY*.U1n_VT_Measmt],

Hold time > 1s,

)

[*YYYY*.Alm_ROV] = 0; /* To return [*YYYY*.Alm_UV] */

Note!

The logic is the same for both primary and secondary 3-phase voltage.

6. 25.HMI_Mode

This setting cooperates with [BI_Rmt/Loc] (i.e. the selection of control mode) and the logic links of RSYN check to determine the RSYN check mode for CB closing (if there is a SCADA system from station control or control centre).

Four configurable RSYN check modes for CB closing are available:

1) Non-check mode;
2) Dead check mode;
3) Synchronism check mode;
4) Loop check mode;

Five command types are available for remote control from SCADA system:

1) Non-check command;

2) Dead check command;

3) Synchronization check command;

4) Loop check command;

5) "Normal control" command;

If (

[BI_Rmt/Loc] = 1 (i.e. remote control mode),

[25.HMI_Mode] = 1 (i.e. Bit4),

Remote control command type = "Normal remote control command",

)

RSYN check mode is determined by the logic links of RSYN check;

Else if (

[BI_Rmt/Loc] = 1 (i.e. remote control mode),

[25.HMI_Mode] = 0 (i.e. Bit2),

Remote control command type ≠ "Non-check command",

)

RSYN check mode is determined by the logic links of RSYN check;

Else If (

[BI_Rmt/Loc] = 0 (i.e. local control mode),

)

RSYN check mode is determined by the logic links of RSYN check;

Else

RSYN check mode is determined by remote control command type;

Note!

Access path of the logic links is "**MainMenu**" -> "**Settings**" -> "**Logic Links**".

7. Cur3P.Opt_CT_Measmt

"1": Inputs Ia and Ic are enough for current measurement (i.e.: Ib is unnecessary).

"0": Inputs Ia, Ib & Ic are all necessary for current measurement.

8. Vol3P.Opt_UN

If (

[Vol3P.Opt_UN] = 0

)

[*YYYY*.UN_Pri] is the voltage input from VT residual (primary value),

[*YYYY*.UN_Sec] is the voltage input from VT residual (secondary value),

Else if (

[Vol3P.Opt_UN] = 1

)

[*YYYY*.UN_Pri] = *YYYY*.Ua_Pri + *YYYY*.Ub_Pri + *YYYY*.Uc_Pri;

YYYY.UN_Sec = *YYYY*.Ua_Sec + *YYYY*.Ub_Sec + *YYYY*.Uc_Sec

/* vector summation */

Access path of [*YYYY*.UN_Pri] is: "**Measurements**" -> "**Measurements3**" -> "**Primary Values**".

Access path of [*YYYY*.UN_Sec] is: "**Measurements**" -> "**Measurements3**" -> "**Secondary Values**".

9. Cur3P.Opt_IN

If (

[Cur3P.Opt_IN] = 0

)

[*YYYY*.IN_Pri] is the primary value of the residual current input,

[*YYYY*.IN_Sec] is the secondary value of the residual current input;

Else if (

[Cur3P.Opt_IN] = 1

)

[*YYYY*.IN_Pri] = *YYYY*.Ia_Pri + *YYYY*.Ib_Pri + *YYYY*.Ic_Pri;

YYYY.IN_Sec = *YYYY*.Ia_Sec + *YYYY*.Ib_Sec + *YYYY*.Ic_Sec

/* vector summation */

Access path of [*YYYY*.IN_Pri] is: "**Measurements**" -> "**Measurements3**" -> "**Primary Values**".

Access path of [*YYYY*.IN_Sec] is: "**Measurements**" -> "**Measurements3**" -> "**Secondary**

Values".

10. *YYYY*.En_CT(1, 2)RevPolarity

"1/0": Enable/Disable reversion of the CT polarity.

11. *YYYY*.En_Alm_VTS

"1/0": Enable/Disable alarm function of VT circuit supervision.

12. *YYYY*.En_Alm_CTS

"1/0": Enable/Disable alarm function of CT circuit supervision.

13. DPOS.Map

"1/0": Enable/Disable alarm function for each [DPOSXX] (XX=01~16)

This logic setting comprises 16 binary bits and is expressed by a hexadecimal number of four digits from 0000H to FFFFH.

If a bit is configured as "1", alarm function for corresponding [DPOSXX] will be enabled. Otherwise, it will be disabled.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Application	Double point binary input 16	Double point binary input 15	Double point binary input 14	Double point binary input 13	Double point binary input 12	Double point binary input 11	Double point binary input 10	Double point binary input 09	Double point binary input 08	Double point binary input 07	Double point binary input 06	Double point binary input 05	Double point binary input 04	Double point binary input 03	Double point binary input 02	Double point binary input 01

Access path of [DPOS*XX*], [NO_DPOS*XX*] and [NC_DPOS*XX*] (*XX*=01~16) is "**MainMenu**" -> "**Status**" -> "**Inputs**" -> "**DPS Inputs**".

Note!

E.g.: If [DPOS.Map] =FFFEH, only the alarm function for [DPOS01] is disabled.

[NO_DPOS*XX*] indicates normally open (abbreviated as NO) contact status of double point *XX*.

[NC_DPOS*XX*] indicates normally closed (abbreviated as NC) contact status of double point *XX*.

[DPOS*XX*] indicates states of double point *XX*.

For CB: NO contact refers to 52a contact; NC contact refers to 52b contact;

For DS: NO contact refers to 89a contact; NC contact refers to 89b contact;

For ES: NO contact refers to 57a contact; NC contact refers to 57b contact.

14. DPOS.t_Alm

Drop off time delay for [DPOS.Alm].

If alarm function for [DPOS*XX*] (*XX*=01~16) is enabled, and corresponding NO contact & NC contact are both open or close for the duration which is greater than "[DPOS.t_DPU_XX]+[DPOS.t_Alm]", an alarm signal named [DPOS.Alm] will be issued.

Access path of [DPOS*XX*] is "**MainMenu**" -> "**Status**" -> "**Inputs**" -> "**DPS Inputs**".

Access path of [DPOS.t_DPU_*XX*] is "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**BI Settings**".

Access path of [DPOS.Alm] is "**MainMenu**" -> "**Status**" -> "**Superv State**" -> "**BCU Superv**".

15. Sum_MMXU.Opt_VoltGrp

Option of voltage group, which will participate in calculation of power.

"0": the first voltage group; "1": the second voltage group;

7.2.2 Syn Settings

No.	Name	Range	Step(Unit)
1	25.U_UV_SynChk	0%Un~100%Un	1%(Un)
2	25.U_Diff_SynChk	0%Un~100%Un	1%(Un)
3	25.f_Diff_SynChk	0.00~3.00	0.01 (Hz)
4	25.df/dt_SynChk	0.10~5.00	0.01(Hz/s)
5	25.phi_Diff_LoopChk	0.10~180.00	0.01(Deg)
6	25.Opt_Mode_DeadChk	1~7	1
7	25.En_VTS_Blk_DeadChk	0 or 1	1
8	25.En_VTS_Blk_SynChk	0 or 1	1
9	25.t_Reset_SynChk	5000~30000	1 (ms)
10	25.U_DeadChk	0%Un~100%Un	1%(Un)
11	25.U_LiveChk	0%Un~100%Un	1%(Un)
12	25.Opt_U_SynChk	0~5	1
13	25.phi_Comp_Diff	0~360	1(Deg)
14	25.t_Close_CB	0~1000	1 (ms)
15	25.Link_BO_Syn	0 or 1	1
16	25.Opt_Mode_SynChk	0 or 1	1
17	25.Opt_Side_Measmt	0~3	1

No.	Name	Range	Step(Unit)
18	25.Opt_Side_Syn	0~3	1

1. 25.U_UV_SynChk

Threshold of under voltage to block CB closing, and it is expressed as a percentage.

If either side of CB for synchronization check is less than this setting, CB closing will be disabled.

CB closing will be disabled if any of the following events is met:

1) [*YYYY*.Uab_Pri] or [*YYYY*.Ubc_Pri] or [*YYYY*.Uca_Pri] < [25.U_UV_SynChk] * [*YYYY*.U1n_VT_Measmt].

2) [*YYYY*.Uab_Sec] or [*YYYY*.Ubc_Sec] or [*YYYY*.Uca_Sec] < [25.U_UV_SynChk] * [*YYYY*.U2n_VT_Measmt].

3) [*YYYY*.Ua_Pri] or [*YYYY*.Ub_Pri] or [*YYYY*.Uc_Pri] < [25.U_UV_SynChk] * [*YYYY*.U1n_VT_Measmt]/$\sqrt{3}$

4) [*YYYY*.Ua_Sec] or [*YYYY*.Ub_Sec] or [*YYYY*.Uc_Sec] < [25.U_UV_SynChk] * [*YYYY*.U2n_VT_Measmt]/$\sqrt{3}$.

5) [*YYYY*.Usyn_Pri] < [25.U_UV_SynChk] * [*YYYY*.U1n_VT_Syn].

6) [*YYYY*.Usyn_Sec] < [25.U_UV_SynChk]*[*YYYY*.U2n_VT_Syn].

2. 25.U_Diff_SynChk

Threshold of voltage difference to block CB closing, and it is expressed as a percentage.

If the voltage difference between both sides of the CB for synchronization check is greater than this setting, CB closing will be disabled.

If [25.Opt_U_SynChk] is configured as phase voltage, CB closing will be disabled if any of the following events is met:

1) [25.U_Diff_Pri] > [25.U_Diff_SynChk] * [*YYYY*.U1n_VT_Measmt]/$\sqrt{3}$.

2) [25.U_Diff_Sec] > [25.U_Diff_SynChk] * [*YYYY*.U2n_VT_Measmt]/$\sqrt{3}$.

If [25.Opt_U_SynChk] is configured as phase-to-phase voltage, CB closing will be disabled if any of the following events is met:

1) [25.U_Diff_Pri] > [25.U_Diff_SynChk] * [*YYYY*.U1n_VT_Measmt].

2) [25.U_Diff_Sec] > [25.U_Diff_SynChk] * [*YYYY*.U2n_VT_Measmt].

3. 25.f_Diff_SynChk

Threshold of frequency difference between both sides of the CB (Δf = |f-fsyn|) for synchronization check.

If the Δf between both sides of the CB is greater than this setting, CB closing will be disabled.

4. 25.df/dt_SynChk

Threshold of df/dt (change rate of frequency difference) between both sides of the CB for synchronization check.

If the df/dt between both sides of the CB is greater than this setting, CB closing will be disabled.

5. 25.phi_Diff_LoopChk

Threshold of phase-angle difference between both sides of the CB for synchronization check.

If the phase-angle difference between the 2 voltages on both sides of the CB is greater than this setting, CB closing will be disabled.

6. 25.Opt_Mode_DeadChk

The "Dead check mode" is determined by the setting [25.Opt_Mode_DeadChk].

[**25.Opt_Mode_DeadChk**]	**Corresponding dead check criterion**
1	Both the incoming side and the reference side adopt dead check.
2	The incoming side adopts live check and the reference side adopts dead check.
3	The incoming side adopts dead check and the reference side adopts live check.
4	The reference side adopts dead check.
5	The incoming side adopts dead check.
6	The incoming side adopts live check and the reference side adopts dead check. Or: The incoming side adopts dead check and the reference side adopts live check.
7	The incoming side adopts live check and the reference side adopts dead check. Or: The incoming side adopts dead check and the reference side adopts live check. Or: Both the incoming side and the reference side adopt dead check.

Note!

[25.Opt_Mode_DeadChk] will only be valid when this device is set to work in "dead check mode".

Note!

In this table, the criterion for dead check is: a voltage will be regarded as dead if it is less than [25.U_DeadChk].

The criterion for live check is: a voltage will be regarded as live if it is greater than [25.U_LiveChk].

7. 25.En_VTS_Blk_DeadChk

"1/0": Enable/Disable the block function of dead check mode if there is alarm of VT circuit failure.

8. 25.En_VTS_Blk_SynChk

"1/0": Enable/Disable the block function of synchronization check mode if there is alarm of VT circuit failure.

9. 25.t_Reset_SynChk

Duration of synchronization check. The check will not precede any longer out of this range.

10. 25.U_DeadChk

This setting is expressed as a percentage.

In "dead check mode", a voltage will be regarded as dead if it is less than this setting.

11. 25.U_LiveChk

This setting is expressed as a percentage.

In "dead check mode", a voltage will be regarded as live if it is greater than this setting.

12. 25.Opt_U_SynChk

Synchronism voltage type.

[25.Opt_U_SynChk]	Corresponding synchronism voltage type
0	Ua
1	Ub
2	Uc
3	Uab
4	Ubc
5	Uca

Note!

[*YYYY*.U1n_VT_Syn] and [*YYYY*.U2n_VT_Syn] (Access path: "**MainMenu**" -> "**Settings**" -> "**System Settings**") should cooperate with this setting.

If [25.Opt_U_SynChk] is configured as "0","1" or "2", [*YYYY*.U1n_VT_Syn] should be configured as phase voltage (e.g.: 76.2kV), and [*YYYY*.U2n_VT_Syn] should be configured as phase voltage (e.g.: 63.51V).

If [25.Opt_U_SynChk] is configured as "3","4" or "5", [*YYYY*.U1n_VT_Syn] should be configured as phase-to-phase voltage (e.g.: 132kV), and [*YYYY*.U2n_VT_Syn] should be configured as phase-to-phase voltage (e.g.: 110V).

13. 25.phi_Comp_Diff

Compensation angle for incoming voltage during synchronization check. The summation of the reference voltage angle and this setting will be compared with the incoming voltage angle.

1) For voltage adoption from different sides of transformer;

2) For voltage adoption of different phases;

3) Other factors.

14. 25.t_Close_CB

Closing time of circuit breaker.

It is the time from receiving closing command pulse until the CB is completely closed.

15. 25.Link_BO_Syn

"1/0": Enable/Disable the output function of synchronism binary output in PWR module (B20).

If the device is in local control mode (i.e. [BI_Rmt/Loc]=0) and all the conditions of synchronism check are satisfied, with [25.Link_BO_Syn]=1, following NO contact(s) (normally open) will be closed according to application and selection of synchronism check side:

App 1 (Single Bay) B20 08~09
App 3 (Dual Bays) B20 04~05 (Bay 1), 06~07 (Bay 2)
App 5 (Transformer) B20 04~05 (HVS), 06~07 (MVS), 08~09 (LVS), 10~11 (LVS BR)

16. 25.Opt_Mode_SynChk

Selection of synchronism check mode.

"0" Normal;

"1" The phase difference in condition 4 is fixed at 1 degree, please refer to "*Synchronization Check Logic*" in Chapter 3 for detail.

17. 25.Opt_Side_Measmt

Selection of measurement (reference) side.

0: HVS, high voltage side;

1: MVS, middle voltage side;

2: LVS, low voltage side;

3: LVS BR, low voltage side branch;

18. 25.Opt_Side_Syn

Selection of synchronism side.

0: HVS, high voltage side;

1: MVS, middle voltage side;

2: LVS, low voltage side;

3: LVS BR, low voltage side branch;

Note!

The values of [25.Opt_Side_Measmt] and [25.Opt_Side_Syn] cannot be same, else there will be an alarm [Alm_Settings_RSYN].

7.2.3 BI Settings

No.	Name	Range	Step(Unit)
1	DPOS.t_DPU_01~25	0~60000	1 (ms)
2	t_DPU_BI_Maintenance	0~60000	1 (ms)
3	t_DPU_BI_Block_Dis	0~60000	1 (ms)
4	t_DPU_BI_Rmt/Loc	0~60000	1 (ms)
5	t_DPU_BI_Manual_Synchro	0~60000	1 (ms)
6	t_DPU_BI_Manual_Open	0~60000	1 (ms)
7	t_DPU_BI_Reserved	0~60000	1 (ms)
8	t_DPU_BI_15(BCD1)	0~60000	1 (ms)
9	t_DPU_BI_16(BCD2)	0~60000	1 (ms)
10	t_DPU_BI_17(BCD3)	0~60000	1 (ms)
11	t_DPU_BI_18(BCD4)	0~60000	1 (ms)
12	t_DPU_BI_19(BCD5)	0~60000	1 (ms)
13	t_DPU_BI_20(BCD6)	0~60000	1 (ms)
14	B*XX*.t_DPU_BI_01~20	0~60000	1 (ms)

Note!

"DPU" is the abbreviation of "Delay Pick Up". "t_DPU" refers to "the debouncing time". If slot B*XX* (*XX* represents the slot No.) is not equipped with a BI module, the corresponding settings [B*XX*.t_DPU_BI_01]…[B*XX*.t_DPU_BI_20] will be hidden automatically.

1. [DPOS.t_DPU_*XX*] (*XX*=01~16)

In order to prevent the situation that NO contact & NC contact are both opened or closed

during CB/DS/ES operation process, these debouncing time settings should be configured to be greater than the duration.

Note!

[DPOS*XX*] indicates the state of double point *XX*.

Access path of [DPOS*XX*] is "**MainMenu**" -> "**Status**" -> "**Inputs**" -> "**DPS Inputs**".

For CB: NO contact refers to 52a contact; NC contact refers to 52b contact;

For DS: NO contact refers to 89a contact; NC contact refers to 89b contact;

For ES: NO contact refers to 57a contact; NC contact refers to 57b contact.

2. [t_DPU_BI_Maintenance]…[B10.t_DPU_BI_20]

In this device, each binary input has an independent debouncing time setting.

The debouncing time (also called delay pickup time) of binary input is the duration for confirming binary input state, i.e.: if binary input state changes and remains unchanged during the duration, and then the binary input state will be confirmed by the device.

7.2.4 Control Settings

No.	Name	Description	Range	Step(Unit)
1	CSWI*XX*.t_DDO_Opn	No.*XX* DDO time of a normally open contact for remote opening or for signaling purpose	0~65535	1(ms)
2	CSWI*XX*.t_DDO_Cls	No. *XX* DDO time of a normally open contact for remote closing or for signaling purpose	0~65535	1(ms)

Note!

"DDO" is the abbreviation of "Delay Drop Off" (i.e.: holding time).

In the above table, *XX*=01~15.

7.2.5 TP Settings

No.	Name	Range	Step(Unit)
1	84.Num_Tap_Pos	0~26	1
2	84.Code_Tap_Pos	0~3	1
3	84.t_DPU_Tap_Pos	0~6000	1(ms)
4	84.En_EmergStop_Tap_Pos	0 or 1	1
5	84.t_EmergStop_Tap_Pos	0~60000	1(ms)

1. 84.Num_Tap_Pos

The maximum number of transformer's tap position, it will take effect only when

[84.Code_Tap_Pos] =3:

2. 84.Code_Tap_Pos

This is the access mode selection of the tap position of the transformer.

There are 4 modes ("0", "1", "2" and "3") available.

1) "0": No binary inputs will be used for tap position indication (abbreviated as TPI).

2) "1": Binary inputs 15 to 20 will be used as Binary-Coded Decimal code (abbreviated as BCD) while binary inputs 21 to 40 will not be used.

   Binary input 15 is the least significant bit however binary input 20 is the most significant bit. The first 4 bits are for binary numbers while the 5th bit and the 6th bit represent ten and twenty respectively.

   Some examples are shown as follows:

   a) If the transformer tap position is 5, then binary inputs 20 to 15 indicate as "00 0101".

   b) If the transformer tap position is 15, then binary inputs 20 to 15 indicate as "01 0101".

   c) If the transformer tap position is 25, then binary inputs 20 to 15 indicate as "10 0101".

3) "2": Binary inputs 15 to 24 will be used to indicate "0~9", binary inputs 25, 26 and 27 denote the tap position lower than 10 or between 10 to 19 or over 19 respectively. Binary inputs 28 to 40 will not be used.

   Some examples are shown as follows:

   a) If the transformer tap-position is 5, then binary inputs 27 to 15 indicate as "0010000100000".

   b) If the transformer tap-position is 15, then binary inputs 27 to 15 indicate as "0100000100000".

   c) If the transformer tap-position is 25, then binary inputs 27 to 15 indicate as "1000000100000".

4) "3": Binary inputs 15 to 40 represent tap positions 1 to 26 respectively. Only 1 binary input would be set as 1 among binary inputs 15 to 40.

   Binary input 15 indicates the lowest tap position of the transformer.

   Binary input 40 indicates the highest tap position of the transformer.

   Some examples are shown as follows:

   a) If binary input 15 is configured as 1 and binary inputs 16 to 40 are all set as 0, it indicate the tap position is 1.

   b) If binary input 40 is configured as 1 and binary inputs 15 to 39 are all set as 0, it indicate the tap position is 26.

3. 84.t_DPU_Tap_Pos

This is the duration for confirming transformer tap position (abbreviated as TP). If TP changes and remains unchanged for this duration, the TP will be confirmed. Otherwise, the binary input state will not be confirmed.

Note!

"DPU" is the abbreviation of "Delay Pick Up". "t_DPU" refers to "the debouncing time".

4. 84.En_EmergStop_Tap_Pos

Enable/Disable the function to stop slip of TP immediately. During tap changer control process, if "slip TP" occurs, the TP will be out of control, and it will step up or down continuously.

An output contact "BO_EmergStopTP" is provided to issue an emergency stop command to block the power source of the motor of the TP changer.

5. 84.t_EmergStop_Tap_Pos

This is used to configure the holding time of output contact "BO_EmergStopTP".

7.2.6 Interlock Settings

No.	Name	Description	Range	Step(Unit)
1	CSWI*XX*.En_Opn_Blk	Enable/Disable interlocking logic control function of No.*XX* opening output.	0 or 1	1
2	CSWI*XX*.En_Cls_Blk	Enable/Disable interlocking logic control function of No.*XX* closing output.	0 or 1	1

Note!

The items in this submenu are applied together with [CSWI*XX*.CILO.EnaOpn] and [CSWI*XX*.CILO.EnaCls] in the submenu "**Status**" -> "**Outputs**" -> "**Interlock Status**".

XX=01~15.

7.2.7 Transducer Settings

No.	Name	Range	Step(Unit)
1	DCAI.Opt_Type_Transducer*XX* (*XX*=01,02,…,08)	0, 1, 2 or 3	1
2	DCAI.Max_Transducer*XX* (*XX*=01,02,…,08)	－60000~60000	1
3	DCAI.Min_Transducer*XX* (*XX*=01,02,…,08)	－60000~60000	1

1. DCAI.Opt_Type_Transducer*XX*

These settings are applied to configure DC analog transducer type, and they cooperate with the jumpers on the DI module to match the type.

DCAI.Opt_Type_Transducer*XX*	Corresponding DC Analog Input
0	0~5V
1	4~20mA
2	0~250V
3	0~48V

2. DCAI.Max_TransducerXX

Maximum values measured by the transducer.

If the temperature range is -50℃~+50℃, the setting value will be 50.

3. DCAI.Min_TransducerXX

Minimum values measured by the transducer.

If the temperature range is -50℃~+50℃, the setting value will be -50.

7.2.8 AC Calbr Settings

This menu consists of the parameters to adjust the accuracy of AC analog inputs.

Note!

The function is used to maintain this device and has already been configured by the manufacturer. It is strongly recommended not to adjust it.

7.2.9 Regulation Settings

No.	Name	Range	Step(Unit)
1	DCAO*XX*.Opt_Type_Regu	0: 4~20mA; 1: 0~10V	1
2	DCAO*XX*.Min_Regu	－60000~60000	0.01
3	DCAO*XX*.Max_Regu	－60000~60000	0.01

1. DCAO*XX*.Opt_Type_Regu

This setting is applied to set the DC analog output type for regulation.

2. DCAOXX.Min_Regu

Minimum regulation value (corresponds to 4mA or 0V) of DC analog output.

3. DCAOXX.Max_Regu

Maximum regulation value (corresponds to 20mA or 10V) of DC analog output.

7.2.10 SV Settings

No.	Name	Range	Step(Unit)
1	SyncUnit.Opt_TimeSyn	0~3	1
2	SyncUnit.En_GPSCheckSample	0~1	1

1. SyncUnit.Opt_TimeSyn

This setting is applied to set the time synchronization mode for NET-DSP Plug-in Module (GOOSE and SV).

SyncUnit.sync_mode	Corresponding time synchronization mode
0	PPS internal
1	IEEE1588
2	PPS external
3	IRIG-B

2. SyncUnit.En_GPSCheckSample

Enable/Disable the adjustment according the GPS synchronization for the sampling of NET-DSP Plug-in module.

7.2.11 PulseIO Settings

No.	Name	Description	Range	Step(Unit)
1	PulseIO.t_PW_*XX*	This is the width of output signal for [PulseIO.Sig_*XX*] corresponding.	0~65535	1 (ms)

Note!

XX=01~06.

Access path of [PulseIO.Sig_*XX*] is: "**Status**" -> "**Inputs**" -> "**PulseIO Inputs**". Please refer to the Section *8.2.4* for more details.

If [PulseIO.t_PulseWidth_XX] is configured as "65535", [PulseIO_SigXX] will be processed as a permanent signal (i.e.: this signal will not drop off).

7.2.12 Misc Settings

No.	Name	Range	Step(Unit)
1	SwitchType*XX*	1~4	1
2	Max_CBOpCap*XX*	1~7	1

1. SwitchType*XX*

This is the type configuration of switch *XX* (2~15) which corresponds to the DPS*XX* in device configuration (double position).

1: Load break switch; 2: Disconnector; 3: Earthing switch; 4: High speed earthing switch;

2. Max_CBOpCap*XX*

CBOpCap is an enumeration representing the physical capabilities of the breaker to operate. It reflects the switching energy as well as additional blocking due to some local problems. CBOpCap is always less or equal to Max_CBOpCap and will be implemented based on CB spring charge status.

More values (8...n) describe higher operating capabilities. A new value, i.e. a new line in the table must start alternating with 'Close' and 'Open' and must end always with 'Open'.

Breaker Operating Capability	Value
None	1
Open	2
Close-Open	3
Open-Close-Open	4
Close-Open-Close-Open	5
Open-Close-Open-Close-Open	6
More	7

7.3 Logic Link Settings

The logic link settings are used to determine whether the relevant function of device is enabled or disabled.

"**MainMenu**" -> "**Settings**" -> "**Logic Links**"

7.3.1 Function Links

No.	Name	Range	Step(Unit)
1	NEWLOCK.Link_IgnExtIntlck	0 or 1	1
2	25.Link_DeadChk	0 or 1	1
3	25.Link_SynChk	0 or 1	1
4	25.Link_LoopChk	0 or 1	1

1. NEWLOCK.Link_IgnExtIntlck

Enable/Disable interlock logic from external bay. If this setting is "0", all the interlock logic from external bay will be considered as satisfied.

2. [25.Link_DeadChk], [25.Link_SynChk] and [25.Link_LoopChk]

These 3 logic links cooperate to determine RSYN check mode for CB closing. Please refer to "*RSYN Check (25)*" in Chapter 3 for more details.

7.3.2 GOOSE Links

The GOOSE link settings are used to determine whether the relevant GOOSE elements are enabled or disabled.

No.	Name	Description	Range	Step(Unit)
1	*XX*.Link_GS_SLRL_*YY*	Enable/Disable the goose channel message supervision in station layer.	0 or 1	1
2	*XX*.Link_GS_PLRL_*YY*	Enable/Disable the goose channel message supervision in process layer.	0 or 1	1

Note!

These links are aim to avoid issuing disconnection alarms if the goose channel relevant is empty due to some situations like remote device out of service.

XX refers to the GOOSE link name that can be configured by the value of the setting [B01_GOOSE_Link0]~[B01_GOOSE_Link16]. Access path: "**MainMenu**" -> "**Settings**" -> "**Device Setup**" -> "**Label Settings**".

YY refers to the No. of GOOSE link. *YY*=01~17.

7.4 Device Setup

"**MainMenu**" -> "**Settings**" -> "**Device Setup**"

7.4.1 Device Settings

No.	Item	Range	Step(Unit)
1	Opt_Caption_103	0, 1 or 2	1
2	Un_BinaryInput	0, 1, 2 or 3	1
3	En_MDisk	0 or 1	1

1. Opt_Caption_103

Select the caption language sent to SAS via IEC103 protocol.

"0": Current language (the same with present LCD display)

"1": Fixed in Chinese;

"2": Fixed in English;

Default value of [Opt_Caption_103] is "0" (i.e.: current language), and please set it to "1" (i.e.: Fixed Chinese) if the SAS is supplied by a Chinese manufacturer.

2. Un_BinaryInput

This setting is used to set the voltage level of binary input module.

"0": 24V; "1": 48V; "2": 110V; "3": 220V "4": 30V; "5":125V;

3. En_MDisk

"1" Use moveable disk to realize backup and recovery function.

"0" Disable the use of moveable disk.

Moveable disk implemented on the MON plug-in module can be used to backup and restore program, settings and configuration.

7.4.2 Communication Settings

No.	Item	Range
1	IEDNAME	N/A
2	IP_LAN1	000.000.000.000~255.255.255.255
3	Mask_LAN1	000.000.000.000~255.255.255.255
4	IP_LAN2	000.000.000.000~255.255.255.255
5	Mask_LAN2	000.000.000.000~255.255.255.255
6	En_LAN2	0 or 1
7	IP_LAN3	000.000.000.000~255.255.255.255
8	Mask_LAN3	000.000.000.000~255.255.255.255
9	En_LAN3	0 or 1
10	IP_LAN4	000.000.000.000~255.255.255.255
11	Mask_LAN4	000.000.000.000~255.255.255.255
12	En_LAN4	0 or 1
13	Gateway	000.000.000.000~255.255.255.255
14	En_Broadcast	0 or 1
15	Addr_RS485A	0~255
16	Baud_RS485A	4800,9600,19200,38400,57600,115200 (bps)
17	Protocol_RS485A	0, 1 or 2
18	Addr_RS485B	0~255
19	Baud_RS485B	4800,9600,19200,38400,57600,115200 (bps)
20	Protocol_RS485B	0, 1 or 2
21	Threshold_Measmt_Net	0~100%
22	Period_Measmt_Net	0~65535s
23	Opt_TimeSyn	Conventional; SAS; Advanced; NoTImeSyn
24	IP_Server_SNTP	000.000.000.000~255.255.255.255
25	OffsetHour_UTC	-12~+12 (hrs)
26	OffsetMinute_UTC	0~60 (min)
27	En_DualNet_SL_GOOSE	0 or 1
28	En_DualNet_PL_GOOSE	0 or 1
29	En_ComplexNet_GOOSE	0 or 1

1. IEDNAME

IED name of this device. If this setting is modified, the IED name in ".cid" file will be changed simultaneously and vice versa.

Note!

If the setting [IEDNAME is modified, do **not** power off this device within 10s! Otherwise, this setting cannot be saved.

2. IP_LAN1, IP_LAN2, IP_LAN3, IP_LAN4

IP address of Ethernet port 1, 2, 3 and 4.

3. Mask_LAN1, Mask_LAN2, Mask_LAN3, Mask_LAN4

Subnet mask of Ethernet port 1, 2, 3 and 4.

4. En_LAN2, En_LAN3, En_LAN4

Enable/Disable Ethernet port 2, Ethernet port 3 and Ethernet port 4 in service.

They are used for Ethernet communication based on the IEC 60870-5-103 protocol. When the IEC 61850 protocol is applied, the IP address of Ethernet A will be GOOSE source MAC address.

Ethernet port 1 is always in service by default.

5. Gateway

IP address of Gateway (router)

6. En_Broadcast

This setting is only used only for IEC 60870-5-103 protocol. If NR network IEC 60870-5-103 protocol is used, the setting must be set as "1".

Enable/Disable the device to send UDP messages through network

7. Addr_RS485A, Addr_RS485B

They are the device's communication addresses via serial ports (port A and port B).

8. Baud_RS485A, Baud_RS485B

Baud rate of rear RS-485 serial port A or B

9. Protocol_RS485A, Protocol_RS485B

Communication protocol of rear RS-485 serial port A or B.

"0": IEC 60870-5-103 protocol;

"1": MODBUS Protocol;

"2": Reserved;

Note!

Above table lists all the communication settings, the device delivered to the user maybe

only shows some settings of them according to the communication interface configuration. Moreover, the settings about the Ethernet ports only listed in this submenu according to the actual number of Ethernet ports.

The standard arrangement of the Ethernet port is two, at most four (predetermined by ordering). Please configure the IP addresses according to actual arrangement of Ethernet numbers, and it is unnecessary to configure the un-useful port/ports. If PCS-Explorer configuration tool auxiliary software is connected with this device through the Ethernet, the IP address of the PCS-Explorer must be set as one of the available IP address of this device.

10. Threshold_Measmt_Net

This is the threshold to send measurement values to SCADA or gateway through IEC 60870-5-103 or IEC61850 protocol.

11. Period_Measmt_Net

This is the time period for this device to send measurement data to SCADA or gateway through IEC 60870-5-103 protocol.

12. Opt_TimeSyn

There are four options for clock synchronization:

1) Conventional

PPS (RS-485): Pulse per second (PPS) via RS-485 differential level

IRIG-B (RS-485): IRIG-B via RS-485 differential level

PPM (DIN): Pulse per minute (PPM) via a configurable binary input

PPS (DIN): Pulse per second (PPS) via a configurable binary input

2) SAS

SNTP (PTP): Unicast (point-to-point) SNTP mode via Ethernet network

SNTP (BC): Broadcast SNTP mode via Ethernet network

Message (IEC103): Clock messages through IEC103 protocol

3) Advanced

IRIG-B (Fiber): IRIG-B via optical-fiber interface

PPS (Fiber): Pulse per second (PPS) via optical-fiber interface

4) NoTimeSyn

When no time synchronization signal is connected to the device, please select this option and the alarm message [Alm_TimeSyn] will not be issued anymore.

"Conventional" mode and "SAS" mode are always supported, but "Advanced" mode is only

supported when NET-DSP module is equipped.

1) When "Conventional" mode is selected, if there is no conventional clock synchronization signal, "SAS" mode will be enabled automatically with the alarm signal [Alm_TimeSyn] be issued simultaneously.

2) When "SAS" is selected, if there is no conventional clock synchronization signal, the device will not send the alarm signal [Alm_TimeSyn].

3) When "Advanced" mode is selected, if there is no conventional clock synchronization signal connected to NET-DSP module, "SAS" mode will be enabled automatically with the alarm signal [Alm_TimeSyn] be issued simultaneously.

4) When "NoTimeSyn" mode is selected, the device will not send alarm signals without time synchronization signal. However, the device can still be synchronized when receiving time synchronization signal.

Note!

The clock message via IEC 60870-5-103 protocol is invalid when the device receives IRIG-B signal through RS-485 port.

13. IP_Server_SNTP

This is the address of the SNTP time synchronization server which sends SNTP timing messages to the device.

14. OffsetHour_UTC, OffsetMinute_UTC

If the IEC61850 protocol is adopted, the time tags of communication message are required according to UTC (Universal Time Coordinated) time.

The setting [OffsetHour_UTC] is used to set the hour offset of the current time zone to the GMT (Greenwich Mean Time) zone; for example, if the device is applied in China, the time zone of China is east 8th time zone, so this setting will be "8".

The setting [OffsetMinute_UTC] is used to set the minute offset of the current time zone to the GMT zone.

Time zone	GMT zone	East 1st	East 2nd	East 3rd	East 4th	East 5th
Setting	0	1	2	3	4	5
Time zone	East 6th	East 7th	East 8th	East 9th	East 10th	East 11th
Setting	6	7	8	9	10	11
Time zone	East/West 12th	West 1st	West 2nd	West 3rd	West 4th	West 5th
Setting	12/-12	-1	-2	-3	-4	-5
Time zone	West 6th	West 7th	West 8th	West 9th	West 10th	West 11th
Setting	-6	-7	-8	-9	-10	-11

15. En_DualNet_SL_GOOSE

Enable/Disable dual GOOSE network for station layer.

16. En_DualNet_SL_GOOSE

Enable/Disable dual GOOSE network for process layer.

17. En_ComplexNet_GOOSE

Enable/Disable mixed GOOSE network (especially for the condition that certain IEDs adopt single network while others adopt dual network) for process layer.

7.4.3 Label Settings

No.	Item	Description
1	B*xx*.Name_SL_*YY*_GCommLink	The name of No.*YY* GOOSE link (station level) in the module at slot *xx*
2	B*xx*.Name_PL_*YY*_GCommLink	The name of No.*YY* GOOSE link (process level) in the module at slot *xx*
3	B*xx*.Name_*YY*_SVCommLink	The name of No.*YY* SV link in the module at slot *xx*

8 Human Machine Interface

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8.1 Overview

Operator can access the device from the front panel. Local communication with the device is possible using a computer via a multiplex RJ45 port on the front panel. Furthermore, remote communication is also possible using a PC with the substation automation system via rear RS485 port or rear Ethernet port. The operator is able to check the device status at any time.

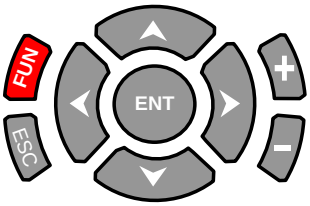
This chapter describes human machine interface (HMI), and give operator an instruction about how to display or print event report, setting and so on through HMI menu tree and display metering value, including r.m.s. current, voltage and frequency etc. through LCD. Procedure to change active setting group or a settable parameter value through keypad is also described in details.

8.1.1 Design

The human-machine interface consists of a human-machine interface (HMI) module which allows a communication to be as simple as possible for the user. The HMI module helps to draw your attention to something that has occurred which may activate an LED or a report displayed on the LCD. Operator can locate the data of interest by navigating the keypad.

No.	Item	Description
1	LCD	A 320×240 (full width chassis) or 240×128 (half width chassis) dot matrix backlight LCD display is visible in dim lighting conditions. The corresponding messages are displayed when there is any operation implemented.
2	LED	20 status indication LEDs, 2 LEDs are fixed as the signals of "**HEALTHY**" (green) and "**ALARM**" (yellow), 18 LEDs are configurable with selectable color among green, yellow and red.
3	Keypad	Navigation keypad and command keys for full access to device.
4	Communication port	A multiplex RJ45 port for debugging.
5	Remote/Local control switch (optional)	Remote/Local mode switch controlled by special key.
6	Unlock/Lock switch (optional)	Switch to release interlock check logic.
7	Manual CB open/close buttons (optional)	2 buttons to manually close or open circuit breaker

8.1.2 Keypad



1. "**ESC**"

    1) Cancel the operation

2) Quit the current menu

2. "**ENT**"

1) Execute the operation

2) Confirm the interface

3. "**FUN**"

1) N/A

4. "◄" and "►"

1) Move the cursor horizontally

2) Enter the next menu or return to the previous menu

5. "▲" and "▼"

1) Move the cursor vertically

2) Select command menu within the same level of menu

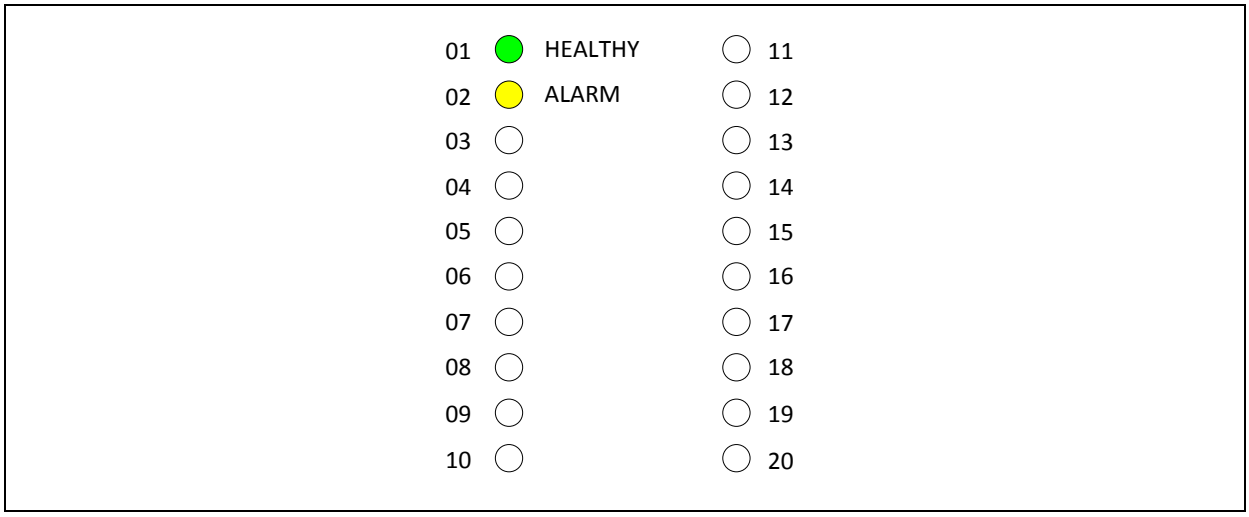
6. "＋" and "－"

1) Modify the value

2) Modify and display the message number

3) Page up/down

8.1.3 LED Indicators



A brief explanation has been made as bellow.

LED	Display	Description
HEALTHY	Off	When the equipment is out of service or any hardware error is defected during self-check.
	Steady Green	Lit when the equipment is in service and ready for operation.

LED	Display	Description
ALARM	Off	When equipment in normal operating condition.
	Steady Yellow	Lit when VT circuit failure, CT circuit failure or other abnormal alarm is issued.

Note!

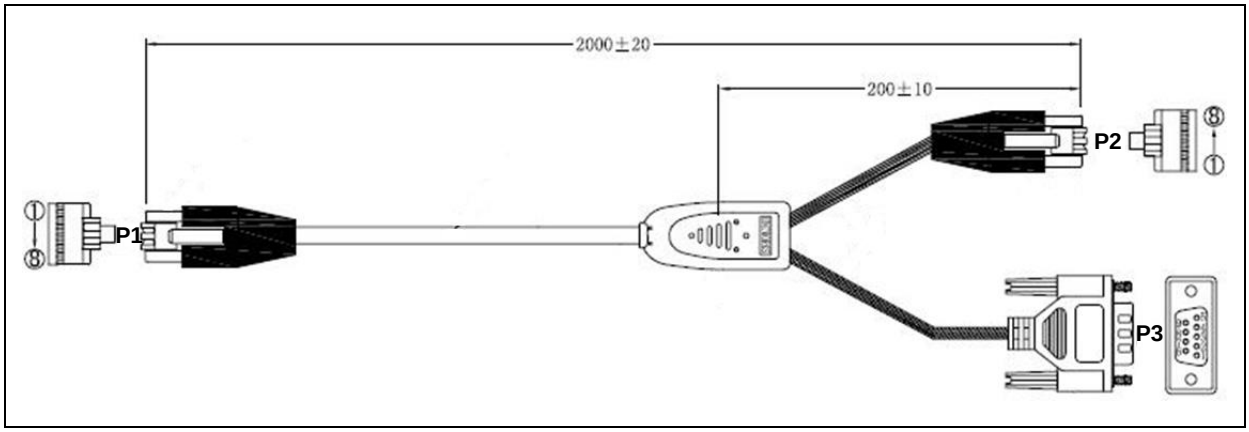
1. "**HEALTHY**" LED can only be turned on by energizing the device and no abnormality detected.
2. "**ALARM**" LED is turned on as long as alarm exists. When all alarm signals disappear, it will be turned off.
3. Other 18 LED indicators with no labels are configurable and user can configure them to be lit by signals of operation element, alarm element and binary output contact according to requirement through PCS-Explorer software. These 18 LEDs are configurable with selectable color among green, yellow and red.
4. All the 20 LED indicators refresh every 30s if there is no change of status.

8.1.4 Control Buttons and Switches (Optional)

Buttons	Remarks
	This button is used to close CB/switch if BCU is in local control mode. Press it to output a manual close command.
	This button is used to open CB/switch if BCU is in local control mode. Press it to output a manual open command.
	This switch is used to release interlock check logic. Switch it to left for ‘Unlock’ or to right for ‘Lock’. "CILO.Disable" change report will be shown up.
	This switch is used to change the BCU into remote/local control mode. Switch it to left for ‘Remote’ or to right for ‘Local’. "BI_Rmt/Loc" change report will be shown up.

8.1.5 Front Debugging Port

There is a multiplex RJ45 port on the front panel. This port can be used as an RS-232 serial port as well as a twisted-pair Ethernet port. As shown in the following figure, a customized cable is applied for debugging via this multiplex RJ45 port.



P1: To connect the multiplex RJ45 port. An 8-core cable is applied here.

P2: To connect the twisted-pair Ethernet port of the computer.

P3: To connect the RS-232 serial port of the computer.

The definition of the 8-core cable in the above figure is introduced in the following table.

Terminal No.	Core color	Function	Device side (Left)	Computer side (Right)
1	Orange & white	TX+ of the ethernet port	P1-1	P2-1
2	Orange	TX- of the ethernet port	P1-2	P2-2
3	Green & white	RX+ of the ethernet port	P1-3	P2-3
4	Blue	TXD of the RS-232 serial port	P1-4	P3-2
5	Brown & white	RXD of the RS-232 serial port	P1-5	P3-3
6	Green	RX- for the ethernet port	P1-6	P2-6
7	Blue & white	The ground connection of the RS-232 port.	P1-7	P3-5
8	Brown		P1-8	

8.1.6 Ethernet Port Setup

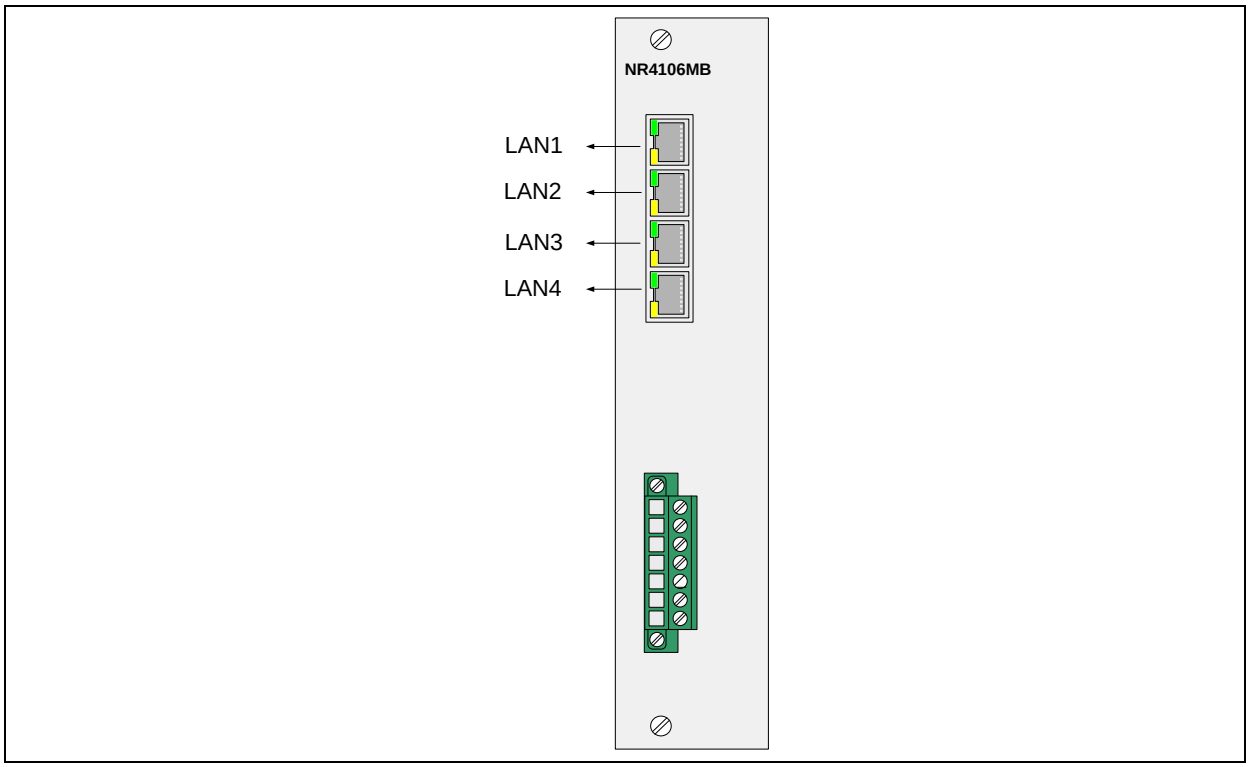
MON plug-in module is equipped with two or four 100Base-TX Ethernet interface. Take NR4106MB as an example, its rear view and the definition of terminals are shown in the following figure.

The Ethernet port can be used to communication with PC via auxiliary software (PCS-Explorer) after connecting the device with PC, so as to fulfill on-line function (please refer to the instruction manual of PCS-Explorer). At first, the connection between the device and PC must be established. Through setting the IP address and subnet mask of corresponding Ethernet interface in the menu "**Settings** -> **Device Setup** -> **Comm Settings**", it should be ensured that the device and PC are in the same network segment. For example, setting the IP address and subnet mask of network A. (using network A to connect with PC)

PC: IP address is set as "198.87.96.102", subnet mask is set as "255.255.255.0"

The IP address and subnet mask of device should be [IP_LAN1] = 198.87.96.*XXX*, [Mask_LAN1] =255.255.255.0, [En_LAN1] =1. (*XXX* can be any value from 0 to 255 except 102)

If the logic setting [En_LAN1] is non-available, it means that network A is always enabled.



Note!

If using other Ethernet network port, for example, Ethernet network B, the logic setting [En_LAN2] must be set as "1".

8.2 Menu Tree

Note!

According to different applications in different engineering requirements, display of menu in HMI may be different.

The descriptions about menu are based on the maximized configuration, for a specific project, if some function is not available, the corresponding submenu will be hidden.

Note!

"*YYYY*" is the function name substitution of different bays that can be "BayMMXU", "Bus1_MMXU", "Bay1_MMXU", "BayMHAN", etc.

8.2.1 Main Menu

Press "▲" of any running interface and enter the main menu. Select different submenu by "▲" and "▼". Enter the selected submenu by pressing "**ENT**" or "►". Press "◄" and return to the previous

menu. Press "**ESC**" back to main menu directly.

Press "▲" to enter the main menu with the interface as shown in the following diagram:

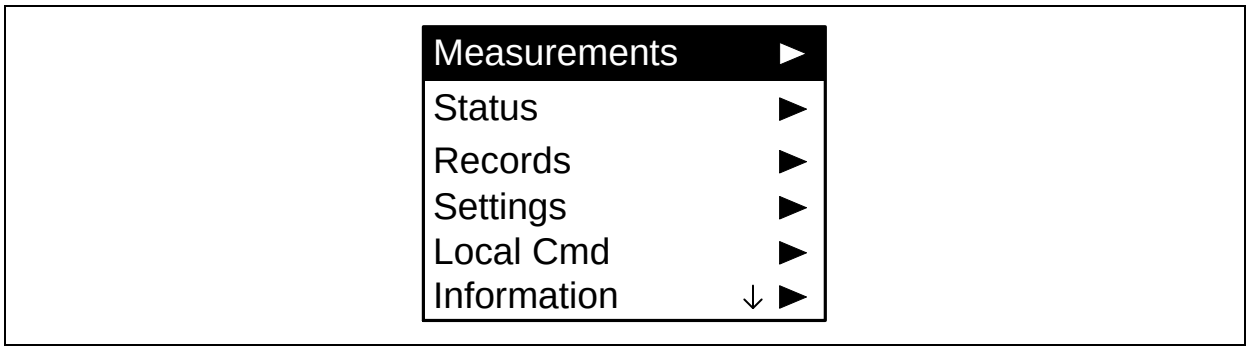


Figure 8.2-1 Main menu (LCD 240×128)

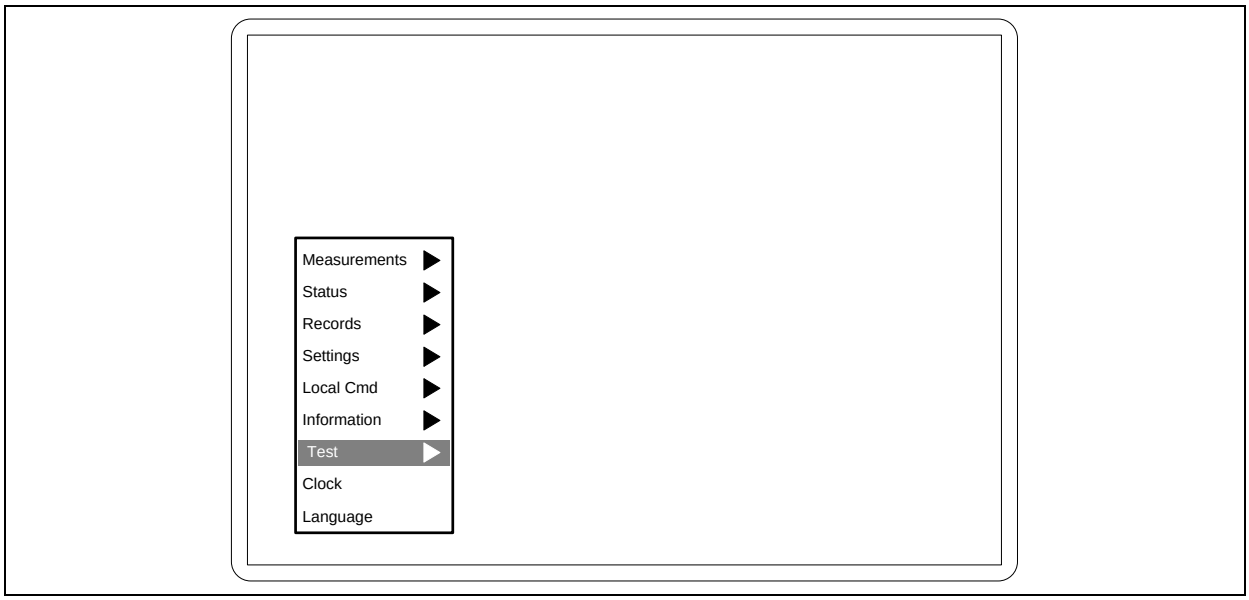
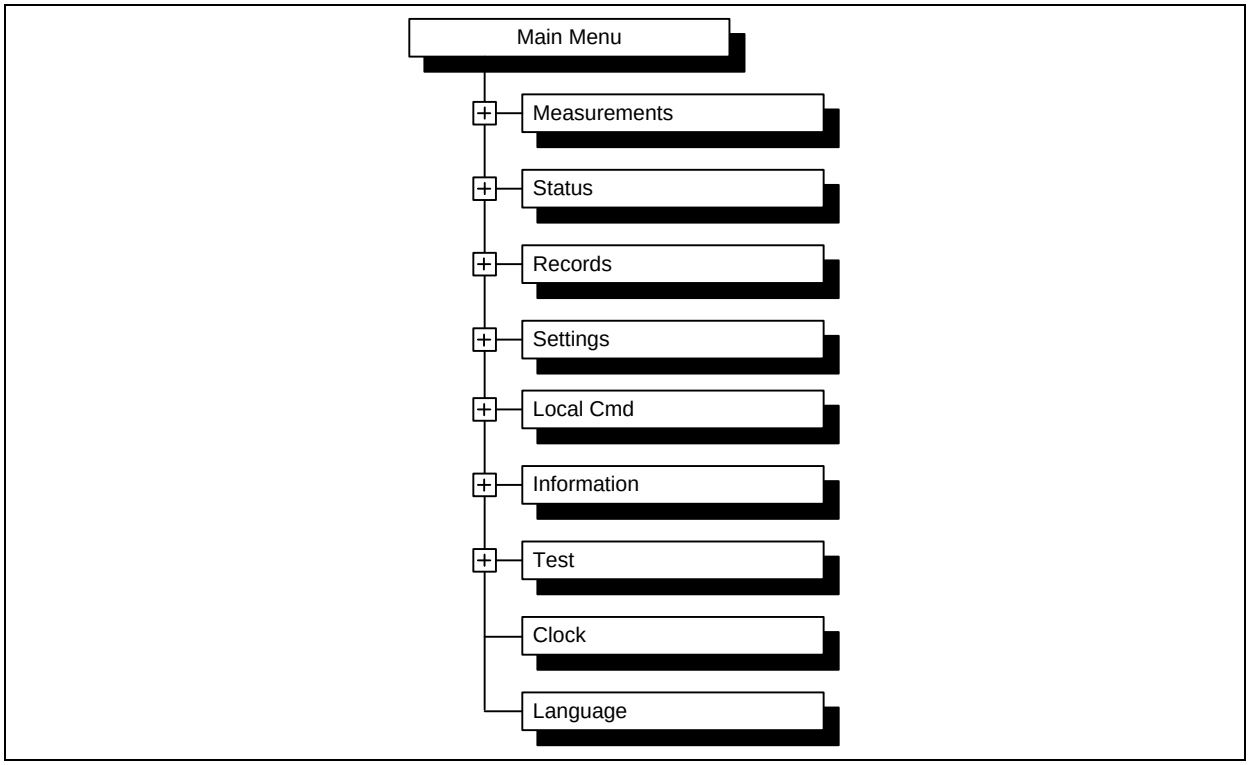
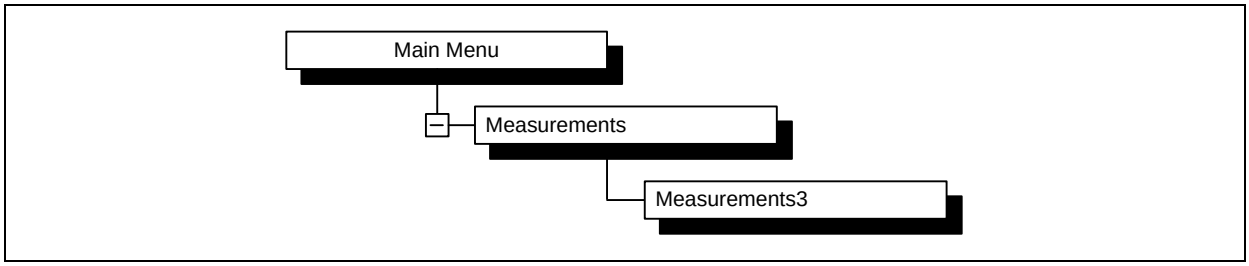


Figure 8.2-2 Main menu (LCD 320×240)

The menu of this device is organized into main menu and submenus, much like a PC directory structure. The menu of this device is divided into several sections:



8.2.2 Measurements



This menu is used to display real-time measured values, including AC voltage, AC current, phase angle and calculated quantities. These data can help users to acquaint the device's status. This menu comprises following submenus.

Table 8.2-1 Description of "Measurements"

No.	Item	Function description
1	Measurement3	Display measured primary values and other calculated quantities.

Table 8.2-2 Description of "Measurements3"

No.	Sign	Description
1	Primary Values	Display the primary value of the AC analog inputs.
2	Secondary Values	Display the secondary value of the AC analog inputs.
3	Primary Power	Display the primary value of P, Q, S and Cos of each phase.
4	Secondary Power	Display the secondary value of P, Q, S and Cos of each phase.
5	Harmonics	Display the harmonic voltages (Harmonic orders: 1-15).

No.	Sign	Description
6	Synchrocheck	Display the measurement (e.g.: frequency difference, voltage difference and etc.) between reference side and incoming side for CB RSYN check.
7	DC Input Pri Val	Display the primary values of the DC analog inputs.
8	DC Input Sec Val	Display the secondary values of the DC analog inputs.
9	Regulation Value	Display the DC voltage/current outputs for regulation.

8.2.2.1 Primary Values

No.	Sign	Description
1	*YYYY*.Ia_Pri	The primary values of three-phase current.
2	*YYYY*.Ib_Pri	
3	*YYYY*.Ic_Pri	
4	*YYYY*.IN_Pri	The primary value of the residual current. If [Cur3P.Opt_IN] =0, it is the primary value of the residual current input. If [Cur3P.Opt_IN] =1, it is the residual current calculated depending on the vector summation of *YYYY*.I_a_Pri, *YYYY*.I_b_Pri and *YYYY*.I_c_Pri (i.e.: *YYYY*.IN_Pri= *YYYY*.I_a_Pri + *YYYY*.I_b_Pri + *YYYY*.I_c_Pri). Access path of [Cur3P.Opt_IN] is: "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**FUN Settings**". Please refer to *Section 7.6* for more details.
5	*YYYY*.Ua_Pri	The primary values of three-phase voltage.
6	*YYYY*.Ub_Pri	
7	*YYYY*.Uc_Pri	
8	*YYYY*.U1_Pri	The primary value of the positive-sequence voltage.
9	*YYYY*.U2_Pri	The primary value of the negative-sequence voltage.
10	*YYYY*.UN_Pri	The primary value of the residual voltage. If [Vol3P.Opt_UN] =0, it is the primary value of the residual voltage input. If [Vol3P.Opt_UN] =1, it is the residual voltage calculated depending on the vector summation of *YYYY*.U_a_Pri, *YYYY*.U_b_Pri and *YYYY*.U_c_Pri (i.e.: *YYYY*.UN_Pri= *YYYY*.U_a_Pri + *YYYY*.U_b_Pri + *YYYY*.U_c_Pri). Access path of [Vol3P.Opt_UN] is: "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**FUN Settings**". Please refer to *Section 7.6* for more details.
11	*YYYY*.Uab_Pri	The primary values of 3 phase-to-phase voltages.
12	*YYYY*.Ubc_Pri	
13	*YYYY*.Uca_Pri	
14	*YYYY*.Usyn_Pri	The primary value of the incoming voltage for CB RSYN check.
15	*YYYY*.f	The reference side frequency which is often applied in synchronism-check for closing CB.
16	*YYYY*.fsyn	The incoming side frequency which is often applied in

No.	Sign	Description
		synchronism-check for closing CB.
17	*YYYY*.P_Pri	The primary value of the active power.
18	*YYYY*.Q_Pri	The primary value of the reactive power.
19	*YYYY*.S_Pri	The primary value of the apparent power.
20	*YYYY*.Cos	Power factor.
21	Sum_MMXU.Ia_Pri	The primary values of three-phase current vector summations of dual bays.
22	Sum_MMXU.Ib_Pri	
23	Sum_MMXU.Ic_Pri	
24	Sum_MMXU.P_Pri	The primary value of the active power vector summation of dual bays.
25	Sum_MMXU.Q_Pri	The primary value of the reactive power vector summation of dual bays.
26	Sum_MMXU.S_Pri	The primary value of the apparent power vector summation of dual bays.
27	Sum_MMXU.Cos	Power factor of power vector summation of dual bays.
28	Sum_MMXU.Iext_Pri	Terminal "13" and "14" on the AI module of PCS-9705 (Dual bays) are used to receive independent external current input. The primary value of the independent external current is displayed as "Sum_MMXU.Iext_Pri" in the submenu "**Measurements**" -> "**Measurements3**" -> "**Primary Values**" of PCS-9705 (Dual bays).

8.2.2.2 Secondary Values

No.	Sign	Description
1	*YYYY*.Ia_Sec	The secondary values of three-phase current.
2	*YYYY*.Ib_Sec	
3	*YYYY*.Ic_Sec	
4	*YYYY*.IN_Sec	The secondary value of the residual current. If [Cur3P.Opt_IN] =0, it is the secondary value of the residual current input. If [Cur3P.Opt_IN] =1, it is the residual current calculated depending on the vector summation of *YYYY*.I_a_Sec, *YYYY*.I_b_Sec and *YYYY*.I_c_Sec (i.e.: *YYYY*.IN_Sec = *YYYY*.I_a_Sec + *YYYY*.I_b_Sec + *YYYY*.I_c_Sec). Access path of [Cur3P.Opt_IN] is: "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**FUN Settings**". Please refer to *Section 7.6* for more details.
5	*YYYY*.Ua_Sec	The secondary values of three-phase voltage.
6	*YYYY*.Ub_Sec	
7	*YYYY*.Uc_Sec	
8	*YYYY*.U1_Sec	The secondary value of the positive-sequence voltage.
9	*YYYY*.U2_Sec	The secondary value of the negative-sequence voltage.

No.	Sign	Description
10	*YYYY*.UN_Sec	The secondary value of the residual voltage. If [Vol3P.Opt_UN] =0, it is the secondary value of the residual voltage input. If [Vol3P.Opt_UN] =1, it is the residual voltage calculated depending on the vector summation of *YYYY*.U_a_Sec, *YYYY*.U_b_Sec and *YYYY*.U_c_Sec (i.e.: *YYYY*.UN_Sec = *YYYY*.U_a_Sec + *YYYY*.U_b_Sec + *YYYY*.U_c_Sec). Access path of [Vol3P.Opt_UN] is: "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**FUN Settings**". Please refer to *Section 7.6* for more details.
11	*YYYY*.Uab_Sec	The secondary values of 3 phase-to-phase voltages.
12	*YYYY*.Ubc_Sec	
13	*YYYY*.Uca_Sec	
14	*YYYY*.Usyn_Sec	The secondary value of the incoming voltage for CB RSYN check.
15	*YYYY*.f	The reference side frequency which is often applied in synchronism-check for closing CB.
16	*YYYY*.fsyn	The incoming side frequency which is often applied in synchronism-check for closing CB.
17	*YYYY*.P_Sec	The secondary value of the active power.
18	*YYYY*.Q_Sec	The secondary value of the reactive power.
19	*YYYY*.S_Sec	The secondary value of the apparent power.
20	*YYYY*.Cos	Power factor.
21	Sum_MMXU.Ia_Sec	The secondary values of three-phase current vector summations of dual bays.
22	Sum_MMXU.Ib_Sec	
23	Sum_MMXU.Ic_Sec	
24	Sum_MMXU.P_Sec	The secondary value of the active power vector summation of dual bays.
25	Sum_MMXU.Q_Sec	The secondary value of the reactive power vector summation of dual bays.
26	Sum_MMXU.S_Sec	The secondary value of the apparent power vector summation of dual bays.
27	Sum_MMXU.Cos	Power factor of power vector summation of dual bays.
28	Sum_MMXU.Iext_Sec	Terminal "13" and "14" on the AI module of PCS-9705 (Dual bays) are used to receive independent external current input. The secondary value of the independent external current is displayed as "Sum_MMXU.Iext_Sec" in the submenu "**Measurements**" -> "**Measurements3**" -> "**Secondary Values**" of PCS-9705 (Dual bays).

8.2.2.3 Primary Power

No.	Sign	Description
1	*YYYY*.Pa_Pri	The primary values of three-phase active power.
2	*YYYY*.Pb_Pri	
3	*YYYY*.Pc_Pri	
4	*YYYY*.Qa_Pri	The primary values of three-phase reactive power.
5	*YYYY*.Qb_Pri	
6	*YYYY*.Qc_Pri	
7	*YYYY*.Sa_Pri	The primary values of three-phase apparent power.
8	*YYYY*.Sb_Pri	
9	*YYYY*.Sc_Pri	
10	*YYYY*.Cosa	Three-phase power factor.
11	*YYYY*.Cosb	
12	*YYYY*.Cosc	
13	*YYYY*.P_Pri	The primary value of active power.
14	*YYYY*.Q_Pri	The primary value of reactive power.
15	*YYYY*.S_Pri	The primary value of apparent power.
16	*YYYY*.Cos	Power factor
17	Sum_MMXU.Pa_Pri	The primary values of three-phase active power vector summations of dual bays.
18	Sum_MMXU.Pb_Pri	
19	Sum_MMXU.Pc_Pri	
20	Sum_MMXU.Qa_Pri	The primary values of three-phase reactive power vector summations of dual bays.
21	Sum_MMXU.Qb_Pri	
22	Sum_MMXU.Qc_Pri	
23	Sum_MMXU.Sa_Pri	The primary values of three-phase apparent power vector summations of dual bays.
24	Sum_MMXU.Sb_Pri	
25	Sum_MMXU.Sc_Pri	
26	Sum_MMXU.Cosa	Three-phase power factor of power vector summations of dual bays.
27	Sum_MMXU.Cosb	
28	Sum_MMXU.Cosc	
29	Sum_MMXU.P_Pri	The primary value of active power vector summation of dual bays.
30	Sum_MMXU.Q_Pri	The primary value of reactive power vector summation of dual bays.
31	Sum_MMXU.S_Pri	The primary value of apparent power vector summation of dual bays.
32	Sum_MMXU.Cos	Power factor of power vector summation of dual bays.

8.2.2.4 Secondary Power

No.	Sign	Description
1	*YYYY*.Pa_Sec	The secondary values of three-phase active power.
2	*YYYY*.Pb_Sec	
3	*YYYY*.Pc_Sec	
4	*YYYY*.Qa_Sec	The secondary values of three-phase reactive power.
5	*YYYY*.Qb_Sec	
6	*YYYY*.Qc_Sec	
7	*YYYY*.Sa_Sec	The secondary values of three-phase apparent power.
8	*YYYY*.Sb_Sec	
9	*YYYY*.Sc_Sec	
10	*YYYY*.Cosa	Three-phase power factor.
11	*YYYY*.Cosb	
12	*YYYY*.Cosc	
13	*YYYY*.P_Sec	The secondary value of active power.
14	*YYYY*.Q_Sec	The secondary value of reactive power.
15	*YYYY*.S_Sec	The secondary value of apparent power.
16	*YYYY*.Cos	Power factor
17	Sum_MMXU.Pa_Sec	The secondary values of three-phase active power vector summations of dual bays.
18	Sum_MMXU.Pb_Sec	
19	Sum_MMXU.Pc_Sec	
20	Sum_MMXU.Qa_Sec	The secondary values of three-phase reactive power vector summations of dual bays.
21	Sum_MMXU.Qb_Sec	
22	Sum_MMXU.Qc_Sec	
23	Sum_MMXU.Sa_Sec	The secondary values of three-phase apparent power vector summations of dual bays.
24	Sum_MMXU.Sb_Sec	
25	Sum_MMXU.Sc_Sec	
26	Sum_MMXU.Cosa	Three-phase power factor of power vector summation of dual bays.
27	Sum_MMXU.Cosb	
28	Sum_MMXU.Cosc	
29	Sum_MMXU.P_Sec	The secondary value of active power vector summation of dual bays.
30	Sum_MMXU.Q_Sec	The secondary value of reactive power vector summation of dual bays.
31	Sum_MMXU.S_Sec	The secondary value of apparent power vector summation of dual bays.
32	Sum_MMXU.Cos	Power factor of power vector summation of dual bays.

8.2.2.5 Harmonics

No.	Sign	Description
1	*YYYY*.U_Hm01~15_Sec	The secondary value of the 1st~15th harmonic voltage.
2	*YYYY*.U_Hm01~15_Pri	The primary value of the 1st~15th harmonic voltage.

8.2.2.6 Synchrocheck

No.	Sign	Description
1	25.f_Diff	The frequency difference between reference side and incoming side for CB synchronism-check.
2	25.df/dt	The df/dt difference between reference side and incoming side for CB synchronism-check.
3	25.phi_Diff	Phase-angle difference between reference side and incoming side for CB synchronism-check.
4	25.U_Diff	The secondary voltage difference between reference side and incoming side for CB synchronism-check.
5	25.U_Diff_Pri	It is the corresponding primary value of [25.U_Diff].

8.2.2.7 DC Input Pri Val

Note!

This submenu is only valid in the PCS-9705 with DI module. Each DI module provides 8 DC analog inputs.

No.	Sign	Description
1	B*XX*.DCAI.Input01~08_Pri	The primary value of No.1~8 DC analog inputs on the AI DC module at slot *XX*.

8.2.2.8 DC Input Sec Val

Note!

This submenu is only valid in the PCS-9705 with DI module. Each DI module provides 8 DC analog inputs.

No.	Sign	Description
1	B*XX*.DCAI.Input01~08_Sec	The secondary value of No.1~8 DC analog inputs on the AI DC module at slot *XX*.

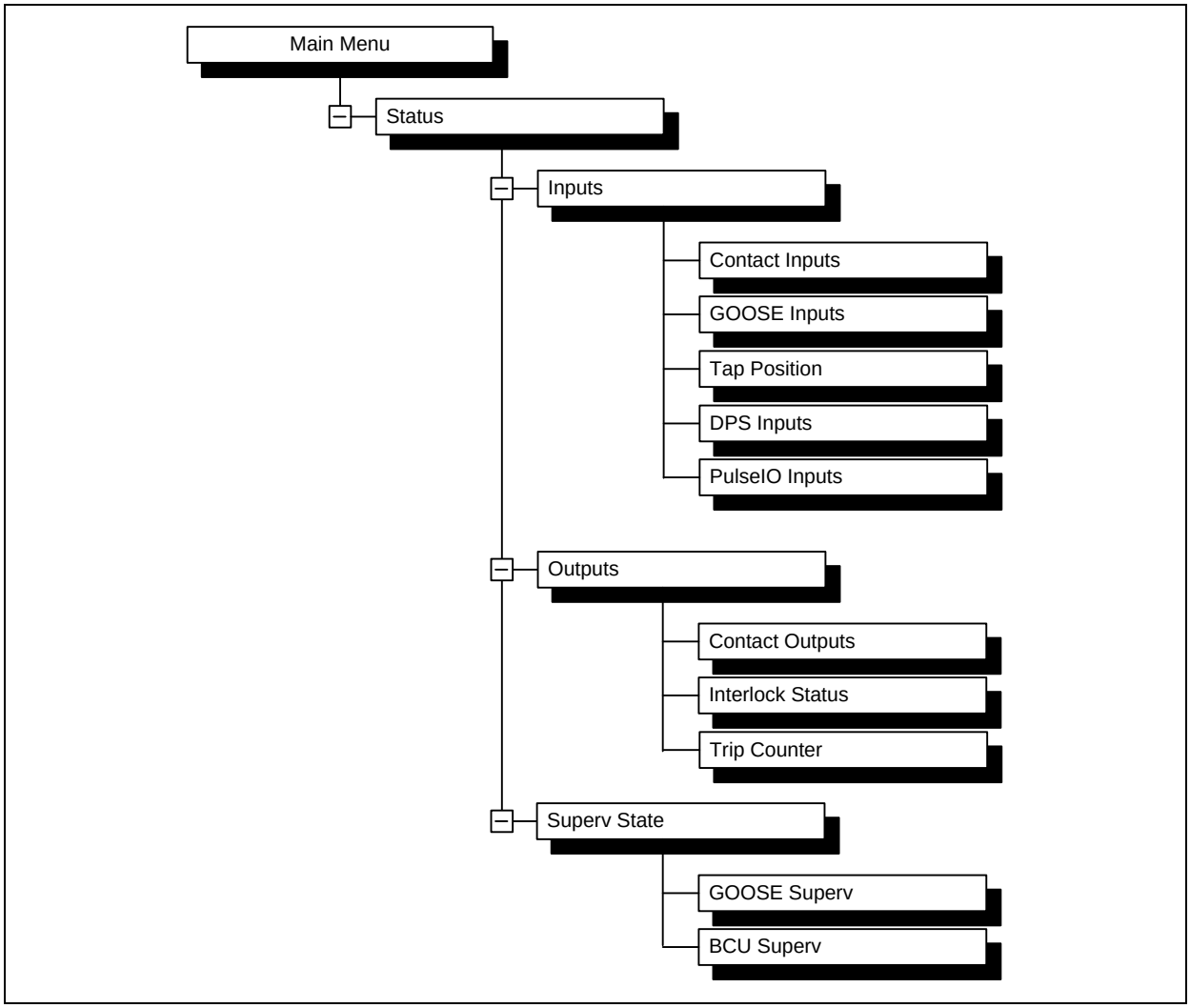
8.2.2.9 Regulation Value

Note!

This submenu is only valid in the PCS-9705 with DO module. Each DO module provides 4 DC analog outputs.

No.	Sign	Description
1	DCAO01~04.Output	No.01~04 DC analog output.

8.2.3 Status



This menu is used to display real-time input signals, output signals and alarm signals of the device. These data can help users to acquaint the device's status. This menu comprises following submenus.

Table 8.2-3 Description of "Status"

No.	Item	Function description
1	Inputs	Display all input signal states.

No.	Item	Function description
2	Outputs	Display all output signal states.
3	Superv State	Display supervision alarm states.

Table 8.2-4 Description of "Inputs"

No.	Item	Function description
1	Contact Inputs	Display states of binary inputs derived from opto-isolated channels Please refer to *Section 6.3.4* for more details.
2	GOOSE Inputs	Reserved.
3	Tap Position	Display states of tap positions. [84.Tap_Pos] is used to indicates transformer tap position.
4	DPS Inputs	[NO_DPOS01], [NC_DPOS01]… [NO_DPOS16], [NC_DPOS16], [DPOS01] …[DPOS16] are provided in this menu to display states of double position binary inputs. [NO_DPOS*XX*] indicatess normally open (abbreviated as NO) contact status of double point *XX*. (*XX*=01~16) [NC_DPOS*XX*] indicatess normally closed (abbreviated as NC) contact status of double point *XX*. [DPOS*XX*] indicatess status of double point *XX*: [DPOS*XX*]="DPS_INT": Intermediate state; [DPOS*XX*]="DPS_OFF": Open; [DPOS*XX*]="DPS_ON": Close; [DPOS*XX*]="DPS_BAD": Bad state. "DPS" is the abbreviation of "Double Point Status information".
5	PulseIO Inputs	Six inputs ([PulseIO.Sig_01]…[PulseIO.Sig_06]) are provided in this menu to display states of signal transmitted directly from SCADA by a special control command. Be compared to normal remote control command, the Select-Before-Operate (abbreviated as SBO) process is cancelled for these signals. BCU receives [PulseIO.Sig_*XX*] and configures the output pulse widths according to the "PulseIO settings"([PulseIO.t_PW_*XX*], *XX*=01~06). Access path of [PulseIO.t_PulseWidth_*XX*] is: "**MainMenu**" -> "**Settings**" -> "**BCU Settings**" -> "**PulseIO Settings**". Only IL Plug-in Module supports this kind of output.

Table 8.2-5 Description of "Outputs"

No.	Item	Function description
1	Contact Outputs	Display states of contact binary outputs.
2	Interlock Status	Display states of interlock result of each remote control. [CSWI*XX*.CILO.EnaOpn] and [CSWI*XX*.CILO.EnaCls] (*XX*=01~15) are

No.	Item	Function description
		listed in this menu. Please refer to *Section 7.2.7* for more details.
3	Trip Counter	Display trip times.

Table 8.2-6 Description of "Contact Outputs"

No.	Item	Function description
1	84.BO_EmergStop_Tap_Pos	During tap changer control process, if "running tap" occurs, transformer tap position will be out of control, and it will step up or down continuously. This device provides an output contact "BO_EmergStopTP" to issue an emergency stop command for transformer tap position control. Therefore, "running tap" can be avoided. Select-Before-Operate (abbreviated as SBO) process is cancelled here so as to stop "running tap" immediately. State of the output contact "BO_EmergStopTP" is displayed as [84.BO_EmergStop_Tap_Pos].
2	M_CSWI*XX*.BO_Sel	State "1" indicates success of selection for manual switch operation
3	M_CSWI*XX*.BO_Exec_Opn	State "1" indicates execution of manual open operation
4	M_CSWI*XX*.BO_Exec_Cls	State "1" indicates execution of manual close operation

Table 8.2-7 Description of "Interlock Status"

No.	Item	Function description
1	CSWI*XX*.CILO.EnaOpn	State "1" indicates satisfaction of all interlock logics for No.*XX* remote open
2	CSWI*XX*.CILO.EnaCls	State "1" indicates satisfaction of all interlock logics for No.*XX* remote close

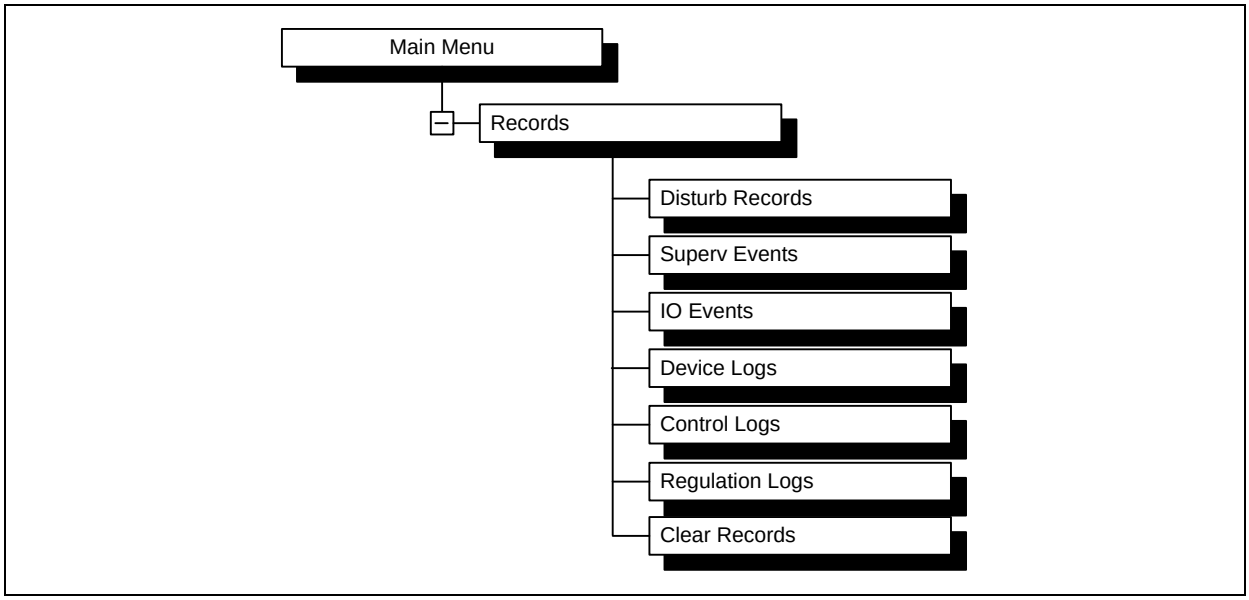
Table 8.2-8 Description of "Trip Counter"

No.	Item	Function description
1	CSWI*XX*.Trip_Counter	Trip times of the No.*XX* control output.
2	DPOS.OpCnt*XX*	State change times of the No.*XX* double position
3	CBOpCap*XX*	CBOpCap represents the physical capability of breaker. It reflects the switching energy as well as additional blocking due to some local problems. CBOpCap is always less or equal to [Max_CBOpCap] (please refer to "*Misc Settings"* in Chapter 7) and will be implemented based on CB spring charge status.

Table 8.2-9 Description of "Superv Stat"

No.	Item	Function description
1	GOOSE Superv	Display states of GOOSE self-supervision signals. Please refer to "*GOOSE Supervision Alarm Signals*" in Chapter 4 for more details.
2	BCU Superv	Display states of other self-supervision signals. Please refer to "*BCU Supervision Alarm Signals*" in Chapter 4 for more details.

8.2.4 Records

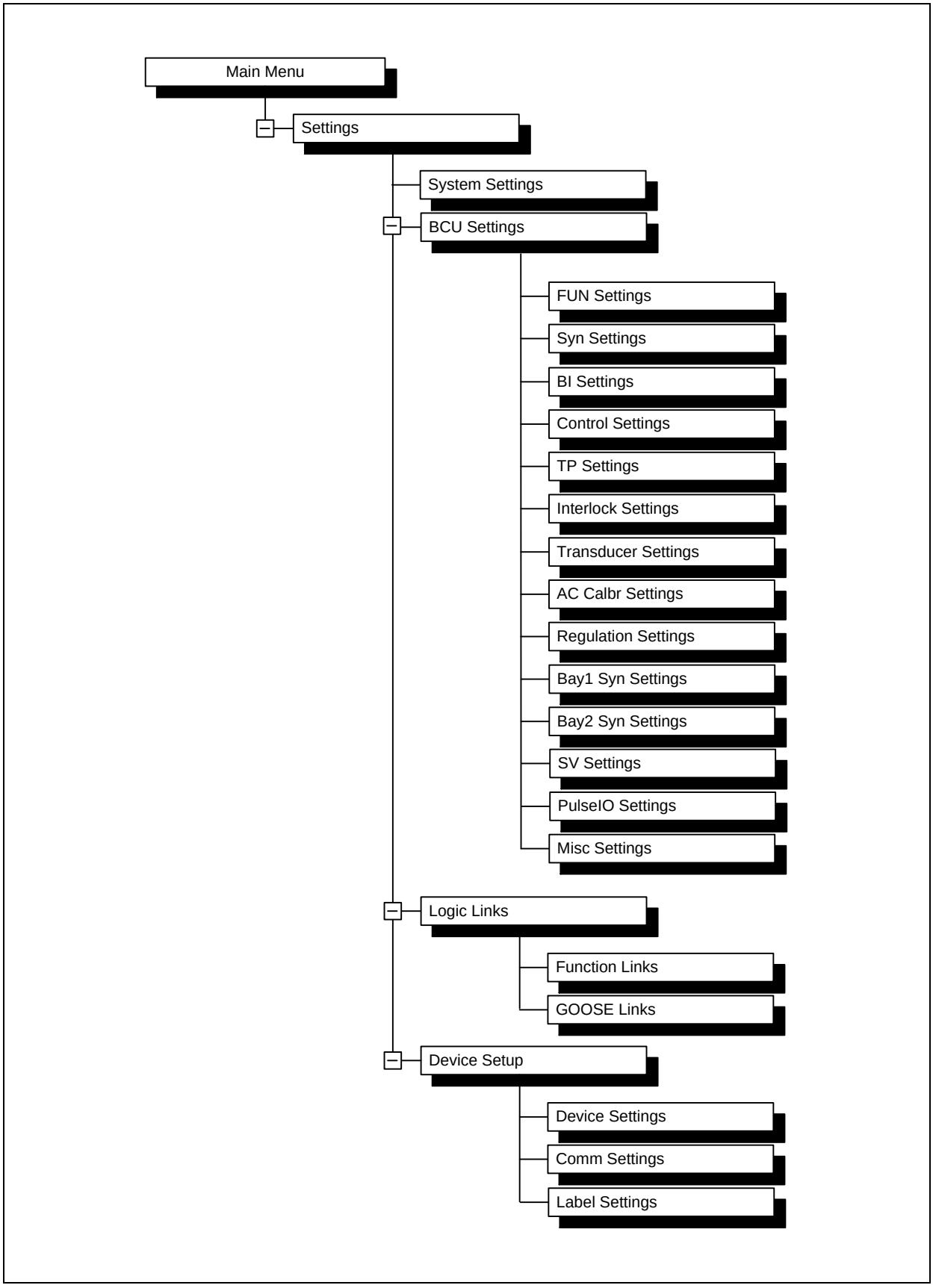


This menu is used to display all kinds of records, including the disturbance records, supervision events, binary events and device logs, so that the operator can load to view and use as the reference of analyzing accidents and repairing the device. All records are stored in non-volatile memory, it can still record them even if it loses its power.

Table 8.2-10 Description of "Records"

No.	Item	Function description
1	Disturb Records	Display disturbance records of the device.
2	Superv Events	Display supervision events of the device.
3	IO Events	Display binary events of the device.
4	Device Logs	Display device logs of the device.
5	Control Logs	Display control (binary output) logs of the device.
6	Regulation Logs	Display regulation (DC analog output) logs of the device.
7	Clear Records	Clear all records.

8.2.5 Settings



This menu comprises the following submenus.

Table 8.2-11 Description of "Settings"

No.	Item	Function description
1	System Settings	Check or modify the system parameters.
2	BCU Settings	Check or modify the measurement and control settings.
3	Logic Links	Check or modify the logic links settings, including function links and GOOSE links.
4	Device Setup	Check or modify the device setup.

Table 8.2-12 Description of "BCU Settings"

No.	Item	Function description
1	FUN Settings	Check or modify miscellaneous functional settings.
2	Syn Settings	Check or modify manual synchronism-check settings.
3	BI Settings	Check or modify binary input settings.
4	Control Settings	Check or modify control (binary output) settings.
5	TP Settings	Check or modify tap position settings.
6	Interlock Settings	Check or modify interlock settings.
7	Transducer Settings	Check or modify transducer input (DC analog input) settings.
8	AC Calbr Settings	Check or modify AC calibration settings.
9	Regulation Settings	Check or modify regulation (DC analog output) settings.
10	Bay1 Syn Settings	Check or modify manual synchronism-check settings of bay 1.
11	Bay2 Syn Settings	Check or modify manual synchronism-check settings of bay 2.
12	SV Settings	Check or modify "SV" (sampled value) settings. This menu is only used for numeric substation.
13	PulseIO Settings	Check or modify "PulseIO" settings. [PulseIO.Sig_*XX*]) is used to display state of signal transmitted from SCADA by a special control command. Compared to normal remote control command, SCADA sends a signal directly to PCS-9705, and Select-Before-Operate (abbreviated as SBO) process is cancelled here. PCS-9705 receives [PulseIO.Sig_*XX*] and configures the pulse widths according to the "PulseIO settings"([PulseIO.t_PulseWidth_*XX*]).
14	Misc Settings	Check or modify settings for switch type and operating capability.

Table 8.2-13 Description of "Logic Links"

No.	Item	Function description
1	Function Links	Check or modify function links settings.
2	GOOSE Links	Check or modify GOOSE links settings.

Table 8.2-14 Description of "Device Setup"

No.	Item	Function description
1	Device Settings	Check or modify the device settings.
2	Comm Settings	Check or modify the communication settings.
3	Label Settings	Check or modify the label settings.

8.2.6 Local Cmd

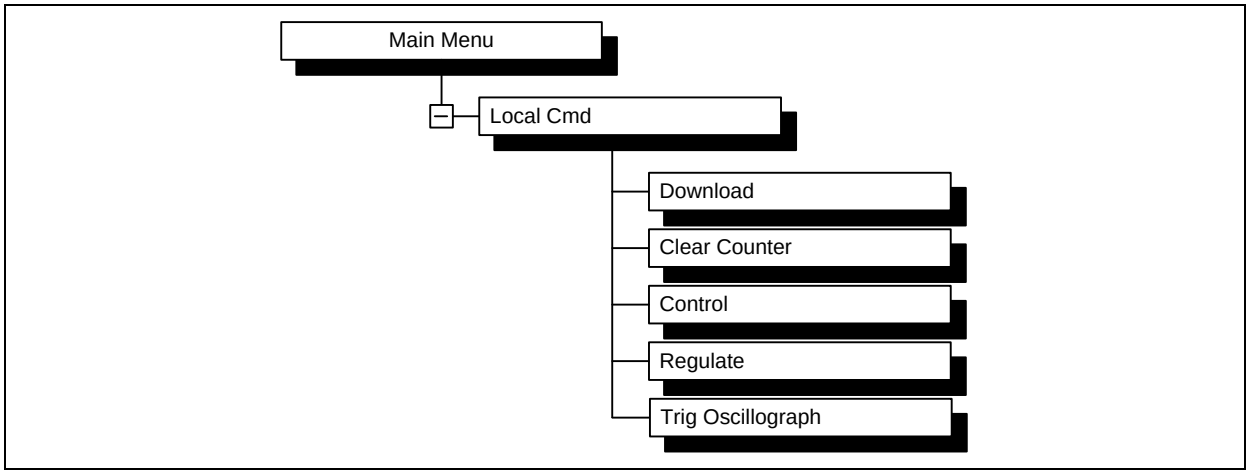
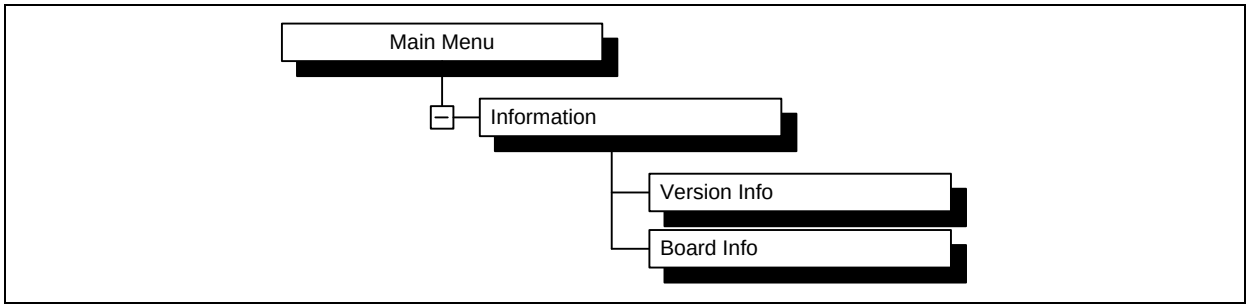


Table 8.2-15 Description of "Local Cmd"

No.	Item	Function description
1	Download	Send out the request of downloading program.
2	Clear Counter	Clear statistic data.
3	Control	Send out control command locally and manually.
4	Regulate	Send out regulate command locally and manually.
5	Trig Oscillograph	Reserved.

8.2.7 Information



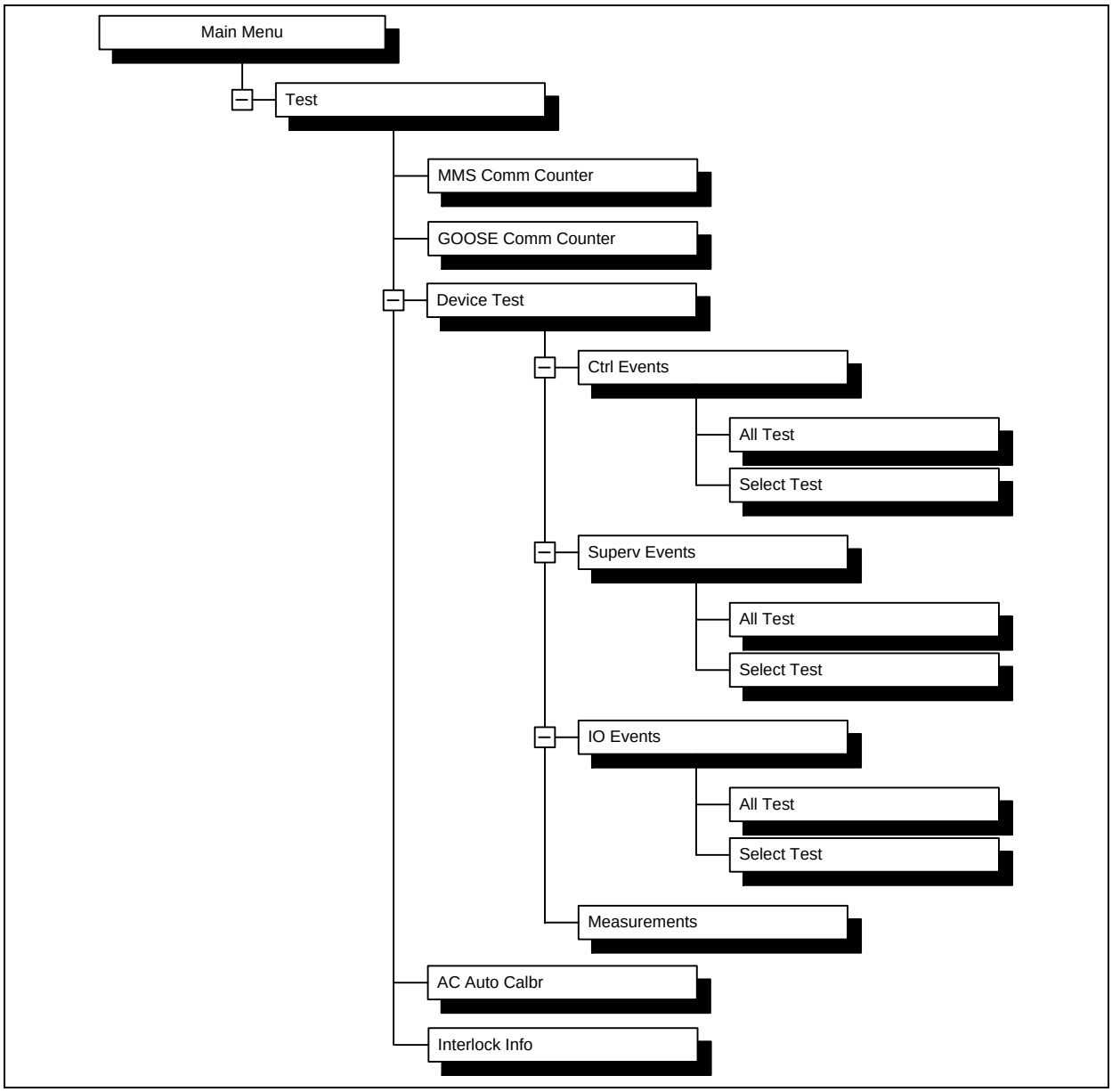
In this menu, the LCD displays software information and the configuration of all kinds of intelligent plug-in modules.

Table 8.2-16 Description of "Information"

No.	Item	Function description
1	Version Info	Display software information of DSP module, MON module and HMI

No.	Item	Function description
		module, which consists of version, creating time of software, CRC codes and management sequence number.
2	Board Info	Monitor and configure working state of each intelligent module.

8.2.8 Test



This menu is mainly used for developers to debug the program and for engineers to maintain the device.

Table 8.2-17 Description of "Test"

No.	Item	Function description
1	MMS Comm Counter	Display statistical data of MMS communication.
2	GOOSE Comm Counter	Display statistical data of GOOSE communication.

No.	Item	Function description
3	Device Test	Automatically generate all kinds of reports or events to transmit to station control or control center, including disturbance events, self-supervision events, binary events and measurements. It can realize the report uploading by different classification, as well as the uploading of all kinds of reports.
4	AC Auto Calbr	This menu consists of the parameters to adjust the accuracy of AC analog input automatically. **Note!** The function is used to maintain this device and has already been set by the manufacturer. It is strongly recommended not to adjust it.
5	Interlock Info	Reserved

Table 8.2-18 Description of "MMS Comm Counter"

No.	Item	Function description
1	Client_Exist	"Client" refers to an object which is connected to PCS-9705 via MMS., it can be a PC with PCS-Explorer tool, a gateway (e.g.: RCS-9698G/H), a station control system (e.g.: PCS-9700 HMI system). [Client_Exist]= "1": Client exists. [Client_Exist]= "0": Client does not exist.

Table 8.2-19 Description of "GOOSE Comm Counter"

No.	Item	Function description
1	N_GS_NetStorm	Times of network storm in GOOSE network.
2	N_GS_SentFail	Failure times to send data via GOOSE network.
3	N_GS_DecodeErr	Failure times to decode the received data via GOOSE network.

Table 8.2-20 Description of "Device Test"

No.	Item	Function description
1	Ctrl Events	Reserved.
2	Superv Events	Simulate and issue self-supervision events.
3	IO Events	Simulate and issue binary inputs.
4	Measurements	Simulate and issue measurements.

Note!

"All Test" means test all the items in the submenu.

"Select Test" means test selectively an item in the submenu.

8.2.9 Clock

The current time of the internal clock can be viewed and modified here.

8.2.10 Language

This menu is mainly used to set LCD display language.

8.3 LCD Display

8.3.1 Overview

Three LCD display methods are provided in this device:

1. Normal display without single line diagram (abbreviated as SLD);
2. Normal display with SLD;
3. Event display.

Note!

If LCD configuration file has been downloaded successfully to this device, SLD will be displayed in normal display. Otherwise, SLD will not be displayed. If any event is detected, the corresponding event display will pop up automatically.

If SLD is not involved in normal display, user can keep pressing "**ENT**" and then press "**ESC**" to switch between normal display (without SLD) and event display.

If SLD is involved in normal display, user can keep pressing "**ENT**" and then press "**ESC**" to switch between normal display (with SLD) and event display.

Three kinds of event display methods are provided:

1. Event display of disturbance records;
2. Event display of supervision events;
3. Event display of IO events.

Note!

Event display of disturbance records can be cleared manually in this way: keep pressing "**ESC**" and then press "**ENT**";

Event display of supervision events cannot be cleared manually, and it will not be cleared until the corresponding supervision events have disappeared;

Event display of IO events only keeps for several seconds and then it will disappear and return to normal display automatically.

8.3.2 Normal Display without SLD

After the device is energized, it takes tens of seconds to complete the initialization of this device. During the initialization of this device, the "**HEALTHY**" LED indicator of this device keeps being lit off.

An example of normal display without SLD is shown in the following figure. The LCD adopts white color as its backlight that will be activated in case of any keyboard operation. Moreover, the backlight will be extinguished automatically if no keyboard operation is detected for duration.

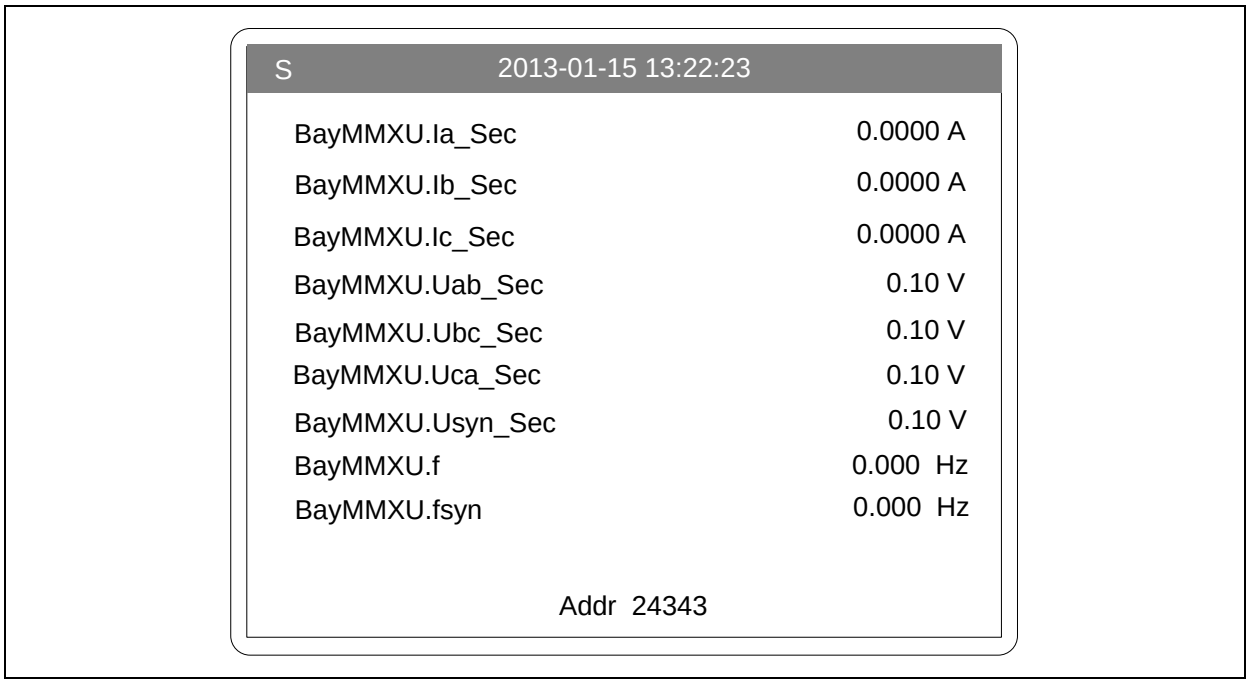


Figure 8.3-1 Normal display without SLD

S indicatess that device clock is synchronized. If "S" disappears, it means that device clock is not synchronized.

2013-01-15 13:22:23 shows current date and time of this device, the format is "yyyy-mm-dd hh:mm:ss".

BayMMXU.Ia_Sec… shows main measurements of this device. If the measurements cannot be displayed in one page, they will be displayed in several pages alternately.

Addr 24343 shows address relevant to IP address of Ethernet A. If IP address of Ethernet A is "xxx.xxx.a.b", the displayed address equals to (a×256+b). E.g.: if IP address of Ethernet A is "198.087.095.023", the displayed address will be "95×256+23=24343".

8.3.3 Normal Display with SLD

An example of normal display with SLD is shown in the following figure. LCD configuration file can be downloaded to this device via network. Control operation through SLD is also supported.

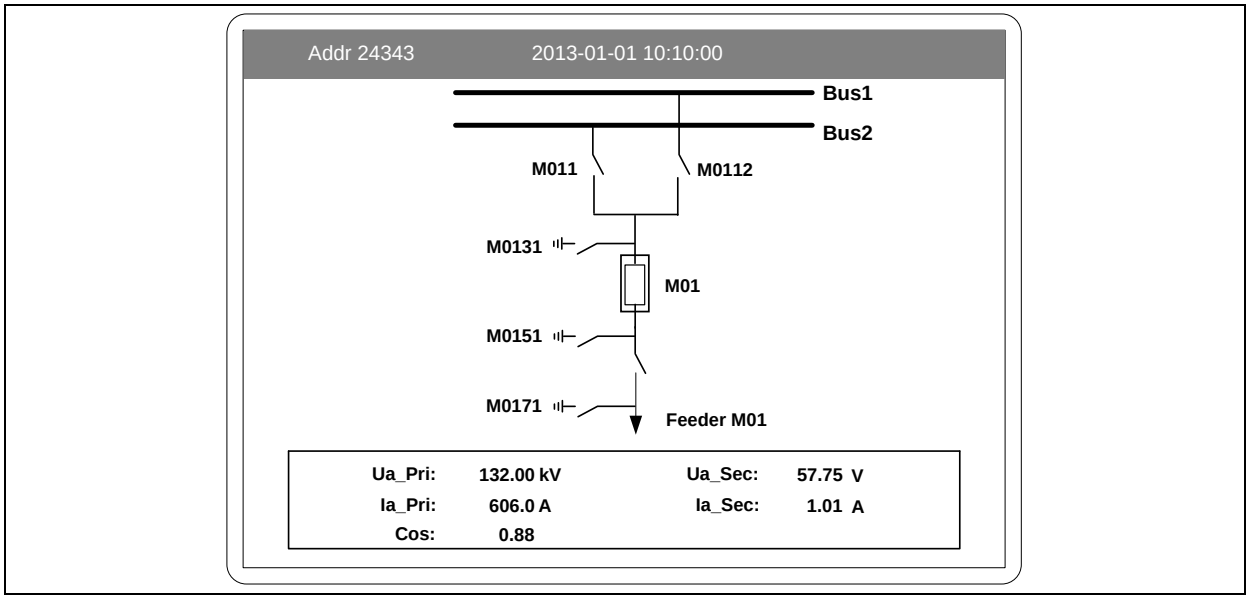


Figure 8.3-2 Normal display with SLD

Signs for the circuit breaker (abbreviated as CB) and switch (DS or ES) are listed in the following table.

Sign	Explanation	Sign	Explanation
	Position of CB: Open		Position of switch: Open
	Position of CB: Closed		Position of switch: Closed
	Position of CB: Intermediate state		Position of switch: Intermediate state
	Position of CB: Bad state		Position of switch: Bad state

8.3.3.1 Control via SLD

In SLD display, press "▼" continuously to select a CB/switch to be opened/closed, and then press key "**ENT**" to control selected CB/switch. The control operation window will be valid for duration after inputting correct password as shown in the following figure. The password for control operation is fixed as "111".

Please refer to "*Remote Control*" (from the 4th step) in Chapter 8 for the following steps of control.

Note!

1. SLD is neccesary for using control buttons to operate CB/switch;
2. Please make sure that the switch is on the right position "Local" when operating;

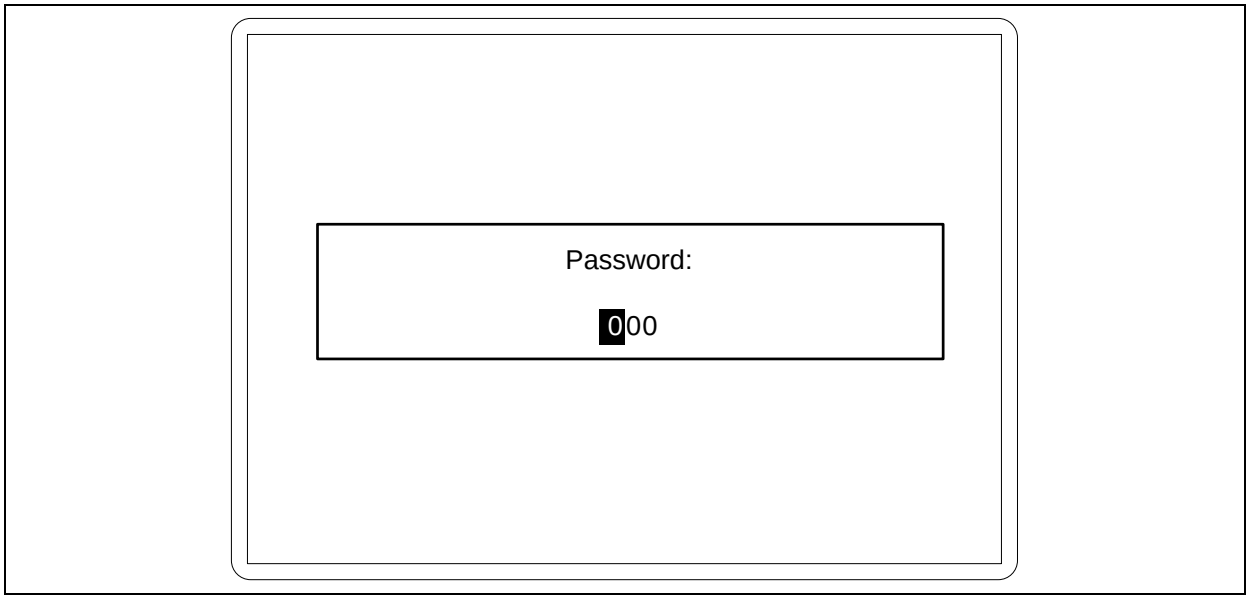


Figure 8.3-3 Password for control operation on SLD

8.3.3.2 Open/Close CB/Switch with Optionnal Control Buttons and Switches

Press key "▼" continuously to select a CB/switch to be opened/closed, and then press either of the 2 control buttons to operate the selected CB/switch. The control operation window will be valid for duration after inputting correct password. The password for control operation is fixed as "111".

Then press key "**ENT**" to confirm the operation and the control operation will be performed.

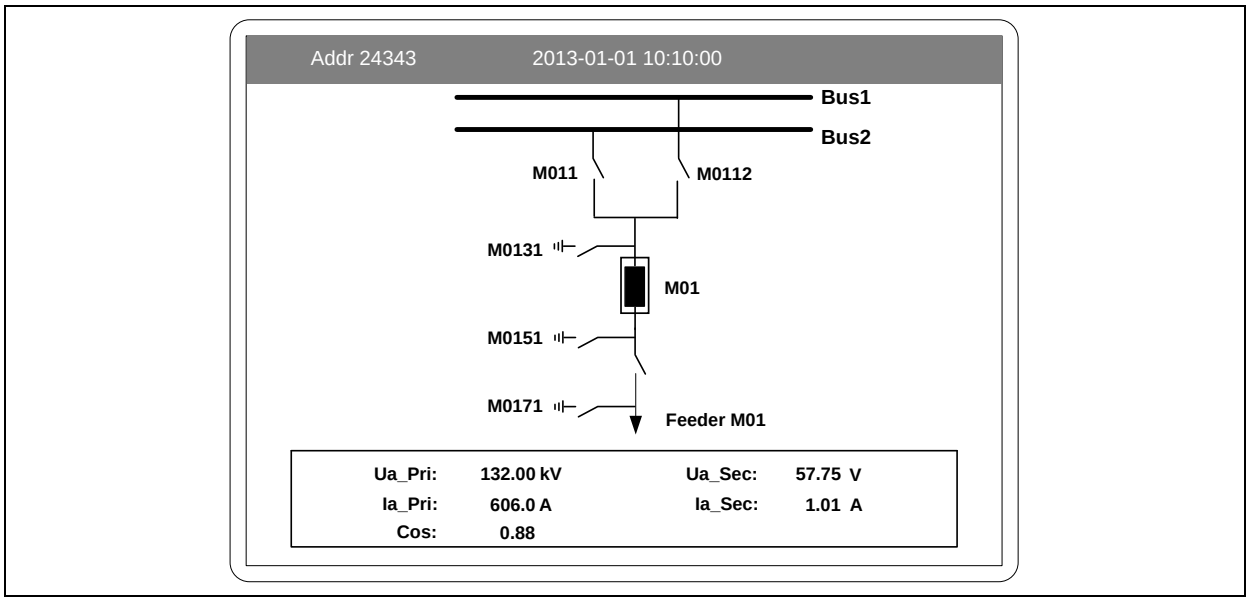


Figure 8.3-4 Open closed CB

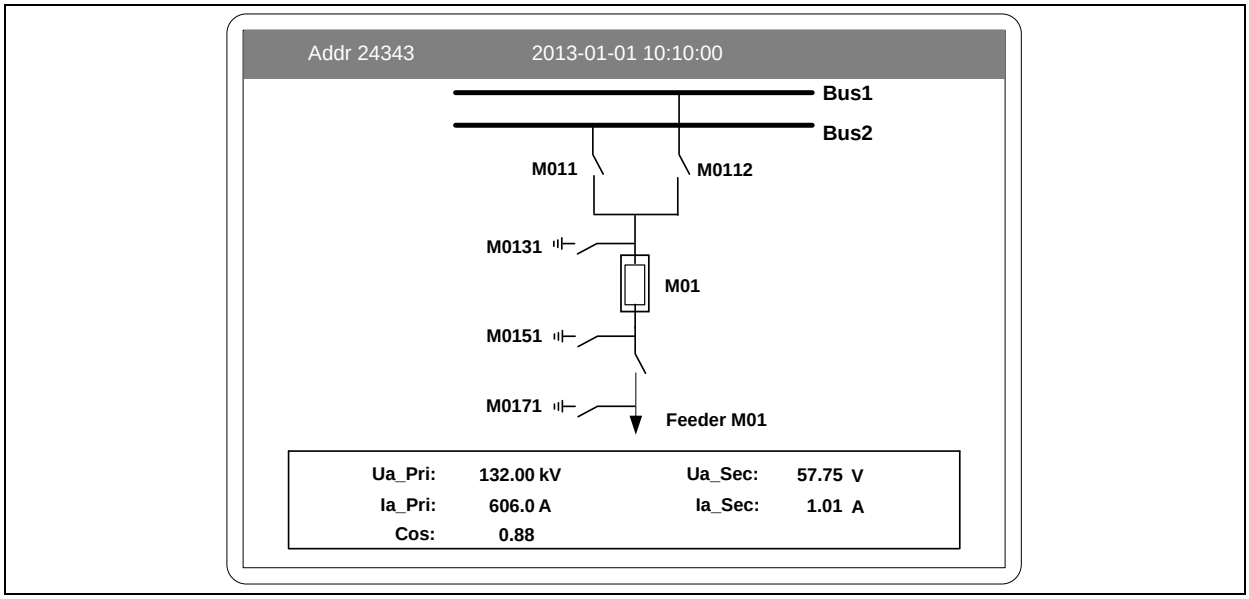


Figure 8.3-5 Close opened CB

Please refer to "*Remote Control*" (from the 4th step) in Chapter 8 for the following steps of control.

Note!

1. SLD is neccesary for using control buttons to operate CB/switch;
2. Please make sure that the switch is on the right position "Local" when operating;

8.3.4 Event Display

8.3.4.1 Display of Supervision Events

This device can store up to 1024 supervision events. During the operation of the device, the supervision event of hardware self-check errors or system operation abnormity will be displayed immediately.

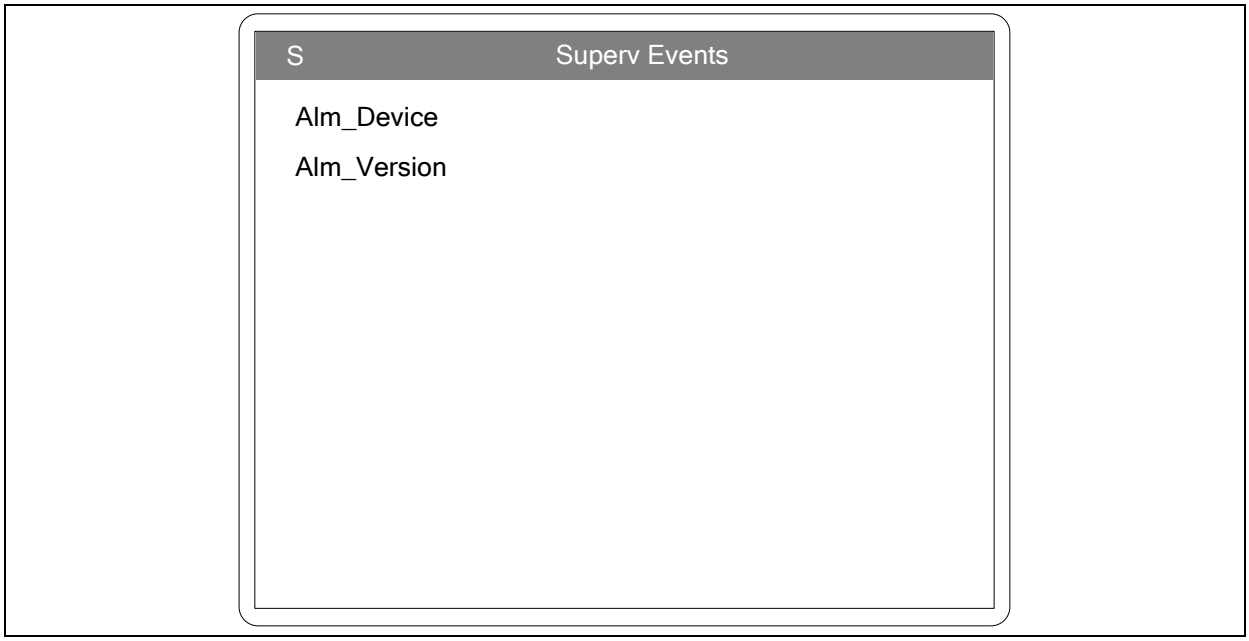


Figure 8.3-6 LCD display of supervision events

S indicatess that device clock is synchronized. If "S" disappears, it means that device clock is not synchronized.

Superv Events shows the title of the supervision events.

Alm_Device, Alm_Version shows the contents of supervision events.

8.3.4.2 Display of IO Events

This device can store up to 1024 IO events (i.e.: binary events). During the operation of the device, the binary input will be displayed once its state has changed, i.e.: from "0" to "1" or from "1" to "0".

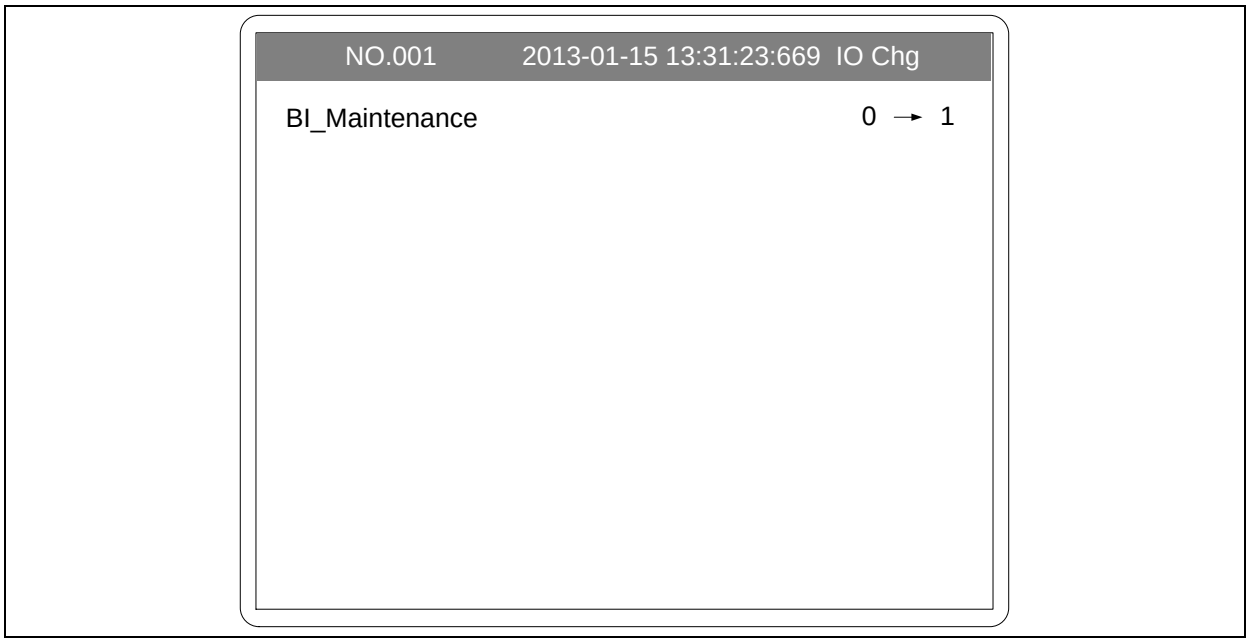


Figure 8.3-7 LCD display of IO events

NO.001	shows the No. of the binary event.
2013-01-15 13:31:23:669	shows date and time when the report occurred, the format is "yyyy-mm-dd hh:mm:ss:fff".
IO Chg	shows the title of the binary event.
BI_Maintenance 0→1	shows the state change of binary input, including binary input name, original state and final state.

8.4 Keypad Operation

8.4.1 View Device Measurements

1. Press "▲" to enter the main menu;
2. Press the "▲" or "▼" to move the cursor to the "**Measurements**" menu, and then press "**ENT**" or "►" to enter the menu;
3. Press "▲" or "▼" to move the cursor to any command menu, and then press "**ENT**" to enter the menu;
4. Press "▲" or "▼" to page up/down (if all information cannot be displayed in one display screen, one screen can display 14 lines of information at most);
5. Press "◄" or "►" to select pervious or next command menu;
6. Press "**ENT**" or "**ESC**" to exit this menu (returning to the "**Measurements**" menu);

8.4.2 View Device Status

1. Press "▲" to enter the main menu.
2. Press "▲" or "▼" to move the cursor to the "**Status**" menu, and then press "ENT" or "►" to enter the menu.
3. Press "▲" or "▼" to move the cursor to any command menu item, and then press "**ENT**" to enter the submenu.
4. Press "▲" or "▼" to page up/down (if not all information can be displayed in one display screen, one screen can display 14 lines of information at most).
5. Press "◄" or "►" to select pervious or next command menu.
6. Press "**ENT**" or "**ESC**" to exit this menu (returning to the "**Status**" menu).

8.4.3 View Device Records

1. Press "▲" to enter the main menu;
2. Press "▲" or "▼" to move the cursor to the "**Records**" menu, and then press "ENT" or "►" to enter the menu;
3. Press "▲" or "▼" to move the cursor to any command menu, and then press "ENT" to enter the menu;

4. Press "▲" or "▼" to page up/down;
5. Press "＋" or "－" to select pervious or next record;
6. Press "◄" or "►" to select pervious or next command menu;
7. Press "**ENT**" or "**ESC**" to exit this menu (returning to the "**Records**" menu).

An example of the command menu "**Device Logs**" is shown in the following figure. Displays of other command menus (for example, "**Disturb Records**") are similar.

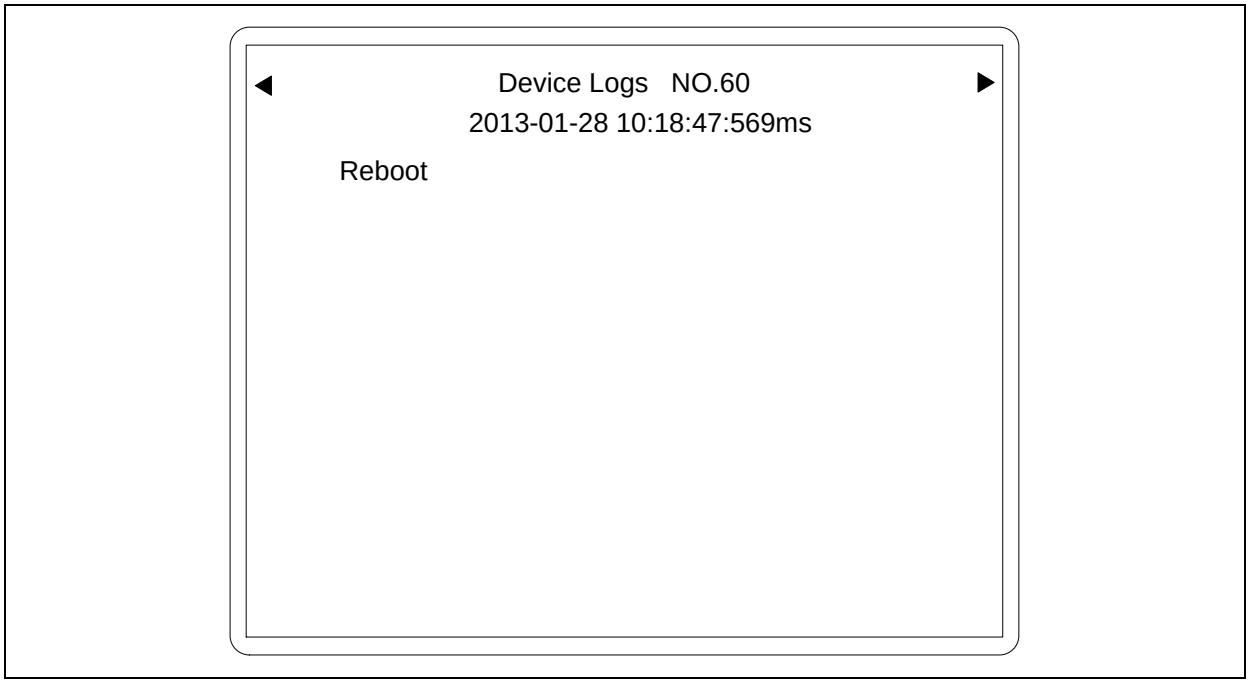


Figure 8.4-1 LCD display of "Device Logs"

Device Logs NO. 60 shows the title and the No. of the device log. This device can store up to 1024 device logs.

2013-01-28 10:18:47:569ms shows date and time when the report occurred, the format is "yyyy-mm-dd hh:mm:ss:fff".

Reboot shows the content of the device log.

Available device logs are listed in the following table.

Table 8.4-1 Available device logs

No.	Message	Description
1	Report_Cleared	All device records (except device logs) have been deleted.
2	Waveform_Cleared	All waveforms have been deleted.
3	Reboot	The device has been rebooted.
4	Settings_Chgd	Device settings have changed.
5	Process_Exit	One or more processes are out of service.

8.4.4 View Device Setting

1. Press "▲" to enter the main menu;
2. Press "▲" or "▼" to move the cursor to the "**Settings**" menu, and then press "**ENT**" or "►" to enter the menu;
3. Press "▲" or "▼" to move the cursor to any command menu, and then press "**ENT**" to enter the menu;
4. Press "▲" or "▼" to move the cursor;
5. Press "+" or "-" to page up/down;
6. Press "◄" or "►" to select pervious or next command menu;
7. Press "**ESC**" to exit this menu (returning to the menu "**Settings**").

Note!

If the displayed information exceeds 14 lines, the scrollbar will appear on the right side of the LCD to indicates the quantity of all displayed information of the command menu and the relative location of information where the current cursor is pointing at.

8.4.5 Modify Device Setting

1. Press "▲" to enter the main menu;
2. Press "▲" or "▼" to move the cursor to the "**Settings**" menu, and then press "**ENT**" or "►" to enter the menu;
3. Press "▲" or "▼" to move the cursor to any command menu, and then press "**ENT**" to enter the menu;
4. Press "▲" or "▼" to move the cursor;
5. Press "+" or "-" to page up/down;
6. Press "◄" or "►" to select pervious or next command menu;
7. Press "**ESC**" to exit this menu (returning to the menu "**Settings**");
8. If selecting the command menu "**System Settings**", move the cursor to the setting item to be modified, and then press "**ENT**".

Press "＋" or "－" to modify the value (if the modified value is of multi-bit, press "◄" or "►" to move the cursor to the digit bit, and then press "＋" or "－" to modify the value), press "**ESC**" to cancel the modification and return to the displayed interface of the command menu "**System Settings**". Press "**ENT**" to automatically exit this menu (returning to the displayed interface of the command menu "**System Settings**").

Move the cursor to continue modifying other setting items. After all setting values are modified, press "◄", "►" or "**ESC**", and the LCD will display "Save or Not?". Directly Press "**ESC**" or Press

"◄" or "►" to move the cursor. Select the "Cancel", and then press "**ENT**" to automatically exit this menu (returning to the displayed interface of the command menu "**System Settings**").

Press "◄" or "►" to move the cursor. Select "**No**" and Press "**ENT**", all modified setting item will restore to its original value, exit this menu (returning to the menu "**Settings**").

Press "◄" or "►" to move the cursor to select "**Yes**", and then press "**ENT**", the LCD will display password input interface.

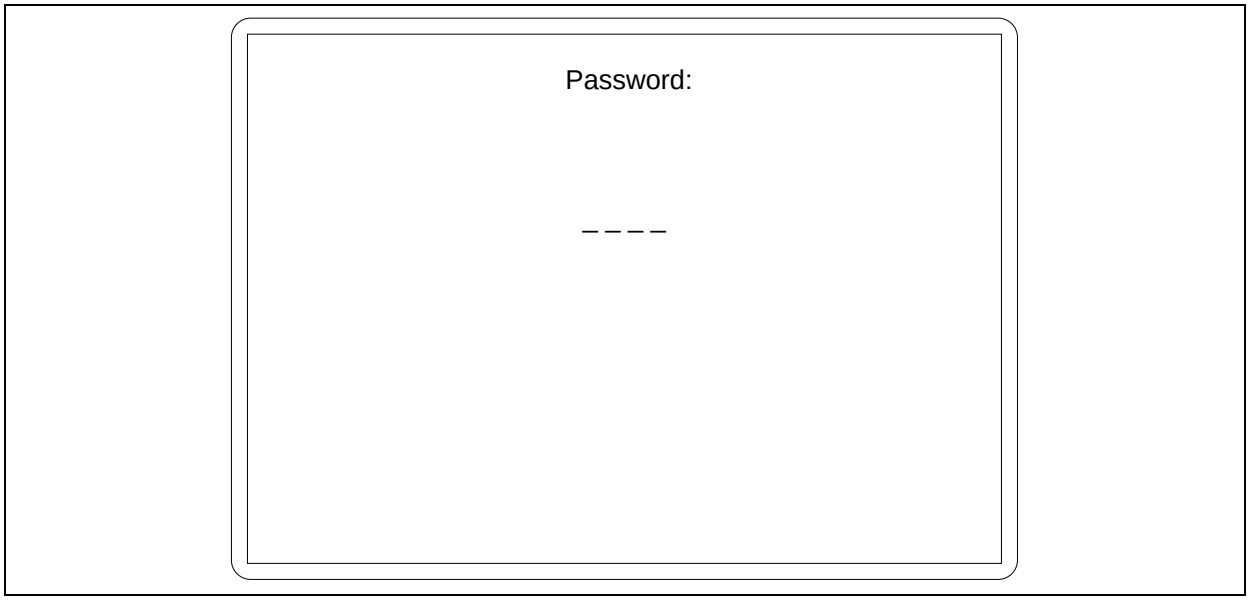


Figure 8.4-2 Password to modify settings

Input a 4-bit password ("＋", "◄", "▲" and "－"). If the password is incorrect, continue inputting it, and then press "**ESC**" to exit the password input interface and return to the displayed interface of the command menu "**System Settings**". If the password is correct, LCD will display "Save Setting …", and then exit this menu (returning to the displayed interface of the command menu "**System Settings**"), with all modified setting items as modified values.

Note!

For different setting items, their displayed interfaces are different but their modification methods are the same. The following is ditto.

Note!

After modifying settings of the device, the "**HEALTHY**" LED indicator of the device will be off, and the device will automatically restart and re-check them. If the check does not pass, the device will be blocked.

8.4.6 Delete Device Records

1. Exit the main menu;
2. Press "＋", "－", "＋", "－" and "**ENT**"; Press "**ESC**" to exit this menu (returning to the original

state). Press "**ENT**" to carry out the deletion.

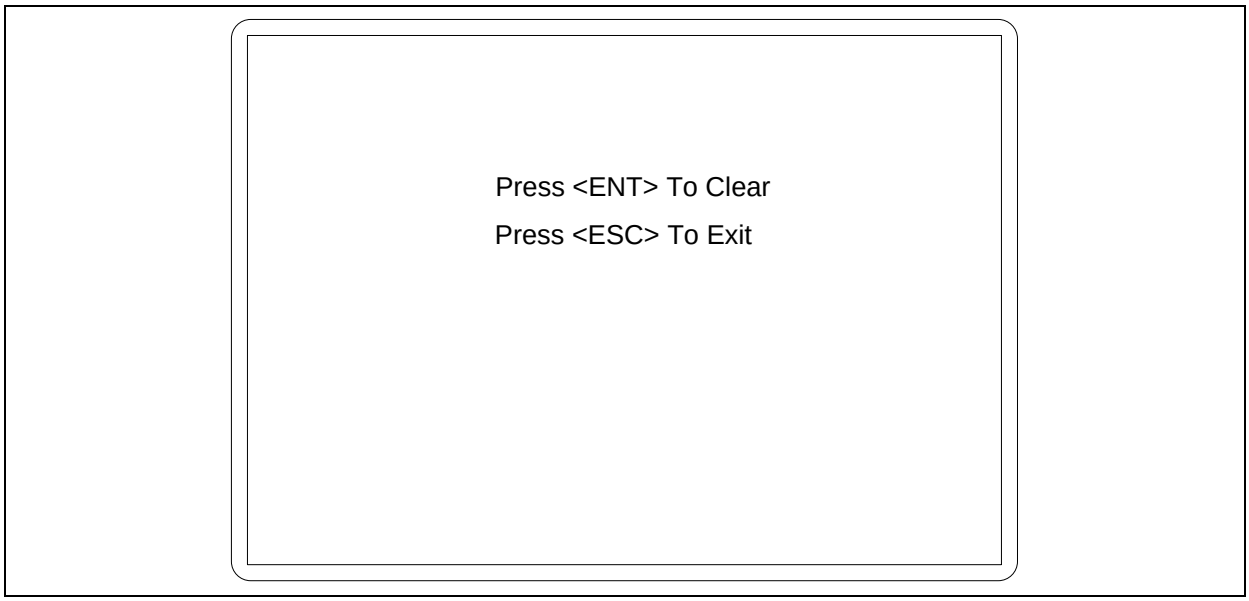


Figure 8.4-3 Confiormation to delete records

Note!

The operation of deleting device message will delete all messages saved by the device, including disturbance records, supervision events, IO events, but not including device logs. Furthermore, the message is irrecoverable after deletion, so the application of the function shall be cautious.

8.4.7 Remote Control

1. Press "▲" to enter the main menu.
2. Press "▲" or "▼" to move the cursor to the command menu "**Local Cmd**", and then press "**ENT**" to enter submenus. Press "▲" or "▼" to move the cursor to the command menu "**Control**", and then press "**ENT**" to enter the password.
3. Input a 3-bit password ("111"). If the password is incorrect, continue inputting it, and then press "**ESC**" to exit the password input interface and return to the displayed interface of the command menu "**Control**". If the password is correct, it will go to the following step.
4. Press "▲" or "▼" to move the cursor to the control object and press "**ENT**" to select the control object.
5. Press "◄" or "►" to select control command press "**ENT**" or "**ESC**" to the next/previous step.

   Three control commands are optional:

   1) Open(Lower) Remote open, or step down transformer tap position;
   2) Close (Raise) Remote close, or step up transformer tap position;
   3) (Stop) During transformer tap position control process, "Stop" is used to

send an emergency stop command to stop "running tap" immediately.

6. Press "◄" or "►" to select RSYN check mode and Press "**ENT**" or "**ESC**" to the next/previous step.

   Five RSYN check modes are optional:

   1) NoCheck Without any check
   2) SynchroCheck Synchronism-check mode
   3) DeadCheck Dead check mode
   4) LoopCheck Loop check mode
   5) EF Line Selection Reserved

7. Press "◄" or "►" to select interlock mode and Press "**ENT**" or "**ESC**" to the next/previous step.

   Two interlock check modes are optional:

   1) InterlockChk Check interlocking criteria
   2) InterlockNotChk Not check interlocking criteria.

8. Press "◄" or "►" to select control type and Press "**ENT**" or "**ESC**" to the next/previous step.

   Three control types are optional:

   1) Select Select control object
   2) Execute Execute control operation
   3) Cancel Cancel control operation

9. The result of control operation will be shown on LCD. Press "**ESC**" to return to the 7th step.

Note!

"Execute" operation must be operated after "Select" operation in manual control mode.

8.4.8 Modify Device Clock

1. Press "▲" to enter the main menu;
2. Press "▲" or "▼" to move the cursor to the "**Clock**" menu, and then press "**ENT**" to enter clock display
3. Press "▲" or "▼" to move the cursor to the date or time to be modified;
4. Press "+" or "-" to modify value, and then press "**ENT**" to save the modification and return to the main menu;
5. Press "**ESC**" to cancel the modification and return to the main menu.

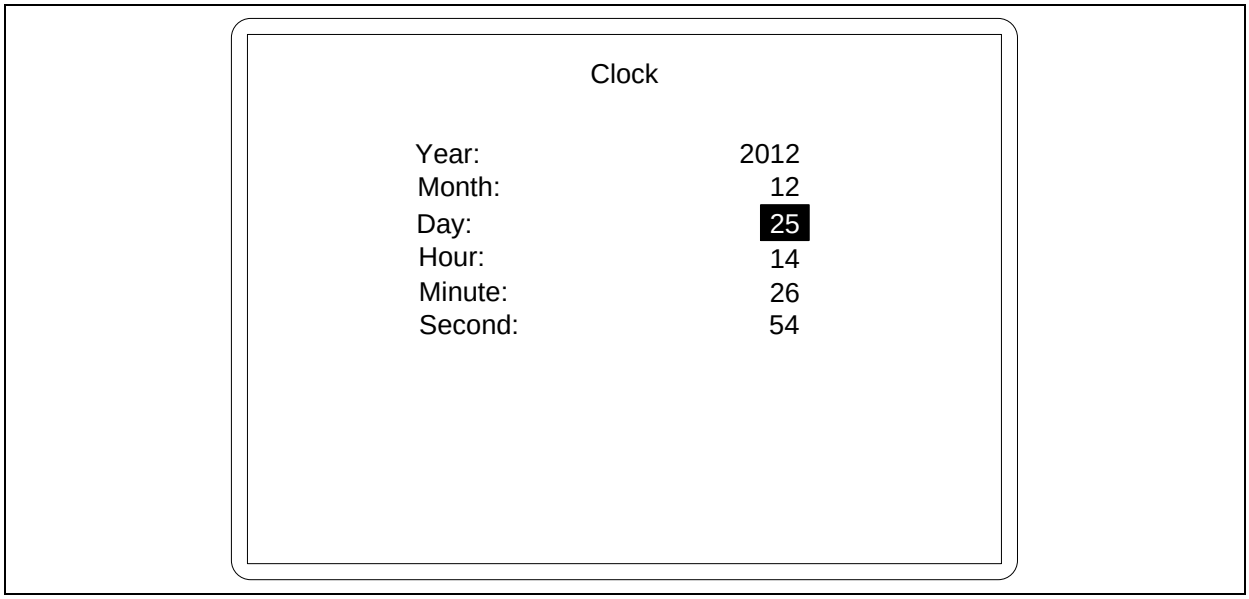


Figure 8.4-4 Modification of device time

8.4.9 Modify Module Information

1. Press "▲" to enter the main menu.
2. Press "▲" or "▼" to move the cursor to the "**Information**" menu, and then press "**ENT**" or "►" to enter the menu.
3. Press "▲" or "▼" to move the cursor to the command menu "**Board Info**", and then press "**ENT**" to enter the menu.
4. Press "▲" or "▼" to move the cursor to the module to modify.
5. Press "**ENT**" to modify the configuration status of the module.
6. Press "**ESC**" to enter the password. Input a 4-bit password ("＋", "◄", "▲" and "－"). If the password is incorrect, continue inputting it. If the password is correct, LCD will display " Board Config OK! Rebooting... ", and then BCU will be reset automatically.

8.4.10 Check Software Version

1. Press "▲" to enter the main menu.
2. Press "▲" or "▼" to move the cursor to the "**Information**" menu, and then press "**ENT**" to enter the submenu.
3. Press "▲" or "▼" to move the cursor to the command menu "**Version Info**", and then press "**ENT**" to display the software version.
4. Press "▲" or "▼" to check all the relative information about the software version (CRC code, management code, programme time, etc.).
5. Press "**ESC**" to return to the main menu.

8.4.11 Communication Test

1. Press "▲" to enter the main menu.
2. Press "▲" or "▼" to move the cursor to the "**Test**" menu, and then press "**ENT**" or "►" to enter the menu.
3. Press "▲" or "▼" to move the cursor to the submenu "**Device Test**", and then press "**ENT**" to enter the submenu and select test item. If "**Disturb Events**", "**Superv Events**" or "**IO Events**" is selected, two options "**All Test**" and "**Select Test**" are provided.
4. Press "▲" or "▼" to move the cursor to select the corresponding command menu "**All Test**" or "**Select Test**".
5. If selecting the "**All Test**", press "**ENT**", and the device will successively carry out all operation element message test one by one.
6. If "**Select Test**" is selected, press "**ENT**". Press "＋" or "－" to page up/down, and then press "▲" or "▼" to move the scrollbar. Move the cursor to select the corresponding item. Press "**ENT**" to execute the communication test of this item, station control or control center will receive corresponding message.

Note!

If no input operation is carried out within 60s, the communication test will exit and return to the "**Select Test**" menu automatically, at this moment, the LCD will display "Communication Test Timeout and Exiting...".

7. Press "**ESC**" to exit this menu (returning to the menu "**Select Test**"), at this moment, the LCD will display "Communication Test Exiting…".

8.4.12 Force Measurement

1. Press "▲" to enter the main menu.
2. Press "▲" or "▼" to move the cursor to the "**Test**" menu, and then press "**ENT**" or "►" to enter the menu.
3. Press "▲" or "▼" to move the cursor to the submenu "**Device Test**", and then press "**ENT**" to enter the submenu "**Measurements**".
4. Press "▲" or "▼" to select the corresponding item. Press "＋" or "－" to modify values for forcing measurement test, station control or control center will receive corresponding modified value.

Note!

The forced value will remain during the test until the exit of this menu.

If no input operation is carried out within 60s, the forcing measurement test will exit and return to the "**Measurements**" menu automatically, at this moment, the LCD will display

"Forcing Measurement Timeout and Exiting...".

5. Press "**ESC**" to exit this menu (returning to the menu "**Measurements**"), at this moment, the LCD will display "Exiting Forcing Measurement...".

8.4.13 Select Language

1. Press "▲" to enter the main menu.
2. Press "▲" or "▼" to move the cursor to the command menu "**Language**", and then press "**ENT**" to enter the menu and the following display will be shown on LCD.

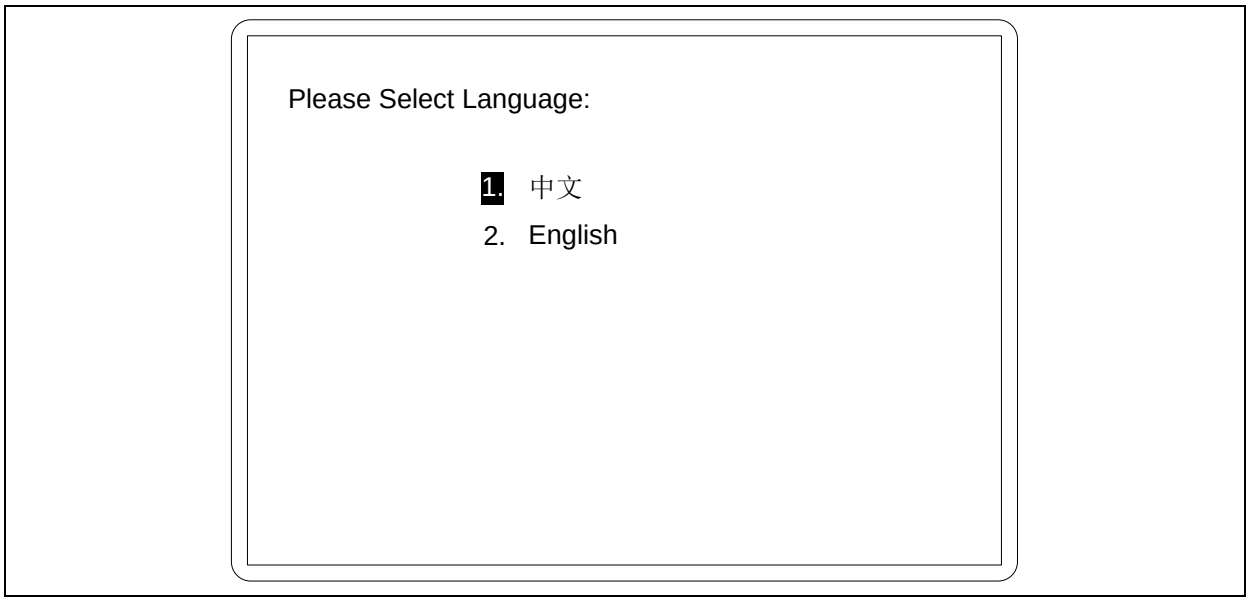


Figure 8.4-5 Selection of display language

3. Press "▲" or "▼" to move the cursor to the language user preferred and Press "**ENT**" to execute language switching. After language switching is finished, LCD will return to defaul display. Otherwise, press "**ESC**" to cancel language switching and return to the menu "**Language**".

9 Configurable Function

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9.1 Overview

Two configuration tools are designed to realize the configurable functions of PCS-9705.

1. PCS-Explorer:

   By adoption of PCS-Explorer software, it is able to make device configuration, function configuration, LCD configuration, binary input and binary output configuration, LED indicator configuration and programming interlocking logic for PCS-9705.

2. SCL Configurator:

   SCL Configurator provides inter-bay interlocking configuration function.

9.2 Configurable Function of PCS-Explorer

PCS-Explorer software is developed to meet customer's demand on functions of UAPC platform device such as device configuration and programmable design. It selects substation as the core of data management and the device as fundamental unit, supporting one substation to govern many devices. The software provides on-line and off-line functions: on-line mode: Ethernet connected with the device supporting IEC60870-5-103 and capable of uploading and downloading configuration files through Ethernet net; off-line mode: off-line setting configuration. In addition, it also supports programmable logic to meet customer's demand.

After function configuration is finished, disabled function will be hidden in the device and in setting configuration list of PCS-Explorer Software. The user can select to show or hide some setting by this way, and modify the setting vale.

Please refer to the instruction manual "*PCS-Explorer Auxiliary Software*" for details.

Functions:

1. Programmable logic (off-line function)
2. Device configuration (off-line function)
3. Function configuration (off-line function)
4. LCD configuration (off-line function)
5. LED indicators configuration (off-line function)
6. Binary signals configuration (off-line function)
7. Setting configuration (off-line & on-line function)
8. Real-time display of analogue and digital quantity of device (on-line function)
9. Display of sequence of report (SOE) (on-line function)
10. File downloading/uploading (on-line function)

9.3 Configurable Function of SCL Configurator

SCL configuration tool is developed for the engineered implementation IEC61850. It can be used to create, edit and view SCL files which conform to IEC61850-6 regulations, and then construct the substation configuration, structures, models, etc. Specially, it can be used to define the message transmitted inter-bay (useful for interlocking).

Please refer to the instruction manual "*SCL Configurator Auxiliary Software*" for details.

Functions:

1. Create the SCD file in accordance with IEC61850-6 regulations.
2. Version management of SCD files.
3. Construct different substation structures and create the complete system specification description (SSD).
4. Import IED file into ICD file which conforms to the IEC61850-6 regulations.
5. Associate different intelligent electronic devices and their logical nodes (LN) to substation details, and complete the configuration of the substation system according to the IEC61850-6 regulations.
6. Edit and maintain the functions and date elements in IED.
7. Define the substation communication (inter-device) configuration.
8. Check the data templates and handle the conflicts.
9. Standard SCL Schema Verification.
10. Expanded grammar and semantic check.

10 Communication

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10.1 Overview

This section outlines the remote communications interfaces of this device. This device supports a choice of 2 protocols via the rear communication interface (RS-485 or Ethernet), selected via the model number by setting. The protocol provided by the device can be chosen from the menu "**Settings→Device Setup→Comm Settings**".

The rear EIA RS-485 interface is isolated and is suitable for permanent connection of whichever protocol is selected. The advantage of this type of connection is that up to 32 devices can be "daisy chained" together using a simple twisted pair electrical connection.

It should be noted that the descriptions contained within this section do not aim to fully detail the protocol itself. The relevant documentation for the protocol should be referred to for this information. This section serves to describe the specific implementation of the protocol in the device.

10.2 Rear Communication Port

10.2.1 RS-485 Interface

This device provides two rear RS-485 communication ports, and each port has three terminals in the 12-terminal screw connector located on the back of the relay and each port has a ground terminal for the earth shield of the communication cable. The rear ports provide RS-485 serial data communication and are intended for use with a permanently wired connection to a remote control center.

10.2.1.1 EIA RS-485 Standardized Bus

The EIA RS-485 two-wire connection provides a half-duplex fully isolated serial connection to the product. The connection is polarized and whilst the product's connection diagrams indicate the polarization of the connection terminals it should be borne in mind that there is no agreed definition of which terminal is which. If the master is unable to communicate with the product, and the communication parameters match, then it is possible that the two-wire connection is reversed.

10.2.1.2 Bus Termination

The EIA RS-485 bus must have 120Ω (Ohm) ½ Watt terminating resistors fitted at either end across the signal wires (refer to the following figure). Some devices may be able to provide the bus terminating resistors by different connection or configuration arrangements, in which case separate external components will not be required. However, this product does not provide such a facility, so if it is located at the bus terminus then an external termination resistor will be required.

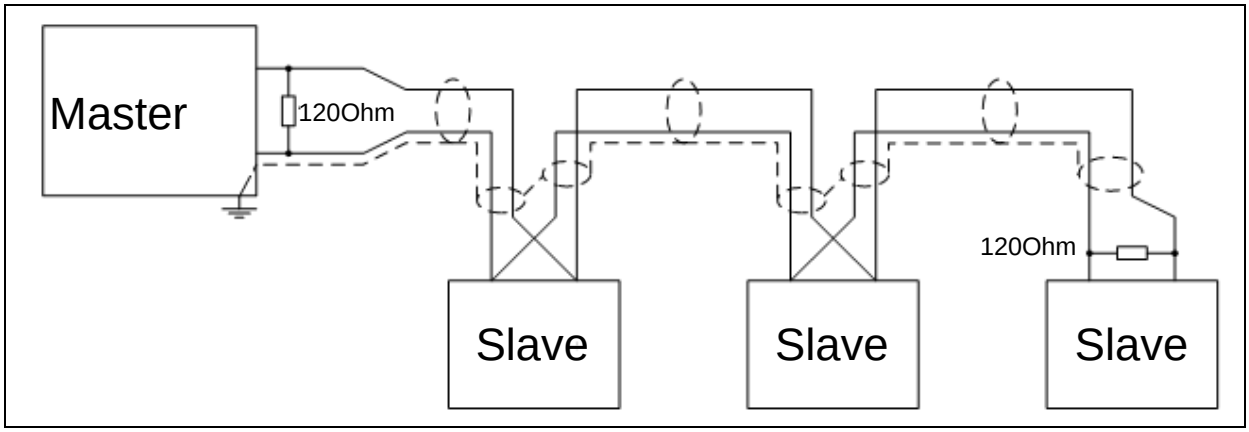

Figure 10.2-1 EIA RS-485 bus connection arrangements

10.2.1.3 Bus Connections & Topologies

The EIA RS-485 standard requires that each device be directly connected to the physical cable that is the communications bus. Stubs and tees are expressly forbidden, such as star topologies. Loop bus topologies are not part of the EIA RS-485 standard and are forbidden by it.

Two-core screened cable is recommended. The specification of the cable will be dependent on the application, although a multi-strand 0.5mm^2 per core is normally adequate. Total cable length must not exceed 500m. The screen must be continuous and connected to ground at one end, normally at the master connection point; it is important to avoid circulating currents, especially when the cable runs between buildings, for both safety and noise reasons.

This product does not provide a signal ground connection. If a signal ground connection is present in the bus cable then it must be ignored, although it must have continuity for the benefit of other devices connected to the bus. At no stage must the signal ground be connected to the cables screen or to the product's chassis. This is for both safety and noise reasons.

10.2.1.4 Biasing

It may also be necessary to bias the signal wires to prevent jabber. Jabber occurs when the signal level has an indeterminate state because the bus is not being actively driven. This can occur when all the slaves are in receive mode and the master is slow to turn from receive mode to transmit mode. This may be because the master purposefully waits in receive mode, or even in a high impedance state, until it has something to transmit. Jabber causes the receiving device(s) to miss the first bits of the first character in the packet, which results in the slave rejecting the message and consequentially not responding. Symptoms of these are poor response times (due to retries), increasing message error counters, erratic communications, and even a complete failure to communicate.

Biasing requires that the signal lines be weakly pulled to a defined voltage level of about 1V. There should only be one bias point on the bus, which is best situated at the master connection point. The DC source used for the bias must be clean; otherwise, noise will be injected. Note that some devices may (optionally) be able to provide the bus bias, in which case external components will not be required.

Note!

It is extremely important that the 120Ω termination resistors be fitted. Failure to do so will result in an excessive bias voltage that may damage the devices connected to the bus.

As the field voltage is much higher than that required, NR cannot assume responsibility for any damage that may occur to a device connected to the network because of incorrect application of this voltage.

Ensure that the field voltage is not being used for other purposes (i.e. powering logic inputs) as this may cause noise to be passed to the communication network.

10.2.2 Ethernet Interface

This device can provide four rear Ethernet interfaces (optional) and they are unattached each other. Parameters of each Ethernet port can be configured in the menu "**Settings→Device Setup→Comm Settings**".

10.2.2.1 Ethernet Standardized Communication Cable

It is recommended to use twisted shielded eight-core cable as the communication cable. A picture is shown below.

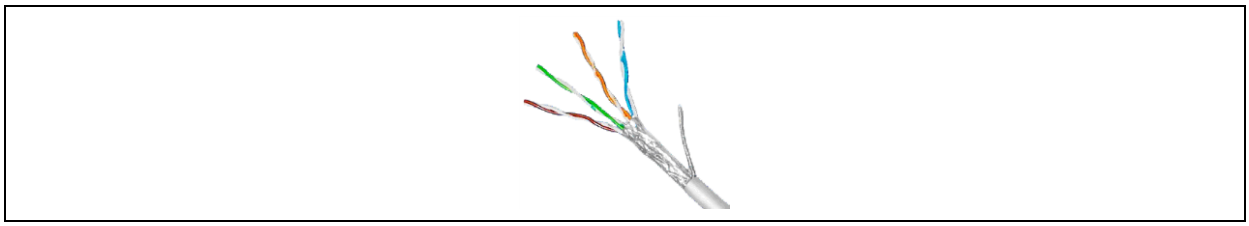

Figure 10.2-2 Ethernet communication cable

10.2.2.2 Connections and Topologies

Each equipment is connected with an exchanger via communication cable, and thereby it forms a star structure network. Dual-network is recommended in order to increase reliability. SCADA is connected to the exchanger and will play a role as master station, other equipment connected to the exchanger will play a role as slave unit.

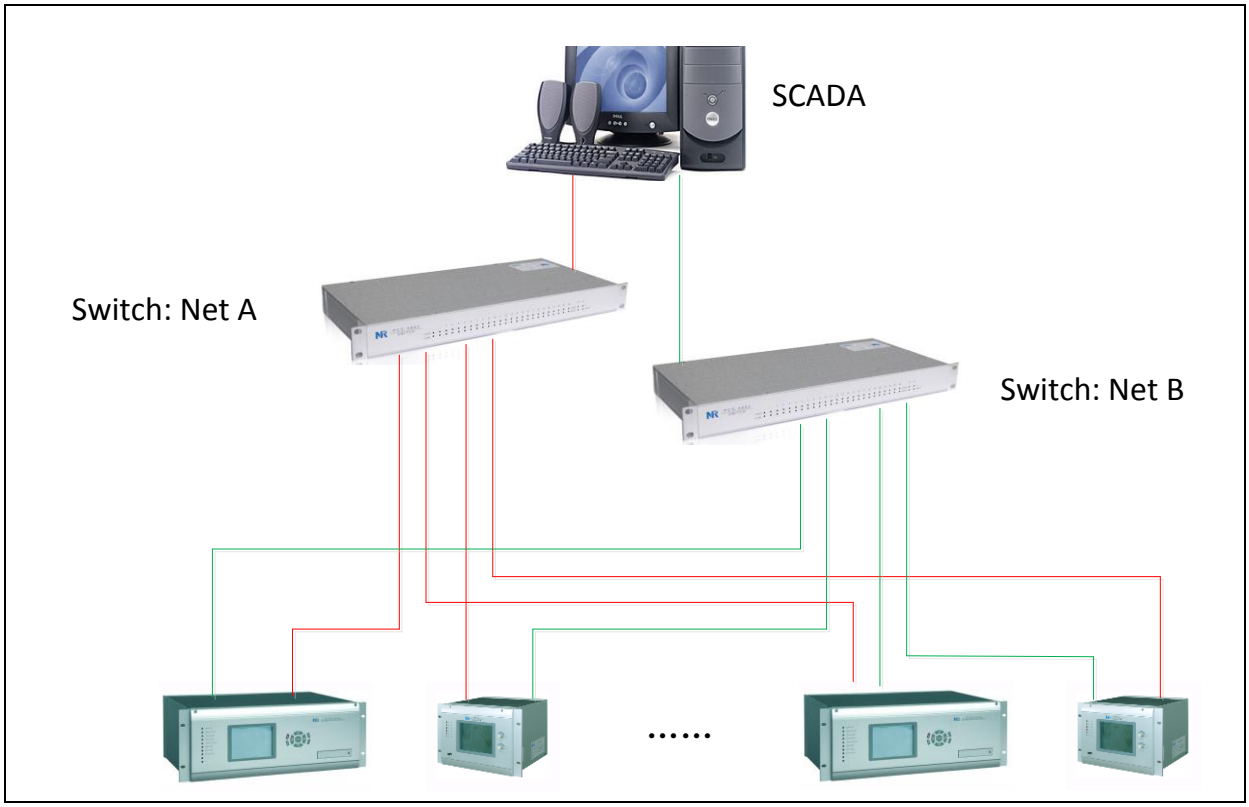

Figure 10.2-3 Ethernet communication structure

10.3 Message Description for IEC61850 Protocol

10.3.1 Overview

The IEC61850 software module is adopted in the device.

The IEC61850 standard is the result of years of work by electric utilities and vendors of electronic equipment to produce standardized communications systems. IEC61850 is a series of standards describing client/server and peer-to-peer communications, substation design and configuration, testing, environmental and project standards. The complete set includes:

1. IEC 61850-1: Introduction and overview
2. IEC 61850-2: Glossary
3. IEC 61850-3: General requirements
4. IEC 61850-4: System and project management
5. IEC 61850-5: Communications and requirements for functions and device models
6. IEC 61850-6: Configuration description language for communication in electrical substations related to IEDs
7. IEC 61850-7-1: Basic communication structure for substation and feeder equipment–Principles and models

8. IEC 61850-7-2: Basic communication structure for substation and feeder equipment - Abstract communication service interface (ACSI)
9. IEC 61850-7-3: Basic communication structure for substation and feeder equipment– Common data classes
10. IEC 61850-7-4: Basic communication structure for substation and feeder equipment– Compatible logical node classes and data classes
11. IEC 61850-8-1: Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3
12. IEC 61850-9-1: Specific Communication Service Mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link
13. IEC 61850-9-2: Specific Communication Service Mapping (SCSM) – Sampled values over ISO/IEC 8802-3
14. IEC 61850-10: Conformance testing

These documents can be obtained from the IEC (http://www.iec.ch). It is strongly recommended that all those involved with any IEC61850 implementation obtain this document set.

10.3.2 Communication Profiles

This device supports IEC61850 server services over TCP/IP communication protocol stacks. The TCP/IP profile requires this device to have an IP address to establish communications. These addresses are located in the submenu "**Settings→Device Setup→Comm Settings**".

1. MMS protocol

IEC61850 specifies the use of the Manufacturing Message Specification (MMS) at the upper (application) layer for transfer of real-time data. This protocol has been in existence for a number of years and provides a set of services suitable for the transfer of data within a substation LAN environment. IEC 61850-7-2 abstract services and objects are mapped to actual MMS protocol services in IEC61850-8-1.

2. Client/server

This is a connection-oriented type of communication. The connection and communication activity is initiated and controlled by the client. Substation computers running HMI programs or SOE logging software are considered as IEC61850 clients. Substation equipment such as protection relays, meters, instrument transformers, tap changers, or bay control units are considered as IEC61850 servers.

Please note that gateways can be considered as clients and servers subject to the communication object. When retrieving data from IEDs within the substation, the gateways are considered as servers whereas transmitting data to control centers, the gateways are considered as clients.

3. Peer-to-peer

This is a non-connection-oriented, high-speed type of communication usually between substation

equipment, such as protection relays, bay control units. GOOSE is the method of peer-to-peer communication.

4. Substation configuration language (SCL)

A substation configuration language is a number of files used to describe IED configurations and communication systems according to IEC 61850-5 and IEC 61850-7. Each configured device has an IED Capability Description (ICD) file and a Configured IED Description (CID) file. The substation single line information is stored in a System Specification Description (SSD) file. The entire substation configuration is stored in a Substation Configuration Description (SCD) file. The SCD file is the combination of the following items: individual ICD files, SSD file, communication system parameters (MMS, GOOSE control block, SV control block), as well as GOOSE/SV connection relationship amongst IEDs.

10.3.3 MMS Communication Network Deployment

To enhance the stability and reliability of SAS, dual-MMS Ethernet is widely adopted. This section is applied to introduce the details of dual-MMS Ethernet technology. Generally, single-MMS Ethernet is recommended to be adopted in the SAS of 110kV and lower voltage levels, while dual-MMS Ethernet is recommended to be adopted in the SAS of voltage levels above 110kV.

Client-server mode is adopted: clients (SCADA, control center and etc.) communicate with the IEDs via MMS communication network, and the IEDs operate as the servers. IEDs are connected to clients passively, and they can interact with the clients according to the configuration and the issued command of the clients.

Three modes for dual-MMS Ethernet (abbreviated as dual-net) are provided as below.

Note!

Hereinafter, the normal operation status of net means the physical link and TCP link are both ok. The abnormal operation status of net means physical link or TCP link is broken.

1. Mode 1: Dual-net full duplex mode sharing the same RCB instance

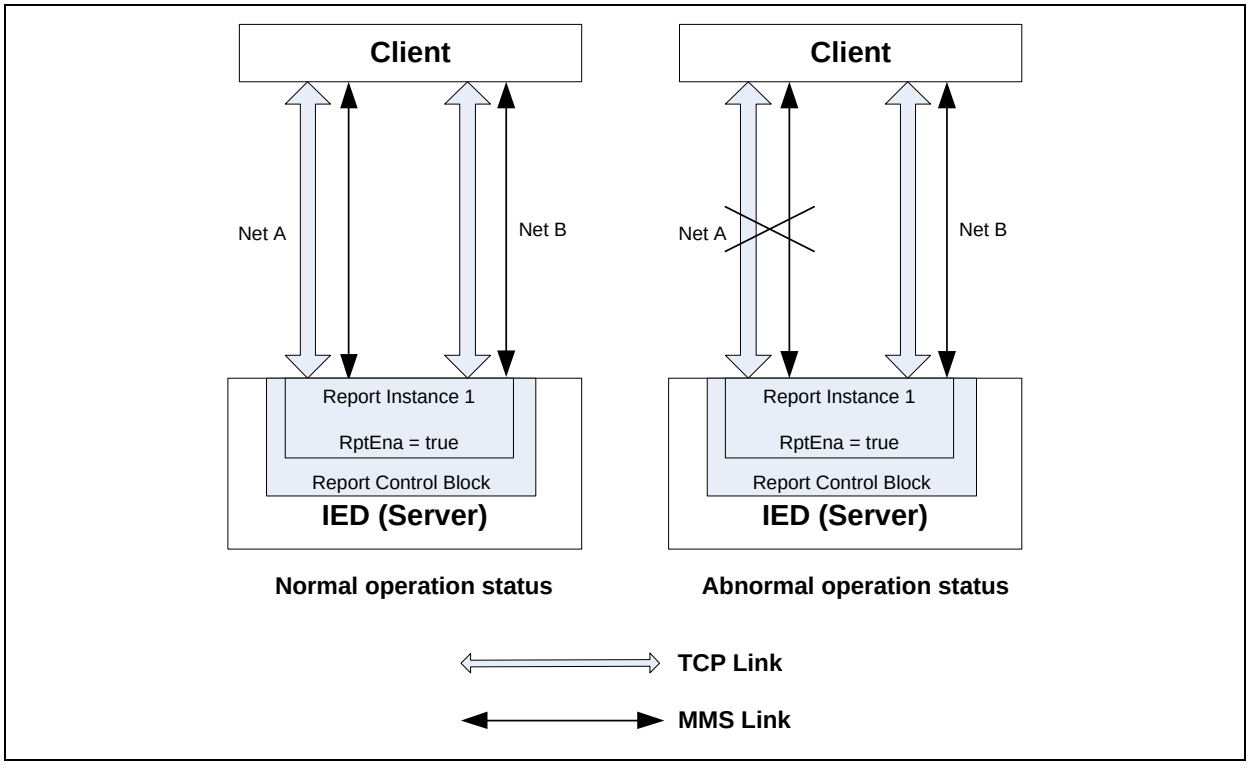

Figure 10.3-1 Dual-net full duplex mode sharing the RCB block instance

Net A and Net B share the same report control block (abbreviated as RCB) enabled by the client. IED sends undifferentiated date through dual-net to the clients. If one net is physically disconnected, the flag of RCB instance (i.e.: “RptEna” in above figure) is still “true”. Only when both Net A and Net B are disconnected, the flag of the RCB instance will automatically change to “false”.

In normal operation status of mode 1, IED provides the same MMS service for Net A and Net B. If one net is physically disconnected (i.e.: “Abnormal operation status” in above figure), the working mode will switch to single-net mode seamlessly and immediately. Network communication supervision is unnecessary here, and Buffered Report Control Block (abbreviated as BRCB) need not to be used. On the other net, date alternation works normally. Therefore, MMS service can interact normally without interruption. This mode ensures no data loss during one net is in abnormal operation status.

In mode 1, one report will be transmitted twice via dual nets for the same report instance, so the client needs to distinguish whether two reports are same according to corresponding EntryIDs.

2. Mode 2: Dual-net hot-standby mode sharing the same RCB instance

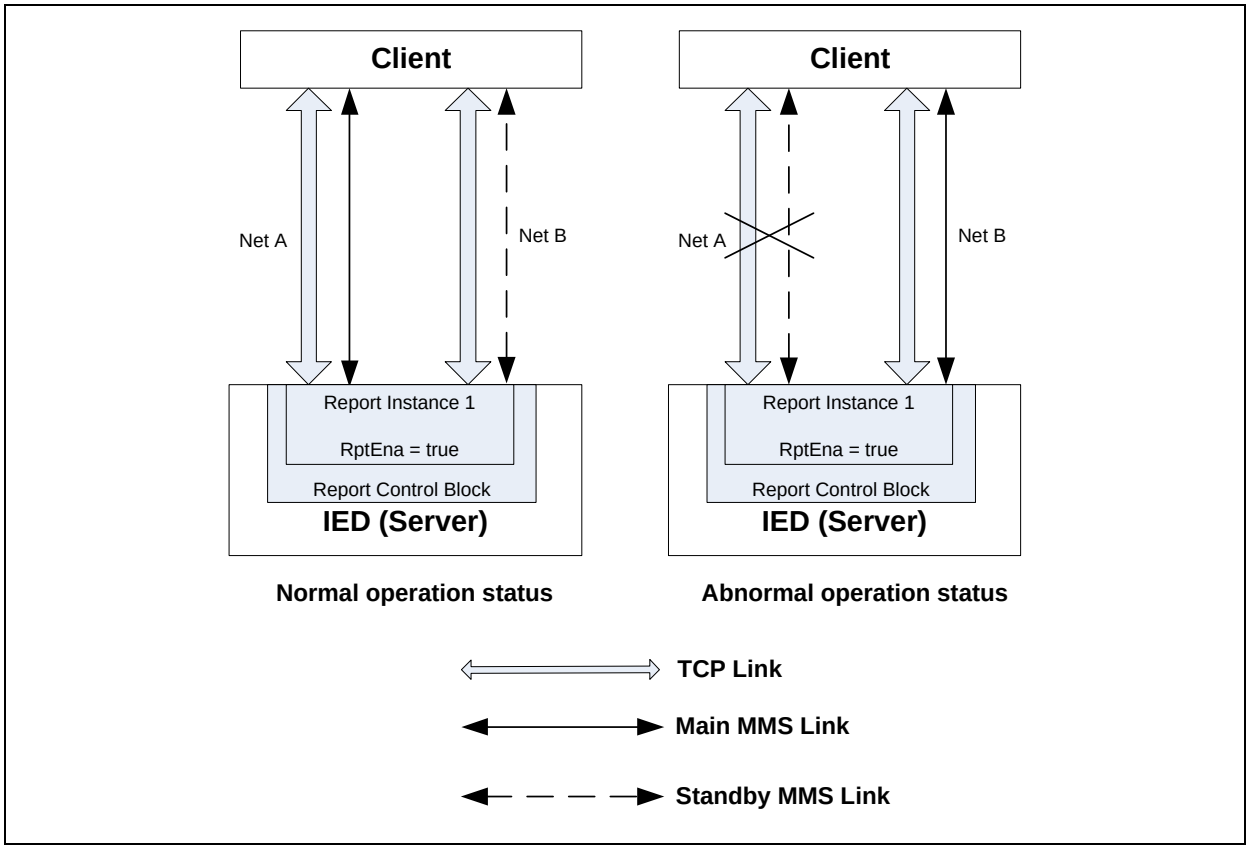

Figure 10.3-2 Dual-net hot-standby mode sharing the same RCB instance

In mode 2, the MMS service is provided on main MMS link, no MMS service interacts on the standby MMS link. The definitions of two links are as follows:

1) Main MMS Link: Physically connected, TCP level connected, MMS report service available.

2) Standby MMS Link: Physically connected, TCP level connected, MMS report service not available.

If the main net fails to operate (i.e.: “Abnormal operation status” in the above figure), the IED will set “RptEna” to “false”. Meanwhile the client will detect the failure by heartbeat message or “keep-alive”, it will automatically enable the RCB instance by setting “RptEna” back to “true” through standby MMS link. By the buffer function of BRCB, the IED can provide uninterrupted MMS service on the standby net. However, the differences of BRCB standards among different manufacturers may cause data loss. Moreover, if duration of net switch is too long, the data loss is positively as the capacity of BRCB’s buffer function is limited.

Note!

In mode 1 and mode 2, Net A IED host address and Net B IED host address must be the same. E.g.: if the subnet mask is 255.255.0.0, network prefix of Net A is 198.120.0.0, network prefix of Net B is 198.121.0.0, Net A IP address of the IED is 198.120.1.2, and then Net B IP address of the IED must be configured as 198.121.1.2, i.e.: Net A IED host address =1x256+2=258, Net B IED host address =1x256+2=258, Net A IED host address

equals to Net B IED host address.

3. Mode 3: Dual-net full duplex mode with 2 independent RCB instances

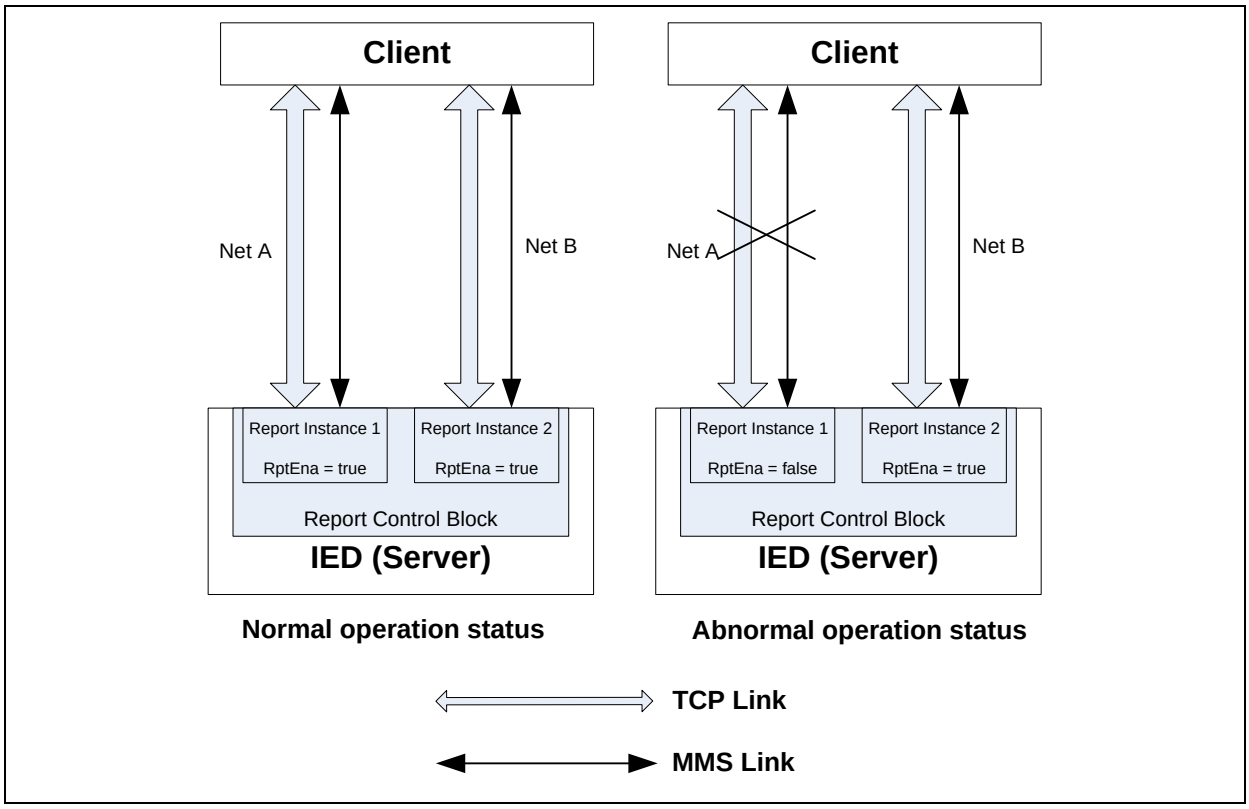

Figure 10.3-3 Dual-net full duplex mode with 2 independent RCB instances

In mode 3, IED provides 2 report instances for each RCB, Net A and Net B work independently from each other, failures of one net will not affect the other net at all.

In this mode, 2 report instances are required for each client. Therefore, the IED may be unable to provide enough report instances if there are too many clients.

Net A and Net B send the same report separately when they operates normally, To ensure no repeated data is saved into database, massive calculation is required for the client.

Moreover, accurate clock synchronization of the IED is required to distinguish whether 2 reports are the same report according to the timestamps. Clock synchronization error of the IED may lead to report loss/redundancy.

As a conclusion:

In mode 2, it is difficult to realize seamless switchover between dual nets;

In mode 3, the IED may be unable to provide enough report instances if too many clients are applied on site.

For the consideration of client treatment and IED implementation, mode 1 (Dual-net full duplex mode sharing the same report instance) is recommended for MMS communication network deployment.

10.3.4 Server Data Organization

IEC61850 defines an object-oriented approach to data and services. An IEC61850 physical device can contain one or more logical device(s) (for proxy). Each logical device can contain many logical nodes. Each logical node can contain many data objects. Each data object is composed of data attributes and data attribute components. Services are available at each level for performing various functions, such as reading, writing, control commands, and reporting.

Each IED represents one IEC61850 physical device. The physical device contains one or more logical device(s), and the logical device contains many logical nodes. The logical node LPHD contains information about the IED physical device. The logical node LLN0 contains common information about the IED logical device.

10.3.4.1 Digital Status Values

The GGIO logical node is available in this device to provide access to digital status points (including general I/O inputs and warnings) and associated timestamps and quality flags. The data content must be configured before the data can be used. GGIO provides digital status points for access by clients. It is intended that clients use GGIO in order to access digital status values from in this device. Clients can utilize the IEC61850 buffered reporting features available from GGIO in order to build **sequence of events** (abbreviated as SOE) logs and HMI display screens. Buffered reporting should generally be used for SOE logs since the buffering capability reduces the chances of missing data state changes. All needed status data objects are transmitted to HMI clients via buffered reporting, and the corresponding buffered reporting control block (abbreviated as BRCB) is defined in LLN0.

10.3.4.2 Analog Values

Most of analog measured values are available through the MMXU logical nodes, and metering values in MMTR, the others in MMXN, MSQI and so on. Each MMXU logical node provides data from an IED current/voltage “source”. There is one MMXU available for each configurable source. MMXU1 provides data from CT/VT source 1(usually for protection purpose), and MMXU2 provides data from CT/VT source 2 (usually for monitor and display purpose). All these analog data objects are transmitted to HMI clients via unbuffered reporting periodically, and the corresponding unbuffered reporting control block (URCB) is defined in LLN0. MMXUx logical nodes provide the following data for each source:

1. MMXU.MX.TotW: three-phase active power
2. MMXU.MX.TotVAr: three-phase reactive power
3. MMXU.MX.TotPF: three-phase power factor
4. MMXU.MX.Hz: frequency
5. MMXU.MX.PPV.phsAB: phase AB voltage magnitude and angle
6. MMXU.MX.PPV.phsBC: phase BC voltage magnitude and angle
7. MMXU.MX.PPV.phsCA: Phase CA voltage magnitude and angle

8. MMXU.MX.PhV.phsA: phase AG voltage magnitude and angle
9. MMXU.MX.PhV.phsB: phase BG voltage magnitude and angle
10. MMXU.MX.PhV.phsC: phase CG voltage magnitude and angle
11. MMXU.MX.A.phsA: phase A current magnitude and angle
12. MMXU.MX.A.phsB: phase B current magnitude and angle
13. MMXU.MX.A.phsC: phase C current magnitude and angle
14. MMXU.MX.A.neut: ground current magnitude and angle

10.3.4.3 LLN0 and Other Logical Nodes

Logical node LLN0 is essential for an IEC61850 based IED. This LN shall be used to address common issues for Logical Devices. In this device, most of the public services, the common settings, control values and some device oriented data objects are available here. The public services may be BRCB, URCB and GSE control blocks and similar global defines for the whole device; the common settings include all the setting items of communication settings, system settings and some of the setting items, which can be configured to 2 or more logical nodes. In LLN0, the item Loc is a device control object, this Do item indicates the local operation for complete logical device, when it is true, all the remote control commands to the IED will be blocked and those commands make effective until the item Loc is changed to false. Besides the logical nodes we describe above, there are some other logical nodes below in the IEDs.

1. MMXU: This LN shall be used to acquire values from CTs and VTs and calculate measurands such as RMS values for current and voltage or power flows out of the acquired voltage and current samples. These values are normally used for operational purposes such as power flow supervision and management, screen displays, state estimation, etc. The requested accuracy for these functions has to be provided.
2. CILO: This LN shall be used to “enable” a switching operation if the interlocking conditions are fulfilled. One instance per switching device is needed. At least all related switchgear positions have to be subscribed. The interlocking algorithm is a local issue.

   This LN is used for the interlocking function at station level and/or at bay level.

   Interlocking may be totally centralized or totally decentralized. Since the interlocking rules are basically the same on bay and station level and based on all related position indications, the different interlocking LNs may be seen as instances of the same LN class Interlocking (IL).

   1) Interlocking of switchgear at bay level

      All interlocking rules referring to a bay are included in this LN. Releases or blockings of requested commands are issued. In the case of status changes affecting interlocking, blocking commands are issued.

   2) Interlocking of switchgear at station level

      All interlocking rules referring to the station are included in this LN. Releases or blockings

of requested commands are issued. Information with the LN bay interlocking is exchanged.

3. MSQI: This LN is used for the sequences and imbalances, for example for stability purpose.

   This LN is used to acquire values from CTs and VTs and to calculate the sequences and imbalances in a three/multi-phase power system.

4. RSYN: This LN is used for synchrocheck/synchronizing or synchronism check.

   The voltage phasor difference from both sides of an open breaker is calculated and compared with predefined switching conditions (synchrocheck). Included is the case that one side is dead (example: energizing a dead line) and the case that the phasor on one side can be actively controlled by “higher” or “lower” (means synchronizing).

   Synchronizing or synchronism-check device is a device that operates when two AC circuits are within the desired limits of frequency, phase-angle and voltage, to permit or to cause the paralleling of these two circuits (IEEE C37.2-1996).

   To avoid stress for the switching device and the network, closing of the circuit breaker is allowed by the synchrocheck only, if the differences of voltage, frequency and phase angle are within certain limits.

5. YLTC: This LN is used for tap changer.

   Device allocated to YPTR allowing changing taps of the winding for voltage regulation.

6. ATCC: This LN is used for automatic tap changer control.

   This LN provides automatic function to keep the voltage of a busbar within a specific range using tap changers. This node operates the tap changer automatically according to given setpoints or by direct operator commands (manual mode).

7. LPHD: Physical device information, the logical node to model common issues for physical device.

8. GAPC: Generic automatic process control, it is used to model in a generic way the processing/automation of functions, for example the sequence control functions for this device.

9. CSWI: Switch controller. This class is used to control all switching conditions of XCBR and XSWI. A remote switching command (for example Select-Before-Operate) arrives here firstly.

10. XCBR: Breaker control. The XCBR logical node is directly associated with the breaker control feature.

11. XCBR1.ST.Pos: This is the position of the breaker. If the breaker control logic indicates that the breaker, or any single pole of the breaker, is closed, then the breaker position state is “on”. If the breaker control logic indicates that the breaker is open, then the breaker position state is “off”.

12. XCBR1.ST.BlkOpn: This is the state of the block open command logic. When true, breaker

open commands from IEC61850 clients will be rejected.

13. XCBR1.ST.BlkCls: This is the state of the block close command logic. When true, breaker close commands from IEC61850 clients will be rejected.

14. XCBR1.CO.Pos: This is where IEC61850 clients can issue open or close commands to the breaker. Select-Before-Operate (abbreviated as SBO) with enhanced security is the only supported IEC61850 control model.

10.3.5 Server Features and Configuration

10.3.5.1 Buffered/Unbuffered Reporting

IEC61850 buffered and unbuffered reporting control blocks locate in LLN0, they can be configured to transmit information of protection trip information (in the Protection logical nodes), binary status values (in GGIO) and analog measured/calculated values (in MMXU, MMTR and MSQI). The reporting control blocks can be configured in CID files, and then be sent to the IED via an IEC61850 client. The following items can be configured.

1. TrgOps: Trigger options.

The following bits are supported by this device:

- Bit 1: Data-change
- Bit 4: Integrity
- Bit 5: General interrogation

2. OptFlds: Option Fields.

The following bits are supported by this device:

- Bit 1: Sequence-number
- Bit 2: Report-time-stamp
- Bit 3: Reason-for-inclusion
- Bit 4: Data-set-name
- Bit 5: Data-reference
- Bit 6: Buffer-overflow (for buffered reports only)
- Bit 7: EntryID (for buffered reports only)
- Bit 8: Conf-revision
- Bit 9: Segmentation

3. IntgPd: Integrity period.

4. BufTm: Buffer time.

10.3.5.2 File Transfer

MMS file services are supported to allow transfer of oscillography, event record or other files from this device.

10.3.5.3 Timestamps

The Universal Time Coordinated (abbreviated as UTC) timestamp associated with all IEC61850 data items represents the latest change time of either the value or the quality flags of the data item.

10.3.5.4 Logical Node Name Prefixes

IEC61850 specifies that each logical node can have a name with a total length of 11 characters. The name is composed of:

1. A five or six-character name prefix.
2. A four-character standard name (for example, MMXU, GGIO, PIOC, etc.).
3. A one or two-character instantiation index.

Complete names are of the form xxxxxxPTOC1, where the xxxxxx character string is configurable. Details regarding the logical node naming rules are given in IEC61850 parts 6 and 7-2. It is recommended that a consistent naming convention be used for an entire substation project.

10.3.5.5 GOOSE Services

IEC61850 specifies the type of broadcast data transfer services: Generic Object Oriented Substation Events (GOOSE). IEC61850 GOOSE services provide virtual LAN (VLAN) support, Ethernet priority tagging, and Ether-type Application ID configuration. The support for VLANs and priority tagging allows for the optimization of Ethernet network traffic. GOOSE messages can be given a higher priority than standard Ethernet traffic, and they can be separated onto specific VLANs. Devices that transmit GOOSE messages also function as servers. Each GOOSE publisher contains a “GOOSE control block” to configure and control the transmission.

The GOOSE transmission (including subscribing and publishing) is controlled by GOOSE logic link settings in device.

This device supports IEC61850 Generic Object Oriented Substation Event (GOOSE) communication. All GOOSE messages contain IEC61850 data collected into a dataset. It is this dataset that is transferred using GOOSE message services. The GOOSE related dataset is configured in the CID file and it is recommended that the fixed GOOSE be used for implementations that require GOOSE data transfer between PCS-9705 series bay control units.

IEC61850 GOOSE messaging contains a number of configurable parameters, all of which must be correct to achieve the successful transfer of data. It is critical that the configured datasets at the transmission and reception devices are an exact match in terms of data structure, and that the GOOSE addresses and name strings match exactly.

10.3.6 ACSI Conformance

10.3.6.1 ACSI Basic Conformance Statement

Services		Client/ Subsrciber	Server /Publisher	PCS-9705
Client-Server Roles				
B11	Server side (of Two-party Application-Association)	—	C1	Y
B12	Client side (of Two-party Application-Association)	C1	—	N
SCSMS Supported				
B21	SCSM: IEC61850-8-1 used	Y	Y	Y
B22	SCSM: IEC61850-9-1 used	N	N	N
B23	SCSM: IEC61850-9-2 used	Y	N	Y
B24	SCSM: other	N	N	N
Generic Substation Event Model (GSE)				
B31	Publisher side	—	O	Y
B32	Subscriber side	O	—	Y
Transmission Of Sampled Value Model (SVC)				
B41	Publisher side	—	O	N
B42	Subscriber side	O	—	N

Where:

C1: Shall be "M" if support for LOGICAL-DEVICE model has been declared

O: Optional

M: Mandatory

Y: Supported by this device

N: Currently not supported by this device

10.3.6.2 ACSI Models Conformance Statement

Services		Client/Subsrciber	Server/Publisher	PCS-9705
M1	Logical device	C2	C2	Y
M2	Logical node	C3	C3	Y
M3	Data	C4	C4	Y
M4	Data set	C5	C5	Y
M5	Substitution	O	O	Y
M6	Setting group control	O	O	Y
Reporting				
M7	Buffered report control	O	O	Y

Services		Client/Subsrciber	Server/Publisher	PCS-9705
M7-1	sequence-number	Y	Y	Y
M7-2	report-time-stamp	Y	Y	Y
M7-3	reason-for-inclusion	Y	Y	Y
M7-4	data-set-name	Y	Y	Y
M7-5	data-reference	Y	Y	Y
M7-6	buffer-overflow	Y	Y	Y
M7-7	entryID	Y	Y	Y
M7-8	BufTm	N	N	N
M7-9	IntgPd	Y	Y	Y
M7-10	GI	Y	Y	Y
M8	Unbuffered report control	M	M	Y
M8-1	sequence-number	Y	Y	Y
M8-2	report-time-stamp	Y	Y	Y
M8-3	reason-for-inclusion	Y	Y	Y
M8-4	data-set-name	Y	Y	Y
M8-5	data-reference	Y	Y	Y
M8-6	BufTm	N	N	N
M8-7	IntgPd	N	Y	Y
Logging				
M9	Log control	O	O	N
M9-1	IntgPd	N	N	N
M10	Log	O	O	N
GSE				
M12	GOOSE	O	O	Y
M13	GSSE	O	O	N
M14	Multicast SVC	O	O	N
M15	Unicast SVC	O	O	N
M16	Time	M	M	Y
M17	File transfer	O	O	Y

Where:

C2: Shall be "M" if support for LOGICAL-NODE model has been declared

C3: Shall be "M" if support for DATA model has been declared

C4: Shall be "M" if support for DATA-SET, Substitution, Report, Log Control, or Time models has been declared

C5: Shall be "M" if support for Report, GSE, or SMV models has been declared

M: Mandatory

Y: Supported by this device

N: Currently not supported by this device

10.3.6.3 ACSI Services Conformance Statement

Services		Server/Publisher	PCS-9705
Server			
S1	ServerDirectory	M	Y
Application association			
S2	Associate	M	Y
S3	Abort	M	Y
S4	Release	M	Y
Logical device			
S5	LogicalDeviceDirectory	M	Y
Logical node			
S6	LogicalNodeDirectory	M	Y
S7	GetAllDataValues	M	Y
Data			
S8	GetDataValues	M	Y
S9	SetDataValues	M	Y
S10	GetDataDirectory	M	Y
S11	GetDataDefinition	M	Y
Data set			
S12	GetDataSetValues	M	Y
S13	SetDataSetValues	O	N
S14	CreateDataSet	O	N
S15	DeleteDataSet	O	N
S16	GetDataSetDirectory	M	Y
Substitution			
S17	SetDataValues	M	Y
Setting group control			
S18	SelectActiveSG	M/O	Y
S19	SelectEditSG	M/O	Y
S20	SetSGValuess	M/O	Y
S21	ConfirmEditSGValues	M/O	Y

Services		Server/Publisher	PCS-9705
S22	GetSGValues	M/O	Y
S23	GetSGCBValues	M/O	Y
Reporting			
Buffered report control block			
S24	Report	M	Y
S24-1	data-change	M	Y
S24-2	qchg-change	M	Y
S24-3	data-update	M	Y
S25	GetBRCBValues	M	Y
S26	SetBRCBValues	M	Y
Unbuffered report control block			
S27	Report	M	Y
S27-1	data-change	M	Y
S27-2	qchg-change	M	Y
S27-3	data-update	M	N
S28	GetURCBValues	M	Y
S29	SetURCBValues	M	Y
Logging			
Log control block			
S30	GetLCBValues	O	N
S31	SetLCBValues	O	N
Log			
S32	QueryLogByTime	O	N
S33	QueryLogAfter	O	N
S34	GetLogStatusValues	O	N
Generic substation event model (GSE)			
GOOSE control block			
S35	SendGOOSEMessage	M	Y
S36	GetGoReference	O	N
S37	GetGOOSEElementNumber	O	N
S38	GetGoCBValues	M	Y
S39	SetGoCBValuess	M	Y
Control			
S51	Select	O	N
S52	SelectWithValue	M	Y

Services		Server/Publisher	PCS-9705
S53	Cancel	M	Y
S54	Operate	M	Y
S55	Command-Termination	O	Y
S56	TimeActivated-Operate	O	N
File transfer			
S57	GetFile	M/O	Y
S58	SetFile	O	Y
S59	DeleteFile	O	N
S60	GetFileAttributeValues	M/O	Y
Time			
	SNTP	M	Y

10.3.7 Logical Nodes

10.3.7.1 Logical Nodes Table

This device supports IEC61850 logical nodes as indicated in the following table. Note that the actual instantiation of each logical node is determined by the product order code.

Nodes	PCS-9705
L: System Logical Nodes	
LPHD: Physical device information	**YES**
LLN0: Logical node zero	**YES**
P: Logical Nodes For Protection Functions	
PDIF: Differential	—
PDIR: Direction comparison	—
PDIS: Distance	—
PDOP: Directional overpower	—
PDUP: Directional underpower	—
PFRC: Rate of change of frequency	—
PHAR: Harmonic restraint	—
PHIZ: Ground detector	—
PIOC: Instantaneous overcurrent	—
PMRI Motor restart inhibition	—
PMSS: Motor starting time supervision	—
POPF: Over power factor	—
PPAM: Phase angle measuring	—
PSCH: Protection scheme	—

Nodes	PCS-9705
PSDE: Sensitive directional earth fault	—
PTEF: Transient earth fault	—
PTOC: Time overcurrent	—
PTOF: Overfrequency	—
PTOV: Overvoltage	—
PTRC: Protection trip conditioning	—
PTTR: Thermal overload	—
PTUC: Undercurrent	—
PTUV: Undervoltage	—
PUPF: Underpower factor	—
PTUF: Underfrequency	—
PVOC: Voltage controlled time overcurrent	—
PVPH: Volts per Hz	—
PZSU: Zero speed or underspeed	—
R: Logical Nodes For Protection Related Functions	
RDRE: Disturbance recorder function	—
RADR: Disturbance recorder channel analogue	—
RBDR: Disturbance recorder channel binary	—
RDRS: Disturbance record handling	—
RBRF: Breaker failure	—
RDIR: Directional element	—
RFLO: Fault locator	—
RPSB: Power swing detection/blocking	—
RREC: Autoreclosing	—
RSYN: Synchronism-check or synchronizing	**YES**
C: Logical Nodes For Control	
CALH: Alarm handling	—
CCGR: Cooling group control	—
CILO: Interlocking	**YES**
CPOW: Point-on-wave switching	—
CSWI: Switch controller	**YES**
G: Logical Nodes For Generic References	
GAPC: Generic automatic process control	**YES**
GGIO: Generic process I/O	**YES**
GSAL: Generic security application	—

Nodes	PCS-9705
I: Logical Nodes For Interfacing And Archiving	
IARC: Archiving	—
IHMI: Human machine interface	—
ITCI: Telecontrol interface	—
ITMI: Telemonitoring interface	—
A: Logical Nodes For Automatic Control	
ANCR: Neutral current regulator	—
ARCO: Reactive power control	—
ATCC: Automatic tap changer controller	**YES**
AVCO: Voltage control	—
M: Logical Nodes For Metering And Measurement	
MDIF: Differential measurements	—
MHAI: Harmonics or interharmonics	—
MHAN: Non phase related harmonics or interharmonic	—
MMTR: Metering	—
MMXN: Non phase related measurement	**YES**
MMXU: Measurement	**YES**
MSQI: Sequence and imbalance	**YES**
MSTA: Metering statistics	—
S: Logical Nodes For Sensors And Monitoring	
SARC: Monitoring and diagnostics for arcs	—
SIMG: Insulation medium supervision (gas)	—
SIML: Insulation medium supervision (liquid)	—
SPDC: Monitoring and diagnostics for partial discharges	—
X: Logical Nodes For Switchgear	
TCTR: Current transformer	—
TVTR: Voltage transformer	—
Y: Logical Nodes For Power Transformers	
YEFN: Earth fault neutralizer (Peterson coil)	—
YLTC: Tap changer	**YES**
YPSH: Power shunt	—
YPTR: Power transformer	—
Z: Logical Nodes For Further Power System Equipment	
ZAXN: Auxiliary network	—
ZBAT: Battery	—

Nodes	PCS-9705
ZBSH: Bushing	—
ZCAB: Power cable	—
ZCAP: Capacitor bank	—
ZCON: Converter	—
ZGEN: Generator	—
ZGIL: Gas insulated line	—
ZLIN: Power overhead line	—
ZMOT: Motor	—
ZREA: Reactor	—
ZRRC: Rotating reactive component	—
ZSAR: Surge arrestor	—
ZTCF: Thyristor controlled frequency converter	—
ZTRC: Thyristor controlled reactive component	—

10.4 IEC60870-5-103 Interface over Serial Port

The IEC60870-5-103 interface via serial port (RS-485) is a master/slave interface with the device as the slave device. It is properly developed by NR.

The device conforms to compatibility level 3.

The following IEC60870-5-103 facilities are supported by this interface:

1. Initialization (reset)
2. Time synchronization
3. Event record extraction
4. General interrogation
5. General commands
6. Disturbance records

10.4.1 Physical Connection and Link Layer

Two EIA RS-485 standardized ports are available for IEC60870-5-103 in this device. The transmission speed is optional: 4800 bit/s, 9600 bit/s, 19200 bit/s or 38400 bit/s.

The link layer strictly abides by the rules defined in the IEC60870-5-103.

10.4.2 Initialization

Whenever the device has been powered up, or if the communication parameters have been changed, a reset command is required to initialize the communications. The device will respond to

either of the two reset commands (Reset CU or Reset FCB), the difference is that the Reset CU will clear any unsent messages in the transmit buffer.

The device will respond to the reset command with an identification message ASDU 5, the COT (Cause Of Transmission) of this response will be either Reset CU or Reset FCB depending on the nature of the reset command.

10.4.3 Time Synchronization

The device time and date can be set using the time synchronization feature of the IEC60870-5-103 protocol. The device will correct for the transmission delay as specified in IEC60870-5-103. If the time synchronization message is sent as a send/confirm message then the device will respond with a confirmation. Whether the time-synchronization message is sent as a send confirmation or a broadcast (send/no reply) message, a time synchronization class 1 event will be generated/produced.

If the device clock is synchronized using the IRIG-B input then it will not be possible to set the device time using the IEC60870-5-103 interface. An attempt to set the time via the interface will cause the device to create an event with the current date and time taken from the IRIG-B synchronized internal clock.

10.4.4 Spontaneous Events

Events are categorized using the following information:

1. Type identification (TYP)
2. Function type (FUN)
3. Information number (INF)

Messages sent to substation automation system are grouped according to IEC60870-5-103 protocol. Operating elements are sent by ASDU2 (time-tagged message with relative time), and status of binary signal and alarm element are sent by ASDU1 (time-tagged message). The cause of transmission (COT) of these responses is 1.

10.4.5 General Interrogation

The GI can be used to read the status of the device, the function numbers, and information numbers that will be returned during the GI cycle. The GI cycle strictly abides by the rules defined in the IEC60870-5-103.

Refer the IEC60870-5-103 standard can get the enough details about general interrogation.

10.4.6 General Service

The generic functions can be used to read the setting and measurement of the device, and modify the setting. Two supported type identifications are ASDU 21 and ASDU 10. For more details about generic functions, see the IEC60870-5-103 standard.

10.4.7 Disturbance Records

This device can store up to eight disturbance records in its memory. A pickup of the fault detector

or an operation of the device can make the device store the disturbance records.

The disturbance records are stored in uncompressed format and can be extracted using the standard mechanisms described in IEC60870-5-103.

11 Installation

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11.1 Overview

The device must be shipped, stored and installed with the greatest care.

Choose the place of installation such that the communication interface and the controls on the front of the device are easily accessible.

Air must circulate freely around the equipment. Observe all the requirements regarding place of installation and ambient conditions given in this instruction manual.

Take care that the external wiring is properly brought into the equipment and terminated correctly and pay special attention to grounding. Strictly observe the corresponding guidelines contained in this section.

11.2 Safety Information

Modules and units may only be replaced by correspondingly trained personnel. Always observe the basic precautions to avoid damage due to electrostatic discharge when handling the equipment.

In certain cases, the settings have to be configured according to the demands of the engineering configuration after replacement. It is therefore assumed that the personnel who replace modules and units are familiar with the use of the operator program on the service PC.

DANGER!

Only insert or withdraw the PWR module while the power supply is switched off. To this end, disconnect the power supply cable that connects with the PWR module.

WARNING!

Only insert or withdraw other modules while the power supply is switched off.

WARNING!

The modules may only be inserted in the slots designated in *Section 6.2*. Components can be damaged or destroyed by inserting boards in the wrong slots.

DANGER!

Improper handling of the equipment can cause damage or an incorrect response of the equipment itself or the primary plant.

WARNING!

Industry packs and ribbon cables may only be replaced or the positions of jumpers be changed on a workbench appropriately designed for working on electronic equipment.

The modules, bus backplanes are sensitive to electrostatic discharge when not in the unit's housing.

The basic precautions to guard against electrostatic discharge are as follows:

1. Should boards have to be removed from this device installed in a grounded cubicle in an HV switchgear installation, please discharge yourself by touching station ground (the cubicle) beforehand.
2. Only hold electronic boards at the edges, taking care not to touch the components.
3. Only works on the board which has been removed from the cubicle on a workbench designed for electronic equipment and wear a grounded wristband. Do not wear a grounded wristband, however, while inserting or withdrawing units.
4. Always store and ship the electronic boards in their original packing. Place electronic parts in electrostatic screened packing materials.

11.3 Check Shipment

Check that the consignment is complete immediately upon receipt. Notify the nearest NR Company or agent, should departures from the delivery note, the shipping papers or the order be found.

Visually inspect all the material when unpacking it. When there is evidence of transport damage, lodge a claim immediately in writing with the last carrier and notify the nearest NR Company or agent.

If the equipment is not going to be installed immediately, store all the parts in their original packing in a clean dry place at a moderate temperature. The humidity at a maximum temperature and the permissible storage temperature range in dry air are listed in *Chapter "Technical Data"*.

11.4 Material and Tools Required

The necessary mounting kits will be provided, including screws, pincers and assembly instructions.

A suitable drill and spanners are required to secure the cubicles to the floor using the plugs provided (if this device is mounted in cubicles).

11.5 Device Location and Ambient Conditions

The place of installation should permit easy access especially to front of the device, i.e. to the human machine interface of the equipment.

There should also be free access at the rear of the equipment for additions and replacement of electronic boards.

Since every piece of technical equipment can be damaged or destroyed by inadmissible ambient conditions, such as:

1. The location should not be exposed to excessive air pollution (dust, aggressive substances).
2. Surge voltages of high amplitude and short rise time, extreme changes of temperature, high levels of humidity, severe vibration and strong induced magnetic fields should be avoided as far as possible.
3. Air must not be allowed to circulate freely around the equipment.

The equipment can in principle be mounted in any attitude, but it is normally mounted vertically (visibility of markings).

WARNING!

Excessively high temperature can appreciably reduce the operating life of this device.

11.6 Mechanical Installation

This device is made of a single layer 4U chassis. Following figure shows the dimensions and cut-out size in the cubicle of this device for reference in mounting.

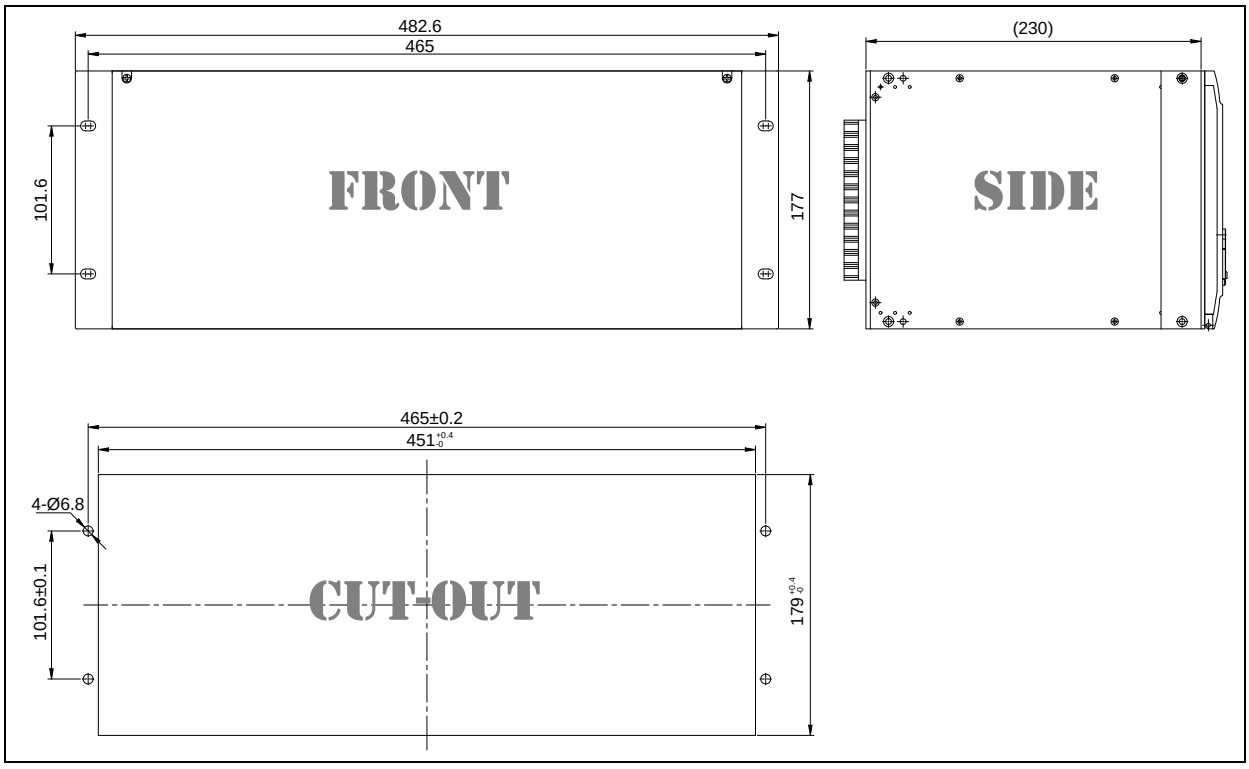

Figure 11.6-1 Dimensions of full width PCS-9705 (unit: mm)

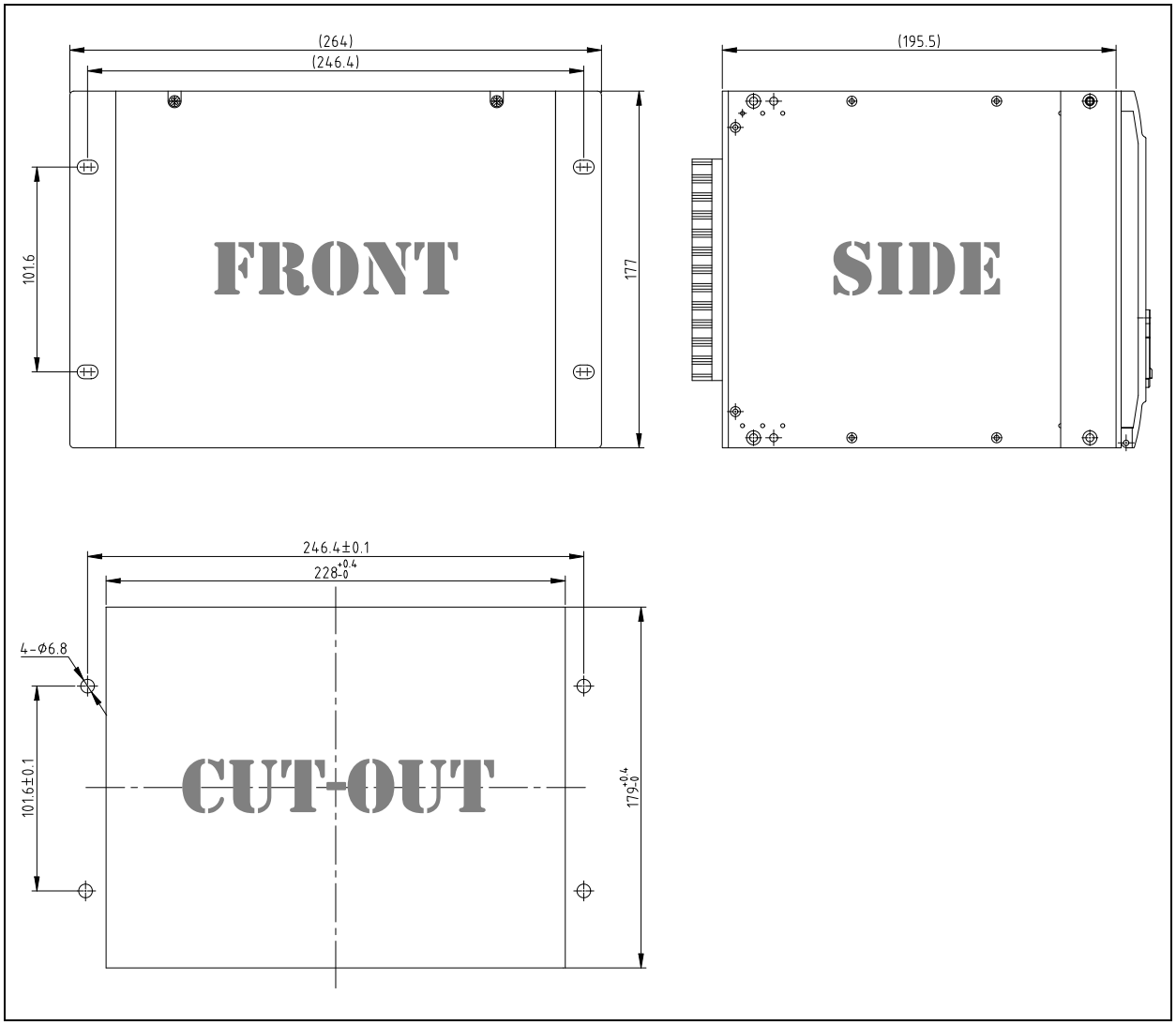

Figure 11.6-2 Dimensions of half width PCS-9705 (unit: mm)

Note!

It is necessary to leave enough space top and bottom of the cut-out in the cubicle for heat emission of this device.

The safety instructions must be abided by when installing the boards, please see *Section 11.2* for the details.

Following figure shows the installation way of a module being plugged into a corresponding slot.

Figure 11.6-3 Demonstration of plugging a board into its corresponding slot

In the case of equipment supplied in cubicles, place the cubicles on the foundations that have been prepared. Take care while doing so not to jam or otherwise damage any of the cables that have already been installed. Secure the cubicles to the foundations.

11.7 Electrical Installation and Wiring

11.7.1 Grounding Guidelines

Switching operations in HV installations generate transient over voltages on control signal cables. There is also a background of electromagnetic RF fields in electrical installations that can induce spurious currents in the devices themselves or the leads connected to them.

All these influences can influence the operation of electronic apparatus.

On the other hand, electronic apparatus can transmit interference that can disrupt the operation of other apparatus.

In order to minimize these influences as far as possible, certain standards have to be observed with respect to grounding, wiring and screening.

Note!

All these precautions can only be effective if the station ground is of good quality.

11.7.2 Cubicle Grounding

The cubicle must be designed and fitted out such that the impedance for RF interference of the ground path from the electronic device to the cubicle ground terminal is as low as possible.

Metal accessories such as side plates, blanking plates etc., must be effectively connected surface-to-surface to the grounded frame to ensure a low-impedance path to ground for RF interference. The contact surfaces must not only conduct well, they must also be non-corroding.

Note!

If the above conditions are not fulfilled, there is a possibility of the cubicle or parts of it forming a resonant circuit at certain frequencies that would amplify the transmission of

interference by the devices installed and also reduce their immunity to induced interference.

Movable parts of the cubicle such as doors (front and back) or hinged equipment frames must be effectively grounded to the frame by three braided copper strips (see *Figure 11.7-1*).

The metal parts of the cubicle housing and the ground rail are interconnected electrically conducting and corrosion proof. The contact surfaces shall be as large as possible.

Note!

For metallic connections please observe the voltage difference of both materials according to the electrochemical code.

The cubicle ground rail must be effectively connected to the station ground rail by a grounding strip (braided copper).

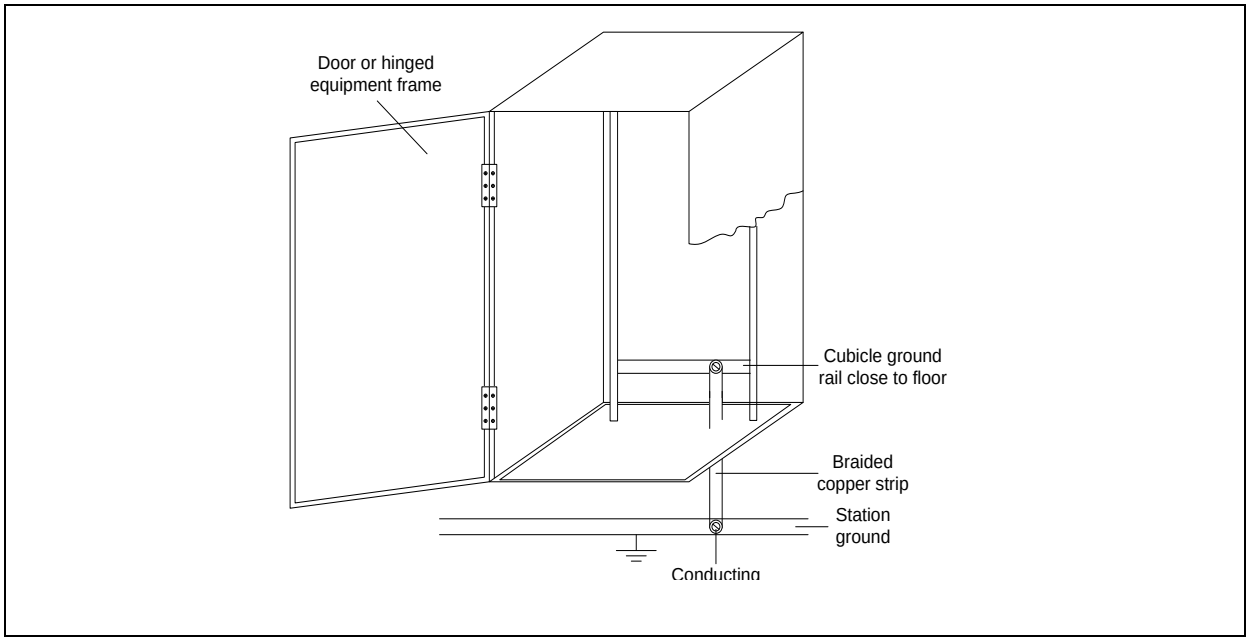

Figure 11.7-1 Cubicle grounding system

11.7.3 Ground Connection on the Device

There is a ground terminal on the rear panel, and the ground braided copper strip can be connected with it. Take care that the grounding strip is always as short as possible. The main thing is that the device is only grounded at one point. Grounding loops from unit to unit are not allowed.

There are some ground terminals on some connectors of this device, and the sign is “GND”. All the ground terminals are connected in the cabinet of this device. Therefore, the ground terminal on the rear panel (see *Figure 11.7-2*) is the only ground terminal of this device.

Figure 11.7-2 Ground terminal of this device

11.7.4 Grounding Strips and their Installation

High frequency currents are produced by interference in the ground connections and because of skin effect at these frequencies, only the surface region of the grounding strips is of consequence.

The grounding strips must therefore be of (preferably tinned) braided copper and not round copper conductors, as the cross-section of round copper would have to be too large.

Proper terminations must be fitted to both ends (press/pinch fit and tinned) with a hole for bolting them firmly to the items to be connected.

The surfaces to which the grounding strips are bolted must be electrically conducting and non-corroding.

The following figure shows the ground strip and termination.

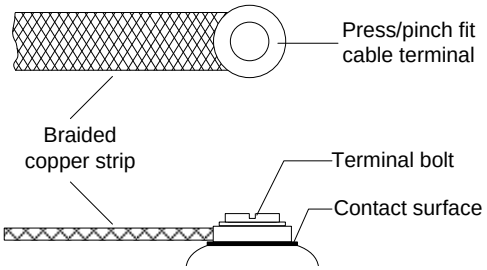

Figure 11.7-3 Ground strip and termination

11.7.5 Guidelines for Wiring

There are several types of cables that are used in the connection of this device: braided copper cable, serial communication cable etc. Recommendation of each cable:

1. Grounding: braided copper cable, 2.5mm^2 ~ 6.0mm^2
2. Power supply, binary inputs & outputs: brained copper cable, 1.0mm^2 ~ 2.5mm^2
3. AC voltage inputs: brained copper cable, 1.0mm^2 ~ 2.5mm^2
4. AC current inputs: brained copper cable, 1.5mm^2 ~ 4.0mm^2
5. Serial communication: 4-core shielded braided cable
6. Ethernet communication: 4-pair shielded twisted category 5E cable

11.7.6 Wiring for Electrical Cables

A female connector is used for connecting the wires with it, and then a female connector plugs into a corresponding male connector that is in the front of one board. See *Chapter "Hardware"* for further details about the pin defines of these connectors.

The following figure shows the glancing demo about the wiring for the electrical cables.

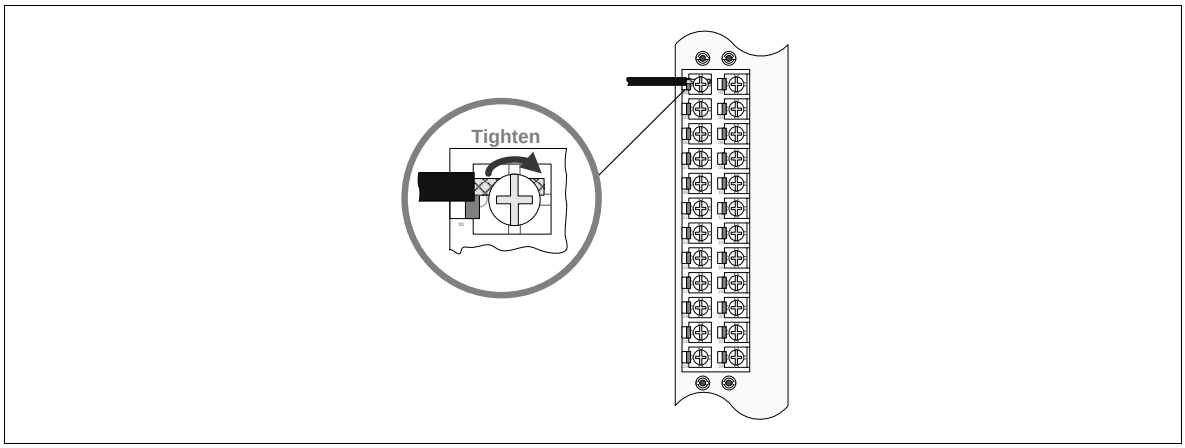

Figure 11.7-4 Glancing demo about the wiring for electrical cables

DANGER!

Never allow the current transformer (CT) secondary circuit connected to this equipment to be opened while the primary system is live. Opening the CT circuit will produce a dangerously high voltage.

12 Commissioning

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12.1 Overview

This device is numerical in their design, implementing all functions in software. The device employs a high degree self-checking so in the unlikely event of a failure, it will give an alarm.

Blank commissioning test and setting records are provided at the end of this manual for completion as required.

Before carrying out any work on the equipment, the user should be familiar with the contents of the safety and technical data sections and the ratings on the equipment's rating label.

12.2 Safety Instructions

WARNING!

Hazardous voltages are present in this electrical equipment during operation. Non-observance of the safety rules can result in severe personal injury or property damage.

WARNING!

Only the qualified personnel shall work on and around this equipment after becoming thoroughly familiar with all warnings and safety notices of this manual as well as with the applicable safety regulations.

Particular attention must be drawn to the following:

1. The earthing screw of the device must be connected solidly to the protective earth conductor before any other electrical connection is made.
2. Hazardous voltages can be present on all circuits and components connected to the supply voltage or to the measuring and test quantities.
3. Hazardous voltages can be present in the device even after disconnection of the supply voltage (storage capacitors!)
4. The limit values stated in the *Chapter "Technical Data"* must not be exceeded at all, not even during testing and commissioning.
5. When testing the device with secondary test equipment, make sure that no other measurement quantities are connected. Take also into consideration that the trip circuits and may be close commands to the circuit breakers and other primary switches are disconnected from the device unless expressly stated.

DANGER!

Current transformer secondary circuits must have been short-circuited before the current leads to the device are disconnected.

WARNING!

Primary test may only be carried out by qualified personnel, who are familiar with the commissioning of the system, the operation of the plant and safety rules and regulations (switching, earthing, etc.).

12.3 Commission Tools

Minimum equipment required:

1. Multifunctional dynamic current and voltage injection test set with interval timer.
2. Multimeter with suitable AC current range and AC/DC voltage ranges of 0~440V and 0~250V respectively.
3. Continuity tester (if not included in the multimeter).
4. Phase angle meter.
5. Phase rotation meter.

Note!

Modern test set may contain many of the above features in one unit.

Optional equipment:

1. An electronic or brushless insulation tester with a DC output not exceeding 500V (for insulation resistance test when required).
2. A portable PC, with appropriate software (this enables the rear communications port to be tested, if this is to be used, and will also save considerable time during commissioning).
3. EIA RS-485 to EIA RS-232 converter (if EIA RS-485 IEC60870-5-103 port is being tested).
4. Tester: HELP-9000.

12.4 Setting Familiarization

When commissioning this device for the first time, sufficient time should be allowed to become familiar with the method by which the settings are applied. A detailed description of the menu structure of this device is contained in *Chapter "Operation Theory" and Chapter "Settings"*.

With the front cover in place all keys are accessible. All menu cells can be read. The LED indicators and alarms can be reset. Protection or configuration settings can be changed, or fault and event records cleared. However, menu cells will require the appropriate password to be entered before changes can be made.

Alternatively, if a portable PC is available together with suitable setting software (such as PCS-9700 HMI software), the menu can be viewed one page at a time to display a full column of data and text. This PC software also allows settings to be entered more easily, saved to a file on

disk for future reference or printed to produce a setting record. Refer to the PC software user manual for details. If the software is being used for the first time, allow sufficient time to become familiar with its operation.

12.5 Product Checks

These product checks cover all aspects of the device which should be checked to ensure that it has not been physically damaged prior to commissioning, is functioning correctly and all input quantity measurements are within the stated tolerances.

If the application-specific settings have been applied to the device prior to commissioning, it is advisable to make a copy of the settings so as to allow them restoration later. This could be done by extracting the settings from the device itself via printer or manually creating a setting record.

12.5.1 With the Device De-energized

This device is fully numerical and the hardware is continuously monitored. Commissioning tests can be kept to a minimum and need only include hardware tests and conjunctive tests. The function tests are carried out according to user's correlative regulations.

The following tests are necessary to ensure the normal operation of the equipment before it is first put into service.

1. Hardware tests

   These tests are performed for the following hardware to ensure that there is no hardware defect. Defects of hardware circuits other than the following can be detected by self-monitoring when the DC power is supplied.

2. User interfaces test
3. Binary input circuits and output circuits test
4. AC input circuits test
5. Function tests

   These tests are performed for the following functions that are fully software-based.

1. Measuring elements test
2. Timers test
3. Conjunctive tests

   The tests are performed after the device is connected with the primary equipment and other external equipment.

1. On load test.
2. Phase sequence check and polarity check.

12.5.1.1 Visual Inspection

After unpacking the product, check for any damage to the device case. If there is any damage, the internal module might also have been affected, contact the vendor. The following items listed are necessary.

1. Device panel

   Carefully examine the device panel, device inside and other parts inside to see that no physical damage has occurred since installation.

2. Panel wiring

   Check the conducting wire which is used in the panel to assure that their cross section meeting the requirement.

   Carefully examine the wiring to see that they are no connection failure exists.

3. Device plug-in modules

   Check each plug-in module of the equipment on the panel to make sure that they are well installed into the equipment without any screw loosened.

4. Earthing cable

   Check whether the earthing cable from the panel terminal block is safely screwed to the panel steel sheet.

5. Switch, keypad, isolator binary inputs and push button

   Check whether all the switches, equipment keypad, isolator binary inputs and push buttons work normally and smoothly.

12.5.1.2 Insulation Test (if required)

Insulation resistance tests are only necessary during commissioning if it is required for them to be done and they have not been performed during installation.

Isolate all wiring from the earth and test the isolation with an electronic or brushless insulation tester at a DC voltage not exceeding 500V, The circuits need to be tested should include:

1. Voltage transformer circuits
2. Current transformer circuits
3. DC power supply
4. Optic-isolated control inputs
5. Output contacts
6. Communication ports

The insulation resistance should be greater than 100MΩ at 500V.

Test method:

To unplug all the terminals sockets of this device, and do the Insulation resistance test for each circuit above with an electronic or brushless insulation tester.

On completion of the insulation resistance tests, ensure all external wiring is correctly reconnected to the device.

12.5.1.3 External Wiring

Check that the external wiring is correct to the relevant device diagram and scheme diagram. Ensure as far as practical that phasing/phase rotation appears to be as expected.

Check the wiring against the schematic diagram for the installation to ensure compliance with the customer's normal practice.

12.5.1.4 Auxiliary Power Supply

The device only can be operated under the auxiliary power supply depending on the device's nominal power supply rating.

The incoming voltage must be within the operating range specified in *Chapter "Technical Data"*, before energizing the device, measure the auxiliary supply to ensure it within the operating range.

Other requirements to the auxiliary power supply are specified in *Chapter "Technical Data"*. See this section for further details about the parameters of the power supply.

WARNING!

Energize this device only if the power supply is within the specified operating ranges in *Chapter "Technical Data"*.

12.5.2 With the Device Energized

The following groups of checks verify that the device hardware and software is functioning correctly and should be carried out with the auxiliary supply applied to the device.

The current and voltage transformer connections must remain isolated from the device for these checks. The trip circuit should also remain isolated to prevent accidental operation of the associated circuit breaker.

12.5.2.1 Front Panel LCD Display

Connect the device to DC power supply correctly and turn the device on. Check program version and forming time displayed in command menu to ensure that are corresponding to what ordered.

12.5.2.2 Date and Time

If the time and date is not being maintained by substation automation system, the date and time should be set manually.

Set the date and time to the correct local time and date using menu item "**Clock**".

In the event of the auxiliary supply failing, with a battery fitted on CPU board, the time and date will be maintained. Therefore when the auxiliary supply is restored the time and date will be correct and not need to set again.

To test this, remove the auxiliary supply from the device for approximately 30s. After being re-energized, the time and date should be correct.

12.5.2.3 Light Emitting Diodes (LEDs)

On power up, the green LED "**HEALTHY**" should have illuminated and stayed on indicating that the device is healthy.

The device has latched signal devices which remember the state of the trip, auto-reclose when the device was last energized from an auxiliary supply. Therefore these indicators may also illuminate when the auxiliary supply is applied. If any of these LEDs are on then they should be reset before proceeding with further testing. If the LED successfully reset, the LED goes out. There is no testing required for that that LED because it is known to be operational.

It is likely that alarms related to voltage transformer supervision will not reset at this stage.

12.5.2.4 Testing HEALTHY and ALARM LEDs

Apply the rated DC power supply and check that the "**HEALTHY**" LED is lighting in green. We need to emphasize that the "**HEALTHY**" LED is always lighting in operation course except that the equipment find serious errors in it.

Produce one of the abnormal conditions listed in *Chapter "Supervision"*, the "**ALARM**" LED will light in yellow. When abnormal condition reset, the "**ALARM**" LED extinguishes.

12.5.2.5 Testing AC Current Inputs

This test verified that the accuracy of current measurement is within the acceptable tolerances.

Apply rated current to each current transformer input in turn; checking its magnitude using a multimeter/test set readout. The corresponding reading can then be checked in the devices menu.

Note!

The closing circuit should remain isolated during these checks to prevent accidental operation of the associated circuit breaker.

Group No.	Item	Input Value	Input Angle	Display Value	Display Angle
Three-phase current 1	Ia				
	Ib				
	Ic				
Three-phase current 2	Ia				
	Ib				
	Ic				
Three-phase current 3	Ia				

Group No.	Item	Input Value	Input Angle	Display Value	Display Angle
	Ib				
	Ic				
Three-phase current …	Ia				
	Ib				
	Ic				

12.5.2.6 Testing AC Voltage Inputs

This test verified that the accuracy of voltage measurement is within the acceptable tolerances.

Apply rated voltage to each voltage transformer input in turn; checking its magnitude using a multimeter/test set readout. The corresponding reading can then be checked in the devices menu.

Note!

The closing circuit should remain isolated during these checks to prevent accidental operation of the associated circuit breaker.

Group No.	Item	Input Value	Input Angle	Display Value	Display Angle
Three-phase voltage 1	Ua				
	Ub				
	Uc				
Three-phase voltage 2	Ua				
	Ub				
	Uc				
Three-phase voltage 3	Ua				
	Ub				
	Uc				
Three-phase voltage…	Ua				
	Ub				
	Uc				

12.5.2.7 Testing Binary Inputs

This test checks that all the binary inputs on the equipment are functioning correctly.

The binary inputs should be energized one at a time, see external connection diagrams for terminal numbers.

Ensure that the voltage applied on the binary input must be within the operating range.

The status of each binary input can be viewed using device menu. Sign “1” denotes an energized input and sign “0” denotes a de-energized input.

Terminal No.	Signal Name	BI Status on LCD	Correctness

12.5.3 On-load Checks

The objectives of the on-load checks are:

1. Confirm the external wiring to the current and voltage inputs is correct.
2. Measure the magnitude of on-load current and voltage (if applicable).
3. Check the polarity of each current transformer.

However, these checks can only be carried out if there are no restrictions preventing the tenderization of the plant being protected.

Remove all test leads, temporary shorting leads, etc. and replace any external wiring that has been removed to allow testing.

If it has been necessary to disconnect any of the external wiring from the device in order to perform any of the foregoing tests, it should be ensured that all connections are replaced in accordance with the relevant external connection or scheme diagram. Confirm current and voltage transformer wiring.

12.6 Final Checks

After the above tests are completed, remove all test or temporary shorting leads, etc. If it has been necessary to disconnect any of the external wiring from the device in order to perform the wiring verification tests, it should be ensured that all connections are replaced in accordance with the relevant external connection or scheme diagram.

Ensure that the device has been restored to service.

If the device is in a new installation or the circuit breaker has just been maintained, the circuit breaker maintenance and current counters should be zero. If a test block is installed, remove the test plug and replace the cover so that the device is put into service.

Ensure that all event records, fault records and alarms have been cleared and LED’s has been reset before leaving the device.

13 Maintenance

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13.2 Failure Tracing and Repair 13-1

13.3 Replace Failed Modules 13-1

13.4 Cleaning 13-3

13.5 Storage 13-3

This device is designed to require no special maintenance. All measurement and signal processing circuit are fully solid state. All input modules are also fully solid state. The output relays are hermetically sealed.

Since the device is almost completely self-monitored, from the measuring inputs to the output relays, hardware and software defects are automatically detected and reported. The self-monitoring ensures the high availability of the device and generally allows for a corrective rather than preventive maintenance strategy. Therefore, maintenance checks in short intervals are not required.

Operation of the device is automatically blocked when a hardware failure is detected. If a problem is detected in the external measuring circuits, the device normally only provides alarm messages.

13.1 Appearance Check

1. The device case should be clean without any dust stratification. Case cover should be sealed well. No component has any mechanical damage and distortion, and they should be firmly fixed in the case. Device terminals should be in good condition. The keys on the front panel with very good feeling can be operated flexibly.
2. It is only allowed to plug or withdraw device board when the supply is reliably switched off. Never allow the CT secondary circuit connected to this equipment to be opened while the primary system is live when withdrawing an AC module. Never try to insert or withdraw the device board when it is unnecessary.
3. Check weld spots on PCB whether they are well soldered without any rosin joint. All dual inline components must be well plugged.

13.2 Failure Tracing and Repair

Failures will be detected by automatic supervision or regular testing.

When a failure is detected by supervision, a remote alarm is issued and the failure is indicated on the front panel with LED indicators and LCD display. It is also recorded in the event record. Failures detected by supervision are traced by checking the "**Superv State**" screen on the LCD.

When a failure is detected during regular testing, confirm the following:

1. Test circuit connections are correct
2. Modules are securely inserted in position
3. Correct DC power voltage is applied
4. Correct AC inputs are applied
5. Test procedures comply with those stated in the manual

13.3 Replace Failed Modules

If the failure is identified to be in the device module and the user has spare modules, the user can

recover the device by replacing the failed modules.

Repair at the site should be limited to module replacement. Maintenance at the component level is not recommended.

Check that the replacement module has an identical module name (AI, PWR, MON, BI, BO, etc.) and hardware type-form as the removed module. Furthermore, the MON module replaced should have the same software version. In addition, the AI and PWR module replaced should have the same ratings.

The module name is indicated on the top front of the module. The software version is indicated in LCD menu "**Information**"->"**Version Info**".

Caution!

When handling a module, take anti-static measures such as wearing an earthed wristband and placing modules on an earthed conductive mat. Otherwise, many of the electronic components could suffer damage. After replacing the MON module, check the settings.

1. Replacing a module
   1) Switch off the DC power supply
   2) Disconnect the trip outputs
   3) Short circuit all AC current inputs and disconnect all AC voltage inputs
   4) Unscrew the module.

Warning!

Hazardous voltage can be present in the DC circuit just after switching off the DC power supply. It takes approximately 30 seconds for the voltage to discharge.

2. Replacing the Human Machine Interface Module (front panel)
   1) Open the device front panel
   2) Unplug the ribbon cable on the front panel by pushing the catch outside.
   3) Detach the HMI module from the device
   4) Attach the replacement module in the reverse procedure.
3. Replacing the AI, DI, PWR, MON, BI or BO module
   1) Unscrew the module connector
   2) Unplug the connector from the target module.
   3) Unscrew the module.
   4) Pull out the module

5) Inset the replacement module in the reverser procedure.

6) After replacing the MON module, input the application-specific setting values again.

Warning!

Units and modules may only be replaced while the supply is switched off and only by appropriately trained and qualified personnel. Strictly observe the basic precautions to guard against electrostatic discharge.

Warning!

When handling a module, take anti-static measures such as wearing an earthed wristband and placing modules on an earthed conductive mat. Otherwise, many of the electronic components could suffer damage. After replacing the MON module, check the settings.

Danger!

After replacing modules, be sure to check that the same configuration is set as before the replacement. If this is not the case, there is a danger of the unintended operation of switchgear taking place or of devices not functioning correctly. Persons may also be put in danger.

13.4 Cleaning

Before cleaning the device, ensure that all AC/DC supplies, current transformer connections are isolated to prevent any chance of an electric shock whilst cleaning. Use a smooth cloth to clean the front panel. Do not use abrasive material or detergent chemicals.

13.5 Storage

The spare device or module should be stored in a dry and clean room. Based on IEC standard 60255-1 the storage temperature should be from -40°C to +70°C, but the temperature of from 0°C to +40°C is recommended for long-term storage.

14 Decommissioning and Disposal

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14.1 Decommissioning

1. Switching off

   To switch off this device, switch off the external miniature circuit breaker of the power supply.

2. Disconnecting Cables

   Disconnect the cables in accordance with the rules and recommendations made by relational department.

Danger!

Before disconnecting the power supply cables that connected with the PWR module of this device, make sure that the external miniature circuit breaker of the power supply is switched off.

Danger!

Before disconnecting the cables that are used to connect analog input module with the primary CTs and VTs, make sure that the circuit breaker for the primary CTs and VTs is switched off.

3. Dismantling

   The device rack may now be removed from the system cubicle, after which the cubicles may also be removed.

Danger!

When the station is in operation, make sure that there is an adequate safety distance to live parts, especially as dismantling is often performed by unskilled personnel.

14.2 Disposal

In every country there are companies specialized in the proper disposal of electronic waste.

Note!

Strictly observe all local and national regulations when disposing of the device.

15 Manual Version History

In the latest version of the instruction manual, several descriptions on existing features have been modified.

Manual version and modification history records

Manual Version		Software Version	Date	Description of change
Source	New			
Beta	R2.00	R2.10	2013-09-10	Form the original manual.
R2.00	R2.01	R2.10.004	2014-01-08	Section 4.1: Add "Alm_Self-Check"; Section 6.3.4: Change binary input contact definition; Section 7.2.14: Change settings' names; Section 7.3.4: Add "Spare Links"; Section 7.2.16: Add "Misc Settings"; Section 8.2.6: Change content according to the changes of menu tree;
R2.01	R2.10	R2.10.004 (APP 1, 2, 3) R2.11.001 (APP 4, 5)	2014-03-28	Add RSYN check mode; Add BCU subtypes (APP 4, 5); Add half width chassis; Add & change certain signals & settings; Update structure & description;
R2.10	R2.11	R2.10.005 (APP 1, 2, 3) R2.11.002 (APP 4, 5)	2014-06-19	Add note for the terminal description of the BI module; Update the template of debugging port

PCS-9799

Station Manager

Instruction Manual

NR Electric Co., Ltd.

Preface

Introduction

This guide and the relevant operating or service manual documentation for the equipment provide full information on safe handling, commissioning and testing of this equipment.

Documentation for equipment ordered from NR is dispatched separately from manufactured goods and may not be received at the same time. Therefore, this guide is provided to ensure that printed information normally present on equipment is fully understood by the recipient.

Before carrying out any work on the equipment, the user should be familiar with the contents of this manual, and read relevant chapter carefully.

This chapter describes the safety precautions recommended when using the equipment. Before installing and using the equipment, this chapter must be thoroughly read and understood.

Health and Safety

The information in this chapter of the equipment documentation is intended to ensure that equipment is properly installed and handled in order to maintain it in a safe condition.

When electrical equipment is in operation, dangerous voltages will be present in certain parts of the equipment. Failure to observe warning notices, incorrect use, or improper use may endanger personnel and equipment and cause personal injury or physical damage.

Before working in the terminal strip area, the equipment must be isolated.

Proper and safe operation of the equipment depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing. For this reason, only qualified personnel may work on or operate the equipment.

Qualified personnel are individuals who:

- Are familiar with the installation, commissioning, and operation of the equipment and of the system to which it is being connected;
- Are able to safely perform switching operations in accordance with accepted safety engineering practices and are authorized to energize and de-energize equipment and to isolate, ground, and label it;
- Are trained in the care and use of safety apparatus in accordance with safety engineering practices;
- Are trained in emergency procedures (first aid).

Instructions and Warnings

The following indicators and standard definitions are used:

DANGER!

It means that death, severe personal injury, or considerable equipment damage will occur if safety precautions are disregarded.

WARNING!

It means that death, severe personal, or considerable equipment damage could occur if safety precautions are disregarded.

CAUTION!

It means that light personal injury or equipment damage may occur if safety precautions are disregarded. This particularly applies to damage to the device and to resulting damage of the protected equipment.

WARNING!

The firmware may be upgraded to add new features or enhance/modify existing features, please make sure that the version of this manual is compatible with the product in your hand.

WARNING!

During operation of electrical equipment, certain parts of these devices are under high voltage. Severe personal injury or significant equipment damage could result from improper behavior.

Only qualified personnel should work on this equipment or in the vicinity of this equipment. These personnel must be familiar with all warnings and service procedures described in this manual, as well as safety regulations.

In particular, the general facility and safety regulations for work with high-voltage equipment must be observed. Noncompliance may result in death, injury, or significant equipment damage.

DANGER!

Never allow the current transformer (CT) secondary circuit connected to this equipment to be opened while the primary system is live. Opening the CT circuit will produce a dangerously high voltage.

WARNING!

- **Exposed terminals**

Do not touch the exposed terminals of this equipment while the power is on, as the high voltage generated is dangerous

- **Residual voltage**

Hazardous voltage can be present in the DC circuit just after switching off the DC power supply. It takes a few seconds for the voltage to discharge.

CAUTION!

- **Earth**

The earthing terminal of the equipment must be securely earthed.

- **Operating environment**

The equipment must only be used within the range of ambient environment detailed in the specification and in an environment free of abnormal vibration.

- **Ratings**

Before applying AC voltage and current or the DC power supply to the equipment, check that they conform to the equipment ratings.

- **Printed circuit board**

Do not attach and remove printed circuit boards when DC power to the equipment is on, as this may cause the equipment to malfunction.

- **External circuit**

When connecting the output contacts of the equipment to an external circuit, carefully check the supply voltage used in order to prevent the connected circuit from overheating.

- **Connection cable**

Carefully handle the connection cable without applying excessive force.

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Version: R1.01

P/N: EN_TXZZ5111.0086.0002

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Documentation Structure

The manual provides a functional and technical description of this device and a comprehensive set of instructions for the device's use and application.

All contents provided by this manual are summarized as below:

1 Introduction

Briefly introduce the application, functions and features about this device.

2 Technical Data

Introduce the technical data about this device, such as electrical specifications, mechanical specifications, ambient temperature and humidity range, communication port parameters, type tests and the certifications that our products have passed.

3 Operation Theory

Introduce the functions of different software modules of this device.

4 Supervision

Introduce the automatic self-supervision function of this device.

5 Hardware

Introduce the hardware structure of this device.

6 Human Machine Interface

Introduce the hardware of the human machine interface (HMI) module and a detailed guide for the user how to use this device through the HMI. It also lists all the information which can be view through the HMI, such as settings, measurements, all kinds of reports etc.

7 Installation

Introduce the recommendations on unpacking, handling, inspection and storage of this device. A guide to the mechanical and electrical installation of this device is also provided, incorporating earthing recommendations.

8 Maintenance

A general maintenance policy for this device is outlined.

9 Decommissioning and Disposal

A general decommissioning and disposal policy for this device is outlined.

10 Manual Version History

List the instruction manual version and the modification history records.

1 Introduction

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1.1 Overview

PCS-9799 is a station manager designed for the highest standards of performance, safety and reliability to meet requirements of a complex substation automation system (SAS). As an integral part of the SAS, it works as a communication manager, which maps signals between protections and control IEDs in industrial or utility substations and higher-level systems such as control centers (CC) or distributed control systems.

PCS-9799 supports several protocols: IEC60870-5-101, IEC60870-5-104, CDT etc. The data can be transmitted in analog channel, digital channel or net to the CC, distributed control systems or other centers, and receive the signals or commands from the remote centers.

The information transmitted in PCS-9799 applies “directly get and send” mode. The device can run independently with the HMI system and no interaction exists between these two.

This product is applicable to:

1. **Power systems**

   Conventional substations and digital substations of various voltage levels;

   New-build substation SAS implementation and old substation reconstruction or upgrade.

2. **Other systems**

   Subway system, light-rail system, and electrified railway system;

   Other industrial automation applications: mines, petrochemical industry and metallurgy, etc.

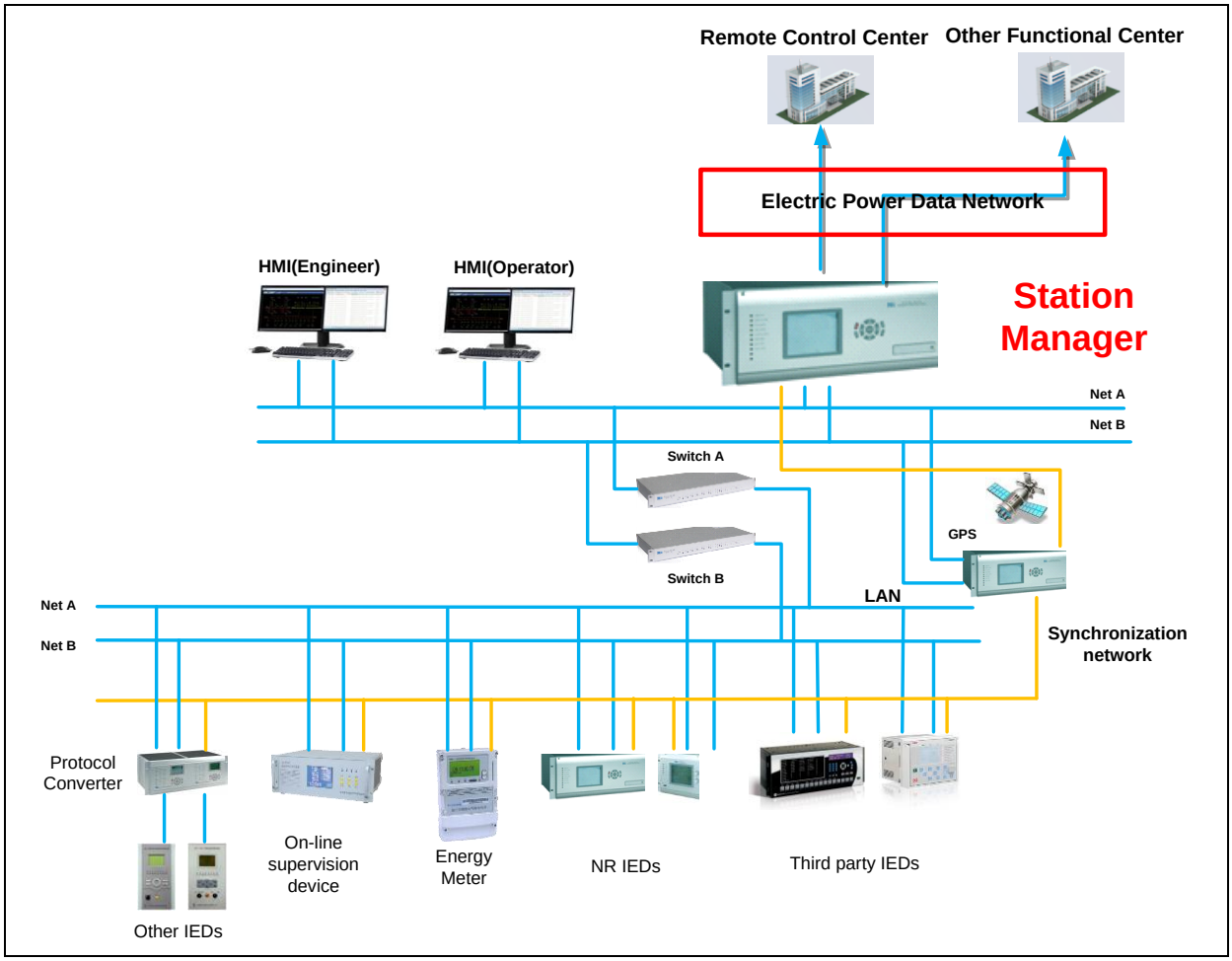

Figure 1.1-1 Typical application of PCS-9799

1.2 Features

1. High performance hardware architecture

- CPU: >1GHz, RAM: 2 GB
- Capable for data management and communication of the SAS of substation or power plant
- Communication ports: 12 Net ports, 15 serial ports (configurable RS232/485/422, MODEM)
- Natural cooling system is adopted to avoid the use of fan
- Solid state disk is adopted to ensure the long service life
- Dual power supply

2. Advanced real-time database

- Object-oriented design
- Compatible for data model IEC61850 and IEC 103

- Multiple models included: Primary/secondary equipment model, association model between primary and secondary equipment, primary schematic diagram model
- Provides full view model and data information for advanced applications
- Unified data gathering and sending for advanced applications

3. Unified historical database

- Embedded historical database, completely solves the problem of large data storage
- Database capacity: >4GB
- Multiple data information: Historical event, operation report, wave file, etc.

4. Real-time data transmission platform

- Furthest ensure the real-time data transmission to the CC which provide the real-time data for the advanced application in CC
- Internal SOE transmission delay: <100ms

5. Powerful synchronization

- Synchronize the internal clock of IEDs by sending synchronization messages
- Independent synchronization system for each MON board (When multiple MON boards are applied)
- Multiple synchronization source supported: Net message, GPS, NTP net synchronization
- Hardware synchronization: IRIG-B

6. Unified substation data sending platform

- The data model transformation between substation and CC is realized by using the SCD file
- Support most of mainstream protocols: IEC60870-5-101/104, IEC60870-5-102, IEC60870-5-103, IEC61850, MODBUS, etc.

7. Powerful configuration tool

- Highly integrated functions
- Total life cycle adoptable: project implementation, running and maintenance, analysis and diagnosis

8. Supervision system scale

- Support up to 300 IEDs
- The scale of database should be no more than 200,000 points

1.3 Functional Configuration

PCS-9799 is a powerful system, which can meet various requirements of different substation. It contains a full series of basic functions focus on substation automation, as well as a variety of advanced functions, which enhance the information transmission and management.

1. **Information acquisition of relays and IEDs**

   Through serial port or net, the device can communicate with the relays and other IEDs to gather their information such as SOE, trip signals.

2. **Information acquisition of BCUs and intelligent meters**

   Through serial port or net, the device can communicate with BCUs and intelligent meters to gather their information such as measurements, status change signals, measurement signals, energy metering signals and other signals.

3. **Information acquisition of auxiliary devices**

   In addition, the device can gather other information of auxiliary devices, which are useful or crucial to the safety of the substation and have them sent to the CC.

4. **Communication with the control centers & distribution centers**

   The device can realize the communication with multiple remote control centers and remote distribution centers with different authorities. The information to different remote terminal can be customized.

5. **Information edit and synthesize**

   Based on the different requirement of different customers, the information may need pro-processed before being sent to the CC. PCS-9799 provides this function with human friendly interface of its configuration tool; moreover, it can conduct some logical rationality check of the processed information.

6. **Remote command record and query**

   The device can record all the commands and operations from the control source, includes remote control select, remote control execute, remote regulate, setting modification select, setting modification execute, reset alarm etc. All the information can be viewed and searched with filter.

7. **Communication status check and supervise**

   The device can automatically check and upload the communication status between itself and the devices connected to PCS-9799. If abnormality is detected the alarm signal can be sent to the CC.

8. **On-line maintain and monitor**

   This powerful function enables the engineers to monitor the running status through the network which includes: running information print, display the message of the net port and

serial port, on-field configuration, database view, force measurement, file transmit, remote reboot. With all this advanced functions, the substation upgrade becomes very convenient.

9. Digital IO

Digital binary input and output module, 13 BI and 4 BO provided.

10. Self-diagnose

During the running time, the device keeps a full supervision on its software and hardware, once an abnormality is found, the device will be self-blocked to ensure no maloperation is conducted, meanwhile, an alarm will be sent out both digitally and hardware output as alarm. If the device is dual equipped, at this time, if the abnormal device is on-duty then it will not only block itself but also activate the backup device to take over all the tasks to ensure the substation is still running normally.

1.4 Glossary

Table 1.4-1 Glossary

No.	Abbreviation	Description
1	AGC	Automatic Generation Control
2	ANSI	American National Standard Institute
3	API	Application Programming Interface
4	ASCII	American Standard Code for Information Interchange
5	BCU	Bay Control Unit
6	CC	Control Center
7	CMMI	Capability Maturity Model Integration
8	CPU	Central Processing Unit
9	DCS	Distributed Control System
10	DCU	Data Concentrator Unit
11	EIA	Electronic Industries Alliance
12	ELV	Extra-Low Voltage
13	HMI	Human Machine Interface
14	IEC	International Electrotechnical Commission
15	IED	Intelligent Electronic Device
16	IRIG	Inter-Range Instrumentation Group time code
17	ISO	International Organization for Standardization
18	LED	Light-Emitting Diode
19	OHSAS	Occupational Health and Safety Assessment Series
20	PWR module	Power supply module
21	RAM	Random-Access Memory
22	RCC	Remote Control Center
23	SAS	Substation Automation System
24	SCADA	Supervisory Control And Data Acquisition

No.	Abbreviation	Description
25	SNTP	Simple Network Time Protocol
26	TCP/IP	Transport Control Protocol/Internet Protocol The internet protocol suite is the set of communications protocols used for the internet and other similar networks.
27	XML	eXtended Markup Language

2 Technical Data

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2.1 General Specification

2.1.1 Electrical Specifications

Rated Voltage (Un)	110Vdc/125Vdc, 220Vdc/250Vdc; 220Vac/250Vac;
Variation	(80% ~ 120%)Un
Ripple in the DC auxiliary voltage	Max 15% of the DC value. Per IEC 60255-11:1979
Burden	<45W

2.1.2 Mechanical Specifications

Chassis color	Silver grey
Weight per device	Approx. 10kg
Chassis material	Aluminum alloy
Location of terminal	Rear panel of the device
Device structure	Plug-in modular type at rear side, integrated frontplate
Protection class	
Standard	IEC 60225-1:2009
Front side	IP40
Other sides	IP20
Rear side, connection terminals	IP20

2.1.3 Ambient Temperature and Humidity Range

Standard	IEC 60255-1:2009
Operating temperature range	-20°C ~ +55°C
Transport and storage temperature range	-40°C ~ +70°C
Permissible humidity	5% ~ 95%, condensation not permissible

2.1.4 Binary Input

Rated voltage	24V	48V
Rated current drain	1.2mA	2.4mA
Pickup voltage	13~17V	26~34V
Dropoff voltage	62% of pickup voltage	
Number	Up to 13 binary inputs according to various hardware configurations	

2.1.5 Binary Output

Output mode	Potential free contact
Continuous carry	5A@250Vac 5A@250Vdc
Pickup time	<8ms (typical 5ms)

Dropoff time	<5ms
Breaking capacity (L/R=40ms)	0.65A@48Vdc 0.30A@110Vdc 0.15A@220Vdc
Burden	300mW
Test voltage across open contact	1000V RMS for 1min
Short duration current	6A@3s 15A@0.5s
Number	Up to 4 binary output according to various hardware configurations

2.1.6 System Specifications

Communication ports	12 Net ports, 15 serial ports (configurable RS232/485/422, MODEM)
Database capacity	>4GB
Internal SOE transmission delay	<100ms
Supervision system scale	Upto 300 IEDs Upto 200,000 points in database

2.2 Communication Port

2.2.1 EIA-232 Port

Baud rate	4.8kbit/s, 9.6kbit/s, 19.2kbit/s, 38.4kbit/s, 57.6kbit/s, 115.2kbit/s
Maximal capacity	1
Transmission distance	<10m
Safety level	Isolation to ELV level
Twisted pair	Screened twisted pair cable

2.2.2 EIA-422/485 Port

Baud rate	4.8kbit/s, 9.6kbit/s, 19.2kbit/s, 38.4kbit/s, 57.6kbit/s, 115.2kbit/s
Protocol	IEC 60870-5-103:1997
Maximal capacity	32
Transmission distance	<500m
Safety level	Isolation to ELV level
Twisted pair	Screened twisted pair cable

2.2.3 Ethernet Port

Connector type	RJ-45
Transmission rate	100Mbits/s
Transmission standard	10Base-T/100Base-TX
Transmission distance	<100m
Safety level	Isolation to ELV level

2.2.4 Clock Synchronization Port

Type	RS-485

Transmission distance	<500m
Maximal capacity	32
Timing standard	IRIG-B
Safety level	Isolation to ELV level

2.2.5 Analog Channel Port

Port number	Up to 9
Baud rate	300bps, 600bps,1200bps asynchronous
Center Frequency	1200Hz, 1350Hz, 1500Hz, 1700Hz, 2880Hz, 3000Hz
Offset Frequency	(±) 150Hz, 200Hz, 300Hz, 400Hz
Output Voltage	0dBm, -6dBm, -12dBm, -18dBm

2.3 Type Tests

2.3.1 Environmental Tests

Dry cold test	IEC60068-2-1:2007
Dry heat test	IEC60068-2-2:2007
Damp heat test, cyclic	IEC60068-2-30:2005

2.3.2 Mechanical Tests

Vibration	IEC 60255-21-1:1988 Class I
Shock and bump	IEC 60255-21-2:1988 Class I

2.3.3 Electrical Tests

Standard	IEC 60255-27:2005
Dielectric tests	Test voltage 2kV, 50Hz, 1min
Standard	IEC 60255-5:2000
Impulse voltage tests	Test voltage 5kV
Overvoltage category	III
Insulation resistance measurements	Isolation resistance >100MΩ@500VDC

2.3.4 Electromagnetic Compatibility

1MHz burst disturbance test	IEC 60255-22-1:2007
	Common mode: class III 2.5kV
	Differential mode: class III 1.0kV
Electrostatic discharge test	IEC60255-22-2:2008 class IV
	For contact discharge: 8kV
	For air discharge: 15kV
Radio frequency interference tests	IEC 60255-22-3:2007 class III
	Frequency sweep Radiated amplitude-modulated 10V/m (rms), f=80~1000MHz

	Spot frequency Radiated amplitude-modulated 10V/m (rms), f=80MHz/160MHz/450MHz/900MHz Radiated pulse-modulated 10V/m (rms), f=900MHz
Fast transient disturbance tests	IEC 60255-22-4:2008
	Power supply, I/O, Earth: class IV, 4kV, 2.5kHz, 5/50ns
	Communication terminals: class IV, 2kV, 5kHz, 5/50ns
Surge immunity test	Per IEC 60255-22-5:2008
	Power supply, AC input, I/O port: class IV, 1.2/50us Common mode: 4kV Differential mode: 2kV
Conducted RF Electromagnetic Disturbance	IEC 60255-22-6:2001
	Power supply, AC, I/O, Comm. Terminal: Class III, 10Vrms, 150 kHz~80MHz
Power Frequency Magnetic Field Immunity	IEC 61000-4-8:2001
	class V, 100A/m for 1min, 1000A/m for 3s
Pulse Magnetic Field Immunity	IEC 61000-4-9:2001
	class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10:2001
	class V, 100kHz & 1MHz–100A/m
Auxiliary power supply performance	IEC60255-11: 2008
	Voltage dips: Up to 500ms for dips to 40% of rated voltage without reset
	Voltage short interruptions: 100ms for interruption without rebooting
Voltage dips and voltage short interruptions	Per IEC 60255-11:1979 20ms for interruption without de-energizing, dips 60% of Un without reset up to 100ms

2.4 Certification

- ISO9001: 2008
- ISO14001: 2004
- OHSAS18001: 2007
- ISO10012: 2003
- CMMI L5
- EMC: 2004/108/EC, EN50263: 1999
- Products safety(PS): 2006/95/EC, EN61010-1: 2001

3 Operation Theory

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3.1 Software Structure

PCS-9799 station manager applies Linux as its software platform. The design of its software is modularized which gives this device high flexibility and applicability.

The software structure is shown in following figure:

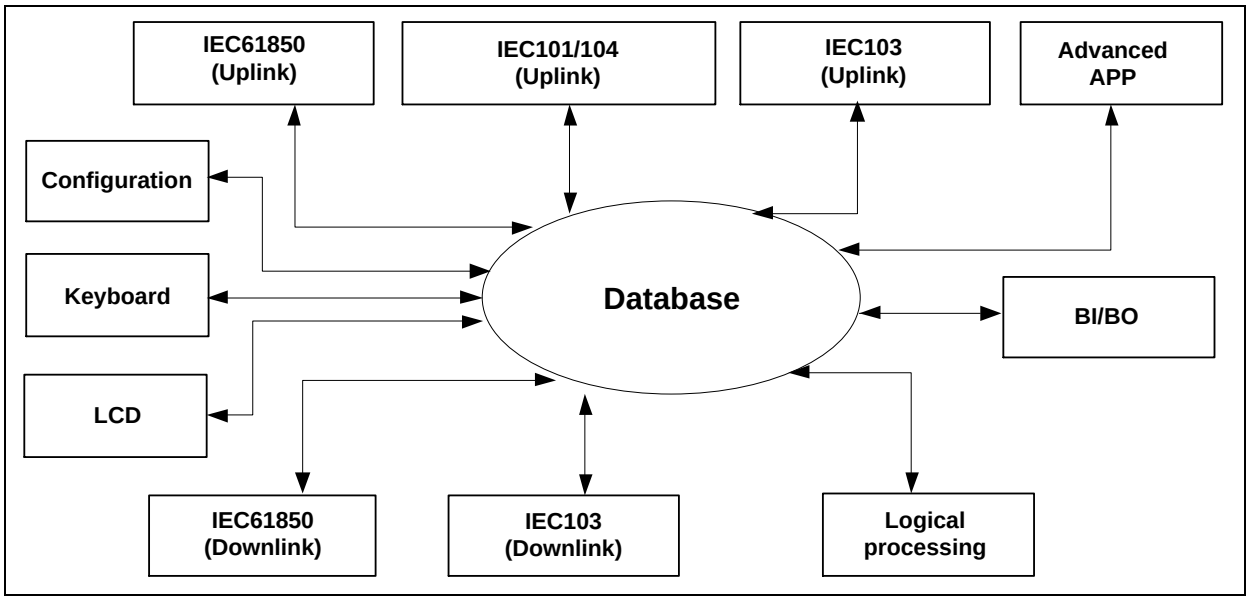

Figure 3.1-1 Software Structure

3.2 Functions of Modules

The details of the modules are listed in following table:

No.	Subsystem	Function
1	Database system	Responsible for the data control and management of the data from device through the downlink protocols and the data to RCC through the uplink protocols. All the data of the device will be saved in the database.
2	Uplink protocol system	Responsible for the communication to the master station (control center, distribution center), includes: build the IEC61850/103 model of the whole substation and sent to the master station through IEC61850/103; interact with the master station through IEC101/104, CDT or other protocols, response the request from the master station and process the control command.
3	Downlink protocol system	Responsible for the communication within the substation, includes: connect to the IEDs with multiple protocols such as IEC61850/103, Modbus; process the control commands from master station.
4	GPS synchronization system	Responsible for the synchronization of the whole substation. Receive and analyze the synchronization signals (Net, IRIG-B, PPS, serial port); send out the standard time signals to the IEDs.

No.	Subsystem	Function
5	Binary input/output system	Responsible for the binary input and output. Acquire the status of IEDs' BI and send out BO base on the status of PCS-9799.
6	HMI system	Responsible for the Human-Machine interaction by indicators, LCD, Keyboard and configuration tools to realize the supervision of running status and communication messages, parameters setting, configurations, diagnose and analyze etc.
7	Logic system	Responsible for the edition and analysis of the synthesized signals; logic processing of the control block logic.
8	Advanced application system	Responsible for the realization of advanced functions.

4 Supervision

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4.1 Overview

When equipment is in energizing process before the LED "**HEALTHY**" is on, the equipment needs to be checked to ensure no errors. Therefore, the automatic supervision function, which checks the health of the system when startup and during normal operation, plays an important role.

The numerical device based on the microprocessor operations is suitable for implementing this automatic supervision function of the system.

In case a fatal fault is detected during automatic supervision, the equipment will be blocked. It means that the some modules of the device are out of service. Before you must re-energize the device to make device back into service, please find out the cause and inform the manufacturer.

When a failure is detected by the automatic supervision, it is followed with an LCD message, LED indication and alarm contact outputs. At the same time event recording will record the failure alarm which can be viewed in event recording report and be printed.

Table 4.1-1 Alarm description

No.	Item	Description	Blocking Device
Fail Signals			
1	Alm_Brd_Overall	The signal is always issued when a certain hardware error is detected, the device will be blocked and all the functions are not available.	Blocked
Alarm Signals			
2	Alm_Process	The certain module of the software is abnormal.	Unblocked
3	Alm_Insuf_Disk	The ROM is not enough for the data storage.	Unblocked
4	Alm_RecvMON1	The data synchronization module1 is out of service.	Unblocked
5	Alm_RecvMON2	The data synchronization module2 is out of service.	Unblocked
6	Alm_RecvMON3	The data synchronization module3 is out of service.	Unblocked
7	Alm_RecvMON4	The data synchronization module4 is out of service.	Unblocked
8	Alm_Cfg_DualDev_Diff	When running in the dual-device mode, the configuration files of two devices are not consistent.	Unblocked
9	Alm_Cfg_Backup_Diff	The on-duty configuration file and the backup configuration files are not consistent (the time stamp of these two files are not same).	Unblocked
10	Alm_MON1_DualDev_Diff	When running in the dual-device mode, the software running on the MON module 1 of the two devices are not consistent.	Unblocked
11	Alm_MON2/MON1_Diff	Within one device, the software running on the MON module 2 and the one on MON module 1 are not consistent.	Unblocked
12	Alm_MON3/MON1_Diff	Within one device, the software running on the MON module 3 and the one on MON module 1 are not consistent.	Unblocked

13	Alm_MON4/MON1_Diff	Within one device, the software running on the MON module 4 and the one on MON module 1 are not consistent.	Unblocked

Table 4.1-2 Troubleshooting

No.	Item	Handling suggestion
Fail Signals		
1	Alm_Brd_Overall	The signal is always issued when a certain hardware error is detected, the device will be blocked and all the functions are not available, please check the hardware of the device (module misplaced, module loose etc.) and contact the manufacturer.
Alarm Signals		
2	Alm_Process	Generally it will recover automatically, if not, please contact the manufacturer.
3	Alm_Insuf_Disk	Generally it will recover automatically, if not, please contact the manufacturer.
4	Alm_RecvMON1	Generally it will recover automatically, if not, please contact the manufacturer.
5	Alm_RecvMON2	Generally it will recover automatically, if not, please contact the manufacturer.
6	Alm_RecvMON3	Generally it will recover automatically, if not, please contact the manufacturer.
7	Alm_RecvMON4	Generally it will recover automatically, if not, please contact the manufacturer.
8	Alm_Cfg_DualDev_Diff	Please check the configuration files or re-download the same file into the two devices.
9	Alm_Cfg_Backup_Diff	Please re-download the latest configuration file into the device and reboot.
10	Alm_MON1_DualDev_Diff	Please contact the manufacturer to update the software of the two devices.
11	Alm_MON2/MON1_Diff	Please contact the manufacturer to update the software of the device.
12	Alm_MON3/MON1_Diff	Please contact the manufacturer to update the software of the device.
13	Alm_MON4/MON1_Diff	Please contact the manufacturer to update the software of the device.

NOTE! If the equipment still cannot restore to normal operation state after suggested procedures, and the on-site engineer cannot locate the problem. Try to reset the device or reboot the device, if it still doesn't work, please inform the manufacturer or the agent for maintenance.

5 Hardware

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5.1 Overview

PCS-9799 is designed based on the new generation of UAPC platform; it adopts 32-bit dual-core high preference processor as its central unit for the communication management, database arrangement, advanced application analyzes, and fault detection; meanwhile it also adopts DDR2 mega RAM to ensure the real-time, high-speed calculation. With the massive storage disk, the hardware of the device is highly integrated which gives the device high extensibility and maintainability. The internal data bus is based on the high-speed Ethernet, which make sure the communications between each module are highly efficient and enable the distribute computing, balance the system load, enhance the system extensibility.

Following figures show front and rear views of PCS-9799 respectively.

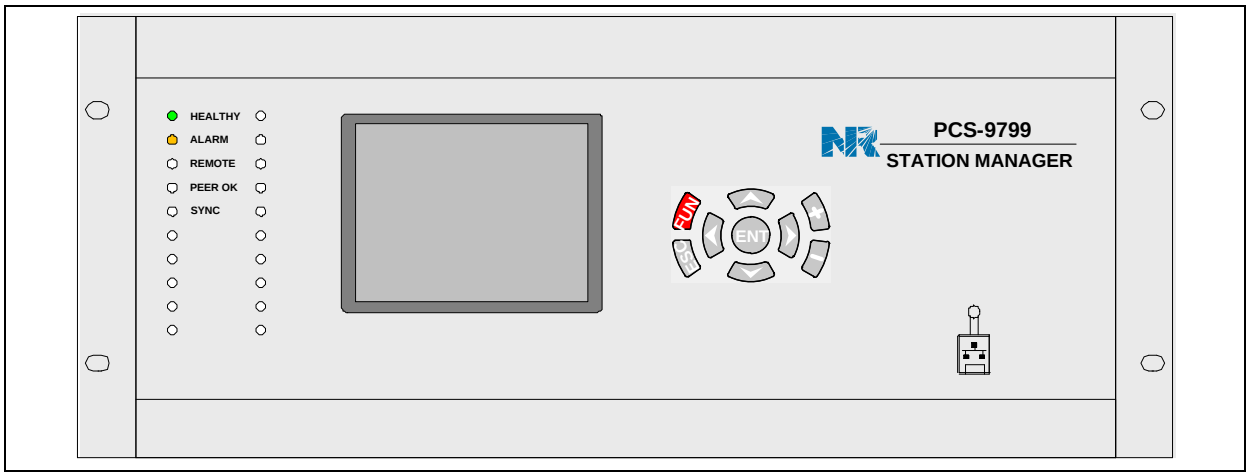


Figure 5.1-1 Front view of PCS-9799

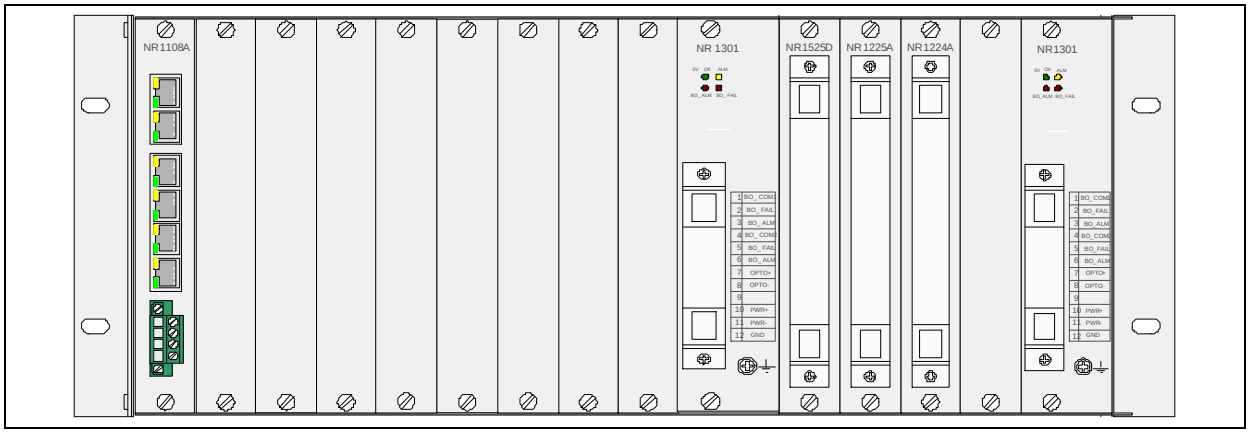


Figure 5.1-2 Rear view of PCS-9799

5.2 Plug-in Module Terminal Definition

Equipment consists of power supply module, MON module, DSP module, output module, signal output module. The definition and application of each module and its terminal is introduced as follows:

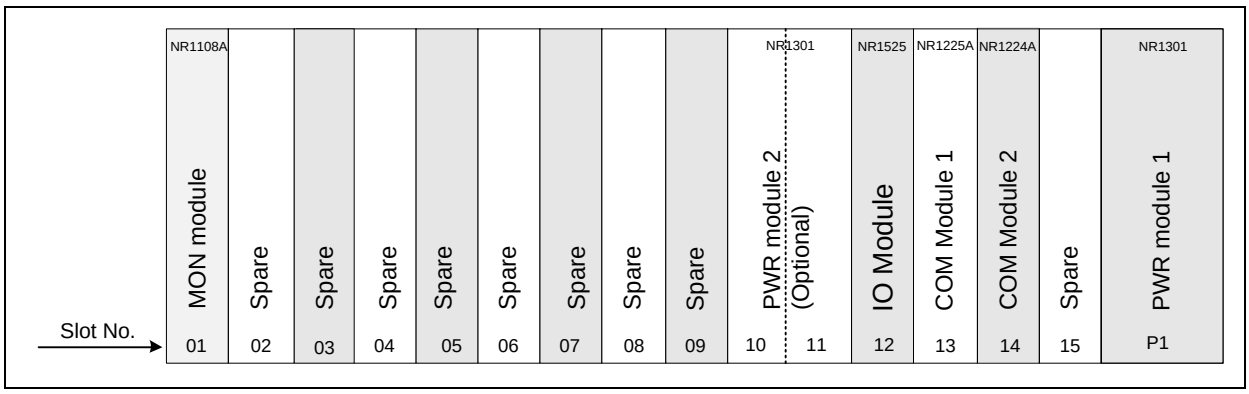


Figure 5.2-1 Rear view of fixed module position

5.2.1 PWR Module (Power Supply)

The power supply module (NR1301) is a DC/DC or AC/DC converter with electrical insulation between input and output. The power supply module has an input voltage range as described in *Chapter "Technical Data"*. The standardized output voltages are +3.3V, +5V, ±12V and +24V DC. The tolerances of the output voltages are continuously monitored.

The +3.3V DC output provides power supply for the microchip processors, and the +5V DC output provides power supply for all the electrical elements that need +5V DC power supply in this device. The ±12V DC output provides power supply for A/D conversion circuits in this device, and the +24V DC output provides power supply for the static relays of this device.

The use of an external miniature circuit breaker is recommended. The miniature circuit breaker must be in the on position when the device is in operation and in the off position when the device is in cold reserve.

A 12-pin connector is fixed on the front of the power supply module at slot P1. The pin definition of the connector is described as below.

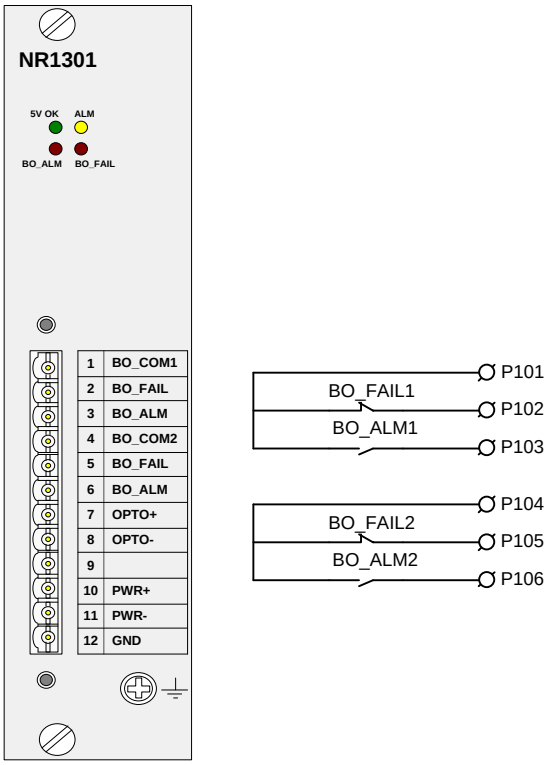


Figure 5.2-2 Pin definition of DC power supply module NR1301

Pin No.	Symbol	Description
01	BO_COM1	Common terminal 1
02	BO_FAIL	Device failure output 1 (01-02, NC)
03	BO_ALM	Device abnormality alarm output 1 (01-03, NO)
04	BO_COM2	Common terminal 2
05	BO_FAIL	Device failure output 2 (0104-0105, NC)
06	BO_ALM	Device abnormality alarm output 2 (0104-0106, NO)
07	OPTO+	Positive pole of power supply for Low-voltage BI module (24V)
08	OPTO-	Negative pole of power supply for Low-voltage BI module (24V)
09		Not used
10	PWR+	Positive pole of power supply for the device (250/220V/125/110V)
11	PWR-	Negative pole of power supply for the device (250/220V/125/110V)
12	GND	Grounded connection of the device

NOTE! The rated voltage of DC power supply module is self-adaptive to 220Vdc and 110Vdc, but the power supply in other DC voltage level or power supply of AC voltage need to be specially ordered, and check if the rated voltage of power supply module is the same as the voltage of external control power supply before equipment being put into

service.

NOTE! The DC power supply module provides pin 0112 and earth connector for grounding of equipment. The pin 0112 shall be connected to earth connector and the connected to the earth copper bar of panel via dedicated grounding wire.

NOTE! Effective grounding is the most important measure for equipment to prevent EMI, so effective grounding must be ensured before the device is put into operation.

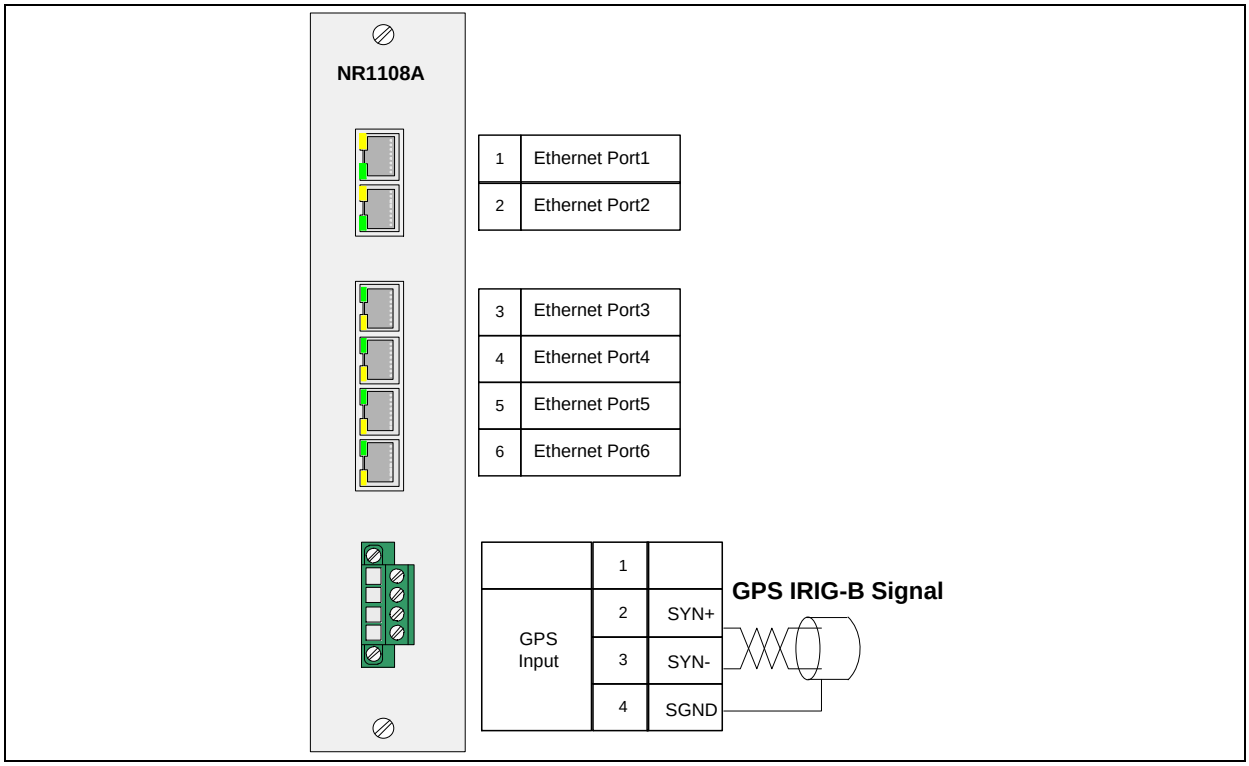
5.2.2 MON Module (Management)

The terminals of MON module (NR1108) and its wiring method are shown in the following figure.

The MON module uses the internal bus to receive the data from other modules of the device. It communicates with the LCD module by RS-485 bus. This module is provided with 100BaseT Ethernet interfaces, PPS/IRIG-B differential time synchronization interface.

The detail performance is as follows:

- RAM: DDR2-667, 1G/2G
- Program space: 128M
- Storage: 4G-128G
- Ethernet Port: 12 100M/10M self-adoptive net ports
- Synchronisation: 1 GPS input interface.



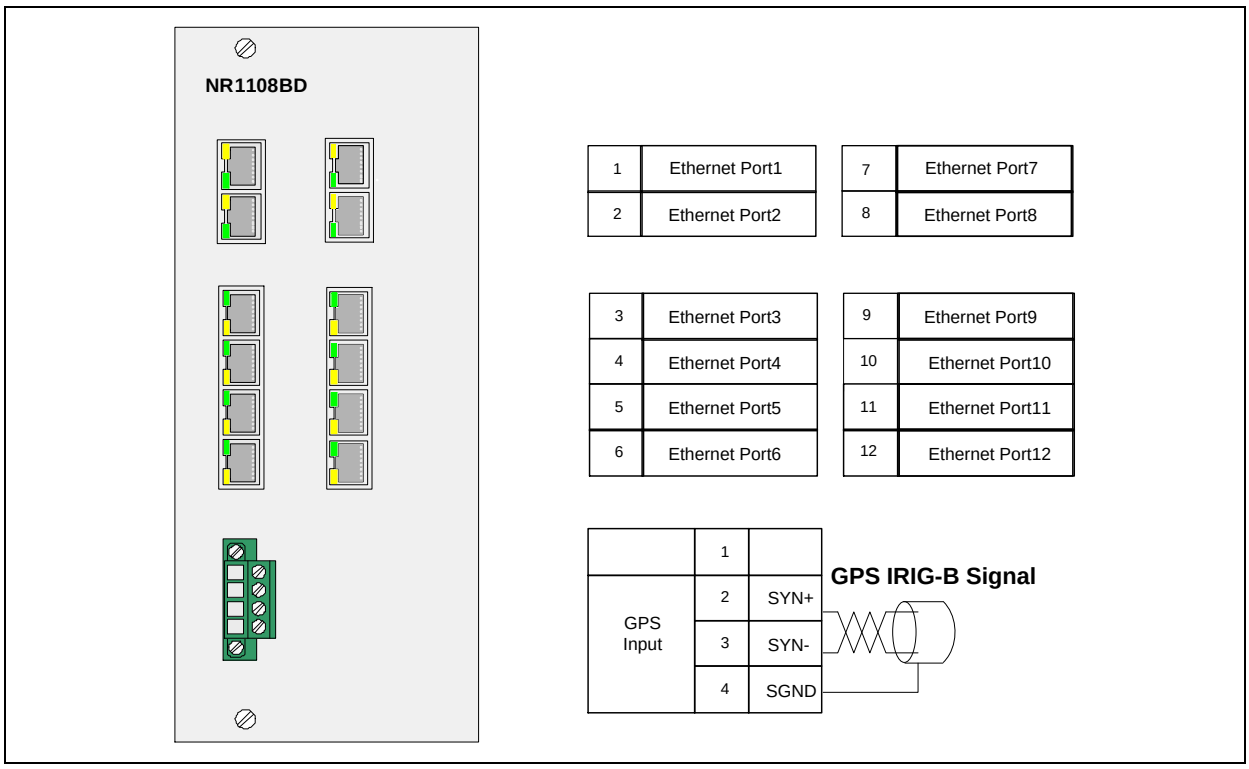


Figure 5.2-3 Rear view of MON module

NOTE! The device supports at most four MON modules, the additional MON modules can be applied in slot 03, 05, 07.

The correct method of connection is shown in *Figure 5.2-4.* Generally, the shielded cables with two pairs of twisted pairs inside shall be applied. One pair of the twisted pairs are respectively used to connect the "+" and "–" terminals of differential signal; the other pair of twisted pairs are used to connect the signal ground of the interface, i.e. connect the signal groundings of all the devices connected with the bus to the twisted pair. The module reserves a free terminal for all the communication ports; the blank terminal does not need to be connected.

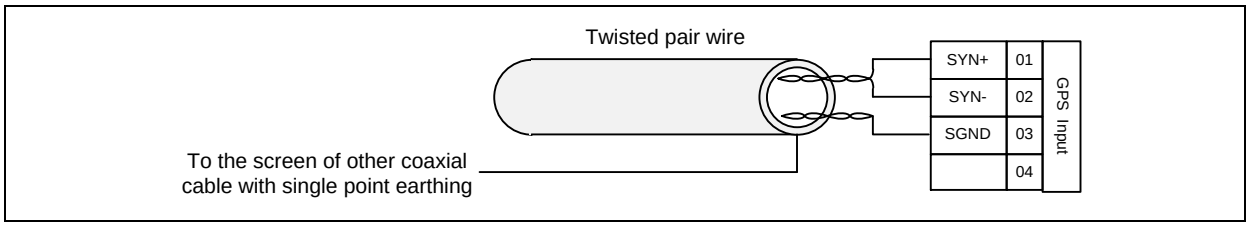


Figure 5.2-4 Wiring of synchronization interface

5.2.3 IO Module (Binary Input and Output)

The IO module (NR1525) provides 13 self-adoptive binary inputs and 4 outputs. The BI meets the specification:

The IO module is with a 22-pin connector for 13 binary inputs and 4 outputs is shown in the following figure.

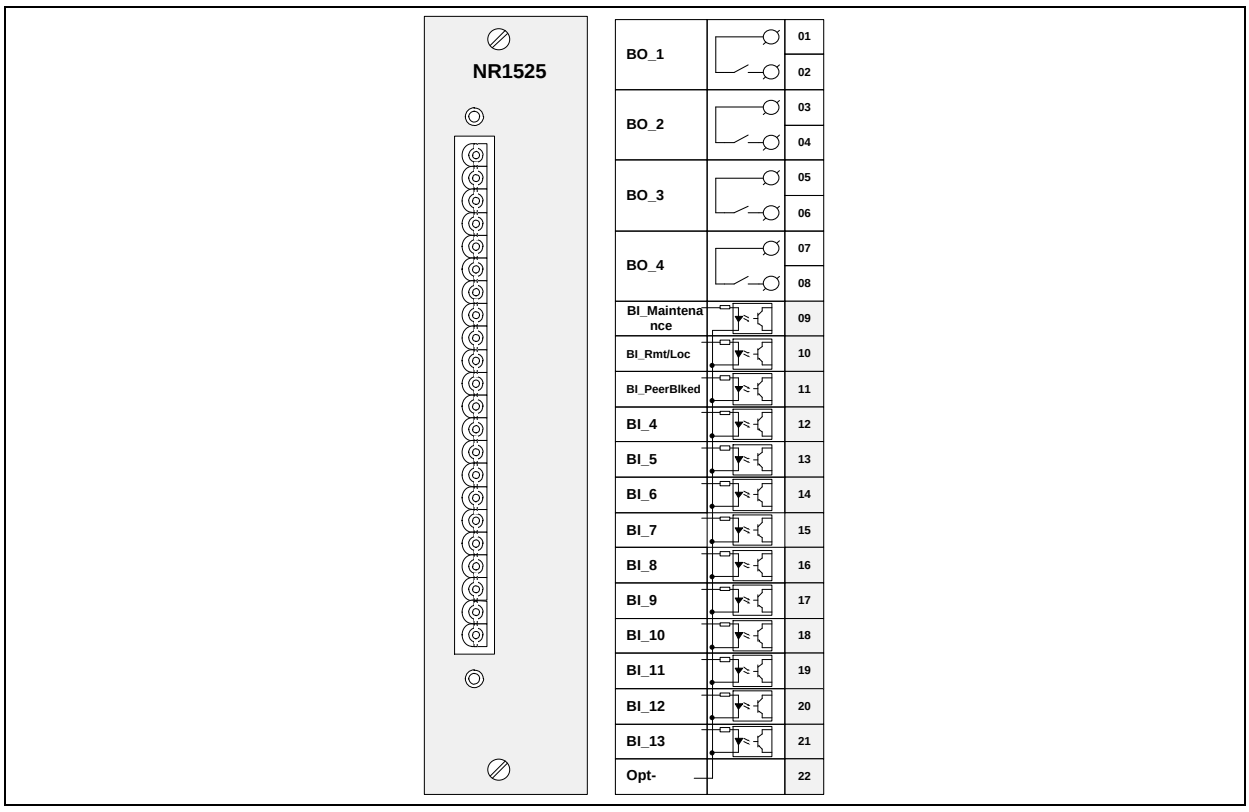


Figure 5.2-5 Pin definition of IO module (NR1525)

The pin definition of NR 1525D is shown as follows respectively.

Pin No.	Defined Symbol	Description
1	BO_1	Binary output 1 (NO) controlled by software.
2		
3	BO_2	Binary output 2 (NO) controlled by software.
4		
5	BO_3	Binary output 3 (NO) controlled by software.
6		
7	BO_4	Binary output 4 (NO) controlled by software.
8		
9	BI_Maintenance	Binary input of indicating the device is under maintenance state.
10	BI_Rmt/Loc	Binary input to switch the local/remote mode.
11	BI_PeerBlked	Binary input of indicating the peer device is blocked.
12	BI_4	Binary input 4.
13	BI_5	Binary input 5.
14	BI_6	Binary input 6.
15	BI_7	Binary input 7.
16	BI_8	Binary input 8.
17	BI_9	Binary input 9.
18	BI_10	Binary input 10.

Pin No.	Defined Symbol	Description
19	BI_11	Binary input 11.
20	BI_12	Binary input 12.
21	BI_13	Binary input 13.
22	Opt-	Negative pole of binary input.

1. Binary input: [BI_Maintenance]

It is used to block communication export when the BI is energized. During equipment maintenance or testing, the BI is then energized not to send reports via communication port, local display and printing still work as usual. The BI should be de-energized when the equipment is restored back to normal.

2. Binary input: [BI_Rmt/Loc]

Binary input to switch the local/remote mode, if it is energized then the device can be controlled remotely, and it can transpond the signal from RCC to IEDs.

3. Binary input: [BI_PeerBlked]

It is used to identify that the other device is blocked, when dual-device configuration is applied.

PCS-9799 can use this module to realize the inter-block between the on-duty device and backup device. The wiring is shown in following figure.

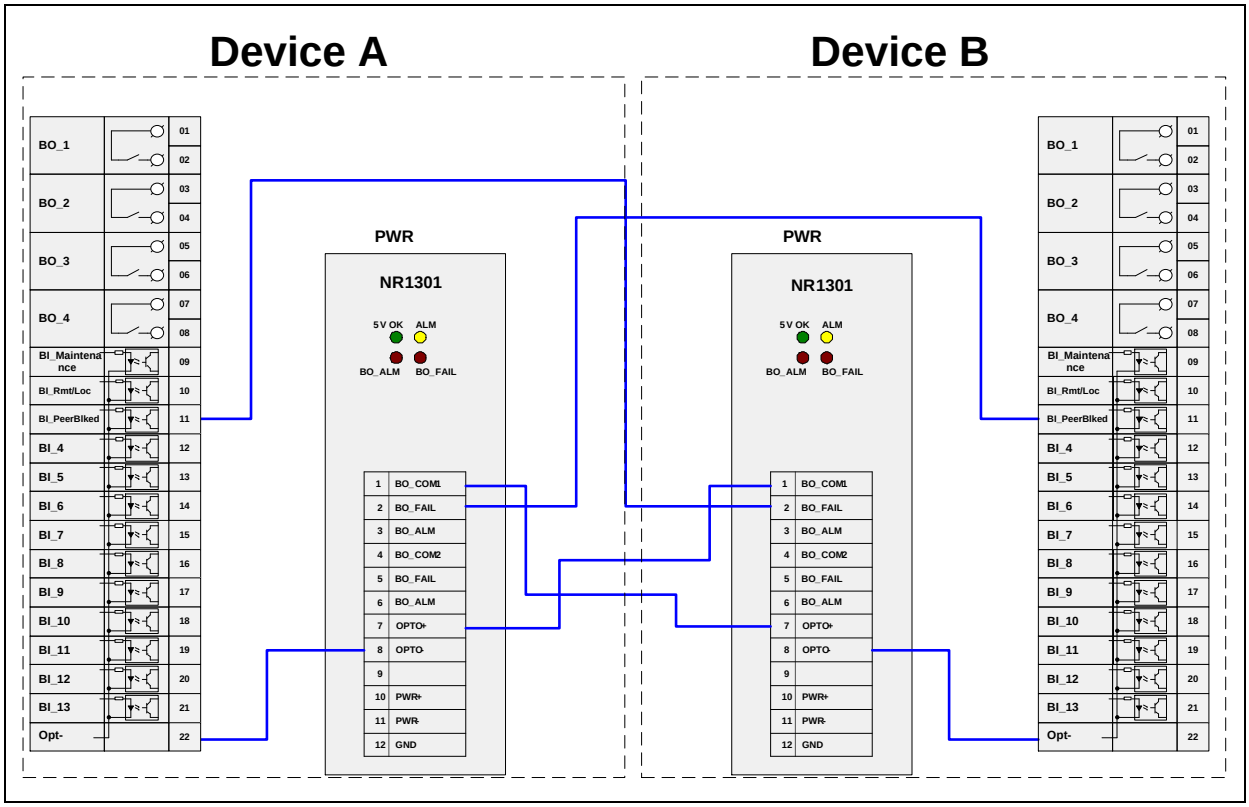


Figure 5.2-6 Wiring of inter-block mode

5.2.4 COM Module

NOTE! The device supports at most 3 COM modules, the COM modules can be applied in slot 13, 14, 15.

- NR1224

The COM module can provide 5 serial ports (RS-485/RS-232), besides, the No.5 port can be set to support RS-422.

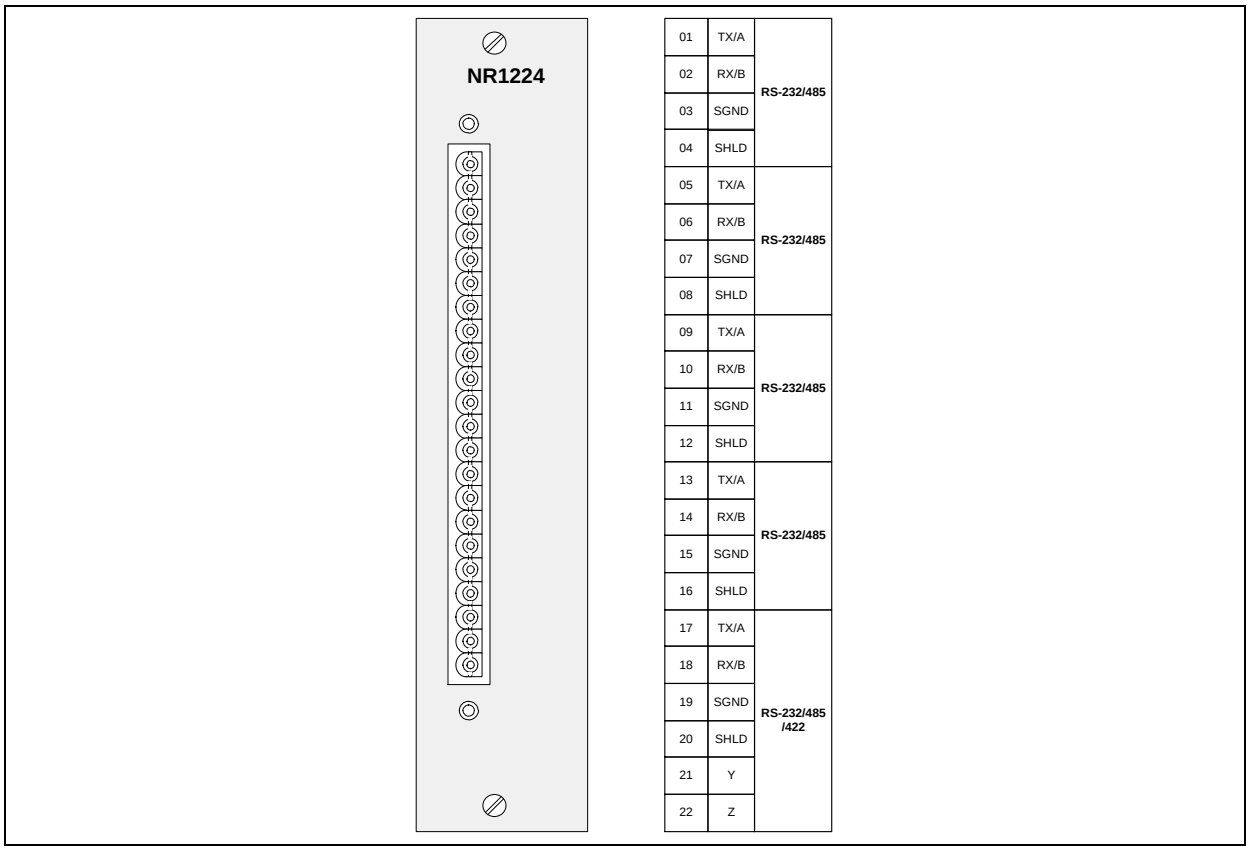


Figure 5.2-7 COM Module

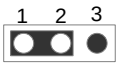
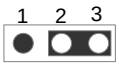
The pin definitions are listed in following table:

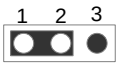
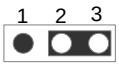
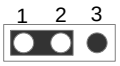
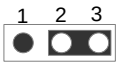
Pin No.	Defined Symbol	Description	Port No.
01	TX/A	RS-232: TX(Send) RS-485: A	Serial port 1
02	RX/B	RS-232: RX(Receive) RS-485: B	
03	SGND	RS-232/RS-485 signal earth	
04	SHLD	RS-232/RS-485 shielded layer	

Pin No.	Defined Symbol	Description	Port No.
05	TX/A	RS-232: TX(Send) RS-485: A	Serial port 2
06	RX/B	RS-232: RX(Receive) RS-485: B	
07	SGND	RS-232/RS-485 signal earth	
08	SHLD	RS-232/RS-485 shielded layer	
09	TX/A	RS-232: TX(Send) RS-485: A	Serial port 3
10	RX/B	RS-232: RX(Receive) RS-485: B	
11	SGND	RS-232/RS-485 signal earth	
12	SHLD	RS-232/RS-485 shielded layer	
13	TX/A	RS-232: TX(Send) RS-485: A	Serial port 4
14	RX/B	RS-232: RX(Receive) RS-485: B	
15	SGND	RS-232/RS-485 signal earth	
16	SHLD	RS-232/RS-485 shielded layer	
17	TX/A	RS-232: TX(Send) RS-485,RS-422: A	Serial port 5
18	RX/B	RS-232: RX(Receive) RS-485,RS-422: B	
19	SGND	RS-232/RS-485 signal earth	
20	SHLD	RS-232/RS-485 shielded layer	
21	Y	RS-422: Y	
22	Z	RS-422: Z	

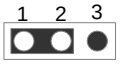
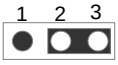
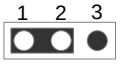
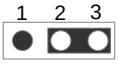
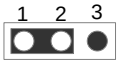
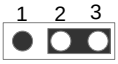
The configuration of each serial port is realized by the wire jumper, the details of each port are listed in following tables.

- Serial port 1

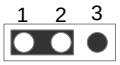
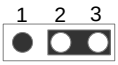
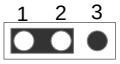
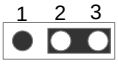
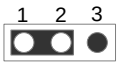
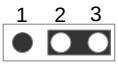
Jumper	RS-485	RS-232
P7		

Jumper	RS-485	RS-232
P8		
P9		
P5	 	

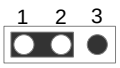
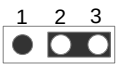
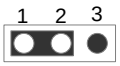
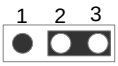
- Serial port 2

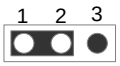
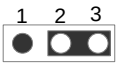
Jumper	RS-485	RS-232
P12		
P13		
P14		
P10	 	

- Serial port 3

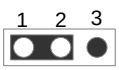
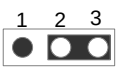
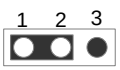
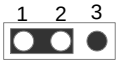
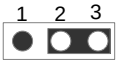
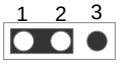
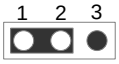
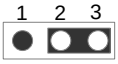
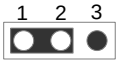
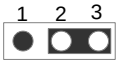
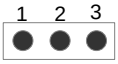
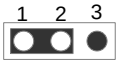
Jumper	RS-485	RS-232
P17		
P18		
P19		
P115	 	

- Serial port 4

Jumper	RS-485	RS-232
P22		
P23		

Jumper	RS-485	RS-232
P24		
P20	 	

- Serial port 5

Jumper	RS-485	RS-232	RS-422
P27			
P28			
P29			
P30			
P31			
P32			
P25	 		
P33			 

NOTE! When the port 1 is used as RS-485 port, the P5 is used as matched resistance.

Normally the jumper is not necessary, if the communication quality is not good enough then users can use this to enhance the quality. Similar principles are adopted in other ports:

Port 2 as RS-485 P10 as matched resistance.

Port 3 as RS-485 P15 as matched resistance.

Port 4 as RS-485 P25 as matched resistance.

Port 5 as RS-422 P33 as matched resistance.

- NR1225

This module provide serial port and modem communication.

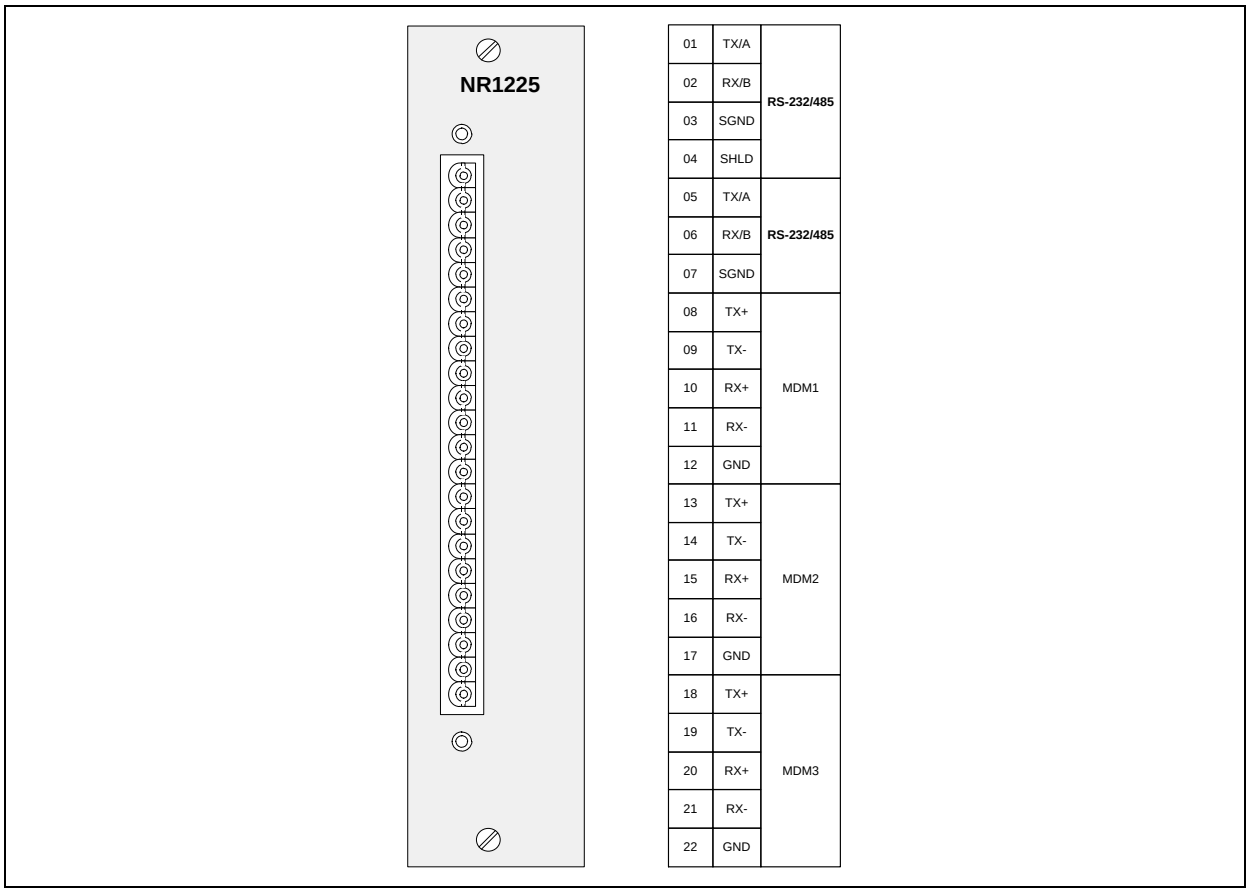


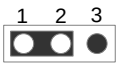
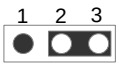
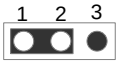
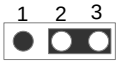
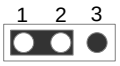
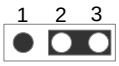
Figure 5.2-8 MDM Module

Pin definitions are as follows:

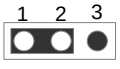
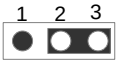
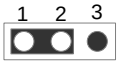
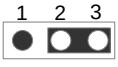
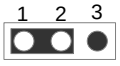
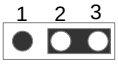
Pin No.	Defined Symbol	Description	Port No.
01	TX/A	RS-232: TX(Send) RS-485: A	Serial port 1
02	RX/B	RS-232: RX(Receive) RS-485: B	
03	SGND	RS-232/RS-485 signal earth	
04	SHLD	RS-232/RS-485 shieled layer	
05	TX/A	RS-232: TX(Send) RS-485: A	Serial port 2
06	RX/B	RS-232: RX(Receive) RS-485: B	

Pin No.	Defined Symbol	Description	Port No.
07	SGND	RS-232/RS-485 signal earth	
08	TX+	Modem Send +	MDM1
09	TX-	Modem Send -	
10	RX+	Modem Receive+	
11	RX-	Modem Receive +	
12	GND	Modem signal earth	
13	TX+	Modem Send +	MDM2
14	TX-	Modem Send -	
15	RX+	Modem Receive +	
16	RX-	Modem Receive +	
17	GND	Modem signal earth	
18	TX+	Modem Send +	MDM3
19	TX-	Modem Send -	
20	RX+	Modem Receive +	
21	RX-	Modem Receive +	
22	GND	Modem signal earth	

- Serial port 1

Jumper	RS-485	RS-232
P7		
P8		
P9		
P5	 	

- Serial port 2

Jumper	RS-485	RS-232
P12		
P13		
P14		
P10		

Jumper	RS-485	RS-232
		

NOTE! When the port 1 is used as RS-485 port, the P6 is used as matched resistance.

Normally the jumper is not necessary, if the communication quality is not good enough then users can use this to enhance the quality. Similar principles are adopted in other ports:

Port 2 as RS-485 P11 as matched resistance.

6 Human Machine Interface

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6.1 Overview

The human-machine interface consists of a human-machine interface (HMI) module which allows a communication to be as simple as possible for the user. The HMI module helps to draw your attention to something that has occurred which may activate a LED or a report displayed on the LCD. Operator can locate the data of interest by navigating the keypad.

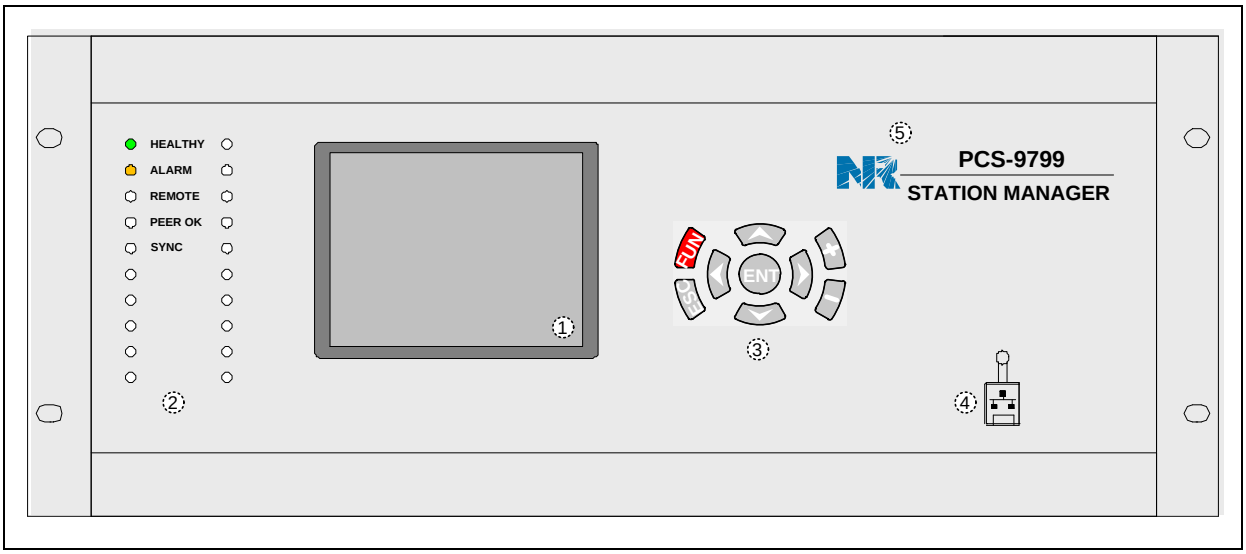

Figure 6.1-1 Front panel of PCS-9799

The function of HMI module:

No.	Item	Description
1	LCD	A 320×240 dot matrix backlight LCD display is visible in dim lighting conditions. The corresponding messages are displayed when there is operation implemented.
2	LED	20 status indication LEDs, first three LEDs are fixed as the signals of "**HEALTHY**" , "**ALARM**" and "**REMOTE**", "**PEER OK**", "**SYNC**", others are configurable.
3	Keypad	Navigation keypad and command keys for full access to device
4	Communication port	a multiplex RJ45 port for local communication with a PC
5	Logo	Type and designation and manufacturer of device

6.1.1 Keypad Operation

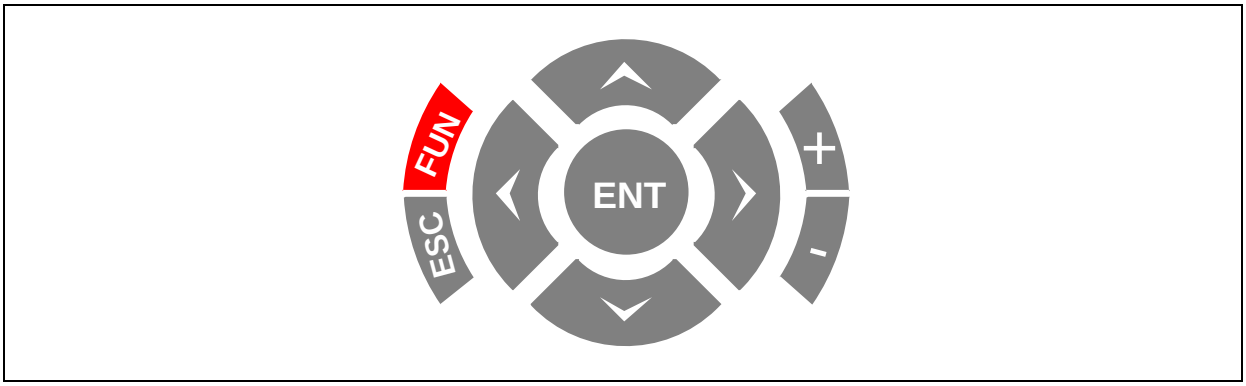

Figure 6.1-2 Keypad mounted on the front panel

1. "**ESC**":
   - Cancel the operation
   - Quit the current menu
2. "**ENT**":
   - Execute the operation
   - Confirm the interface
3. "**FUN**"
   - Activate the switching function
4. leftward and rightward direction keys ("◄" and "►"):
   - Move the cursor horizontally
   - Enter the next menu or return to the previous menu
5. upward and downward direction keys ("▲" and "▼")
   - Move the cursor vertically
   - Select command menu within the same level of menu
6. plus and minus sign keys ("＋" and "－")
   - Modify the value
   - Modify and display the message number
   - Page up/down

6.1.2 LED Indications

A brief explanation has been made as bellow.

LED	Display	Description
HEALTHY	Off	When the equipment is out of service or any hardware error is detected during self-check.
	Green	Lit when the equipment is in service and running well.
ALARM	Off	When equipment in normal operating condition.
	Yellow	Lit when abnormal alarm is issued.
REMOTE	Off	When the device is in local control.
	On	When the BI of enable remote control is energized, it indicates that the device can be controlled remotely.
PEER OK	Off	When the peer device is block or the communication between the two station managers is abnormal.
	On	Indicates that the communication between the two station managers is ok.
SYNC	Off	No synchronization signal is received.
	On	The device is successfully synchronized with the time source.

NOTE! The **"HEALTHY"** LED can only be turned on by energizing the equipment again to restart the relay.

6.1.3 Ethernet Pot Setup

MON plug-in module is equipped with 100Base-TX Ethernet interface. The Ethernet port can be used to communication with PC via auxiliary software. At first, the connection between the device and PC must be established. Through setting the IP address and subnet mask of corresponding Ethernet interface in the menu "**Settings→Comm Settings→IP**", it should be ensured that the protection device and PC are in the same network segment. For example, setting the IP address and subnet mask of network A. (using network A to connect with PC)

PC: IP address is set as "198.87.96.102", subnet mask is set as "255.255.255.0"

6.2 Ports for Debugging

In the front panel of PCS-9799, a "Console" port is designed for configuration. This "Console" port adopts RJ45 terminal in which an Ethernet and a RS232 port are integrated.

By default, please logon and configure the device. RS-232 port is a backup port for users to monitor the startup process or do other operations.

As shown in the following figure, a customized cable is applied for debugging via this multiplex RJ45 port.

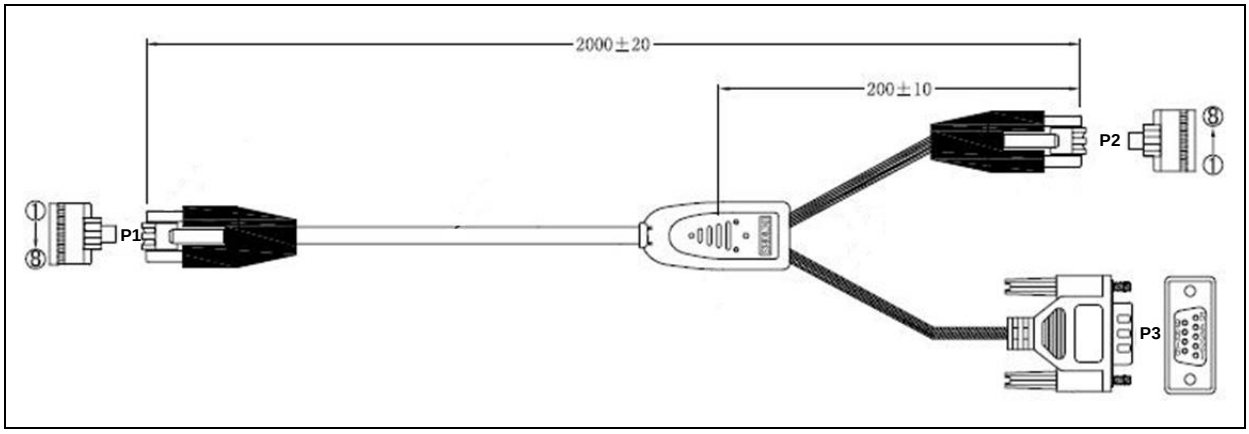

Figure 6.2-1 Corresponding cable of the RJ45 port in the front panel

In the above figure and the following table:

P1: To connect the multiplex RJ45 port. An 8-core cable is applied here.

P2: To connect the twisted-pair Ethernet port of the computer.

P3: To connect the RS-232 serial port of the computer.

The definition of the 8-core cable in the above figure is introduced in the following table.

Table 6.2-1 Definition of the 8-core cable

Terminal No.	Core color	Function	Device side (Left)	Computer side (Right)
1	Orange & white	TX+ of the Ethernet port	P1-1	P2-1
2	Orange	TX- of the Ethernet port	P1-2	P2-2
3	Green & white	RX+ of the Ethernet port	P1-3	P2-3
4	Blue	TXD of the RS-232 serial port	P1-4	P3-2
5	Brown & white	RXD of the RS-232 serial port	P1-5	P3-3
6	Green	RX- for the Ethernet port	P1-6	P2-6
7	Blue & white	The ground connection of the RS-232 port.	P1-7	P3-5
8	Brown		P1-8	

6.3 Understand the HMI Menu Tree

6.3.1 Overview

Press “▲” of any running interface and enter the main menu. Select different submenu by “▲” and “▼”. Enter the selected submenu by pressing “**ENT**” or “►”. Press “◄” and return to the previous menu. Press “ESC” and exit the main menu directly. For sake of executing the command menu again, one command menu will be recorded in the quick menu after its first execution. Five latest menu commands can be recorded in the quick menu. When the five menu commands are recorded, the latest menu command will cover the earliest one, adopting the “first in first out” principle. It is arranged from top to bottom and in accordance with the execution order of command menus. Press “▲” to enter the main menu with the interface as shown in the following diagram:

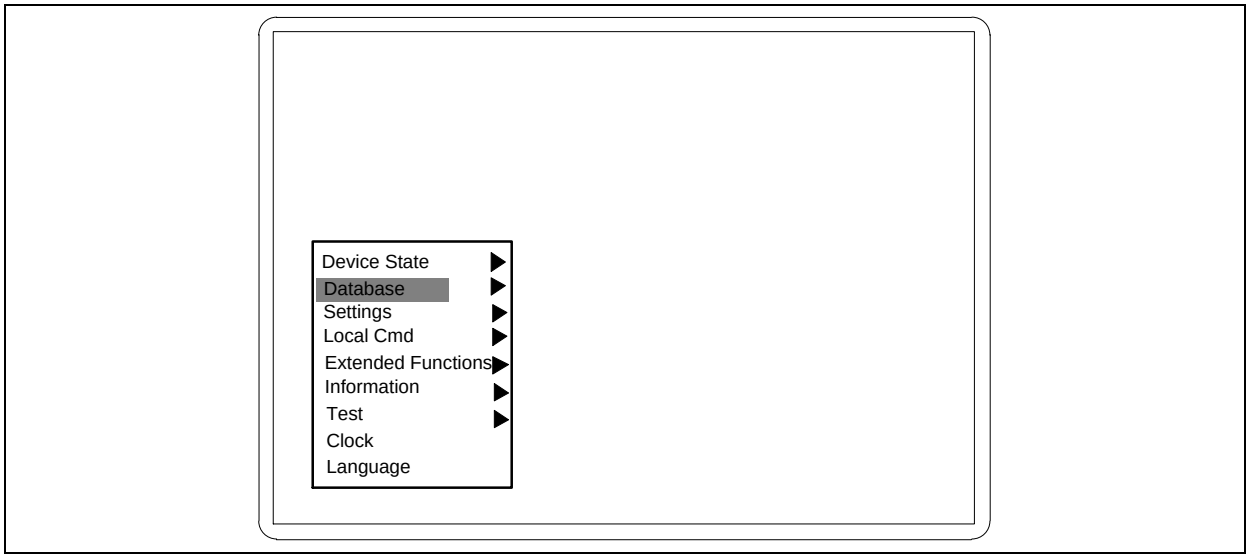

Figure 6.3-1 The default menu of PCS-9799

For the first powered device, there is no recorded shortcut menu. Press "▲" to enter the main menu with the interface as shown in the following diagram:

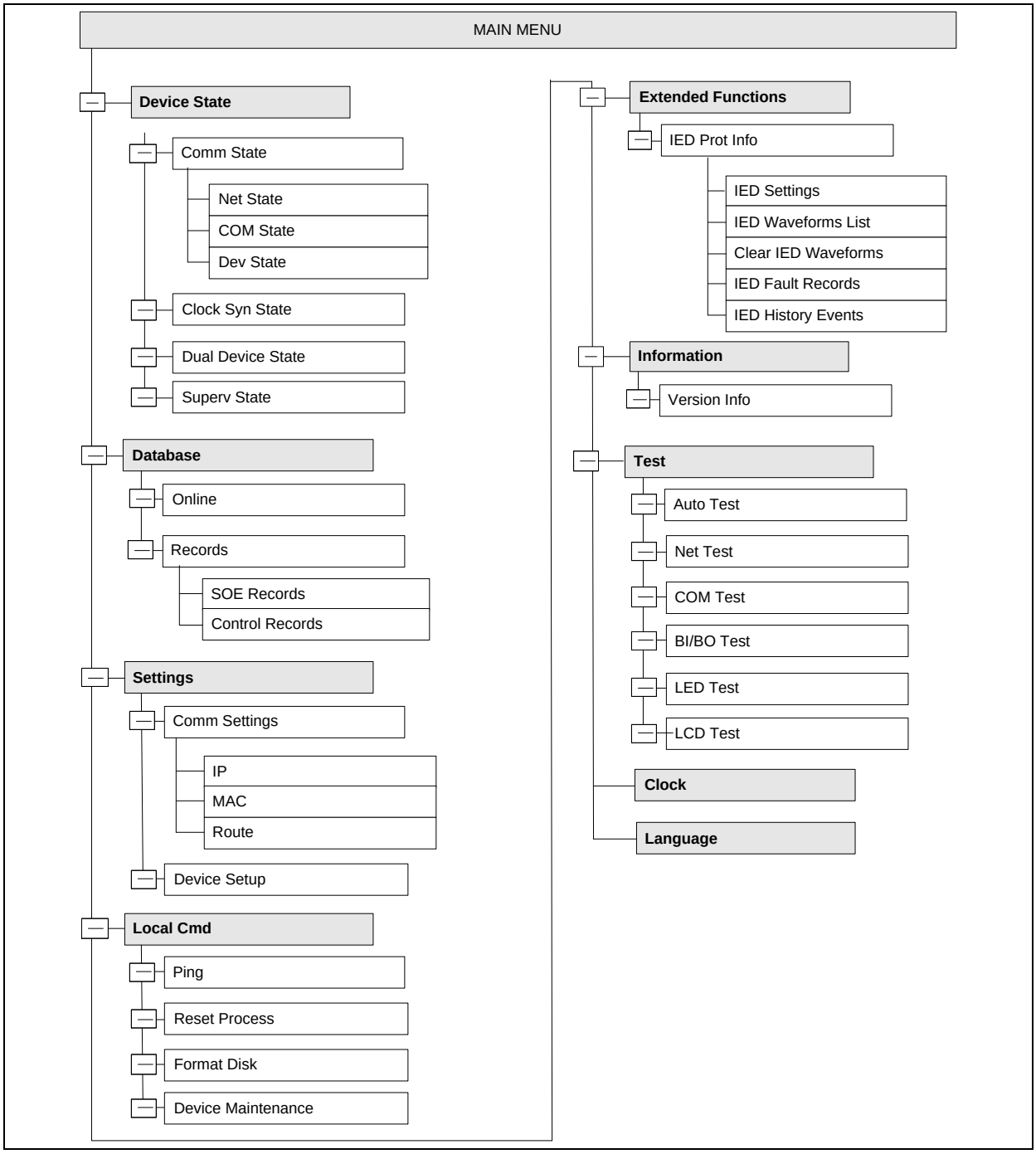

Figure 6.3-2 Tree diagram of total command menu

Under the main interface, press "▲" to enter the main menu, and select submenu by pressing "▲", "▼" and "ENT". The command menu adopts a tree shaped content structure. The above diagram provides the integral structure and all the submenus under menu tree of the protection device.

NOTE! The menu shown in above figure is not the specific-application menu. For each project, the menu varies with the configuration.

6.3.2 Device State

This menu is mainly used to display the real time states of the device, including the communication

states, the clock synchronization states, the state of the peer device and the alarms etc.

The menu "**Device State**" has following submenus.

No.	Item	Description
1	Comm State	To display the states of the communication with IEDs connected to this device.
2	Clock Syn State	To display the states of the clock synchronization.
3	Dual Device State	To display the states of the peer device.
4	Superv State	To display the alarms of this device.

6.3.2.1 Comm State

The menu "**Comm State**" has following submenus.

No.	Item	Description
1	Comm State	The communication states of the devices.
2	Net State	The communication states of the net ports.
3	COM State	The communication states of the COM ports.

6.3.3 Database

This menu is mainly used to display the state of the real-time and historical data.

The menu "**Database**" has following submenus.

No.	Item	Description
1	Online	To display all the real-time data including the binary inputs, the measurements, the tap positions, the metering data, the settings, parameters and etc.
2	Records	To display all the historical data, including SOE reports and operation reports.

6.3.3.1 History

The menu "**History**" has following submenus.

No.	Item	Description
1	SOE Records	To display the SOE (sequence of event) reports.
2	Control Records	To display the operation reports.

6.3.4 Settings

This menu is used to configure the parameters of the device, which include the device address, ID, IP address, MAC address, the route table etc.

This menu includes the following command menus.

No.	Item	Function description
1	Comm Settings	To display and set and set the IP, MAC address and the route table.
2	Device Setup	To display and set and set the device address and ID.

NOTE! To validate the new parameters of this menu, please reboot the device after the modification.

6.3.4.1 Net

The menu "**Net**" has following submenus.

No.	Item	Description
1	IP	To display and set IP address.
2	MAC	To display and set MAC address.
3	Route	To display and set the route table.

6.3.5 Local Cmd

This menu is used to do certain operation on the device.

This menu includes the following command menus.

No.	Item	Function description
1	Ping	To ping a certain IP or network segment for testing.
2	Reset Process	To reset the progress of certain application.
3	Format Disk	To format the disk (flash).
4	Device Maintenance	To enable the state of maintenance of the device.

6.3.6 Extended Functions

This menu is used to do display and configure the date, which related to the PMU function and the protection signal management function of the device.

This menu includes the following command menus.

No.	Item	Function description
1	IED Prot Info	To upload and display all the protection information connected to the device, which includes the protection settings, wave files, etc. and users can search and delete certain fault report and the historical event.

6.3.6.1 IED Prot Info

The menu "**IED Prot Info**" has following submenus.

No.	Item	Function description
1	IED Settings	To display the settings of the protection devices.
2	IED Waveforms List	To display the waveforms of the protection devices.
3	Clear IED Waveforms	To delete the waveforms of the protection devices.
4	IED Fault Records	To display the fault reports of the protection devices.
5	IED History Events	To display the historical events of the protection devices.

6.3.7 Information

This menu is mainly used to display the version of the firmware, the version of the configuration and the time of downloading the configuration.

6.3.8 Test

This menu is used to do the testing of the device.

This menu includes the following command menus and submenus.

No.	Item	Function description
1	Auto Test	To start the entire test automatically.
2	Net Test	To start the self-test of all the net port of the MON board.
3	COM Test	To start the self-test of the serial port of the device.
4	BI/BO Test	To start the self-test of the BI and BO board of the device.
5	LED Test	To start the self-test of the 17 indicators of the device.
6	LCD Test	To start the self-test of the LCD display of the device.

6.3.9 Clock

This menu is mainly used to set the time of the device.

6.3.10 Language

This menu is mainly used to set LCD display language.

6.4 Understand the LCD Display

6.4.1 Overview

When the equipment is powered on, the LCD will display the following graph.

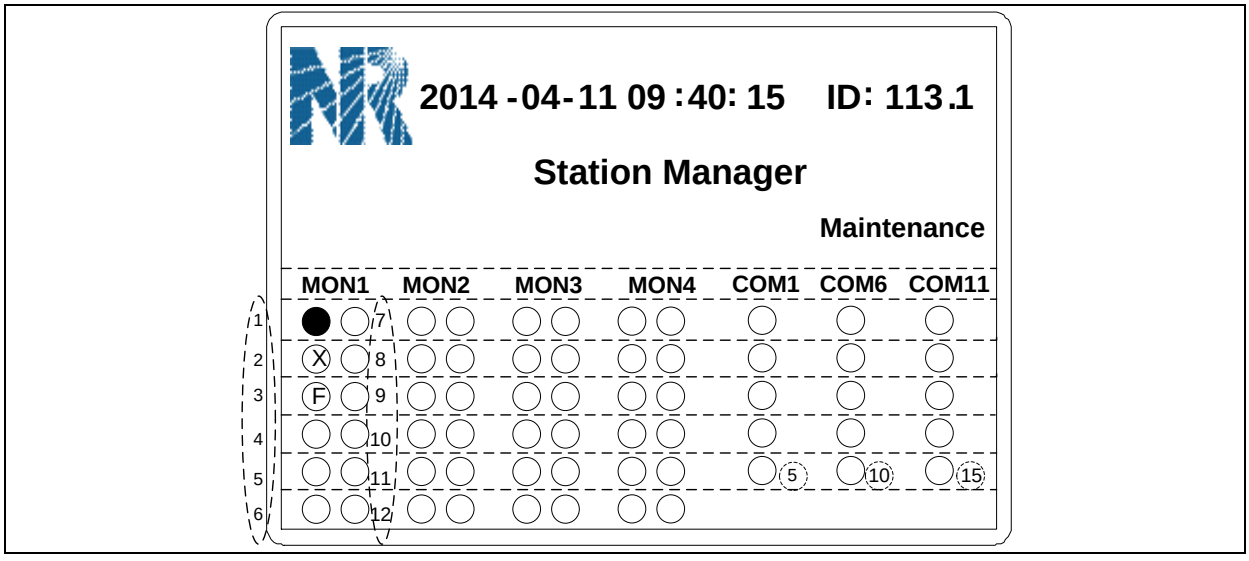

Figure 6.4-1 LCD display view of PCS-9799

This is the normal display of the LCD, each circle on the LCD represents a communication state of each port. The MONx (x=1,2,3,4) means the 4 MON boards, the 12 circles represents the 12 net ports of the board. The COMx (1, 6,11) means the three COM boards, each board has 5 COM ports.

The meaning of the circles:

●: This port is enabled and the communication is ok.

Ⓧ: This port is enabled but the communication is abnormal, if this is a net port, it means all the communications through this port are abnormal

Ⓕ: This port is enabled, but the physical connection is abnormal.

◯: This port is disabled.

7 Installation

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7.1 General

The equipment must be shipped, stored and installed with the greatest care.

Choose the place of installation such that the communication interface and the controls on the front of the device are easily accessible.

Air must circulate freely around the equipment. Observe all the requirements regarding place of installation and ambient conditions given in this instruction manual.

Take care that the external wiring is properly brought into the equipment and terminated correctly and pay special attention to grounding. Strictly observe the corresponding guidelines contained in this section.

7.2 Safety Instructions

Modules and units may only be replaced by correspondingly trained personnel. Always observe the basic precautions to avoid damage due to electrostatic discharge when handling the equipment.

In certain cases, the settings have to be configured according to the demands of the engineering configuration after replacement. It is therefore assumed that the personnel who replace modules and units are familiar with the use of the operator program on the service PC.

DANGER! Only insert or withdraw the PWR module while the power supply is switched off. To this end, disconnect the power supply cable that connects with the PWR module.

WARNING! Only insert or withdraw other modules while the power supply is switched off.

WARNING! Components can be damaged or destroyed by inserting boards in the wrong slots.

DANGER! Improper handling of the equipment can cause damage or an incorrect response of the equipment itself or the primary plant.

WARNING! Industry packs and ribbon cables may only be replaced or the positions of jumpers be changed on a workbench appropriately designed for working on electronic equipment. The modules, bus backplanes are sensitive to electrostatic discharge when not in the unit's housing.

The basic precautions to guard against electrostatic discharge are as follows:

- Only hold electronic boards at the edges, taking care not to touch the components.
- Always store and ship the electronic boards in their original packing. Place electronic parts in electrostatic screened packing materials.

7.3 Checking the Shipment

Check that the consignment is complete immediately upon receipt. Notify the nearest NR Company or agent, should departures from the delivery note, the shipping papers or the order be found.

Visually inspect all the material when unpacking it. When there is evidence of transport damage, lodge a claim immediately in writing with the last carrier and notify the nearest NR Company or agent.

If the equipment is not going to be installed immediately, store all the parts in their original packing in a clean dry place at a moderate temperature. The humidity at a maximum temperature and the permissible storage temperature range in dry air are listed in *Section 2.*

7.4 Material and Tools Required

The necessary mounting kits will be provided, including screws, pincers and assembly instructions.

A suitable drill and spanners are required to secure the cubicles to the floor using the plugs provided (if this device is mounted in cubicles).

7.5 Device Location and Ambient Conditions

The place of installation should permit easy access especially to front of the device, i.e. to the human machine interface of the equipment.

There should also be free access at the rear of the equipment for additions and replacement of electronic boards.

Since every piece of technical equipment can be damaged or destroyed by inadmissible ambient conditions, such as:

1. The location should not be exposed to excessive air pollution (dust, aggressive substances).
2. Severe vibration, extreme changes of temperature, high levels of humidity, surge voltages of high amplitude and short rise time and strong induced magnetic fields should be avoided as far as possible.
3. Air must not be allowed to circulate freely around the equipment.

The equipment can in principle be mounted in any attitude, but it is normally mounted vertically

(visibility of markings).

WARNING! Excessively high temperature can appreciably reduce the operating life of this device.

7.6 Mechanical Installation

This device is made of a single layer 4U height chassis with eight connectors on its rear panel. Following figure shows the dimensions of this device for reference in mounting.

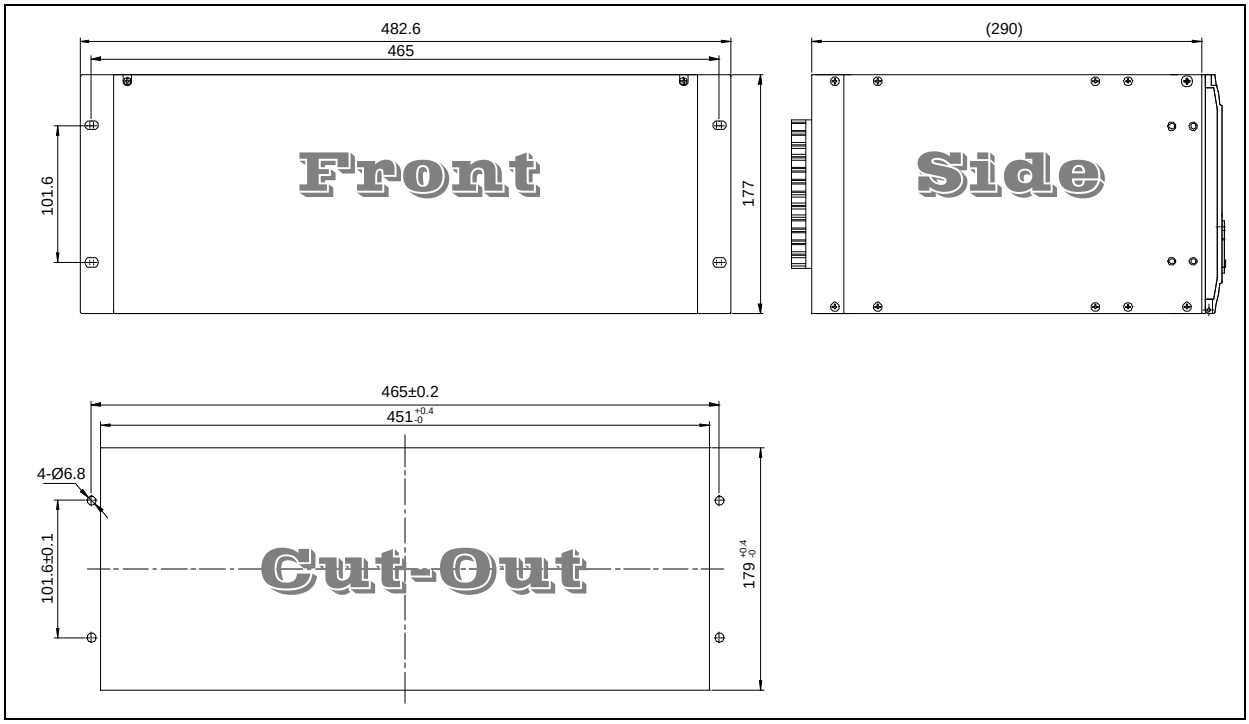

Figure 7.6-1 Dimensions of PCS-9799

NOTE! It is necessary to leave enough space top and bottom of the cut-out in the cubicle for heat emission of this device.

The safety instructions must be abided by when installing the boards, please see *Section 7.2* for the details.

Following figure shows the installation way of a module being plugged into a corresponding slot.

Figure 7.6-2 Demonstration of plugging a board into its corresponding slot

In the case of equipment supplied in cubicles, place the cubicles on the foundations that have been prepared. Take care while doing so not to jam or otherwise damage any of the cables that have already been installed. Secure the cubicles to the foundations.

7.7 Electrical Installation and Wiring

7.7.1 Grounding Guidelines

Switching operations in HV installations generate transient over voltages on control signal cables. There is also a background of electromagnetic RF fields in electrical installations that can induce spurious currents in the devices themselves or the leads connected to them.

All these influences can influence the operation of electronic apparatus.

On the other hand, electronic apparatus can transmit interference that can disrupt the operation of other apparatus.

In order to minimize these influences as far as possible, certain standards have to be observed with respect to grounding, wiring and screening.

NOTE! All these precautions can only be effective if the station ground is of good quality.

7.7.2 Cubicle Grounding

The cubicle must be designed and fitted out such that the impedance for RF interference of the ground path from the electronic device to the cubicle ground terminal is as low as possible.

Metal accessories such as side plates, blanking plates etc., must be effectively connected surface-to-surface to the grounded frame to ensure a low-impedance path to ground for RF interference. The contact surfaces must not only conduct well, they must also be non-corroding.

NOTE! If the above conditions are not fulfilled, there is a possibility of the cubicle or parts of it forming a resonant circuit at certain frequencies that would amplify the transmission of interference by the devices installed and reduce their immunity to induced interference.

Movable parts of the cubicle such as doors (front and back) or hinged equipment frames must be effectively grounded to the frame by three braided copper strips (see *Figure 7.7-1*).

The metal parts of the cubicle housing and the ground rail are interconnected electrically conducting and corrosion proof. The contact surfaces shall be as large as possible.

NOTE! For metallic connections, please observe the voltage difference of both materials according to the electrochemical code.

The cubicle ground rail must be effectively connected to the station ground rail by a grounding strip (braided copper).

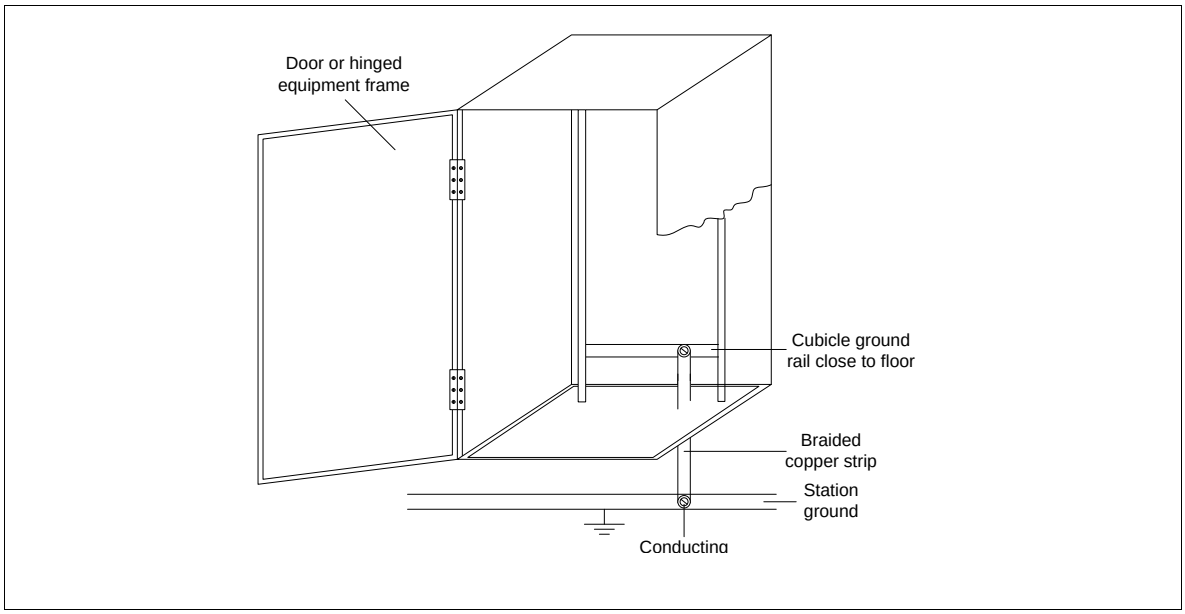

Figure 7.7-1 Cubicle grounding system

7.7.3 Ground Connection on the Device

There is a ground terminal on the rear panel, and the ground braided copper strip can be connected with it. Take care that the grounding strip is always as short as possible. The main thing is that the device is only grounded at one point. Grounding loops from unit to unit are not allowed.

There are some ground terminals on some connectors of this device, and the sign is “GND”. All the ground terminals are connected in the cabinet of this device. Therefore, the ground terminal on the rear panel (see *Figure 7.7-2*) is the only ground terminal of this device.

Figure 7.7-2 Ground terminal of this device

7.7.4 Grounding Strips and their Installation

High frequency currents are produced by interference in the ground connections and because of skin effect at these frequencies, only the surface region of the grounding strips is of consequence.

The grounding strips must therefore be of (preferably tinned) braided copper and not round copper conductors, as the cross-section of round copper would have to be too large.

Proper terminations must be fitted to both ends (press/pinch fit and tinned) with a hole for bolting them firmly to the items to be connected.

The surfaces to which the grounding strips are bolted must be electrically conducting and non-corroding.

The following figure shows the ground strip and termination.

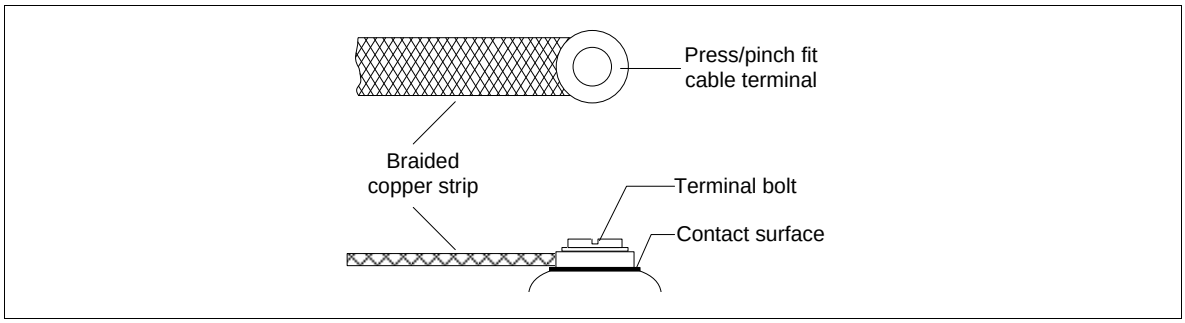

Figure 7.7-3 Ground strip and termination

7.7.5 Guidelines for Wiring

There are several types of cables that are used in the connection of this device: braided copper cable, serial communication cable etc. Recommendation of each cable:

- Grounding: braided copper cable, 2.5mm^2 ~ 6.0mm^2
- Power supply, binary inputs & outputs: brained copper cable, 1.5mm^2 ~ 2.5mm^2
- AC voltage inputs: brained copper cable, 1.5mm^2 ~ 2.5mm^2
- AC current inputs: brained copper cable, 2.5mm^2 ~ 6.0mm^2
- Serial communication: 4-core shielded braided cable
- Ethernet communication: 4-pair screened twisted category 5E cable

8 Maintenance

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8.4 Cleaning 8-1

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8.1 Appearance Check

It is recommended that products supplied by NR receive periodic monitoring after installation. In view of the critical nature of the device, it is desirable to confirm that they are operating correctly at regular intervals.

8.2 Regular Testing

Check whether the "**HEALTHY**" LED indicator is lit on as green when this device is in normal operation.

Check whether the status of the corresponding LED indicators of the Ethernet port which has connected a device is correct.

8.3 Failure Tracing and Repair

If "**HEALTHY**" LED indicator is lit off, please check the power supply input.

If the status of the corresponding LED indicators of the Ethernet port which has connected a device is incorrect, please check the following items:

1) Whether the equipment connected to this device operates normally.
2) Whether the cable is intact and is fixed tightly.
3) Check whether a specific Ethernet port failed to operate normally by using another Ethernet port to link the equipment.

8.4 Cleaning

Before cleaning the equipment ensure that all AC and DC supplies, current transformer and voltage transformer connections are isolated to prevent any chance of an electric shock whilst cleaning. Use a smooth cloth to clean the front panel. Do not use abrasive material or detergent chemicals.

8.5 Storage

The spare device or module should be stored in a dry and clean room. Based on IEC standard 60255-1 the storage temperature should be from -40°C to +70°C, but the temperature of from -20°C to +55°C is recommended for long-term storage.

9 Decommissioning and Disposal

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9.1 Decommissioning

9.1.1 Switching Off

To switch off this device, switch off the external miniature circuit breaker of the power supply.

9.1.2 Disconnecting Cables

Disconnect the cables in accordance with the rules and recommendations made by relational department.

DANGER! Before disconnecting the power supply cables that connected with the PWR module of this device, make sure that the external miniature circuit breaker of the power supply is switched off.

9.2 Dismantling

The device rack may now be removed from the system cubicle, after which the cubicles may also be removed.

DANGER! When the station is in operation, make sure that there is an adequate safety distance to live parts, especially as dismantling is often performed by unskilled personnel.

9.3 Disposal

In every country there are companies specialized in the proper disposal of electronic waste.

Note! Strictly observe all local and national regulations when disposing of the device.

10 Manual Version History

In the latest version of the instruction manual, several descriptions on existing features have been modified.

Manual version and modification history records

Manual Version		Software Version	Date	Description of change
Source	New			
	R1.00	R2.30	2014-04-20	Form the original manual.
R1.00	R1.01	R2.30	2014-06-06	Added *Chapter 3 and Chapter 5*. Errors revised in *Chapter 2.* Updated HMI menu in *Chapter 6.*

7410xxxx-OPE/INC 14-xxxx

Conformance Test Report for Client System with IEC61850-8-1 interface

Arnhem, Date , June 11, 2014

For KEMA Nederland B.V.
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By order of NARI, China

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98 pages 1 annexes xx approved : xxxx 14-xx-xx

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1 INTRODUCTION

1.1 Identifications

The following table gives the exact identification of the test environment used for this conformance test of a IEC 61850 CLIENT system.

SUT	PCS-9700 SCADA/HMI Workstation Software version R1 (2014-04-27) HP Z600 workstation with Windows 7 professional
MANUFACTURER	NR Electric CO., Ltd. 69, Suyuan Avenue Nanjing 211102 China
PICS	Protocol Implementation Conformance Statement for the IEC 61850 interface in PCS-9700 May 22, 2014
MICS	Model Implementation Conformance Statement for the IEC 61850 interface in PCS-9700 May 22, 2014
TICS	TISSUES Implementation Conformance Statement for the IEC 61850 interface in PCS-9700 May 22, 2014
PIXIT	Protocol Implementation eXtra Information for Testing (PIXIT) for the IEC 61850 interface in PCS-9700 May 22, 2014
SCD	SCL Files set for Client testing version 1.00.04
TEST INITIATOR	MANUFACTURER
TEST FACILITY	KEMA Nederland B.V. Protocol Competence & Test Center Utrechtseweg 310, Arnhem, The Netherlands Accredited by the UCA IUG to issue the Level A Certificates
TEST ENGINEER	Niels Heijker, niels.heijker@dnvgl.com
TEST SESSION	12-23 May 2014, Nanjing, China
SERVER SIMULATOR	UniCA IED Simulator version 3.26.01 with test suite 1.00.04
ANALYSER	UniCA Analyzer 61850 version 5.28.04
HMI	Sm console
TIME SERVER	KEMA SNTP Master

1.2 Background

The *TEST FACILITY*s assignment was to answer the following question:

"Does the protocol implementation of the SUT, conform to the IEC 61850 standard and the PICS, MICS, TICS, PIXIT documents as configured with SCD?"

To answer this question, *TEST FACILITY* has performed a **conformance test** of the IEC 61850 implementation in the *SUT*. This test has been performed according procedures and conditions set forth in IEC 61850 part 10 and UCA IUG Quality Assurance Program.
TEST FACILITY is accredited by the UCA IUG to perform formal IEC 61850 conformance tests and issue the Level A certificate.

1.3 Purpose of this document

The purpose of this document is to describe the conformance test procedure and results of the *TEST SESSION* concerning the IEC 61850 implementation in the *SUT*.

The test procedures verify the client system under test against conformant servers.

The test results are the basis of the conformance statement.

1.4 Contents of this document

Chapter 2 shows the list of relevant normative and other references, used to provide input for the conformance test.

Chapter 3 describes the various relevant components for the conformance test and their configuration as used in the conformance test, including the SUT. This chapter also gives an overview and introduction to the various test groups that together constitute the conformance test.

Chapter 4 and 5 give an overview and summary of the test results, the conclusion(s) and recommendations.

Appendix A specifies the detailed test procedures and their outcome, appendix B contains detailed comments on test results, for instance when a defect is detected, including the actual message flow if appropriate.

1.5 Glossary

SUT	System Under Test
HMI	Human machine interface
MICS	Model Implementation Conformance Statement
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
SCD	Substation configuration description in SCL-format
SCL	Substation Configuration Language
SNTP	Simple Network Time Protocol
TICS	TISSUES Implementation Conformance Statement
TISSUE	Technical issue
TPCL	Test Procedure Change List
UCA IUG	UCA International Users Group

2 REFERENCES

2.1 Normative

The tests defined in this document are based on the following IEC 61850 documents:

- IEC/TR 61850-1, Communication networks and systems in substations – Part 1: Introduction and overview; First edition 2003-04;
- IEC/TS 61850-2, Communication networks and systems in substations – Part 2: Glossary; First edition 2003-08;
- IEC 61850-3, Communication networks and systems in substations – Part 3: General requirements; First edition 2003-01;
- IEC 61850-4, Communication networks and systems in substations – Part 4: System and project management; First edition 2003-01;
- IEC 61850-5, Communication networks and systems in substations – Part 5: Communication requirements for functions and device models; First edition 2003-07;
- IEC 61850-6, Communication networks and systems in substations – Part 6: Substation Automation System configuration language; First edition 2004-03;
- IEC 61850-7-1, Communication networks and systems in substations – Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models; First edition 2003-07;
- IEC 61850-7-2, Communication networks and systems in substations – Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI); First edition 2003-05;
- IEC 61850-7-3, Communication networks and systems in substations – Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes and attributes; First edition 2003-05;
- IEC 61850-7-4, Communication networks and systems in substations – Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node and data object addressing; First edition 2003-05;
- IEC 61850-8-1, Communication networks and systems in substations – Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO/IEC 9506-1 and ISO/IEC 9506-2) and to ISO/IEC 8802-3; First edition 2004-05;
- IEC 61850-10, Communication networks and systems in substations – Part 10: Conformance testing; First edition 2005-05.

2.2 Other

- ISO/IEC 9646-1:1994 OSI-Conformance testing methodology and framework, Part 1: General Concepts;
- UCA IUG: Quality Assurance Program for IEC Device Implementation Testing and Test System Accreditation and Recognition, Version 2.6, March 8, 2007;
- UCA IUG: Quality Assurance Program Addendum for IEC 61850 Specific Product Testing, Version 1.0, March 8, 2007;
- UCA IUG: Test Center Accreditation and Recognition Procedure;
- For IEC 61850 Device Testing, V1.1, August, 2006;
- TISSUES: http://www.tissues.iec61850.com;
- Test Procedures Change List (TPCL) for IEC 61850 client test procedures revision 1.1

Version 1.2.

3 THE CONFORMANCE TEST

3.1 Components in the test environment

The test environment consists of the following components:

- SUT
- SERVER SIMULATOR 1..N
- ANALYSER
- Ethernet HUB
- TIME SERVER

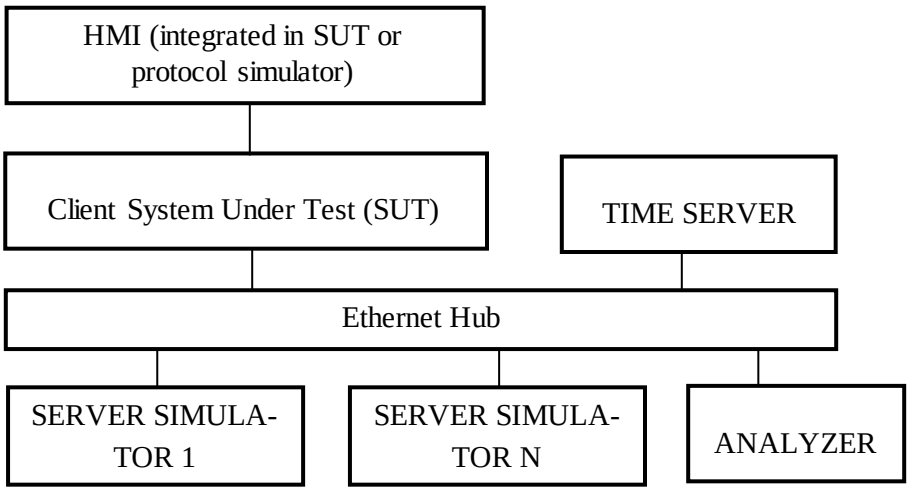

Figure 3.1 The test environment

The HMI can be integrated into the SUT (typically a substation control system) or in case the SUT is a protocol gateway the HMI is a protocol simulator with a HMI.

The server simulator requirements are:

- Modeling:
- contain all common data classes supported by the SUT;
- contain several new data objects within a standard logical node;
- contain several new data attributes within a standard data object (common data class);
- contain several new enum types and enum values.
- Configuration:
- one or more servers with preconfigured datasets with data objects
- one or more servers with dynamic datasets (when supported by SUT)
- one or more servers with report control block indexing
- one or more servers without report control block indexing

- Communication:
- support all conformance blocks supported by the SUT in one or more servers;
- support all ASCI services supported by the SUT;
- one or more servers with all supported control models.

3.2 Overview of the test suite

The abstract test cases and detailed test procedures are structured as follows:

- Documentation and version control (IEC 61850-4)
- Configuration file (IEC 61850-6)
- Data model (IEC 61850-7-3 and IEC 61850-7-4)
- Mapping of ACSI models and services (IEC 61850-7-2 and IEC 61850-8-1)
  - Application Association
  - Server & Logical Device & Logical Node & Data
  - Data Set
  - Substitution
  - Setting Group Control
  - Unbuffered and Buffered Reporting
  - Logging
  - Generic Substation Events
  - Control
  - Time Synchronization
  - File Transfer.

The *PICS* is used to select the applicable test procedures to be included in the test.

In general if a problem occurs on a connection to one server this shall have no impact on the connections to other servers.

4 TEST RESULTS

Table 4.1 in this Chapter describes the summary of the conformance test results. References shown in the table columns refer to references of individual test procedures in appendix A.

The **Passed** column indicates the test cases with test result Passed, the **Failed** column with test result Failed and the **Inconclusive** column for test result Inconclusive. For details refer to the applicable test procedure in Appendix A.

When all mandatory test cases within a conformance block are Passed or Inconclusive the SUT has passed the test for that conformance block.

Table 4.1 Summary of test results for *SUT (Copy from certificate)*

Conformance Block	Mandatory	Conditional
1: Basic Exchange	cAss1, cAss2, cAss3, cAss4, cAssN1, cAssN4, cAssN5, cAssN6	cAssN7 cSrv1, cSrv2, cSrv3, cSrv4, cSrv5, cSrv6, cSrv7, cSrvN1, cSrvN2, cSrvN3, cSrvN4, cSrvN5, cSrvN6
2: Data Sets		cDs1, cDs2, cDs5, cDsN1a, cDsN1b
2+: Data Set Definition	cDs6, cDsN4	cDs7, cDsN5
3: Substitution	cSub1	cSub2, cSub3
4: Setting Group Selection	cSg2, cSgN1	cSg1
4+: SETTING GROUP DEFINITION	cSg3, cSg4	
5: Unbuffered Reporting	cRp3, cRp4, cRp5, cRp8, cRp9, cRp10, cRpN2, cRpN3, cRpN7, cRpN8	cRp1, cRp2, cRp6, cRp7, cRpN1, cRpN4
6: Buffered Reporting	cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr12, cBrN2, cBrN3, cBrN7, cBrN8, cBrN9	cBr1, cBr2, cBr6, cBr7, cBr13, cBrN1, cBrN4
12a: Direct control	cCtl4, cCtlN1 cDOns1, cDOns2	cCtl1, cCtl2, cCtl3
12b: SBO control	cCtl4, cCtlN1 cSBOns1, cSBOns2, cSBOns3	cCtl1, cCtl2, cCtl3, cSBOns4
12c: Enhanced Direct Control	cCtl4, cCtlN1 cDOes1, cDOes2	cCtl1, cCtl2, cCtl3
12d: Enhanced SBO control	cCtl4, cCtlN1, cSBOes1, cSBOes2, cSBOes3	cCtl1, cCtl2, cCtl3 cSBOes4
13: TIME SYNC	cTm1	cTm2, cTmN1
14: File transfer	cFt1, cFt2, cFt3, cFtN1, cFtN2	cFt5

5 CONCLUSION AND RECOMMENDATIONS

When all applicable test cases within a conformance block are Passed or Inconclusive the SUT has passed the test for that conformance block.

Based on the test results described in this report, *TEST FACILITY* declares the tested IEC 61850 implementation in the *SUT* has **not shown to be non-conforming** to the IEC 61850 standard, *PICS*, *MICS*, *TICS*, *PIXIT* documents and *SCD* configuration.

5.1 Recommendations following from the test

The following comments and recommendations apply for the *SUT*:

- When enabling a report control block, the client will not check the datSet, confRev or rptId field. It is recommend to check these fields before enabling a report otherwise there is a risk that a mismatch in the configuration is only noticed when a report is received..
- The test was executed by using an HMI GUI that a normal user would not see or use, this HMI consists of a basic treeview containing all servers. When using this HMI most actions have to be performed manually:
  - When performing the control testcases the operator needs to read the stVal and write the ctlNum and orCat manually. It is recommended to always check the ctlMode before operating and to automatically update the ctlNum.
  - Quality values are displayed as bit-strings, the operator needs to manually convert them to the correct quality values.
- GetDataDefinition is performed on Functional Constraint level.

ANNEX A TEST PROCEDURES AND RESULTS

A1 Documentation and version control (IEC 61850-4)

Id	Test procedure	Verdict
cDoc1	Check if the major/minor software version in the PICS documentation and the SUT do match (IEC61850-4)	PASSED
cDoc2	Check if the major/minor software version manufacturer PIXIT documentation and software version of the SUT does match (IEC61850-4). PIXIT shall indicate the required information as requested in the test cases in this document.	PASSED
cDoc3	Check if the major/minor software version in manufacturer TICS documentation and software version of the SUT does match (IEC65180-4). TICS shall indicate if the SUT supports servers that implemented or not implemented the TISSUE.	PASSED
cDoc4	Check if the major/minor software version manufacturer MICS documentation and software version of the SUT does match (IEC61850-4). MICS shall indicate which CDC's and/or CDC parts are supported by the SUT, for example arrays.	PASSED

A2 Configuration file (IEC 61850-6)

Id	Test procedure	Verdict
cCnf1	Check if the SUT process the data names, data types as configured in the SCL configuration file.	PASSED
cCnf2	Change at least 5 end-user configurable parameters that are displayed by the SUT in the SCL configuration file, configure the SUT using the SCL configuration file (using the supplied configuration tool) and check the updated configuration. Restore the original SCL file and re-configure the SUT to its original state.	PASSED
cCnf3	Verify that client can handle the ConfigRev management in SCL and exposed by the server in LLN0.NamPlt.configRev as described in the PIXIT. On a mismatch the SUT shall behave as described In the PIXIT (note that, if the PIXIT describes that the SUT does not check such a mismatch, no action is required by the SUT)	PASSED

A3 Data model (IEC 61850-7-3 and IEC 61850-7-4)

Id	Test procedure	Verdict
cMdl1	Verify that the client can handle the maximum name length and expands objects like SDOs correctly (PIXIT)	PASSED
cMdl2	Verify that SUT supports the following naming conventions for the supported control blocks: a) unbuffered report control block – not indexed b) unbuffered report control block – indexed c) buffered report control blocks d) setting group control block e) GOOSE control block f) Log control block	PASSED
cMdl3	Verify that SUT can read and process the mandatory & optional attributes from the CDCs in part 7-3 unless stated otherwise in the MICS	PASSED

A4 Mapping on MMS (IEC 61850-7-2 and IEC 61850-8-1)

The test procedures are structured according to conformance blocks. The following table specifies which ACSI services, mapped on MMS, are mandatory/conditional for each conformance block for IEC 61850-8-1 Client systems.

Table A.4.1: ACSI services per conformance block for IEC 61850-8-1 Client systems

Conformance Block	Mandatory	Conditional
1: Basic Exchange	Associate Abort and/or Release	GetAllDataValues SetDataValues GetServerDirectory GetLogicalDeviceDirectory GetLogicalNodeDirectory (DATA) GetDataDirectory GetDataDefinition GetDataValues
2: Data Set		GetDataSetValues SetDataSetValues GetLogicalNodeDirectory (DATASET) GetDataSetDirectory

Conformance Block	Mandatory	Conditional
2+: Data Set Definition	CreateDataSet DeleteDataSet	
3: Substitution	SetDataValues	
4: Setting Group Selection	SelectActiveSG GetSGCBValues	GetLogicalNodeDirectory (SGCB) GetSGValues
4+: Setting Group Definition	SelectEditSG, GetSGValues SetSGValues ConfirmEditSGValues	
5: Unbuffered Reporting	Receive Report GetURCBValues SetURCBValues	GetLogicalNodeDirectory (URCB)
6: Buffered Reporting	Receive Report GetBRCBValues SetBRCBValues	GetLogicalNodeDirectory (BRCB)
7: Logging	GetLCBValues GetLogicalNodeDirectory (LOG) QueryLogByTime or QueryLogAfter GetLogStatusValues	GetLogicalNodeDirectory (LCB) SetLCBValues
12a: Direct control	Operate	TimeActivatedOperate
12b: SBO control	Select, Operate	Cancel, TimeActivatedOperate
12c: Enhanced Direct Control	Operate Receive CommandTermination	TimeActivatedOperate
12d: Enhanced SBO control	SelectWithValue, Operate Receive CommandTermination	Cancel, TimeActivatedOperate
13: Time sync	TimeSynchronization	
14: File transfer	GetServerDirectory(FILE) GetFileAttributeValues GetFile	SetFile DeleteFile

The following table specifies which test procedures are mandatory/conditional for each conformance block. Conditions refer to the SCL - IED - Services section, the PICS or PIXIT.

Table A.4.2: Test procedures per conformance block

Conformance Block	Mandatory	Conditional
1: Basic Exchange	cAss1, cAss2, cAss3, cAss4, cAssN1, cAssN4, cAssN5, cAssN6	Automatic startup: cAssN7 GetXxxDirectory[1]: cSrv1, cSrv2, cSrv3, cSrv4, cSrvN1 GetDataValues: cSrv5, cSrvN3 SetDataValues: cSrv6, cSrvN4 GetAllDataValues: cSrv7, cSrvN2 Quality: cSrvN5 TimeQuality: cSrvN6
2: Data Sets		GetDataSetValues: cDs3, cDsN2 SetDataSetValues: cDs4, cDsN3 GetLogicalNodeDirectory(DATA-SET): cDs1, cDsN1a GetDataSetDirectory: cDs2, cDs5, cDsN1b
2+: Data Set Definition	cDs6, cDsN4	DeleteDataSet: cDs7, cDsN5
3: Substitution	cSub1	Substituted: cSub2, cSub3
4: Setting Group Selection	cSg2, cSgN1	GetLogicalNodeDirectory(SGCB): cSg1 GetSGValues: cSg3
4+: Setting Group Definition	cSg3, cSg4	
5: Unbuffered Reporting	cRp3, cRp4, cRp5, cRp8, cRp9, cRp10, cRpN2, cRpN3, cRpN7, cRpN8	GetLogicalNodeDirectory(URCB): cRp1, cRpN1 SetURCBValue(RptID or Datset): cRp2 Buffer time: cRp6 General interrogation: cRp7 Reserved: cRpN4 Unsupported optflds: cRpN5 Unsupported trigger: cRpN6
6: Buffered Reporting	cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr12, cBrN2, cBrN3, cBrN7, cBrN8, cBrN9	GetLogicalNodeDirectory(BRCB): cBr1, cBrN1 SetBRCBValue(RptID or Datset): cBr2 Buffer time: cBr6 General interrogation: cBr7 Purge buffer: cBr13

[1] GetXxxDirectory = GetServerDirectory, GetLogicalDeviceDirectory, GetLogicalNodeDirectory(DATA), GetDataDirectory and GetDataDefinition

Conformance Block	Mandatory	Conditional
		Reserved: cBrN4 Unsupported optflds: cBrN5 Unsupported trigger: cBrN6
12a: Direct control	cCtl4, cCtlN1, cDOns1, cDOns2	Test: cCtl1 Check: cCtl2 Change control model: cCtl3
12b: SBO control	cCtl4, cCtlN1, cSBOns1, cSBOns2, cSBOns3	Test: cCtl1 Check: cCtl2 Change control model: cCtl3 Cancel: cSBOns4
12c: Enhanced Direct Control	cCtl4, cCtlN1, cDOes1, cDOes2	Test: cCtl1 Check: cCtl2 Change control model: cCtl3
12d: Enhanced SBO control	cCtl4, cCtlN1, cSBOes1, cSBOes2, cSBOes3	Test: cCtl1 Check: cCtl2 Change control model: cCtl3 Cancel: cSBOes4
13: Time sync	cTm1	Optional: cTm2 TimeQuality: cTmN2 ClockNotsynchronized: cTmN1
14: File transfer	cFt1, cFt2, cFt3, cFtN1, cFtN2	SetFile: cFt4, cFtN3 DeleteFile: cFt5

Note1: cAssN2 and cAssN3 are not applicable for part 8-1
Note2: Time activated control and logging test procedures are not available yet
Note3: cCtlN2 is out of scope for IEC 61850 conformance testing

The focus of the conformance test is the application layer. For IEC 61850-8-1 the communication services are mapped on the reliable TCP transport layer. As such the testing of transport related errors like "no response" and "delayed response" are out-of-scope. These are implicitly tested by disconnecting the Ethernet cable between the server and the switch.

In general if a problem occurs on a connection to one server this may have no impact on the connections to other servers.

The following paragraphs describe the abstract test cases and the corresponding detailed test procedure.

A4.1 Block 1: Basic services

Abstract test cases for Application Association

Test case	Test case description
cAss1	Associate and force client to release a TPAA (IEC 61850-7-2 7.4, 8-1 10.2)
cAss2	Force the client to associate with maximum number of servers simultaneously (PIXIT).
cAss3	Verify that losing and restoring the TPAA between SUT and server has no effect on existing TPAA between SUT and other servers.
cAss4	Verify the client can handle servers with small (4k) and large (64k) MMS PDU size, the client should keep on proposing it's original MMS PDU size

Note1: The client is always considered to be the calling node

Test case	Test case description
cAssN1	Associate and server responds with negative response due to AccessPoint mismatch.
cAssN2	Associate and server responds with negative response due to AuthenticationParameter mismatch.
cAssN3	Associate and server releases TPAA (IEC 61850-7-2 7.4). SUT should try to re-establish the association after the configured period (PIXIT).
cAssN4	Associate and server-abort TPAA (IEC 61850-7-2 7.4). SUT should try to re-establish the association after the configured period (PIXIT).
cAssN5	Associate and server denies TPAA (IEC 61850-7-2 7.4). SUT should try to re-establish the association after the configured period (PIXIT).
cAssN6	Disconnect the communication interface, the SUT should detect link lost within a specified period.
cAssN7	Interrupt and restore the power supply, the SUT shall automatically establish the configured associations when ready (PIXIT).

Detailed test procedures for Application Association

cAss1	Associate and force client to release a TPAA (IEC 61850-7-2, 7.4)	Passed
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 1. SUT accepts Associate.response+ from server 2. SUT returns to "state" where it is able to start a new TPAA with the same server		
Test description 1. Set-up a TPAA with one server 2. Force SUT to release or abort TPAA 3. Repeat step 1 and 2, 10 times		
Comment SUT does not support abort.		

cAss2	Associate to maximum servers	Passed
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 1. SUT accepts Associate.response+ from all servers 2. SUT returns to "state" where it is able to start new TPAAs with the same servers		
Test description 1. Set-up a TPAA with the maximum number of servers as specified in the PIXIT 2. Force SUT to release or abort all open TPAAs 3. Repeat step 1 and 2, 10 times		
Comment Tested with 150 servers		

cAss3	Restore lost association	Passed
IEC 61850-7-2 clause 7.4, figure 7 and 8 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 1. SUT accepts Associate.response+ from all servers 2. SUT detects connection loss and tries to reconnect to the server. All other TPAAs shall remain active. 3. SUT successfully restores the connection to the server 4. SUT receives and accepts the Release.response+ from all servers or receives and accepts the abort response+ from all servers		
Test description 1. Set-up a TPAA with at least two servers 2. Force a TPAA disconnect for one server 3. Restore the situation where the disconnected server is able to accept a new TPAA 4. Force SUT to release or abort all TPAAs		
Comment		

cAss4	Verify that the client can handle servers with small and large MMS PDU size	Passed
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 1. Client accepts Associate.response+ from all servers 2. SUT receives and accepts the Release.response+ from all servers or receives and accepts the abort response+ from all servers		
Test description 1. Set-up a TPAA with at least two servers where one server has a small PDU size (4k), and the other server has a large PDU size (64k). 2. Force SUT to release or abort all open TPAAs		
Comment Tested with 2 servers		

cAssN1	Access point mismatch	Passed
IEC 61850-8-1 clause 10.2, 25 and table 111 PIXIT		
Expected result 2. The TPAA fails 4. The TPAA fails 6. The TPAA fails		
Test description 1. Set-up the SUT and one server to have a mismatching Transport Selector 2. Set-up a TPAA between the SUT and the server 3. Set-up the SUT and one server to have a mismatching Presentation Selector 4. Set-up a TPAA between the SUT and the server 5. Set-up the SUT and one server to have a mismatching Session Selector 6. Set-up a TPAA between the SUT and the server		
Comment		

cAssN4	Server abort	Passed
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 1. SUT accepts Associate.response+ from server 2. SUT receives and responds correctly to the abort request from the server		
Test description 1. Set-up a TPAA with one server 2. Force server to abort TPAA 3. Repeat step 1 and 2, 10 times		
Comment		

cAssN5	Server deny	Passed
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 2. SUT detects the Association failure and responds as specified in the PIXIT.		
Test description 1. Set-up test configuration with at least two servers 2. Force the SUT to perform an Associate request for all servers which is denied (response-) by one server caused by a mismatching session or presentation selector 3. Repeat step 1 and 2, 10 times		
Comment		

cAssN6	Detection of lost link	Passed
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 3. SUT shall detect the lost link and shall try to reconnect to the server 4. SUT shall set-up a TPAA with the server		
Test description 1. Connect the SUT and one server to a hub 2. Set-up a TPAA with the server 3. Disconnect the physical link, between the hub and the server, some seconds longer than the timeout specified in the PIXIT 4. Reconnect the Ethernet cable		
Comment		

cAssN7	Power supply interrupt	Passed
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 3. SUT behaves as specified in the PIXIT.		
Test description 1. Set-up a TPAA between SUT and all servers as configured in SCL 2. Interrupt the power supply to SUT 3. Restore the power supply to SUT		
Comment		

Abstract test cases for server, logical device, logical node and data

Test case	Test case description
cSrv1	Check the SUT is able to request a GetServerDirectory(LOGICAL-DEVICE) for all the logical devices of the configured servers (See Note 2).
cSrv2	For each GetServerDirectory(LOGICAL-DEVICE) response check the client issues a GetLogicalDeviceDirectory request.
cSrv3	Force SUT to send a GetLogicalNodeDirectory(DATA) request for each responded Logical Node from cSrv2.
cSrv4	Force SUT to send the following requests for a subset of the GetLogicalNodeDirectory(DATA): a) GetDataDirectory request and check response (IEC 61850-7-2, 10.4.4) b) GetDataDefinition request and check response (IEC 61850-7-2, 10.4.5)
cSrv5	Verify that after start-up the client is able to update the process values of the configured servers.
cSrv6	Request a SetDataValues of the different basic types (with for example FC=CF) and check the services.
cSrv7	Request GetAllDataValues for the required functional constraints and check if the SUT updates its model (IEC 61850-7-2, 9.2.3)

NOTE 1 Configured servers means the servers the client is configured to communicated with. The client at least needs to know the parameters to establish an association with them.

Test case	Test case description
cSrvN1	Check that the SUT still communicates with other servers when it requests the following services with negative response: a) GetServerDirectory(LOGICAL-DEVICE), b) GetLogicalDeviceDirectory, c) GetLogicalNodeDirectory(DATA), d) GetDataDirectory, e) GetDataDefinition.
cSrvN2	Check that the SUT is able to communicate with other connected servers after a request for GetAllDataValues fails in the following circumstances: a) The response is negative. b) The response comes with mismatching data objects.
cSrvN3	Check that the SUT is able to communicate with other connected servers after a request for GetDataValues fails in the following circumstances: a) The response is negative. b) The response comes with mismatching data objects. c) The value is out of the valid range for this data.

Test case	Test case description
cSrvN4	Check that the SUT is able to communicate with other connected servers after a request for SetDataValues fails in the following circumstances: a) The response is negative. b) One of the data values is read-only
cSrvN5	If SUT detects/notify changes in the "Quality" attribute, force a server to change the values in the Quality of the measured/status values monitored by the SUT and check the behaviour described in the PIXIT.
cSrvN6	If SUT detects/notify changes in the timeStamp's "TimeQuality" attribute, force a server to change the values in the TimeQuality of the measured/status values monitored by the SUT and check the behaviour described in the PIXIT.

NOTE 2 "Client reports an error" can be anything to notify the end-user some error has happened

Detailed test procedures for server, logical device, logical node and data

cSrv1	GetServerDirectory(LOGICAL-DEVICE)	Passed
IEC 61850-7-2 clause 8, 9, 10 IEC 61850-8-1 clause 11, 12, 13		
Expected result 2. SUT accepts a GetServerDirectory.Response+ from the server		
Test description 1. Set-up a TPAA with at least two servers 2. SUT request for each server a GetServerDirectory(LOGICAL-DEVICE) 3. Continue with cSrv2		
Comment		

cSrv2	GetLogicalDeviceDirectory	Passed
IEC 61850-7-2 clause 8, 9, 10 IEC 61850-8-1 clause 11, 12, 13		
Expected result 1. SUT accepts a GetLogicalDeviceDirectory.Response+ from the server		
Test description 1. SUT request for each responded LogicalDevice a GetLogicalDeviceDirectory 2. Continue with cSrv3		
Comment		

cSrv3	GetLogicalNodeDirectory	Passed
IEC 61850-7-2 clause 8, 9, 10 IEC 61850-8-1 clause 11, 12, 13		
Expected result 1. SUT accepts a GetLogicalNodeDirectory(DATA).Response+ from the server		
Test description 1. SUT request for each responded LogicalNode a GetLogicalNodeDirectory(DATA) 2. Continue with cSrv4		
Comment		

cSrv4	GetDataDirectory / GetDataDefinition	Passed
IEC 61850-7-2 clause 8, 9, 10 IEC 61850-8-1 clause 11, 12, 13		
Expected result 1. SUT accepts a GetDataDirectory/GetDataDefinition.Response+ from the server		
Test description 1. SUT request for responded dataobjects a GetDataDirectory/GetDataDefinition 2. Release the TPAA with all servers		
Comment - GetDataDirectory and GetDataDefinition are mapped to the MMS GetVariableAccessAttributes service By default SUT will perform a GetDataDefinition for all objects that are referenced in a dataSet. The used dataSets contained objects with functional constraints ST and MX, for this testcase the GetDataDefinition for the other functional constraints was done through the datamodel.		

cSrv5	GetDataValues	Passed
IEC 61850-7-2 clause 9.2.3, 10.4.2 IEC 61850-8-1 clause 12.3.2, 13.2.1 PIXIT		
Expected result 2-3. SUT accepts a GetDataValues.Response+ from server		
Test description 1. Set-up a TPAA with one server 2. SUT request GetDataValues of at least two data attributes 3. SUT request GetDataValues of at least two data objects		
Comment		

cSrv6	SetDataValues	Passed
IEC 61850-7-2 clause 10.4.3 IEC 61850-8-1 clause 13.2.2 PIXIT		
Expected result 2. SUT accepts a SetDataValues.Response+ from server		
Test description 1. Set-up a TPAA with one server 2. SUT request SetDataValues on a writable data attribute with FC = CF, DC, SP or on a non-standard EX with one of the basic type: boolean, integer, float, bitstring or enumerated.		
Comment		

cSrv7	GetAllDataValues	Passed
IEC 61850-7-2 clause 9.2.3, 10.4.2 IEC 61850-8-1 clause 12.3.2, 13.2.1 PIXIT		
Expected result 2. SUT accepts a GetAllDataValues.Response+ from server		
Test description 1. Set-up a TPAA with one server 2. SUT request GetAllDataValues of at least two Functional Constraints		
Comment		

cSrvN1	GetLogicalDeviceDirectory & GetDataDefinition negative	Passed

IEC 61850-7-2 clause 8.2.1, 10.4
IEC 61850-8-1 clause 11, 12, 13
PIXIT

Expected result

1,3,5,7,9,11.	SUT associates with the server and responds as specified in PIXIT. SUT shall continue with the other servers
2,4.	SUT accepts a GetLogicalDeviceDirectory.Response- from the server and continues as specified in PIXIT
6,8.	SUT accepts a GetDataDefinition.Response- from the server and continues as specified in PIXIT
10,12.	SUT receives a GetDataDefinition response and continues as specified in PIXIT

Test description

1. Reconfigure/rename the LogicalDevice for one server only and restart the server
2. SUT requests GetLogicalDeviceDirectory of the previously known logical device
3. Reconfigure/rename the LogicalNode (in a valid existing logical device) for one server only and restart the server
4. SUT requests GetLogicalDeviceDirectory of the previously known logical node
5. Reconfigure/rename a data object (in a valid existing logical node) for one server only and restart the server
6. SUT requests GetDataDefinition of the previously known data object
7. Reconfigure/rename a data attribute (in a valid existing data object) for one server only and restart the server
8. SUT requests GetDataDefinition of the previously known data attribute
9. Reconfigure CDC type of a data object (more data attributes then expected) for one server only and restart the server
10. SUT requests GetDataDefinition of a known data object with more data attributes then expected
11. Reconfigure CDC type of a data object (less attributes then expected) for one server only and restart the server
12. SUT requests GetDataDefinition of a known data object with less attributes then expected

Comment

See IEC 61850-7-4 for valid LogicalNode Names.

For IEC 61850-8-1:

- GetLogicalNodeDirectory(DATA) and GetLogicalDeviceDirectory are mapped to the MMS GetNamedList service
- GetDataDirectory and GetDataDefinition are mapped to the MMS GetVariableAccessAttributes service

Steps 1 to 2 are not applicable to the SUT since the GetServerDirectory service is always requested on Association and all mismatches at the Logical Device level are immediately detected.

Steps 3 to 4 are not applicable to the SUT since the GetLogicalDeviceDirectory service is always requested using the information retrieved online disregarding any previous old Logical Node name.

cSrvN2	GetAllDataValues negative	Passed
IEC 61850-7-2 clause 9.2.3 IEC 61850-8-1 clause 12.3.2 PIXIT		
Expected result 1,3,5,7. SUT associates with the server and responds as specified in PIXIT. SUT shall continue with the other servers 2,4. SUT accepts a GetAllDataValues.Response- from the server and continues as specified in PIXIT 6,8. SUT receives a GetAllDataValues response and continues as specified in PIXIT		
Test description 1. Reconfigure/rename the LogicalDevice for one server only and restart the server 2. SUT requests GetAllDataValues of the previously known logical device 3. Reconfigure/rename the LogicalNode (in a valid existing logical device) for one server only and restart the server 4. SUT requests GetAllDataValues of the previously known logical node 5. Reconfigure CDC type of a data object (more data attributes then expected) for one server only and restart the server 6. SUT requests GetAllDataValues of a known data object with more data attributes then expected 7. Reconfigure CDC type of a data object (less attributes then expected) for one server only and restart the server 8. SUT requests GetAllDataValues of a known data object with less attributes then expected		
Comment See IEC 61850-7-4 for valid LogicalNode Names.		

cSrvN3	GetDataValues negative	Passed

IEC 61850-7-2 clause 10.4.2
IEC 61850-8-1 clause 13.2.1
PIXIT

Expected result

1,3,5,7,9,11. SUT associates with the server and responds as specified in PIXIT. SUT shall continue with the other servers

2,4,6,8. SUT accepts a GetDataValues.Response- from the server and continues as specified in PIXIT

10,12. SUT receives a GetDataValues response and continues as specified in PIXIT

Test description

1. Reconfigure/rename the LogicalDevice for one server only and restart the server
2. SUT requests GetDataValues of the previously known logical device
3. Reconfigure/rename the LogicalNode (in a valid existing logical device) for one server only and restart the server
4. SUT requests GetDataValues of the previously known logical node
5. Reconfigure/rename a data object (in a valid existing logical node) for one server only and restart the server
6. SUT requests GetDataValues of the previously known data object
7. Reconfigure/rename a data attribute (in a valid existing data object) for one server only and restart the server
8. SUT requests GetDataValues of the previously known data attribute
9. Reconfigure CDC type of a data object (more data attributes then expected) for one server only and restart the server
10. SUT requests GetDataValues of a known data object with more data attributes then expected
11. Reconfigure CDC type of a data object (less attributes then expected) for one server only and restart the server
12. SUT requests GetDataValues of a known data object with less attributes then expected

Comment

cSrvN4	SetDataValues negative	Passed

IEC 61850-7-2 clause 10.4.3
IEC 61850-8-1 clause 13.2.2
PIXIT

Expected result

1,3,5,7,9,11. SUT associates with the server and responds as specified in PIXIT. SUT shall continue with the other servers

2,4,6,8,13. SUT accepts a SetDataValues.Response- from the server and continues as specified in PIXIT

10,12. SUT receives a SetDataValues response and continues as specified in PIXIT

Test description

1. Reconfigure/rename the LogicalDevice for one server only and restart the server
2. SUT requests SetDataValues of the previously known logical device
3. Reconfigure/rename the LogicalNode (in a valid existing logical device) for one server only and restart the server
4. SUT requests SetDataValues of the previously known logical node
5. Reconfigure/rename a data object (in a valid existing logical node) for one server only and restart the server
6. SUT requests SetDataValues of the previously known data object
7. Reconfigure/rename a data attribute (in a valid existing data object) for one server only and restart the server
8. SUT requests SetDataValues of the previously known data attribute
9. Reconfigure CDC type of a data object (more data attributes then expected) for one server only and restart the server
10. SUT requests SetDataValues of a known data object with more data attributes then expected
11. Reconfigure CDC type of a data object (less attributes then expected) for one server only and restart the server
12. SUT requests SetDataValues of a known data object with less attributes then expected
13. SUT requests SetDataValues of an existing read-only data attribute

Comment

cSrvN5	Quality values	Passed
IEC 61850-7-2 clause 10.4.2 IEC 61850-8-1 clause 13.2.1 PIXIT		
Expected result 1. SUT processes the quality as specified in the PIXIT.		
Test description 1. Change the value of attribute q of a data object of one server to: - Validity: Invalid - Validity: Questionable – Failure = true - Validity: Questionable – OldData = true - Source = Substituted (by another client) - Test = true - OperatorBlocked = true		
Comment		

cSrvN6	Time Quality values	Passed
IEC 61850-7-2 clause 10.4.2 IEC 61850-8-1 clause 13.2.1 PIXIT		
Expected result 1-3. SUT processes the time quality as specified in the PIXIT.		
Test description 1. Force server to respond with data object with time quality “clock failure” 2. Force server to respond with data object with time quality “clock not synchronised” 3. Force server to respond with data object with time quality “leap seconds known”		
Comment		

A4.2 Block 2: Data set

Test case	Test case description
cDs1	Force SUT to request a GetLogicalNodeDirectory(DATASET) of the Logical Nodes of the configured servers.
cDs2	Check that the SUT can perform a GetDataSetDirectory request for all the DataSets of the server.
cDs3	Check that the SUT can send a GetDataSetValues request and handle the response
cDs4	Check SUT can request a SetDataSetValues and handle the respond
cDs5	Verify that the client checks the pre-configured datasets in the SCD file. If any deviation is detected the SUT behaves as specified in the PIXIT

Test case	Test case description
cDsN1	Check that the SUT still communicates with other servers when the following requests return a negative response: a) GetLogicalNodeDirectory (DATASET) b) GetDataSetDirectory
cDsN2	Check that the SUT still communicates with other servers properly when it performs a GetDataSetValues request on one server and one of the following situations happens: a) The response is negative. b) The response contains more/less members than expected c) The response contains reordered members of different types d) The response contains reordered members of the same type
cDsN3	Check that the SUT still communicates with other servers properly when it performs a SetDataSetValues request on one server and the response is negative.

Detailed test procedures for Data Set

cDs1	GetLogicalNodeDirectory(DATASET)	Passed
IEC 61850-7-2 clause 9.2.2 IEC 61850-8-1 clause 12.3.1		
Expected result 1. SUT accepts the respond.		
Test description 1. Force SUT to perform a GetLogicalNodeDirectory(DATASET) request for each server and logical device		
Comment For IEC 61850-8-1 the GetLogicalNodeDirectory(DATASET) is mapped on a GetNameList and a logical device as parameter		

cDs2	GetDataSetDirectory	Passed
IEC 61850-7-2 clause 11.3.6 IEC 61850-8-1 clause 14.3.5		
Expected result 1. SUT accepts the respond.		
Test description 1. Force SUT to perform a GetDataSetDirectory request for the data sets used by the SUT		
Comment		

cDs5	Pre-configured dataset deviations	Passed
IEC 61850-7-2 clause 11.3 IEC 61850-8-1 clause 14.3 PIXIT		
Expected result 3. SUT responds as specified in PIXIT on the reconfigured datasets.		
Test description 1. Stop one server 2. Reconfigure the server to force the following mismatches in different datasets: - Insert a new dataset element in the middle of a dataset - Delete a dataset element in the middle of a dataset - Reorder 2 dataset members in a dataset of a different data type - Reorder 2 dataset members in a dataset of the same data type 3. Start the server and force the SUT to perform a GetDataSetDirectory request on all the datasets used by the SUT		
Comment		

cDsN1	GetLogicalNodeDirectory(DATASET).response- and Get-DataSetDirectory.response-	Passed
IEC 61850-7-2 clause 9.2.2, 11.3.6 IEC 61850-8-1 clause 12.3.1, 14.3.5 PIXIT		
Expected result 4. The SUT processes the negative response and continues as specified in PIXIT 5. The SUT processes the response as specified in the PIXIT 6. The SUT does not send the request or behaves as specified in PIXIT		
Test description a) 1. Stop one server 2. Reconfigure the server in the following way: o Rename a dataset in one logical device o Add a dataset in another logical device o Rename another logical device 3. Start the server 4. Force the SUT to perform a GetLogicalNodeDirectory(DATA-SET) request for the previously known logical device 5. Force the SUT to perform a GetLogicalNodeDirectory(DATA-SET) request for the logical device which contains the dataset that was newly added b) 6. Force the SUT to perform a GetDataSetDirectory request for the previously known dataset		
Comment		

A4.2+ Block 2+: Data set definition

Test case	Test case description
cDs6	Check if the SUT can send a correct CreateDataSet request for: a) a non-persistent dataset b) a persistent dataset
cDs7	Request a DeleteDataSet service and check the client sends the request properly and is able to process the response of the server.

Test case	Test case description
cDsN4	Check if the SUT still communicates with other servers after it receives a CreateDataSet.response-
cDsN5	Check if the SUT still communicates with other servers after it receives a DeleteDataSet.response-

Detailed test procedures for Data Set definition

cDs6	CreateDataSet	Passed
IEC 61850-7-2 clause 11.3.4 IEC 61850-8-1 clause 14.3.3 PIXIT		
Expected result 1a) The SUT sends a correct CreateDataSet request 1b) The SUT sends a correct CreateDataSet request		
Test description 1. Force SUT to: a) Perform a CreateDataSet request to create a non-persistent dataset b) Perform a CreateDataSet request to create a persistent dataset		
Comment		

cDs7	DeleteDataSet	Passed
IEC 61850-7-2 clause 11.3.5 IEC 61850-8-1 clause 14.3.4 PIXIT		
Expected result 1a). SUT sends correct DeleteDataset request 1b). SUT sends correct DeleteDataset request		
Test description 1. Force SUT to: a) Perform a DeleteDataSet request on a non-persistent dataset b) Perform a DeleteDataSet request on a persistent dataset		
Comment		

cDsN4	CreateDataSet.response-	Passed
IEC 61850-7-2 clause 11.3.4 IEC 61850-8-1 clause 14.3.3 PIXIT		
Expected result 1. SUT behaves as specified in the PIXIT		
Test description 1. Force SUT the send a CreateDataSet request that returns a CreateDataSet.response-		
Comment		

cDsN5	DeleteDataSet.response-	Passed
IEC 61850-7-2 clause 11.3.5 IEC 61850-8-1 clause 14.3.4 PIXIT		
Expected result 1. SUT behaves as specified in the PIXIT		
Test description 1. Force SUT to send a DeleteDataSet request that returns a DeleteDataSet.response-		
Comment		

A4.3 Block 3: Substitution

cSub1	Verify SUT can enable substitution, enter a substituted value and disable substitution
cSub2	Verify SUT can proces the source "substituted" for substituted values
cSub3	Verify SUT can proces the source "substituted" for values substituted by another client

Detailed test procedures for Substitution

cSub1	Substitute a value	Passed
IEC 61850-7-2 clause 12 IEC 61850-8-1 clause 15		
Expected result 1. SUT sends successful SetDataValues requests for the values with functional constraint SV 2. SUT successfully enables substitution 3. SUT successfully disables substitution		
Test description 1. SUT substitutes the values of data objects in one server by another valid value of the following type: - single point status - double point status - enumerated status - integer measurand - floating point measurand - quality 2. SUT enables substitution 3. SUT disables substitution		
Comment		

cSub2	Verify that SUT can process the source "substituted" for substituted value	Passed

IEC 61850-7-2 clause 12
IEC 61850-8-1 clause 15

Expected result

2. SUT succesfully enables substitution
3. SUT processes the new substituted value and quality with source “substituted” when transmitted by the report or GetDataValues response
4. SUT succesfully disables substitution
5. SUT processes the original process value and quality with source “process” when transmitted by the GetDataValues response

Test description

1. SUT substitutes the values of data objects in one server by another valid value of the following type:
   - single point status
   - double point status
   - enumerated status
   - integer measurand
   - floating point measurand
   - quality
2. SUT enables substitution
3. Force the SUT to perform a GetDataValues request on the substituted data
4. SUT disables substitution
5. Force the SUT to perform a GetDataValues request on the data that is no longer substituted

Comment

cSub3	Substitute a value by another client	Passed
IEC 61850-7-2 clause 12 IEC 61850-8-1 clause 15		
Expected result 1. SUT displays the substituted value and quality when transmitted by the report or a Get-DataValue response		
Test description 1. Use another client to substitute a value and quality of a data object		
Comment		

A4.4 Block 4: Setting group selection

cSg1	Check that the SUT can send a correct GetLogicalNodeDirectory(SGCB) request
cSg2	Verify the SUT can select a setting group (IEC 61850-7-2 clause 13 figure 18). For each setting group: a) SelectActiveSG of the setting group b) GetSGCBValues to verify active setting group

cSgN1	Force the SUT to perform the following requests in a way that makes the server return a response-: a) SelectActiveSG (IEC 61850-7-2 clause 13.3.2) b) GetSGCBValues (IEC 61850-7-2 clause 13.3.7) The SUT should respond to these responses as specified in the PIXIT.

Detailed test procedures for Setting group selection

cSg1	Check that the SUT can send a correct GetLogicalNodeDirectory(SGCB) request	Passed
IEC 61850-7-2 clause 9.2.2 IEC 61850-8-1 clause 12.3.1 PIXIT		
Expected result 1. The SUT sends a correct GetLogicalNodeDirectory(SGCB) request		
Test description 1. Force the SUT to send a GetLogicalNodeDirectory(SGCB) request for each logical device in each server		
Comment		

cSg2	Select setting group	Passed
IEC 61850-7-2 clause 13.3.2 IEC 61850-8-1 clause 16.2.1 PIXIT		
Expected result 1. The SUT sends a correct SelectActiveSG request 2. The SUT sends a correct GetSGCBValues request		
Test description 1. Force the SUT to perform a SelectActiveSG request to select first setting group of a SGCB 2. Force the SUT to perform a GetSGCBValues request to read the active setting group 3. Repeat step 1 and 2 for the other setting groups in the SGCB		
Comment		

cSgN1	Pre-configured setting group deviations	Passed
IEC 61850-7-2 clause 9.2.2, 13.3.2 IEC 61850-8-1 clause 12.3.1, 16.2.1 PIXIT		
Expected result 1. The SUT responds as specified in PIXIT to the negative responses from the server		
Test description 1. Force the SUT to send the following requests with invalid/non existing parameters: a) SelectActiveSG b) GetSGCBValues		
Comment		

A4.4+ Block 4+: Setting group definition

cSg3	Verify SUT can get setting group values [FC=SG] (IEC 61850-7-2 clause 13 figure 18). For each setting group: a) SelectActiveSG of the first setting group b) Use GetSGValues [FC=SG] to verify the values are of first setting group
cSg4	Verify SUT can edit setting group values

Detailed test procedures for Setting group definition

cSg3	Get setting group values	Passed
IEC 61850-7-2 clause 13.3.6 IEC 61850-8-1 clause 16.2.5 PIXIT		
Expected result 1. SUT requests SelectActiveSG 2. SUT requests GetSGValues		
Test description 1. Request SelectActiveSG to Select first setting group of a server 2. Request GetSGValues [FC=SG] to verify setting group values 3. Repeat for another setting group		
Comment		

cSg4	Edit setting group values	Passed
IEC 61850-7-2 clause 13.3 IEC 61850-8-1 clause 16.2 PIXIT		
Expected result 1. SUT requests SelectActiveSG 2. SUT requests GetSGValues[FC=SE] 3. SUT requests SetSGValues[FC=SE] 4. SUT requests ConfirmEditSG		
Test description 1. Request SelectEditSG to select first setting group of a server 2. Request GetSGValues[FC=SE] to get the current setting group values 3. Request SetSGValues[FC=SE] to set the new setting group values 4. Request ConfirmEditSG		
Comment		

A4.5 Block 5: Unbuffered Reporting

Test case	Test case description
cRp1	Force the SUT to perform a GetLogicalNodeDirectory(URCB) request for the logical nodes declared in the PIXIT.
cRp2	SetURCBValues for RptID and DatSet.Check that the SUT overwrites mismatching RptID and DatSet values in URCBs.
cRp3	Verify the client is able to process the reports with different optional fields.
cRp4	Verify the client is able to process unbuffered reports with the following supported trigger conditions: a) on integrity b) on update (dupd) c) on update with integrity (dupd+integrity) d) on data change (dchg) e) on data and quality change (dchg+qch) f) On data and quality change with integrity period (dchg+qchg)
cRp5	Verify the client is able to process segmented reports
cRp6	Verify client can change the (pre-)configured Buffer Time (IEC 61850-7-2 clause 14.2.2.9)
cRp7	Verify client can force a General interrogation
cRp8	Verify that the SUT configures and enables the URCB's as specified in the SCD file. The SUT is only allowed to write to the "dyn" URCB fields in the SCL.
cRp9	Verify that the SUT can process reports with complex structured data (for example WYE and DEL data objects)
cRp10	Verify that the SUT can handle reports with basic data (for example stVal and quality)

Test case	Test case description
cRpN1	Check that the SUT still communicates with other servers when it performs a GetLogical-NodeDirectory(URCB) request which returns a negative response.
cRpN2	Check that the SUT still works properly when it performs a GetURCBValues request which returns a negative response.
cRpN3	Check that the SUT still works properly when it performs a SetURCBValues request which returns a negative response.
cRpN4	Check that the SUT still works properly when it performs a SetURCBValues request while the URCB is reserved by another client (Resv=TRUE, PIXIT)
cRpN5	Check that the SUT keeps functioning normally if it receives a report that contains OptFlds that the SUT does not support.
cRpN6	Check that the SUT keeps functioning normally if it receives a report that contains Trigger options that the SUT does not support.

Test case	Test case description
cRpN7	Check that the SUT behaves as described in the PIXIT when a URCB in the server has a different configuration than expected.
cRpN8	Verify that the SUT detects a change in the ConfRev attribute (Configuration revision, IEC 61850-7-2, 14.2.2.7) of the Report Control Block. When the SUT does not perform the ConfRev check it should check the dataset members. The means of detection need to be specified in the PIXIT.

Detailed test procedures for Unbuffered Reporting

cRp1	GetLogicalNodeDirectory(URCB)	Passed
IEC 61850-7-2 clause 9.2.2 IEC 61850-8-1 clause 12.3.1 PIXIT		
Expected result 1. SUT correctly requests GetLogicalNodeDirectory(URCB)		
Test description 1. Force the SUT to perform a GetLogicalNodeDirectory(URCB)		
Comment		

cRp2	SetURCBValues for RptID and DatSet	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 4. The SUT configures the new values.		
Test description 1. Stop SUT 2. Configure the “RptID” and the “DatSet” fields for a report control block in the SUT SCL file for one server to be different from the values in the server. 3. Configure RptID and DatSet in the ReportSettings for the server to be “Dyn” 4. Start SUT and force SUT to perform a SetURCBValues request for the mismatching RptID and DatSet		
Comment		

cRp3	SUT is able to process unbuffered reports with different optional fields	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 3. The SUT sets the configured optional fields before enabling the URCB. 4. The SUT is able to process the report.		
Test description 1. Stop SUT 2. Configure the minimum optional fields supported by the SUT for a report control block in the SUT SCL file for one server. 3. Start SUT and force SUT to enable a URCB 4. Generate a report for the configured URCB 5. Repeat step 1 to 4, this time configuring the maximum optional fields supported by the SUT in step 2		
Comment		

cRp4	SUT is able to process unbuffered reports with different trigger conditions	Passed

IEC 61850-7-2 clause 14.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT

Expected result

4. SUT is able to process the reports sent by the server.

Test description

1. Stop SUT
2. Configure the following (combination of) trigger conditions supported by the SUT for a URCB in the SUT SCL file for one server:
   a) integrity
   b) data update (dupd)
   c) data update and integrity (dupd+integrity)
   d) data change (dchg)
   e) data change and quality change (dchg+qchg)
   f) data change, quality change and integrity (dchg+qchg+integrity)
3. Start SUT and force SUT to enable the report URCB.
4. Force events related to the trigger conditions configured in step 2, that are related to members in the dataset of the RCB. If the trigger condition "Integrity" was configured in step 2, wait for the configured integrity period to expire.

Comment

SUT does not show the trigger condition for the received report

cRp5	SUT can process segmented unbuffered reports	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT can process the reported valuechange(s)		
Test description 1. Force a server to send a segmented, unbuffered report with a data- and/or quality-change		
Comment		

cRp6	Change buffer time	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully sends the SetURCBValues request.		
Test description 1. Force the SUT to perform a SetURCBValues request to change the BufTm of a URCB		
Comment		

cRp7	Verify client can force a General interrogation on an unbuffered report control block	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully performs a general interrogation request		
Test description 1. Force the SUT to perform a general interrogation request on a URCB		
Comment		

cRp8	Enable all URCBs specified in SCL	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. The SUT configures all URCBs as specified in the SUT SCL		
Test description 1. Force SUT to enable all URCBs that are configured in the SUT SCL		
Comment		

cRp9	Verify that the SUT can process URCB reports with complex structured data	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully configures and enables the report control block 2. SUT processes the report as normal		
Test description 1. Force SUT to Configure and enable an unbuffered report control block which contains complex structured data (e.g. WYE or DEL). 2. Force the server to send a report for the unbuffered report control block		
Comment		

cRp10	Verify that the SUT can process URCB reports with basic data	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully configures and enables the report control block 2. The SUT processes the report as normal		
Test description 1. Force the SUT to Configure and enable an unbuffered report control block which contains basic (unstructured) data (e.g. stVal or q) 2. Force the server to send a report for the unbuffered report control block.		
Comment		

cRpN1	Renamed URCB	Passed
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. The SUT behaves as specified in the PIXIT		
Test description 1. Stop a server 2. Reconfigure a URCB in the server SCL with a new valid name 3. Start server and force the SUT to perform a GetLogicalNodeDirectory(URCB) request for the LD that contains the URCB		
Comment		

cRpN2	GetURCBValues.response-	Passed
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. SUT is able to communicate to other servers and behaves like stated in PIXIT for the server with the deleted URCB.		
Test description 1. Stop a server 2. Remove a URCB in the server SCL 3. Start server and force the SUT to perform a GetURCBValues request for the non existing URCB		
Comment		

cRpN3	SetURCBValues.response-	Passed
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. The SUT processes the SetURCBValues.response- as specified in the PIXIT		
Test description 1. Stop a server 2. Change the server configuration so that one or more of the following URCB elements which where previously writable become read-only: DatSet, RptID, OptFlds, BufTm, TrgOps, IntgPd 3. Start server and force the SUT to perform a SetURCBValues request for one or more of the read-only URCB elements		
Comment		

cRpN4	Report block is already reserved	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. The SUT processes the SetURCBValues.response- as specified in the PIXIT		
Test description 1. Use another client to reserve a URCB prior to SUT and force SUT to perform a SetURCB-Values request on the reserved URCB		
Comment		

cRpN7	SUT is able to handle report control blocks with a mismatching configuration	Passed

IEC 61850-7-2 clause 14.2

IEC 61850-8-1 clause 17.1, 17.2

PIXIT

Expected result

4. The SUT behaves as described in the PIXIT.

Test description

1. Stop a server
2. Configure a URCB in the server SCL file in the following way:
   a) Change the referenced dataset into a new valid dataset
   b) Change the RptID
   c) Configure the dataset linked to a URCB in the server SCL file in the following way:
      - change the order of dataset members, without changing the order of the datatypes
      - change the order of dataset members, hereby changing the order of the datatypes
      - remove a dataset element from the middle of the dataset
      - add a dataset element in the middle of a dataset
3. Set DatSet and RptID in the reportsettings (for the server containing the URCB) to conf.
4. Start the server and force the SUT to enable the URCB

Comment

SUT does not read rptID before enabling a report

Datset elements are only checked when a report has been received.

This test case has been performed by adding a GI after enabling the report.

cRpN8	SUT is able to detect a change in ConfRev	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 3. The SUT behaves as described in the PIXIT.		
Test description 1. Stop a server 2. Increment the value for confRev of a URCB in the server SCL and remove a member from the referenced dataset 3. Start the server and force SUT to enable the URCB 4. Repeat step 1 to 3, this time without changing the referenced dataset in step 2		
Comment		

A4.6 Block 6: Buffered Reporting

Test case	Test case description
cBr1	Force the SUT to perform a GetLogicalNodeDirectory(BRCB) request for the logical nodes declared in the PIXIT.
cBr2	SetBRCBValues for RptID and DatSet. Check that the SUT overwrites mismatching RptID and DatSet values in all BRCBs..
cBr3	Verify the client is able to process the reports with different optional fields.
cBr4	Verify the client is able to process buffered reports with the following supported trigger conditions: a) on integrity b) on update (dupd) c) on update with integrity (dupd+integrity) d) on data change (dchg) e) on data and quality change (dchg+qch) f) On data and quality change with integrity period (dchg+qchg)
cBr5	Verify the client is able to process segmented reports
cBr6	Verify client can change the (pre-)configured Buffer Time (IEC 61850-7-2 clause 14.2.2.9)
cBr7	Verify client can force a General interrogation
cBr8	Verify that the SUT configures and enables the BRCBs as configured in the SCD file. The SUT is only allowed to write to the "dyn" BRCB fields in the SCL.
cBr9	Verify that the SUT can handle reporting of complex structured data (for example WYE and DEL data objects)
cBr10	Verify that the SUT can handle reporting of basic data (for example stVal and quality)
cBr11	Verify the SUT is able to process reports buffered during a lost association a) without bufferoverflow (PIXIT) b) with bufferoverflow
cBr12	Verify the SUT is able to request specific buffered reports after restoring a lost association by setting the EntryID
cBr13	Verify the SUT is able to purge buffered reports

Test case	Test case description
cBrN1	Check that the SUT still communicates with other servers when it performs a GetLogicalNodeDirectory (BRCB) request which returns a negative response.
cBrN2	Check that the SUT still works properly when it performs a GetBRCBValues request which returns a negative response.
cBrN3	Check that the SUT still works properly when it requests a SetBRCBValues and the response is negative.
cBrN4	Check that the SUT still works properly when it requests a SetBRCBValues and the BRCB is used by or pre-assigned to another client. (PIXIT)
cBrN5	Check that the SUT keeps functioning normally if it receives a Report which contains OptFlds that the SUT does not support.
cBrN6	Check that the SUT keeps functioning normally if it receives a Report which contains Trigger Options that the SUT does not support.
cBrN7	Mismatching reports: a) Report with a mismatching DataSet. b) Report with a mismatching RptID c) Report with mismatching references of the Data (when data references are enabled). Check the behaviour described in the PIXIT.
cBrN8	Verify that the SUT detects a change in the ConfRev attribute (Configuration revision, IEC 61850-7-2, 14.2.2.7) of the Report Control Block. When the SUT does not perform the ConfRev check it should check the dataset members. The means of detection needs to be specified in the PIXIT.
cBrN9	Verify the SUT can handle a severe buffer overflow with SetBRBValues(EntryID) response-

Detailed test procedures for Buffered Reporting

cBr1	GetLogicalNodeDirectory(BRCB)	Passed
IEC 61850-7-2 clause 9.2.2 IEC 61850-8-1 clause 12.3.1 PIXIT		
Expected result 1. SUT correctly requests GetLogicalNodeDirectory(BRCB)		
Test description 1. Force the SUT to perform a GetLogicalNodeDirectory(BRCB)		
Comment		

cBr2	SetBRCBValues for RptID and DatSet	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 4. The SUT configures the new values.		
Test description 1. Stop SUT 2. Configure the "RptID" and the "DatSet" fields for a report control block in the SUT SCL file for one server to be different from the values in the server. 3. Configure RptID and DatSet in the ReportSettings for the server to be "Dyn" 4. Start SUT and force SUT to perform a SetBRCBValues request for the mismatching RptID and DatSet		
Comment		

cBr3	SUT is able to process buffered reports with different optional fields	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 3. The SUT sets the configured optional fields before enabling the BRCB. 4. The SUT is able to process the report.		
Test description 1. Stop SUT 2. Configure the minimum optional fields supported by the SUT for a report control block in the SUT SCL file for one server. 3. Start SUT and force SUT to enable a BRCB 4. Generate a report for the configured BRCB 5. Repeat step 1 to 4, this time configuring the maximum optional fields supported by the SUT in step 2		
Comment		

cBr4	SUT is able to process buffered reports with different trigger conditions	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 4. SUT is able to process the reports sent by the server.		
Test description 1. Stop SUT 2. Configure the following (combination of) trigger conditions supported by the SUT for a BRCB in the SUT SCL file for one server: a) integrity b) data update (dupd) c) data update and integrity (dupd+integrity) d) data change (dchg) e) data change and quality change (dchg+qchg) f) data change, quality change and integrity (dchg+qchg+integrity) 3. Start SUT and force SUT to enable the report BRCB. 4. Force events related to the trigger conditions configured in step 2, that are related to members in the dataset of the RCB. If the trigger condition "Integrity" was configured in step 2, wait for the configured integrity period to expire.		
Comment		

cBr5	SUT can process segmented buffered reports	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT can process the reported valuechange(s)		
Test description 1. Force a server to send a segmented, buffered report with a data- and/or quality-change		
Comment		

cBr6	Change buffer time	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully sends the SetBRCBValues request.		
Test description 1. Force the SUT to perform a SetBRCBValues request to change the bufTm of a BRCB		
Comment		

cBr7	Verify client can force a General interrogation on a buffered report control	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully performs a general interrogation request		
Test description 1. Force the SUT to perform a general interrogation request on a BRCB		
Comment		

cBr8	Enable all BRCBs specified in SCL	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. The SUT configures all BRCBs as specified in the server SCL		
Test description 1. Force SUT to enable all BRCBs that are configured in the server SCL		
Comment		

cBr9	Verify that the SUT can process BRCB reports with complex structured data	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully configures and enables the report control block 2. The SUT processes the report as normal		
Test description 1. Force the SUT to Configure and enable a buffered report control block which contains complex structured data. (e.g. WYE or DEL) 2. Force the server to send a report for the buffered report control block		
Comment		

cBr10	Verify that the SUT can process BRCB reports with basic data	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully configures and enables the report control block 2. The SUT processes the report as normal		
Test description 1. Force the SUT to Configure and enable a buffered report control block which contains basic (unstructured) data (e.g. stVal or q) 2. Force the server to send a report for the buffered report control block		
Comment		

cBr11	Process buffered reports with and without buffer overflow	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 5. The SUT handles the buffered reports 8. The SUT handles the buffered reports as specified in PIXIT		
Test description 1. Configure and enable a BRCB with trigger conditions data change and all supported optional fields. 2. Force data changes in a server to force reports 3. Disconnect the Ethernet cable between the server and switch 4. Force data changes in the server to force report buffering 5. Restore the Ethernet connection 6. Disconnect the Ethernet cable between the server and switch 7. Force many data changes in the server to force buffer overflow 8. Restore the Ethernet connection		
Comment		

cBr12	Set EntryId of buffered reports	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 5. The SUT is able to process the buffered reports		
Test description 1. Configure and enable a BRCB with trigger conditions data change and/or quality change, and all supported optional fields. 2. Force data/quality changes in a server to force reports 3. Disconnect the Ethernet cable between switch and the server 4. Force data/quality changes in the server to force buffered reports 5. Restore the Ethernet connection 6. Force SUT to send a correct SetBRCBValues request for the EntryID that was last received by the SUT		
Comment		

cBr13	Purge buffered reports	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 6. The SUT requests purge buffer		
Test description 1. Configure and enable a BRCB with trigger conditions data change and/or quality change, and all supported optional fields. 2. Force data/quality changes in a server to force reports 3. Disconnect the Ethernet cable between switch and the server 4. Force data/quality changes in the server to force buffered reports 5. Restore the Ethernet connection 6. Force SUT to purge buffered reports (PIXIT)		
Comment		

cBrN1	Renamed BRCB	Passed
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. The SUT behaves as specified in the PIXIT		
Test description 1. Stop a server 2. Reconfigure a BRCB in the server SCL with a new valid name 3. Start server and force the SUT to perform a GetLogicalNodeDirectory(BRCB) request for the LD which contains the BRCB		
Comment		

cBrN2	GetBRCBValues.response-	Passed
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. SUT is able to communicate to other servers and behaves like stated in PIXIT for the server with the deleted BRCB.		
Test description 1. Stop a server 2. Remove a BRCB in the server SCL 3. Start server and force the SUT to perform a GetBRCBValues request for the non existing BRCB		
Comment		

cBrN3	SetBRCBValues.response-	Passed
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. The SUT processes the SetBRCBValues.response- as specified in the PIXIT		
Test description 1. Stop a server 2. Change the server configuration so that one or more of the following BRCB elements which where previously writable become read-only: DatSet, RptID, OptFlds, BufTm, TrgOps, IntgPd 3. Start server and force the SUT to perform a SetBRCBValues request for one or more of the read-only BRCB elements		
Comment		

cBrN4	Report block is already reserved	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. The SUT behaves as specified in the PIXIT		
Test description 1. Use another client to enable a BRCB prior to SUT and force SUT to perform a SetBRCB-Values request on the BRCB		
Comment		

cBrN7	SUT is able to handle report control blocks with a mismatching configuration	Passed

IEC 61850-7-2 clause 14.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT

Expected result

4. The SUT behaves as described in the PIXIT.

Test description

1. Stop a server
2. Configure a BRCB in the server SCL file in the following way:
   a) Change the referenced dataset into a new valid dataset
   b) Change the RptID
   c) Configure the dataset linked to a BRCB in the server SCL file in the following way:
      - change the order of dataset members, without changing the order of the datatypes
      - change the order of dataset members, hereby changing the order of the datatypes
      - remove a dataset element from the middle of the dataset
      - add a dataset element in the middle of a dataset
3. Set DatSet and RptID in the ReportSettings (for the server containing the BRCB) to conf.
4. Start the server and force the SUT to enable the BRCB

Comment

cBrN8	SUT is able to detect a change in ConfRev	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 3. The SUT behaves as described in the PIXIT.		
Test description 1. Stop a server 2. Increment the value for confRev of a BRCB in the server SCL and remove a member from the referenced dataset 3. Start the server and force SUT to enable the BRCB 4. Repeat step 1 to 3, this time without changing the referenced dataset in step 2		
Comment		

cBrN9	Set non-existing EntryID	Passed
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 5. The SUT will behave as specified in PIXIT		
Test description 1. Force data changes in a server to force reports 2. Disconnect the Ethernet cable between the Ethernet switch and the server 3. Force many data changes in a server to force a buffer overflow 3. Restore the Ethernet connection 4. Force SUT to perform a SetBRCBValues request with an EntryID from a discarded report		
Comment		

A4.12 Block 12: Control

Test case	Test case description
cCtl1	Check if the SUT is able to set the TEST field in the commands (PIXIT).
cCtl2	Check if the SUT is able to set the following (combination of) CHECK bits in the commands (PIXIT) for the supported control models: a) Synchro Check b) Interlock Check c) Synchro Check and Interlock Check
cCtl3	Check if the SUT is able to change control model using online services (PIXIT).
cCtl4	Verify the values of originator category, origin identification and the control number (PIXIT)

Test case	Test case description
cCtlN1	Check if the SUT reacts as described in the PIXIT when it detects a control model mismatch: a) Server status-only, SUT expects controllable b) Server SBO, SUT expects direct operate c) Server direct operate, SUT expects SBO d) Server SBO enhanced SUT expects SBO normal
cCtlN2	Check if the SUT reacts as described in the PIXIT when it detects a control model that is not initialized in the SCL file

The testing of the control model has been divided in the four possible control models that can be implemented:

- Direct control with normal security.
- SBO control with normal security.
- Direct control with enhanced security.
- SBO control with enhanced security.

Detailed test procedures for Control

cCtl1	Test mode	Passed
IEC 61850-7-2 clause 17.5.2.4 IEC 61850-8-1 clause 20, Annex E		
Expected result DO normal/enhanced security: 1a. The SUT sends the Operate request with Test flag = true SBO normal security: 1b. The SUT sends the Operate requests with Test flag = true SBO enhanced security: 1c. The SUT sends the SelectWithValue and Operate requests with Test flag = true		
Test description DO normal/enhanced security: 1a. Force the SUT to perform an Operate request with the Test flag set SBO normal security: 1b. Force the SUT to perform a Select request followed by an Operate request with the Test flag set SBO enhanced security: 1c. Force the SUT to perform a SelectWithValue request followed by an Operate request, both with the Test flag set		
Comment		

cCtl2	Synchro and interlock check	Passed

IEC 61850-7-2 clause 17.5.2.5
IEC 61850-8-1 clause 20, Annex E
PIXIT

Expected result

The SUT sends the request(s) with the Check bits as specified in PIXIT.

Test description

DO normal/enhanced security:

a) Force the SUT to send an Operate request with the Synchro Check bit set
b) Force the SUT to send an Operate request with the Interlock Check bit set
c) Force the SUT to send an Operate request with the Interlock and Synchro Check bit set

SBO normal security:

a) Force the SUT to perform a Select and Operate request with the Synchro Check bit set
b) Force the SUT to perform a Select and Operate request with the Interlock Check bit set
c) Force the SUT to perform a Select and Operate request with the Interlock and Synchro Check bit set

SBO enhanced security:

a) Force the SUT to perform a SelectWithValue and Operate request, both with the Synchro Check bit set
b) Force the SUT to perform a SelectWithValue and Operate request, both with the Interlock Check bit set
c) Force the SUT to perform a SelectWithValue and Operate request, both with the Interlock and the Synchro Check bit set

Comment

cCtl3	Change control model	Passed
IEC 61850-7-2 clause 17.2, 17.3 IEC 61850-8-1 clause 20, Annex E PIXIT		
Expected result The SUT sends the SetDataValues request with the corresponding control model		
Test description 1. Force the SUT to perform a SetDataValues request to change control model to "Direct control with normal security" 2. Force the SUT to perform a SetDataValues request to change control model to "SBO control with normal security" 3. Force the SUT to perform a SetDataValues request to change control model to "Direct control with enhanced security" 4. Force the SUT to perform a SetDataValues request to change control model to "SBO control with enhanced security"		
Comment		

cCtl4	Verify control number and originator	Passed
IEC 61850-7-2 clause 17.2, 17.3 IEC 61850-8-1 clause 20, Annex E PIXIT		
Expected result The SUT sets the control number and the originator as specified in PIXIT		
Test description Execute the applicable control model specific test cases		
Comment this is a continuous effort during the conformance test of the supported control models SUT does not automatically increment the control number and/or set the originator category and it is up to the Operator to set those when issuing the control service.		

cCtlN1	Control model deviations	Passed
IEC 61850-7-2 clause 17.2, 17.3 IEC 61850-8-1 clause 20, Annex E PIXIT		
Expected result 4. The SUT responds as specified in the PIXIT		
Test description 1. Stop a server 2. Reconfigure the server: a) Reconfigure one controllable object to status only b) Reconfigure one SBO object to direct operate c) Reconfigure one direct object to SBO d) Reconfigure SBO enhanced security control object to SBO normal security 3. Start server 4. Force the SUT to perform a Select/Operate request for the reconfigured control object		
Comment		

A4.12a Block 12a: Direct Control

Test case	Test case description
cDOns1	OperReq[test ok] resp+ Perform a correct Operate request. Check that the SUT does not generate an error.
cDOns2	OperReq[test not ok] resp- Client requests Oper resulting in Test not ok. Check that the SUT realizes the operation failed.
cDOns3	TimOperReq[test not ok] resp- Client requests TimOper resulting in Test not ok. Check that the SUT realizes the time operation failed.
cDOns4	TimOperReq[test ok] + TimerExpired[test ok] resp+ Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test Ok'. Verify the WaitForActionTime results in a timer expired 'Test ok' and that the SUT realizes the operation succeeded.
cDOns5	TimOperReq[test ok] + TimerExpired[test not ok] resp- Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test Ok'. Force situation that the WaitForActionTime results in a timer expired 'Test not ok'. Check that the SUT realizes the operation failed.

Applicable detailed test procedures for Direct Control with normal security (DOns).

cDOns1	Successful Operate	Passed
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7		
Expected result 1. The SUT processes the response		
Test description 1. Force the SUT to perform an Operate request on a DOns control object		
Comment		

cDOns2	Failed Operate	Passed
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7		
Expected result 1. The SUT processes the response- as specified in the PIXIT		
Test description 1. Force the SUT to perform an Operate request on a DOns control object that results in a Operate.response- with a Last Application Error (Tissue #246)		
Comment		

A4.12b Block 12b: SBO Control

Test case	Test case description
cSBOns1	SelectReq[test not ok] resp-: Force the SUT to perform a Select request that results in Test not ok. Check that the SUT handles the Select.response- as specified in the PIXIT.
cSBOns2	SelectReq[test ok] resp+ and OperReq[test ok] resp+ of selected object Force the SUT to send a Select request for an SBOns object. Force the SUT to perform a correct Operate request. Check that the SUT sends correct Select and Operate requests.
cSBOns3	SelectReq[test ok] resp+ and OperReq[test not ok] resp- of selected object. Force the SUT to perform a correct Select request, followed by an Operate request that results in Test not ok. Check that the SUT is able to process the Operate.response-
cSBOns4	SelectReq[test ok] resp+ and CancelReq of selected object. Check that the SUT can send a correct Cancel request.
cSBOns5	SelectReq[test ok] resp+ and TimOperReq[test ok] resp+ of selected object Check that the SUT is able to send a correct TimeActivated Operate request and that the SUT is able to process the response.
cSBOns6	SelectReq[test ok] resp+ and TimOperReq[test not ok] resp- of selected object Check that the SUT can process a Operate.response-

Applicable detailed test procedures for SBO Control with normal security (SBOns).

cSBOns1	Failed Select	Passed
IEC 61850-7-2 clause 17.2.2, 17.5.3.2 IEC 61850-8-1 clause 20.4 PIXIT		
Expected result 3. The SUT handles the Select.response- as described in the PIXIT		
Test description 1. Force the SUT to perform a correct Select request for which the server sends a response-		
Comment		

cSBOns2	Select and successful Operate	Passed
IEC 61850-7-2 clause 17.2.2, 17.5.3.5 IEC 61850-8-1 clause 20.7		
Expected result 1. The SUT sends a correct Select request for the SBOns object 2. The SUT sends a correct Operate request on the selected SBOns object		
Test description 1. Force the SUT to perform a Select request on an SBOns object 2. Force the SUT to perform an Operate request on the selected SBOns object		
Comment		

cSBOns3	Select and failed Operate	Passed
IEC 61850-7-2 clause 17.2.2, 17.5.3.5 IEC 61850-8-1 clause 20.7		
Expected result 5. SUT indicates Operate failure		
Test description 1. Force the SUT to send a correct Select request 2. Force the SUT to perform an Operate request that results in an Operate.response- with a Last Application error (Tissue #246)		
Comment SUT does not show the Last Application error		

cSBOns4	Cancel	Passed
IEC 61850-7-2 clause 17.2.2, 17.5.3.4 IEC 61850-8-1 clause 20.6		
Expected result 1. The SUT sends a correct Select request 2. The SUT sends a correct Cancel request		
Test description 1. Force the SUT to perform a Select request for an SBOns object 2. Force the SUT to perform a Cancel request on the selected object		
Comment		

A4.12c Block 12c: Direct Control with Enhanced Security

Test case	Test case description
cDOes1	OperReq[test ok] resp+: Force the SUT to send a correct Operate request that causes the server to send an Operate.response+ and: a) a CommandTermination+. b) a CommandTermination- (PIXIT) Check that the SUT processes the CommandTermination+ and the CommandTermination- as specified in the PIXIT
cDOes2	OperReq[test not ok] resp-: Check that the SUT behaves as specified in the PIXIT when it receives an Operate.response-
cDOes3	TimOperReq[test not ok] resp-: Check that the SUT behaves as described in the PIXIT when it receives a Operate.response-
cDOes4	TimOperReq[test ok] resp+: Force the SUT to send a correct TimeActivated Operate request that causes the server to send a Operate.response+ and: a) a CommandTermination+ b) a CommandTermination- Check that the SUT can process the CommandTermination+ and the CommandTermination-

Applicable detailed test procedures for Direct Control with enhanced security (DOes).

cDOes1	Successful Operate with command termination	Passed
IEC 61850-7-2 clause 17.3.2, 17.5.3.5 IEC 61850-8-1 clause 20.7 and 20.8 PIXIT		
Expected result 1. Check that the SUT processes the Command termination as specified in the PIXIT		
Test description 1. Force the SUT to send a correct Operate request that causes the server to send an Operate.response+ and: a) a CommandTermination+ b) a CommandTermination-		

Comment

cDOes2	Operate failure	Passed
IEC 61850-7-2 clause 17.3.2, 17.5.3.5 IEC 61850-8-1 clause 20.7 and 20.8 PIXIT		
Expected result 1. The SUT processes the Operate.response- as specified in the PIXIT		
Test description 1. Force the SUT to perform an Operate that results in an Operate.response-		
Comment		

A4.12d Block 12d: Enhanced SBO Control

Test case	Test case description
cSBOes1	SelectWithValue [test not ok] resp-: Force the SUT to perform a SelectWithValue request that results in a test not ok.
cSBOes2	SelectWithValue [test ok] resp+ and OperReq[test ok] resp+ of selected object Force the SUT to send a correct SelectWithValue request, followed by a correct Operate request.
cSBOes3	SelectWithValue [test ok] resp+ and OperReq[test not ok] resp- of selected object. Force the SUT to send a correct SelectWithValue request, followed by an Operate request that results in test not ok. Check that the SUT behaves as described in the PIXIT when it recieves the Operate.response-
cSBOes4	SelectWithValue [test ok] resp+ and CancelReq of selected object. Force the SUT to send a correct SelectWithValue request, followed by a correct Cancel request.
cSBOes5	SelectWithValue [test ok] resp+ and TimOperReq[test ok] resp+ of selected object Force the SUT to perform a correct SelectWithValue request, followed by a correct TimeActivedOperare request. Check that the SUT processes the response as specified in the PIXIT.
cSBOes6	SelectWithValue [test ok] resp+ and TimOperReq[test ok] resp- of selected object Force the SUT to perform a correct SelectWithValue request, followed by a TimeActivedOperate request that results response-..

Applicable detailed test procedures for SBO Control with enhanced security (SBOes).

cSBOes1	SelectWithValue – test not ok	Passed
IEC 61850-7-2 clause 17.3.3, 17.5.3.3 IEC 61850-8-1 clause 20.5, 20.8		
Expected result 2. SUT indicates SelectWithValue failure		
Test description 1. Force the SUT to perform a SelectWithValue request that results in a SelectWith-Value.response-		
Comment		

cSBOes2	SelectWithValue and successfull Operate	Passed
IEC 61850-7-2 clause 17.3.3, 17.5.3.5 IEC 61850-8-1 clause 20.5, 20.7, 20.8		
Expected result 1. The SUT performs a correct SelectWithValue request 2. The SUT performs a correct Operate request		
Test description 1. Force the SUT to perform a SelectWithValue request for an SBOes object 2. Force the SUT to perform an Operate request for the selected object		
Comment		

cSBOes3	SelectWithValue and failed Operate	Passed
IEC 61850-7-2 clause 17.3.3, 17.5.3.5 IEC 61850-8-1 clause 20.5, 20.7, 20.8		
Expected result 1. The SUT performs a correct SelectWithValue request 2. The SUT performs a correct Operate request		
Test description 1. Force the SUT to perform a SelectWithValue request 2. Force the SUT to perform an Operate request that results in an Operate.response-		
Comment		

cSBOes4	Cancel	Passed
IEC 61850-7-2 clause 17.3.3, 17.5.3.4 IEC 61850-8-1 clause 20.6, 20.8		
Expected result 1. The SUT performs a correct SelectWithValue request 2. The SUT performs a correct Cancel request		
Test description 1. Force the SUT to perform a SelectWithValue request 2. Force the SUT to perform a Cancel request		
Comment		

A4.13 Block 13: Time and time synchronization

cTm1	Verify that the SUT supports the SCSM time synchronisation, Change the time in the time server and verify the SUT uses the new time
cTm2	Check that the timestamp accuracy of the SUT matches the documented timestamp accuracy.

cTmN1	Verify that a lost time synchronisation is detected after a specified period and the timestamp quality invalid is set
cTmN2	Verify the SUT handles the time stamp quality coming from the time server

Detailed test procedures for Time and time synchronization

cTm1	Time synchronisation	Passed
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21 PIXIT		
Expected result 3. The SUT uses the new timestamp		
Test description 1. SUT exposes the time and time quality as specified in the PIXIT 2. Test engineer changes the time of the time server and waits till SUT has received the new time synch message 3. SUT exposes the time and time quality as specified in the PIXIT		
Comment		

cTm2	Time accuracy	Passed
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21 PIXIT		
Expected result 1. SUT timestamp accuracy matches with the documented accuracy 3. SUT uses the new timestamp		
Test description 1. SUT displays the time and time quality (PIXIT) or requests a service including the timestamp 2. Test engineer changes the time of the time server and waits till SUT has received the new time synch message 3. SUT displays the time and time quality (PIXIT) or requests a service including the timestamp		
Comment		

cTmN1	Time synchronisation lost	Passed
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21, PIXIT		
Expected result 1. SUT uses the correct timestamp 3. SUT uses the timestamp with “ClockNotsynchronized” 5. SUT uses the correct timestamp		
Test description 1. SUT displays the time and time quality (PIXIT) or requests a service including the timestamp 2. Test engineer stops or disconnects the time server and waits for the SUT to detect the time server is lost 3. SUT displays the time and time quality (PIXIT) or requests a service including the timestamp 4. Test engineer restarts or reconnects the time server and waits till SUT has received the time synch message 5. SUT displays the time and time quality (PIXIT) or requests a service including the timestamp		
Comment		

A4.14 Block 14: File transfer

cFt1	Verify that the SUT can send a GetServerDirectory(FILE) request with correct parameters and that the SUT is able to process the response (IEC 61850-7-2 clause 6.2.2)
cFt2	Verify that the SUT can send a GetFileAttributeValues request with correct parameters and verify that the SUT is able to process the response (IEC 61850-7-2 clause 20.2.4)
cFt3	Verify that the SUT can send a GetFile request with correct parameters and verify the SUT handles the response (IEC 61850-7-2 clause 20.2.1)
cFt4	Verify that the SUT can perform a SetFile request with correct parameters and handles the response (IEC 61850-7-2 clause 6.2.2)
cFt5	Verify that the SUT can send a DeleteFile request with correct parameters and verify that the SUT can process the response

cFtN1	Verify that the SUT is able to process a GetFile.response-
cFtN2	Verify that the SUT is able to process a GetFileAttributeValues.response-
cFtN3	Force the SUT to perform a SetFile request that results in a SetFile.response-. Check that the SUT processes the response as specified in the PIXIT.

Detailed test procedures for File transfer

cFt1	GetServerDirectory(FILE)	Passed
IEC 61850-7-2 clause 6.2.2 IEC 61850-8-1 clause 9.3, 23.2 PIXIT		
Expected result 1. The SUT processes the GetServerDirectory response		
Test description 1. Force the SUT to perform a GetServerDirectory(FILE) request with and without folder name		
Comment GetServerDirectory(FILE) and GetFileAttributeValues are mapped on the same MMS service		

cFt2	GetFileAttributeValues	Passed
IEC 61850-7-2 clause 6.2.2 IEC 61850-8-1 clause 9.3, 23.2 PIXIT		
Expected result 1. The SUT processes the GetFileAttributeValues response		
Test description 1. Force the SUT to perform a GetFileAttributeValues request with and without folder name		
Comment GetServerDirectory(FILE) and GetFileAttributeValues are mapped on the same MMS service		

cFt3	GetFile	Passed
IEC 61850-7-2 clause 20.2.1 IEC 61850-8-1 clause 23.2.1 PIXIT: file size 0		
Expected result 1. The SUT processes the file 2. The SUT processes the file 3. The SUT processes the file		
Test description 1. Force the SUT to perform a GetFile request for a small file of about 1kB 2. Force the SUT to perform a GetFile request for a file with file size 0 (unknown) 3. Force the SUT to perform a GetFile request for a large file of about 1MB		
Comment		

cFt5	DeleteFile	Passed
IEC 61850-7-2 clause 20.2.2 IEC 61850-8-1 clause 23.2.3		
Expected result 1. The SUT sends a correct DeleteFile request		
Test description 1. Force the SUT to perform a DeleteFile request on an existing, deletable file		
Comment		

cFtN1	GetFile.response-	Passed
IEC 61850-7-2 clause 20.2.1 IEC 61850-8-1 clause 23.2.1 PIXIT		
Expected result 1. The SUT processes the GetFile.response-		
Test description 1. Force the SUT to perform a GetFile request that results in a GetFile.response-		
Comment		

cFtN2	GetFileAttributeValues.response-	Passed
IEC 61850-7-2 clause 20.2.4 IEC 61850-8-1 clause 23.2.4 PIXIT		
Expected result 1. The SUT processes the GetFileAttributeValues.response-		
Test description 1. Force the SUT to perform a GetFileAttributeValues request that results is a GetFileAttributeValues.response-		
Comment		

IEC 61850 Certificate Level A[1]

No. 74105929-OPE/INC 14-1822

Issued to:
NR Electric CO., Ltd.
69, Suyuan Avenue
Nanjing 211102
China

For the client system:
PCS-9700 SCADA/HMI Workstation
Software version R1 (2014-04-27)
Hardware: HP Z600 workstation with
Windows 7 Professional

Issued by:

The client system has not shown to be non-conforming to:

IEC 61850 First Edition Parts 6, 7-1, 7-2, 7-3, 7-4 and 8-1

Communication networks and systems in substations

The conformance test has been performed according to IEC 61850-10 and UCA IUG Conformance Test Procedures for Client System with IEC 61850-8-1 interface, revision 1.1 with TPCL[2] version 1.2 with client system's protocol, model and technical issue implementation conformance statements: "Protocol Implementation Conformance Statement for the IEC 61850 interface in PCS-9700, May 22, 2014", "Model Implementation Conformance Statement for the IEC 61850 interface in PCS-9700, May 22, 2014", "TISSUES Implementation Conformance Statement for the IEC 61850 interface in PCS-9700, May 22, 2014" and product's extra information for testing: "Protocol Implementation eXtra Information for Testing (PIXIT) for the IEC 61850 interface in PCS-9700, May 22, 2014".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases):

1	Basic Exchange (22/22)	12a	Direct Control (7/7)
2	Data Sets (5/9)	12b	SBO Control (9/9)
2+	Data Set Definition (4/4)	12c	Enhanced Direct Control (7/7)
3	Substitution (3/3)	12d	Enhanced SBO Control (9/9)
4	Setting Group Selection (3/4)	13	Time Synchronization (3/4)
4+	Setting Group Definition (2/2)	14	File Transfer (6/8)
5	Unbuffered Reporting (16/18)		
6	Buffered Reporting (20/22)		

This certificate includes a summary of the test results as carried out at Nanjing, China with UniCA Multi IED Simulator version 3.26.01 and UniCA Analyzer 61850 version 5.28.04. This document has been issued for information purposes only, and the original paper copy of the DNV KEMA report No. 74105929-OPE/INC 14-1821 will prevail.

The test has been carried out on one single specimen of the client system as referred above and submitted to DNV KEMA by NR Electric CO., Ltd. The manufacturer's production process has not been assessed. This attestation does not imply that DNV KEMA has approved any product other than the specimen tested.

Arnhem, May 22, 2014

M. Adriaensen
Head of Department Operational Excellence

R. Schimmel
Certification Manager

[1] Level A - Independent test lab with certified ISO 9001 Quality System
[2] TPCL - Test Procedure Change List

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Applicable Test Procedures from the UCA IUG Conformance Test Procedures for Client System with IEC 61850-8-1 interface, revision 1.1 with TPCL version 1.2

	Conformance Block	Mandatory	Conditional
1:	Basic Exchange	cAss1, cAss2, cAss3, cAss4, cAssN1, cAssN4, cAssN5, cAssN6	cAssN7 cSrv1, cSrv2, cSrv3, cSrv4, cSrv5, cSrv6, cSrv7, cSrvN1, cSrvN2, cSrvN3, cSrvN4, cSrvN5, cSrvN6
2:	Data Sets		cDs1, cDs2, cDs5, cDsN1a, cDsN1b
2+:	Data Set Definition	cDs6, cDsN4	cDs7, cDsN5
3:	Substitution	cSub1	cSub2, cSub3
4:	Setting Group Selection	cSg2, cSgN1	cSg1
4+:	Setting Group Definition	cSg3, cSg4	
5:	Unbuffered Reporting	cRp3, cRp4, cRp5, cRp8, cRp9, cRp10, cRpN2, cRpN3, cRpN7, cRpN8	cRp1, cRp2, cRp6, cRp7, cRpN1, cRpN4
6:	Buffered Reporting	cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr12, cBrN2, cBrN3, cBrN7, cBrN8, cBrN9	cBr1, cBr2, cBr6, cBr7, cBr13, cBrN1, cBrN4
12a:	Direct control	cCtl4, cCtlN1 cDOns1, cDOns2	cCtl1, cCtl2, cCtl3
12b:	SBO control	cCtl4, cCtlN1 cSBOns1, cSBOns2, cSBOns3	cCtl1, cCtl2, cCtl3, cSBOns4
12c:	Enhanced Direct Control	cCtl4, cCtlN1 cDOes1, cDOes2	cCtl1, cCtl2, cCtl3
12d:	Enhanced SBO control	cCtl4, cCtlN1, cSBOes1, cSBOes2, cSBOes3	cCtl1, cCtl2, cCtl3 cSBOes4
13:	Time sync	cTm1	cTm2, cTmN1
14:	File transfer	cFt1, cFt2, cFt3, cFtN1, cFtN2	cFt5

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IEC 61850 Certificate Level A[1]

No. 74100349-MOC/INC 11-2070

Issued to:
NR Electric Co., Ltd
No.69 Suyuan Avenue
Jiangning District, Nanjing City
P.R. China, 211102

For the product:
PCS-9705 Bay Control Unit
Hardware version PCS-9000-HW-V1.06
Software version PCS-9000-SW-V2.12

Issued by: KEMA

The product has not shown to be non-conforming to:

IEC 61850-6, 7-1, 7-2, 7-3, 7-4 and 8-1

Communication networks and systems in substations

The conformance test has been performed according to IEC 61850-10 with product's protocol, model and technical issue implementation conformance statements: "PCS-9000 Platform Series IEC 61850 Protocol Implementation Conformance Statement (PICS)", "PCS-9705 Bay Control Unit IEC 61850 Model Implementation Conformance Statement (MICS)", "TISSUES Implementation Conformance Statement for the IEC 61850 interface in PCS-9000 Platform Series" and product's extra information for testing: "Protocol Implementation eXtra Information for Testing (PIXIT) for the IEC 61850 interface in PCS-9000 Platform".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases as defined in the UCA International Users Group Device Test procedures v2.2b):

1	Basic Exchange (19/24)	9a	GOOSE Publish (7/12)
2	Data Sets (3/6)	9b	GOOSE Subscribe (10/10)
3	Substitution (4/4)	12a	Direct Control (7/11)
4	Setting Group Selection (3/3)	12d	Enhanced SBO Control (12/19)
4+	Setting Group Definition (7/7)	13	Time Synchronization (4/5)
5	Unbuffered Reporting (15/18)	14	File Transfer (6/7)
6	Buffered Reporting (17/20)		

This Certificate includes a summary of the test results as carried out at KEMA in The Netherlands with UniCAsim 61850 version 3.23.02 with test suite 3.23.00 and UniCA 61850 analyzer 4.22.05. The test is based on the UCA International Users Group Device Test Procedures version 2.2b. This document has been issued for information purposes only, and the original paper copy of the KEMA report: No. 74100349-MOC/INC 11-2069 will prevail.

The test has been carried out on one single specimen of the product as referred above and submitted to KEMA by NR Electric Co., Ltd.. The manufacturer's production process has not been assessed. This Certificate does not imply that KEMA has certified or approved any product other than the specimen tested.

Arnhem, August 23, 2011

M. Adriaensen
Regional Director Management & Operations Consulting

S.J.T. Mulder
Senior Test Engineer

1 Level A - Independent Test lab with certified ISO 9000 or ISO 17025 Quality System

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Applicable Test Procedures from the UCA International Users Group Device Test Procedures version 2.2b

Conformance Block	Mandatory	Conditional
1: Basic Exchange	Ass1, Ass2, Ass3, AssN2, AssN3, AssN4, AssN5 Srv1, Srv2, Srv3, Srv4, Srv5, SrvN1abcd, SrvN4	Srv6, Srv7, Srv8, SrvN1e, SrvN3
2: Data Sets	Dset1, Dset10a, DsetN1ae	
3: Substitution	Sub1, Sub2, Sub3, SubN1	
4: Setting Group Selection	Sg1, SgN1a	Sg3
4+: Setting Group Definition	Sg2, Sg4, SgN1b, SgN2, SgN3, SgN4, SgN5	
5: Unbuffered Reporting	Rp1, Rp2, Rp3, Rp4, Rp7, Rp10 RpN1, RpN2, RpN3, RpN4	Rp5, Rp8, Rp9, RpN5, RpN6
6: Buffered Reporting	Br1, Br2, Br3, Br4, Br7, Br8, Br9, Br12 BrN1, BrN2, BrN3, BrN4, BrN5	Br5, Br10, Br11, BrN6
9a: GOOSE publish	Gop2, Gop3, Gop4, Gop7	Gop1, Gop6, GopN1
9b: GOOSE subscribe	Gos1a, Gos2, Gos3, GosN1, GosN2, GosN3, GosN4, GosN5, GosN6	Gos1b
12a: Direct control	CtlN3, CtlN8, DOns1, DOns3	Ctl2, Ctl7, CtlN11
12d: Enhanced SBO control	Ctl3, CtlN1, CtlN2, CtlN3, CtlN4, CtlN9 SBOes1, SBOes2, SBOes3	Ctl2, Ctl7, CtlN11
13: Time sync	Tm1, Tm2, TmN1	Tm3
14: File transfer	Ft1, Ft2ab, Ft4, FtN1ab	Ft2c, FtN1cd

All configuration file and data model tests have been successfully performed for the product variants using the same hardware and software version: PCS-9611, PCS-9612, PCS-9613, PCS-9631, PCS-9641, PCS-9651, PCS-9658 and PCS-9671.

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

PO NO:

PROJECT NAME:

DOCUMENT NAME: FACTORY ACCEPTANCE TEST (FAT)

DOCUMENT NO.:

ISSUE & DATE: Rev.01 & 30/04/2014

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1. FAT Requirements

1.1 Scope of Tests

The Factory Acceptance Test will be performed at manufacturer's premises in China. The tests shall verify that the Substation Automation System Control functions are normal during the test. Documenting the testing of the Protection portion of the substation is not in the scope of this FAT document.

All tests on BCUs shall be performed on BCUs along with the set of protection relays in their respective panels.

The FAT tests have been divided into relevant sections in order to perform the tests systematically. Upon successful verification of the tests in each section, pertinent forms and test results shall be signed by customer or by its representatives.

1.2 FAT Hardware Environment

The following hardware equipments are to be present during FAT:

- Bay Control Units
- HMI /Redundant HMI system consisting of redundant servers.
- Time Synchronizing Equipment consisting of GPS Receiver Unit.
- Substation Controller/Gateway Subsystem.
- LAN Switch Equipment.
- Networking /Auxiliary Panel.

1.3 Software Environment

The Software to be used will include the following applications:

- The PCS-9700 with IEC 61850 (Server/Client) capability.
- The PCS-9700 (HMI) with IEC 61850 (Client) capability.
- Gateway with or higher IEC 60870-5-101/104 capability.

Configuration files shall be downloaded prior to commencement of tests shall be the actual configuration files for project.

1.4 Test Equipment

The following equipments are required to conduct the test.

- DR PC to be used for Configuration Applications for different IEDs.
- Digital Multi-meter.
- Three phase injection KIT for supplying 3 phase current and voltage.
- 4-20mA injection Kit
- Protocol Analyzer

1.5 Statement of System Acceptance

Upon satisfactory completion of all applicable tests specified in this document and the proper disposition of all properly documented and witnessed discrepancies resulting from tests specified in the procedure, the system, tested and witnessed by customer is functionally accepted by customer.

In view of this, the MICC/CIP is being issued by CUSTOMER.

1.6 Duration of Factory Acceptance Test

The duration of Factory Acceptance Testing is estimated to be 5 working days. For practical reason, the FAT will comprise testing of typical bays along with the respective set of protection relays.

1.7 Regression Testing

This section identifies any regression testing performed to validate that any problems encountered have been correctly rectified. The items for regression test are as outlined in the Regression Testing Table.

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Table 1.1 Regression Testing Table

Deficiency	Description	Failure Category Level	Regression Tests Performed & Accepted

Certified By:

CUSTOMER Representative NR Electric

2 Pre FAT Tests

2.1 Document Verification

Purpose

This test verifies that the correct manufacturing drawings and documentation for the equipment/system under test will be used during the Factory Acceptance Test.

Setup/Program

Ensure that the documentations are readily available for reference in the FAT room.

Procedure

1. Verify that drawings (printed and/or soft copies) of all assembled equipment are present.

Table 2.1 Drawing Verification Log.

S.NO.	Document Reference	Pass/Fail
1		
2		
3		
4		

2. Verify all required hardware and software manuals are present.

Table 2.2 Hardware & Software Manuals Verification Log.

S.NO.	Manual	Pass/Fail
1	RCS-9698H Remote Terminal Unit Manual	
2	PCS-9700 Manual	
3		
4		

Hard copies will be made available.

3. Guaranteed Technical Particulars (GTPs) as approved by CUSTOMER are included in Appendix A for reference.

4. Copy of Customer specification for reference is made available in the FAT room.

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Certified By:

CUSTOMER Representative NR Electric

2.2 Equipment Verification

2.2.1 Visual Verification

Purpose

To verify that all hardware equipment required in the contract are available in the FAT room for testing.

Setup/Program

Ensure that the test equipment is in FAT room

Procedure

1. Visually inspect units and individual modules for cleanliness and ensure that they are free from damage.
2. Visually inspect the units for correct wiring practices and ensure that they are free from insulation damage.
3. Ensure the equipment is configured for proper point capacity as per approved drawings.
4. Ensure all modules, terminations and cables have the proper location labels as per approved drawings.
5. Ensure that all earth ground and shield connections are correctly bonded in the panels.
6. Ensure all equipment is free for all foreign material (Dust, Solder, droppings etc.)

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Table 2.3 Equipments Visual Inspections Log.

S.NO.	Equipment	Serial No.	Pass/Fail
1	OWS -1		
2	OWS -2		
3	A4 LaserJet Printer		
4	Dot Matrix printer		
5	Gateway - 1		
6	Gateway – 2		
7	Disturbance Recorder PC		
8	Server-Main		
9	Server-Backup		

Certified By:

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2.2.2 Power Checks

Purpose

To ensure that the SAS equipments installed in the panels control rooms are operating when connected to the nominal specified power supply.

Setup/Program

Perform the steps below to confirm correct operation of all equipment connected to the power supplies.

Procedure

1. Verify that all AC/DC equipments are powered at the nominal AC/DC supply voltage input. Using a Digital Multi-meter verify that the nominal AC/DC supply voltage is present.

2. Verify that there are no abnormalities seen when the equipments are turned ON.

Table 2.5 Power Checks Log.

S.NO.	Panel	Equipment	Device Power ON	Pass/Fail
1	N/A	Operator Station -1		
2	N/A	Operator Station -2		
3	N/A	DR PC		
4	Communication Panel	Server-Main		
5	Communication Panel	Server-Standby		
6	N/A	LaserJet Printer		
7	N/A	Dot Matrix printer		
8	N/A	BCUs		
9	N/A	IEDs		

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2.2.3 Firmware Verification

Purpose

To verify and record that the Equipment Firmware used in the FAT are correct firmware.

Setup/Program

Ensure that the test equipment is in FAT room.

Procedure

Using Device Display verify that all BCU equipment have the correct firmware version.

Table 2.6 Firmware Verification Log.

S.NO.	Equipment	Model	Operating System/Firmware	Pass/Fail
1	Operator Station -1			
2	Operator Station -2			
3	DR PC			
4	Server-Main			
5	Server-Standby			
6	Laserjet Printer			
7	Dot Matrix printer			
8	Gateway	RCS-9698H		
6	Ethernet Switches			
7				
8	IED's (IEC61850 Compliant) for 1 Complete Diameter and typical bays	PCS-902, PCS-921, PCS-978…		

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2.2.4 Test Equipment Inspection

Purpose

To ensure that the Test Equipment to be used is operational.

Setup/Program

Ensure that the test equipment is in the FAT room.

Procedure

Visual inspection of calibration stickers and certificates. Power up and verification that units are operational.

Table 2.7 Test Equipment Inspection Log

S.NO.	Equipment	Calibration Check	Device Power ON	Pass/Fail
1	3 Phase Injection Kit			
2	Digital Multi Meter			
3	220V DC Source for powering up all SAS Panels			
4	4-20 mA Injection Kit			
8	Protocol Analyzer			

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2.3 LAN Communication Functional Check

Purpose

To verify that

- Ethernet connections in the Substation Automation System are functional and running.
- LAN Switch Redundancy is functional.

To establish that in the event of a loss in communications, the SAS device are offline and that when communications link is restored, the SAS device are automatically back online.

Setup/Program

Ensure that the test equipment is in FAT room.

Procedure

LAN SWITCH (BACKBONE/CONTROL ROOM) RING REDUNDANCY CHECK

1. On the first Switch, disconnect the 1st port LAN cable.
2. Verify that the Devices connected to this LAN switch segment do not fail.
3. On the first Switch, disconnect the 2nd port LAN cable.
4. Verify that the devices connected to this LAN switch segment do not fail.
5. On the second Switch, disconnect the 1st port LAN cable.
6. Verify that the devices connected to this LAN switch segment do not fail.
7. On the second Switch, disconnect the 2nd port LAN cable.
8. Verify that the devices connected to this LAN switch segment fail.
9. Restore the 1st port LAN cable; verify that the communications to the devices are restored.
10. Restore the rest of LAN cables observing that there is no communications failure in the process.
11. Repeat steps 1 to 10 for the rest of Backbone LAN Switches

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Table 2.8 LAN Communication Functional Check test Results Log.

S.NO.	Panel	Equipment	Communication check	Pass/Fail
1				
2				
3				

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2.4 Substation Gateway IEC 60870-5-101 Serial Communication Port Check

Purpose

To perform preliminary verification that the IEC 60870-5-101 Communication Ports are functional.

Note the following:
PLCC communications are not tested at this point.

Setup/Program

1. Ensure that the test equipment is in FAT room.
2. Use an IEC 60870-5-101 Master Station Simulator to poll with General Interrogation and data changes. ;

Procedure

1. Verify that communication is established with the simulator ASE test set.
2. Verify that the simulator is sending request on the primary channel and that the SAS Gateway is responding on the primary (Main) channel.
3. Disconnect the simulator from the primary channel and connect it to the secondary channel; verify that the SAS Gateway responds to the requests on the secondary channel also.

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3 Time Synchronization Equipment Tests

3.1 Time Synchronization Equipment Functional Check

The time synchronization test shall be performed by making GPS as the master clock for synchronizing all IED's present on ring network.

Setup/Program

Ensure that the test equipment is in FAT room

Procedure

1. Disconnect the GPS Receiver Antenna. Set the GPS Receiver to send Local Time.
2. Confirm that IED's, Operator Workstations and Substation Gateway Times match this local time. This confirms that the SNTP packets are broadcasted by the GPS receiver.
3. Confirm that GPS Receiver is not synchronized to satellite time.
4. Connect the GPS receiver Antenna. Verify that the GPS receiver is locked with the satellites. Verify that the GPS is updated to satellite time.
5. Confirm that the External Time Display Unit, The IEDs, Operator Workstations and the Substation Gateway are updated to the corrected time.

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3.2 System Time Synchronization Check

Purpose

To verify that the GPS Receiver System Time is received by all SAS devices and working according to the time synchronization requirements of IEC 61850.

Setup/Program

Ensure that the test equipment is in FAT room.

Procedure

SAS IED / OWS TIME SYNCHRONIZATION

1. Select a SAS IED/OWS. Take note of the IED/OWS local time.
2. Disconnect the LAN Communications of the IED/OWS. Change the IED/OWS local time to some random selected time. Observe this condition for about a minute.
3. Restore LAN connection to the IED/OWS. Verify that the local time is automatically corrected to the GPS time.
4. Repeat Step 3 for all SAS IED/OWS.

Table 3.1 Time Synchronization Tests Results log.

S.NO.	Equipment	Pass/Fail
1	Operator Station -1	
2	Operator Station -2	
3	DR PC	
4	Server-Main	
5	Server-Standby	
6	Gateway	
7	BCUs	
8	IED’s (IEC61850 Compliant) for typical Diameter	

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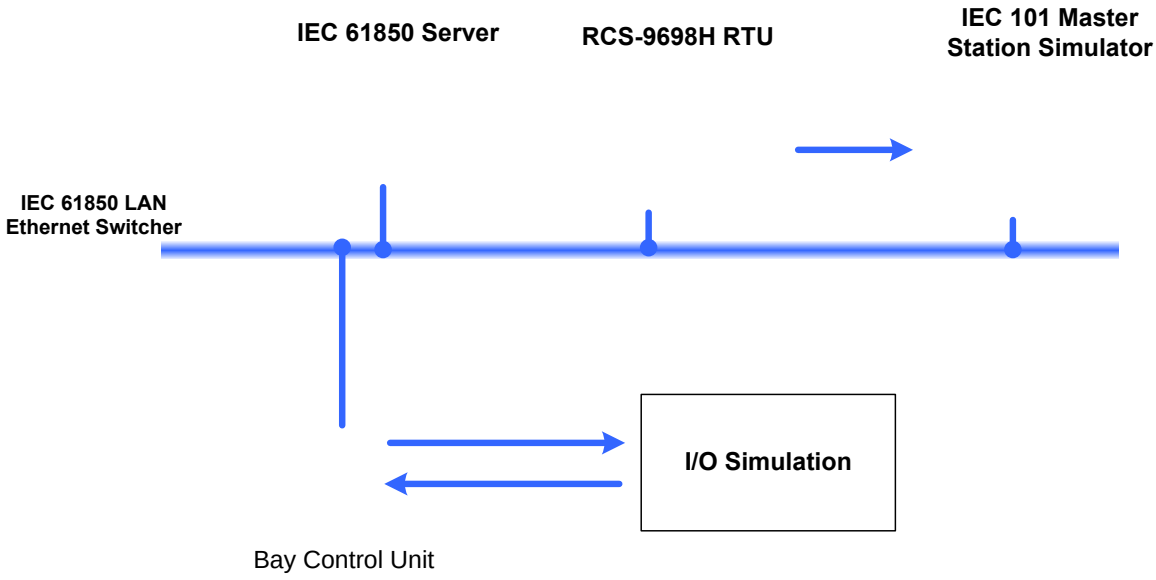
4 SAS Functional Tests

4.1 BCU Input / Output Test Setups

For the purposes of the FAT, the Digital input, Output and Analog input tests are setup as shown below.



4.2 BCU Input/ Output Data Retrieval

The following are the procedures in the BCU I/O Data retrieval. The individual BCU Test result logs are to be filled up in the following sections.

4.2.1 Digital input Retrieval

Purpose

To verify that the change of state and SOEs of Digital input points are updated in the BCU MMI, the Operator Workstations and Master Station Simulator.

To verify that the Digital inputs are mapped correctly as per the approved drawing.

Setup/Program

1. Connect the test Jig to the BCU under test.
2. Go to the BCU MMI Digital inputs Display screen.
3. On the OWS-1 go to event list.
4. On the OWS-2 go to alarm list.

Procedure

1. Select a Digital input point on the BCU under test.
2. Change its state from 0' to '1' (single points) or from '00' to '11' (double points) by toggling the corresponding jig.
3. Verify that the state of this point in the BCU MMI is changed correctly.
4. Verify that the state of this point in the OWS-1 event list screen is changed correctly.
5. For points configured with alarm, verify that alarms are displayed in the Alarm Screen of the OWS-2 with correct time stamp.
6. For points considered in the IEC 60870-101 List, verify that the state of this point in the Master Station Simulator is changed correctly with correct time stamp.
7. Change its state from '1' to '0' (single points) or from '11' to '00' (double points) by toggling the corresponding jig.
8. Repeats step 3 to 6
9. Repeat 1 to 8 for all Digital input points to be tested on this BCU.
10. Repeat steps 1 to 9 for all BCU's available on the test platform.

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4.2.2 Digital Output

Purpose

To verify that digital output operations are successfully executed. To verify that the Digital Output points are mapped correctly according ~ the approved drawings & Data List.

Setup/Program

1. Connect the test jig to the BCU under test.
2. Go to the BCU MMI Digital Outputs Display screen.
3. On the OWS-1 go to event list.
4. On the OWS-2 go to alarm list.

Procedure

1. Choose a BCU to test. From the OWS workstation initiate digital output requests.
2. Verify that the corresponding output activated.

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4.2.3 Analog inputs (For Transformers, Reactors & Auxiliary BCU)

Purpose

To verify that Analog input points are updated in the BCU MMI, the Operator Workstation. To verify that the Analog inputs points are mapped correctly according to the approved drawings.

Setup/Program

1. Connect the AC/DC Signal injection Unit to the BCU under test. inject 3-phase AC voltage and current signal (Phase to Neutral) to the inputs.
2. Go to Bay wise Detail screen in Operator Workstations & BCU MMI.
3. For the purpose of the FAT all AC & DC Analog Threshold values have been set to the following:

   Low-Low = 90% of the Nominal Value
   Low = 95% of the Nominal Value
   High = 105% of the Nominal Value
   High-High = 110% of the Nominal Value

Procedure

AC ANALOG INPUTS

1. Verify that the correct readings and accuracy are presented in the BCU MMI display screens and the OWS Detail Screens for the voltage and current values.
2. Change the values of each phase between 85% to 115% of Nominal.
3. Confirm that the corresponding readings are changed.
4. Verify that analog alarms are generated according to the level of voltage inputs.
5. Repeat steps 1 to 4 for all the BCUs available on the test platform

DC ANALOG INPUTS

1. Verify that the correct readings and accuracy are presented in the BCU MMI display screens and the OWS Detail Screens for the simulated 4-20mA inputs.
2. Change the values to 4mA, 8mA, 12mA,16mA and 20mA. Confirm that readings adjust from 0% to 100% in 25% intervals.

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4.3 Software interlock Logic

Purpose

To verify that software interlock logic for CBs and isolators are operational based on simulated conditions.

Note: Since not all interlock conditions can be tested during FAT, other interlock inputs shall be simulated by shorting auxiliary contacts at the terminal blocks of the panels.

Setup

1. Set up the test jig to simulate software interlock positive negative test conditions.
2. Set up shorting links to simulate other auxiliary contacts
3. Refer approved drawings.

Procedure

1. Select a BCU to test.
2. Refer to the interlock conditions for testing. First set up a negative condition. Attempt to operate controls related to the interlock logic being tested. Verify that the interlock is not successful.
3. Set up for a positive test condition. Verify that interlock is successful when control operation is performed on related to the interlock logic being tested.

CB/ Isolators	CB/ Isolators Interlock Negative Test Result	CB/ Isolators Interlock Positive Test Result	CB/ Isolator Condition	Pass/Fail

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4.4 Synchronizing Tests

4.4.1 Check Synchronization

Purpose

To verify that incoming and Running (Reference) voltages are within the synchronizing range before the circuit breaker can close. The circuit breaker will not close if any of the limiting parameters is not within the check synchronizing range. For practical reasons this FAT will not include the testing of Running Voltage selection for the Synchronization.

Setup

1. Set up the BCU to check synchronizing ranges as follows:

   - Phase Differences Specification requirement states Phase Difference shall not exceed 15°.
   - Voltage Difference Specification requirement states Voltage Difference shall not exceed 10%.
   - Slip Frequency Specification requirement states Slip Frequency shall not exceed 0.45%.

2. Set up the 3 Phase injection Kit to supply the Running Voltage & Selected Voltage to BCU TMU card (CT/VT card).
3. Set up the 3 Phase injection Kit to the following test cases:

Table 4.2 Check Synchronization Test Settings

Test Case	Voltage Difference in p.u	Phase Y Difference in Degrees	Expected Sync Close Results	Pass/Fail
1	0.20	40.0	No	
2	0.12	40.0	No	
3	0.10	20.0	No	
4	0.09	20.0	No	
5	0.09	17.0	No	
6	0.10	16.0	No	
7	0.10	15.0	Yes	
8	0.05	10.0	Yes	

NOTE: In Factory, only voltage variations can be demonstrated.

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Procedure

1. Select a BCU and corresponding Circuit Breaker to Test.
2. Using the 3 Phase injection kit, inject the Running & Selected Voltage to the BCU and apply the differences as shown in the above table.
3. Open the Detailed view of the selected Bay on the OWS and verify the voltage references.
4. Initiate the CB Close Request.
5. Verify that the Circuit Breaker closes only when the configured settings are satisfied.

CB	CB Condition	Pass/Fail

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4.4.2 Dead Source Condition

Purpose

To verify that when the following conditions are met, the Synchrocheck logic permits the immediate closure of the Circuit Breaker.

- Dead Line-Dead Bus
- Dead Line-Live Bus
- Live Line-Dead Bus

Setup

1. Set up the BCU to check synchronizing settings as follows:

- Presence of Line Voltage (Param1) - 70%
- Absence of Line Voltage (Param2) - 40% ^.
- Presence of Bus Voltage (Param3) - 70%
- Absence of Bus Voltage (Param4) - 40%

Procedure

The absolute values of the two voltages (Vline and Vbusbar) must be above or below settable thresholds, to permit the circuit breaker closing. The following voltage controls are available:

- not (Vline) and not(Vbusbar) - (Dead Line-Dead Bus)
- not (Vline) and Vbusbar- (Dead Line-Live Bus)
- Vline and not (Vbusbar) - (Live Line-Dead Bus)
- Vline and Vbusbar- (Live Line-Live Bus)

With Vline and Vbusbar TRUE if the measured voltage is above the threshold V> (param 1 and param 3), and not(Vline) and not(Vbusbar) TRUE if the measured voltage is below the threshold V< (param 2 and param 4). These threshold are given in % of the nominal voltage value.

The selection of the voltage control is made during the configuration phase.

Test Case	Description	Expected Sync Close Results	Pass/Fail
DL-DB	In case of the absence of both voltages i.e. not(Vline) or not(Vbusbar)	Yes	
DL-LB	In case of the absence of one of the two voltages i.e. not(Vline) and Vbusbar	Yes	

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LL-DB	In case of the absence of one of the two voltages i.e. Vline and not(Vbusbar)	Yes	
LL-LB	In Case of the presence of both voltages i.e. Vline and Vbusbar, Set beyond ranges	No	
LL-LB	In Case of the presence of both voltages Vline and Vbusbar, Set good ranges	Yes	

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5 OWS / SERVER Test

5.1 OWS FUNCTION TEST

5.1.1 OWS Security and Access Test

Purpose

To verify that the OWS system has Security Classes that are enabled and configured properly.

Setup

1. Ensure that the OWS Servers are running.
2. Refer to the following table on the user capabilities per access levels

Table 5.1 OWS Access Level

Access Level	Public Odyssey	Operator	Station Engineer	Administrator
Display System Status & View Screens	Yes	Yes	Yes	Yes
Controls - CB, Isolators	No	Yes	Yes	Yes
Acknowledge/Clear Alarms	No	Yes	Yes	Yes
Change OWS Config.	No	No	No	Yes
Create/Disable/Delete User Account	No	No	No	Yes
Change User Profile/ Access Level	No	No	No	Yes
Relay Setting Change	No	No	Yes	Yes
System Management Tools (SMT)	No	No	No	Yes

NOTE: Administrator has the rights to access the Relay Settings and SMT, however, these tools are installed in DRPC, so the same can be accessed through the DRPC.

Procedure

1. Start OI Client, by default the user will be logged in as "Public Odyssey".
2. Verify that this user class has proper access level as per OWS Security Classification.

3. Go to any bay detail screen. Verify if access to tool bar and object controls are according to the allowed in the access level logged in.
4. Repeat steps 1 to 3 for the other OWS Usernames (Operator, Protection, Administrator)
5. Repeat steps 1 to 4 for the other Workstations

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5.1.2 Validation of electrical views

Purpose

To verify that the Single Line Diagram and Bay Detail Screens on the OWS system are configured properly and are in correct operating condition.

Setup

1. Ensure that the OWS & Servers are running.
2. Log in as an ”Operator”.

Procedure

1. Verify the layout of each SLD on the OWS.
2. Verify the device number and device description for each device.
3. Verify all displayed analog and digital values on the detailed bay view screens.
4. Click on each device object and confirm that the correct popup screen or bay/view detail screen is displayed.
5. Repeat steps 1 to 4 for each SLD / Detailed Bay View.

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5 1.3 Validation of the SYSTEM overview

Purpose

To verify that the System Overview is configured properly as per the System Architecture Drawing and are in correct operating condition.

Setup

1. Ensure that the OWS Servers are running.
2. Log in as an "Operator".

Procedure

1. Open System View on any of the OWS.
2. Verify that the display color of OWS equipment is green when it is healthy.
3. Verify that the display color of OWS equipment is Red when it is faulty/ Communication Failure.
4. Repeat action 1 for other PC, BCU & IED's.

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5.1.4 Validation of Events and Alarm Management

Purpose

To verify that the Alarm and Events Points are configured properly and in correct operating condition.

Setup

1. Ensure that the OWS & Servers are running.
2. Display the Alarm/Event Screen.

Table 5.2 Validation of the Events and Alarm Management on OWS

Sr. No.	Activity	Pass/Fail
1	Verify that separate logs are available for alarm and events	
2	Verify that suitable filters (sorting by date, time etc) are provided for both alarms and events	
3	Verify that an Alarm is displayed in the Alarm as well as on the Event Screen with proper description and Time Stamp	
4	Verify the alarm acknowledgement facility and verify that their display changes in alarm viewer according to the alarm status (active/inactive; acknowledged/not acknowledged)	

Procedure

1. Select a Digital input Point from one of the BCUs configured as an Alarm
2. Change the state of the selected input
3. Verify that an Alarm is displayed in the Alarm Screen with proper description and Time Stamp.
4. Acknowledge this alarm.
5. Go to Event Screen and verify that this alarm is displayed in the list.
6. Verify that the same has been printed on the Dot Matrix Printer.
7. Repeat Steps 1 to 6 for the several Digital input

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5.1.5 Validation of Historic Trend

Purpose

To verify that the trending in the OWS system are configured properly and are correct operating condition.

Setup

1. Ensure that the OWS & Servers are running.
2. Go to Trend Screen.

Table 5.3 Validation Historic Trend on OWS

Sr. No.	Activity	Pass/Fail
1	Verify the AI indication with correct unit on OWS.	
2	Verify the same for different values.	
3	Verify the trend associated with same measurement.	
4	Verify that the Time Scale in Historical Mode Screen functions properly.	

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5.1.6 Reports Function

Purpose

To verify that the Reports Functions (Historical Report) in the OWS/OWS system are configured properly and are in correct operating condition.

Setup

1. Ensure that the OI Client is running.

Procedure

Historical Report

1. Generate some Digital / Analog events in the BCU.
2. Click on the PCS-9700 shortcut present on the OWS desktop.
3. Select the Range of date by selecting the Start Date and End Date.
4. Verify the same generated events in the Historical Report have produced.

Daily Report (Hourly Mean Value of Analog Data Points

1. Inject Voltage & Current through 3 Phase injection Kit to any BCU.
2. Verify the values on the detailed view of the selected BCU.
3. Select the daily Report Button of line BCU on the PACIS RTMS.
4. Verify the daily Report have produced Hourly instantaneous Value of the selected BCU.

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5.2 Server Test

5.2.1 Validation of OWS & Server Memory and Disk Utilization

Purpose

To verify that the OWS & Server's have Memory and Disk Usage and allocation those are within the specification requirements.

Setup

Ensure that the OI Servers are running and functioning properly.

Table 5.4 Validation of OWS Memory and Disk Utilization

Computer	Physical Memory	Hard Drive Free Space	PASS/FAIL
OWS-1			
OWS-2			
Server(Main)			
Server(Backup)			

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5.2.2 Hot-Standby Server Redundancy Checks

Purpose

To verify that the Server Redundancy is operational during the crash of OI Server.
In the redundancy setup, Server (Main) and Server (Backup) is configured as Primary and Secondary Servers and OWS-1 & OWS-2 are their respective Clients.

Setup

1. Ensure that the Servers (Main & Backup) & Clients (OWS-1, OWS-2) are running.

Procedure

1. With both Servers operational, verify that OI Clients are connected with their primary servers and can perform normal functions i.e open different screens, alarm and trend screen.
2. On Server (Main), close the OI Server Application.
3. Observe that both OI Clients (OWS-1, 2) are now connected with the Server (Backup) (i.e. Secondary Server) and receives communications from the remote devices.
4. Re-establish the initial conditions by restoring the server (Main) and OWS-1 is connected to main server.
5. On Server (Backup), close the OI Server Application.
6. Observe that both OI Clients are now connected with the Server (Main) (i.e. Primary Server) and receives communications from the remote devices.
7. Restore the servers to their original condition.

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5.2.3 Shutdown & Startup of Servers

Purpose

To verify that the Server Redundancy is operational during the shutdown of the active server.
In the redundancy setup, Server (Main) is configured as the Primary Server and Server(Backup) is configured as Secondary Server.

Setup

Ensure that the Servers & Clients are running.

Procedure

1. With both Servers operational, verify that OI Clients are connected with their respective servers.
2. Shutdown Server (Main). Observe that OI Client on OWS-2 is still connected with the Server (Backup) and receives communications from the remote devices without interruption.
3. Startup Server (Main). Observe that there is no interruption to the Bay Level Devices on OWS-2. Re-establish the initial conditions by starting the server applications on main server.
4. Shutdown Server (Backup). Observe that OI Client on OWS-1 is still connected with Server (Main) without any interruption.
5. Startup Server (Backup). Re-establish the initial conditions by starting the server applications on Backup server. Observe that there is no interruption to the connection of Bay Level Devices on OWS-2.

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6 SUBSTATION CONTROLLER/GATEWAY FUNCTIONS TEST

6.1 Substation Controller Device Reporting

Purpose

To verify that the Substation Controller (OI Server/Client) is successfully communicating with the bay level devices using IEC 61850 protocol.

Setup

1. Ensure that the OI Server/Clients are running.
2. Go to the System Architecture Screen on OI Client.

Procedure

1. On the System Architecture screen, verify that the bay device status is Green.
2. Select any BCU/IED and disconnect the LAN cable, verify that the System Architecture screen shows the bay device is Red.
3. Connect the LAN cable. Monitor the communication between OI Server and remote device and verify that the data exchange between the two TCP/IP addresses gets established.
4. Verify that the System Architecture Screen shows that the device is Green again.
5. Repeat the above procedures for other devices.

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6.2 IEC 60870-5-1 OI Data Retrieval

The setup of the tests has already been included in the BCU Functional Tests in Section 2.4.

6.2.1 Master Digital inputs Retrieval

Purpose

To verify that the Substation Gateway is polled for Digital input for SOE correctly by the Master Simulator.

Procedure

1. Inject digital input changes to some test single point and double point inputs.
2. Verify change of the state in the Gateway and Master Simulator.

6.2.2 Master Digital Output Control

Purpose

To verify that control requests from the Master Simulator to the Substation Gateway are successfully executed.

Procedure

1. From the Master Simulator, initiate a test Digital Output request to a BCU.
2. Observe that Digital Output request is successful by verifying that the corresponding DO contact is activated. Also verify on the Gateway Machine that the command is successful.

6.2.3 Master Analog Inputs Retrieval

Purpose

To verify that substation gateway is polled for Analog Input data correctly by the Master Simulator.

Procedure

1. Inject Analog inputs and verify that the Analog data are correctly received by the Master Simulator.

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7 DR PC TESTS

7.1 Setting and Configuration of BGUs Purpose

Purpose

To verify that the BCU database is configured in SCE (System Configuration Editor) and download is possible via SMT (System Management Tool). Settings of BCU like Change of IP Address etc are possible via CAT (Computer Administration Tool).

Setup

1. Ensure that DR PC is running.

Procedure

1. Change some parameters in SCE for the BCU to test. Compile the Database for which parameters have been changed.
2. Run SMT on the DR and select the compiled Database. Connect the BCU for which the parameters have been changed.
3. Download the database.
4. Verify that the download is successful and check the DB version on BCU.

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7.2 Network Monitoring System

Purpose

To verify that the Network Monitoring System (NMS) application software can perform the following functions on the LAN devices:

- Configuration Management
- Fault Management
- Performance Monitoring

  Note that the Network Management System is based on Simple Network Monitoring Protocol (SNMP). Some background on this protocol is needed to understand how the application software works.

Procedure

1. Verify that NMS software used monitors LAN devices statistics and present these using displays.
2. Verify that it maintains connectivity and device status, issues alarms on errors conditions. This can be verified in the OI client screens.
3. Verify that it has tools for maintenance of addressed and links.

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7.3 Setting of Protection Relays

7.3.1 Setting of NR Protection Relays

Purpose

To verify that the Setting of NR Protection Relays can be changed via the back port of Protection Relays.

Setup

1. Ensure that DR PC is running.
2. PCS-Explore software is properly installed on DR PC.

Procedure

1. Ensure that DR PC and the Relays are available on the network.
2. Run PCS-Explore and connect with the Protection relay. Verify that the connection is successful.
3. Extract the settings from the connected Protection Relay. After extracting, select the parameter needs to be modified. Upload the changes to the connected relay.
4. Verify that the parameter is changed by using the front display of Protection Relay.

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7.3.2 Setting of Third Party Protection Relays

Purpose

To verify that the Setting of Third party Protection Relay can be changed via the Ethernet port of Protection Relays.

Setup

1. Ensure that DR PC is running.
2. Third party software is properly installed on DR PC.

Procedure

1. Connect the Ethernet cable between Ethernet switch and Protection relay for which test to be performed.
2. Run Third party software and connect with the Protection relay. Verify that the connection is successful.
3. Extract the settings from the connected Protection Relay. After extracting, select the parameter needs to be modified. Upload the changes to the connected relay.
4. Verify that the parameter is changed by using the front display of Protection Relay.

Also, Demonstrate to the addition of Third party Relay in PCS-9700 SAS System.

Table 7.3.2 List of Third party makes numerical relays used in typical circuits.

LIST OF Schneider MAKE NUMERICAL RELAYS USED IN TYPICAL CIRCUITS.		
Sr. NO	RELAY	RESULT
1		
2		

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7.4 Disturbance File Retrieval

Purpose

To verify that the automatic disturbance file is uploaded to DR PC when the disturbance is created in PCS Relays. . ., ~

Setup

1. Ensure that DR PC is running.
2. System Management Tool (SMT) should be running on the DR PC. .~ ~ .,

Procedure

1. Create the Disturbance on any PCS Relay. Verify that the disturbance has been created in the relay.
2. Observe that the Disturbance File is automatically created in the DR PC.
3. Open the Disturbance file on E-View software.

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7.5 Abbreviation

The Abbreviations used in this document are listed below:
SAS- Substation Automation System
IED- Intelligent Electronic Device
HMI- Human Machine Interface
PC- Personal Computer
LAN-Local Area Network
DR-Disturbance Recorder
DMP-Dot Matrix Computer
RCC-Remote Control Centre
RLDC- Regional Load Dispatch Centre
LN-Logical Node
BCU-Bay Control Unit
GOOSE- Generic Object Oriented Substation Event
SNMP: Simple Network Management Protocol
SNTP: Simple Network Time Protocol
SLD: Single Line Diagram
NMS: Network Monitoring System

Quaid-e-Azam Solar Power (Pvt.) Ltd.

Quaid-e-Azam Solar Power (Pvt.) Limited

Organization: HU KE

Check: LIU XIAO HONG

Auditor: LIN YU JUN

Ratify: QIAO WEI

100 MWp Solar Photovoltaic (PV) Project

SCADA SIGNALS LIST

22-4-2015

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iLF CONSULTING ENGINEERS

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
TRANSMISSION LINE								
1	1Y-001	CB	901	SF6 LOW PRESSURE ALARM	DI	PCS-9705C	SCADA	H194-I-D-0040
2	1Y-002	CB	903	MOTOR TIME DELAY FAULT ALARM	DI	PCS-9705C	SCADA	H194-I-D-0040
3	1Y-003	CB	905	TEMPERATURE & HUMIDITY	DI	PCS-9705C	SCADA	H194-I-D-0040
4	1Y-004	CB	907	MOTOR POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
5	1Y-005	CB	909	CONTROL POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
6	1Y-006	CB	911	NON SPRING SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0040
7	1Y-007	CB	913	SF6 LOW PRESSURE LOCK	DI	PCS-9705C	SCADA	H194-I-D-0040
8	1Y-008	CB	915	REMOTE STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0040
9	1Y-009	CB	917	CB CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
10	1Y-010	CB	919	CB OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
11	1Y-011	DS1	921	DS1 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
12	1Y-012	DS1	923	DS1 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
13	1Y-013	DS2	925	DS2 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
14	1Y-014	DS2	927	DS2 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
15	1Y-015	DS3	929	DS3 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
16	1Y-016	DS3	931	DS3 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
17	1Y-017	ES1	933	ES1 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
18	1Y-018	ES1	935	ES1 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
19	1Y-019	ES2	937	ES2 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
20	1Y-020	ES2	939	ES2 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
21	1Y-021	ES3	941	ES3 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
22	1Y-022	ES3	943	ES3 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
23	1Y-023	DS1	945	REMOTE SIGNAL DS 1	DI	PCS-9705C	SCADA	H194-I-D-0040
24	1Y-024	DS2	947	REMOTE SIGNAL DS 2	DI	PCS-9705C	SCADA	H194-I-D-0040
25	1Y-025	DS3	949	REMOTE SIGNAL DS 3	DI	PCS-9705C	SCADA	H194-I-D-0040
26	1Y-026	DS1	951	DS 1 AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
27	1Y-027	DS2	953	DS 1 DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
28	1Y-028	DS2	955	DS 2 AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
29	1Y-029	DS2	957	DS 2 DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
30	1Y-030	DS3	959	DS 3 AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
31	1Y-031	ES3	961	DS 3 DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
32	1Y-032	ENERGY METER	963	LOSS POWER	DI	PCS-9705C	SCADA	H194-I-D-0040
33	1Y-033	ENERGY METER	965	VT1 AND VT2 START	DI	PCS-9705C	SCADA	H194-I-D-0040
34	1Y-034	MPR	967	DIST INT FAIL	DI	PCS-9705C	SCADA	H194-I-D-0040
35	1Y-035	MPR	969	ZM1 TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
36	1Y-036	MPR	971	ZM2 TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
37	1Y-037	MPR	973	ZM3 TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
38	1Y-038	MPR	975	ZM4 TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
39	1Y-039	MPR	977	STFW L1	DI	PCS-9705C	SCADA	H194-I-D-0040
40	1Y-040	MPR	979	STFW L2	DI	PCS-9705C	SCADA	H194-I-D-0040
41	1Y-041	MPR	981	STFW L3	DI	PCS-9705C	SCADA	H194-I-D-0040
42	1Y-042	MPR	983	STFW PE	DI	PCS-9705C	SCADA	H194-I-D-0040
43	1Y-043	MPR	985	DIST TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
44	1Y-044	MPR	987	POWER SWING	DI	PCS-9705C	SCADA	H194-I-D-0040
45	1Y-045	BPR	989	O/C TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
46	1Y-046	BPR	991	O/C INTERNAL FAIL	DI	PCS-9705C	SCADA	H194-I-D-0040

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
47	1Y-047	BPR	993	TCS 1 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0040
48	1Y-048	BPR	995	TCS 1 OK	DI	PCS-9705C	SCADA	H194-I-D-0040
49	1Y-049	BPR	997	TCS 2 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0040
50	1Y-050	BPR	999	TCS 2 OK	DI	PCS-9705C	SCADA	H194-I-D-0040
51	1Y-051	DS1	103	DS 1 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0039
52	1Y-052	DS1	113	DS 1 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0039
53	1Y-053	DS2	103	DS 2 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0039
54	1Y-054	DS2	113	DS 2 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0039
55	1Y-055	DS3	103	DS 3 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0039
56	1Y-056	DS3	113	DS 3 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0039
57	1Y-057	BCU	GY901	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0040
58	1Y-058	BCU	GY903	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0040
59	1Y-059	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
60	1Y-060	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
61	1Y-061	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
62	1Y-062	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0038
63	1Y-063	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0038
64	1Y-064	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0038
65	1Y-065	CT3	A431	MAIN PROTECTION CURRENT(PHASE A)	AI	REL650	SCADA	H194-I-D-0038
66	1Y-066	CT3	B431	MAIN PROTECTION CURRENT(PHASE B)	AI	REL650	SCADA	H194-I-D-0038
67	1Y-067	CT3	C431	MAIN PROTECTION CURRENT(PHASE C)	AI	REL650	SCADA	H194-I-D-0038
68	1Y-068	CT4	A441	FAULT RECORDER CURRENT(PHASE A)	AI	PCS-996	SCADA	H194-I-D-0038
69	1Y-069	CT4	B441	FAULT RECORDER CURRENT(PHASE B)	AI	PCS-996	SCADA	H194-I-D-0038
70	1Y-070	CT4	C441	FAULT RECORDER CURRENT(PHASE C)	AI	PCS-996	SCADA	H194-I-D-0038
71	1Y-071	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	REF610	SCADA	H194-I-D-0038
72	1Y-072	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	REF610	SCADA	H194-I-D-0038
73	1Y-073	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	REF610	SCADA	H194-I-D-0038
74	1Y-074	CT6	A310	BUSBAR PROTECTION CURRENT(PHASE A)	AI	PCS-915	SCADA	H194-I-D-0038
75	1Y-075	CT6	B310	BUSBAR PROTECTION CURRENT(PHASE B)	AI	PCS-915	SCADA	H194-I-D-0038
76	1Y-076	CT6	C310	BUSBAR PROTECTION CURRENT(PHASE C)	AI	PCS-915	SCADA	H194-I-D-0038
77	1Y-077	VT1	A710II	PROTECTION VOLTAGE(PHASEA)	AI	REF610 & REL650	SCADA	H194-I-D-0038
78	1Y-078	VT1	B710II	PROTECTION VOLTAGE(PHASEB)	AI	REF610 & REL650	SCADA	H194-I-D-0038
79	1Y-079	VT1	C710II	PROTECTION VOLTAGE(PHASEc)	AI	REF610 & REL650	SCADA	H194-I-D-0038
80	1Y-080	VT2	A630Y	BUSBAR 1 MEASURE VOLTAGE(PHASEA)	AI	PCS-9705C	SCADA	H194-I-D-0038
81	1Y-081	VT2	B630Y	BUSBAR 1 MEASURE VOLTAGE(PHASEB)	AI	PCS-9705C	SCADA	H194-I-D-0038
82	1Y-082	VT2	C630Y	BUSBAR 1 MEASURE VOLTAGE(PHASEC)	AI	PCS-9705C	SCADA	H194-I-D-0038
83	1Y-083	VT3	A640Y	BUSBAR 2 MEASURE VOLTAGE(PHASEA)	AI	PCS-9705C	SCADA	H194-I-D-0038
84	1Y-084	VT3	B640Y	BUSBAR 2 MEASURE VOLTAGE(PHASEB)	AI	PCS-9705C	SCADA	H194-I-D-0038
85	1Y-085	VT3	C640Y	BUSBAR 2 MEASURE VOLTAGE(PHASEC)	AI	PCS-9705C	SCADA	H194-I-D-0038
86	1Y-086	VT4	A710J	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
87	1Y-087	VT4	B710J	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
88	1Y-088	VT4	C710J	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
89	1Y-089	LINE VT 25	B609	LINE MEASURE VOLTAGE (PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0038
90	1Y-090	LINE VT (25,79)	B609	LINE PROTECTION VOLTAGE (PHASE B)	AI	REL650	SCADA	H194-I-D-0038
91	2Y-001	CB	901	SF6 LOW PRESSURE ALARM	DI	PCS-9705C	SCADA	H194-I-D-0040
92	2Y-002	CB	903	MOTOR TIME DELAY FAULT ALARM	DI	PCS-9705C	SCADA	H194-I-D-0040
93	2Y-003	CB	905	TEMPERATURE & HUMIDITY	DI	PCS-9705C	SCADA	H194-I-D-0040

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
94	2Y-004	CB	907	MOTOR POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
95	2Y-005	CB	909	CONTROL POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
96	2Y-006	CB	911	NON SPRING SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0040
97	2Y-007	CB	913	SF6 LOW PRESSURE LOCK	DI	PCS-9705C	SCADA	H194-I-D-0040
98	2Y-008	CB	915	REMOTE STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0040
99	2Y-009	CB	917	CB CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
100	2Y-010	CB	919	CB OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
101	2Y-011	DS1	921	DS1 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
102	2Y-012	DS1	921	DS1 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
103	2Y-013	DS2	923	DS2 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
104	2Y-014	DS2	921	DS2 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
105	2Y-015	DS3	925	DS3 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
106	2Y-016	DS3	921	DS3 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
107	2Y-017	ES1	927	ES1 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
108	2Y-018	ES1	921	ES1 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
109	2Y-019	ES2	929	ES2 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
110	2Y-020	ES2	921	ES2 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
111	2Y-021	ES3	931	ES3 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0040
112	2Y-022	ES3	921	ES3 OPEN	DI	PCS-9705C	SCADA	H194-I-D-0040
113	2Y-023	DS1	933	REMOTE SIGNAL DS 1	DI	PCS-9705C	SCADA	H194-I-D-0040
114	2Y-024	DS2	935	REMOTE SIGNAL DS 2	DI	PCS-9705C	SCADA	H194-I-D-0040
115	2Y-025	DS3	937	REMOTE SIGNAL DS 3	DI	PCS-9705C	SCADA	H194-I-D-0040
116	2Y-026	DS1	939	DS 1 AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
117	2Y-027	DS2	941	DS 1 DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
118	2Y-028	DS2	943	DS 2 AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
119	2Y-029	DS2	945	DS 2 DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
120	2Y-030	DS3	947	DS 3 AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
121	2Y-031	ES3	949	DS 3 DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
122	2Y-032	ENERGY METER	951	LOSS POWER	DI	PCS-9705C	SCADA	H194-I-D-0040
123	2Y-033	ENERGY METER	953	VT1 AND VT2 START	DI	PCS-9705C	SCADA	H194-I-D-0040
124	2Y-034	MPR	955	DIST INT FAIL	DI	PCS-9705C	SCADA	H194-I-D-0040
125	2Y-035	MPR	957	ZM1 TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
126	2Y-036	MPR	959	ZM2 TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
127	2Y-037	MPR	961	ZM3 TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
128	2Y-038	MPR	963	ZM4 TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
129	2Y-039	MPR	965	STFW L1	DI	PCS-9705C	SCADA	H194-I-D-0040
130	2Y-040	MPR	967	STFW L2	DI	PCS-9705C	SCADA	H194-I-D-0040
131	2Y-041	MPR	969	STFW L3	DI	PCS-9705C	SCADA	H194-I-D-0040
132	2Y-042	MPR	971	STFW PE	DI	PCS-9705C	SCADA	H194-I-D-0040
133	2Y-043	MPR	973	DIST TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
134	2Y-044	MPR	975	POWER SWING	DI	PCS-9705C	SCADA	H194-I-D-0040
135	2Y-045	BPR	977	O/C TRIP	DI	PCS-9705C	SCADA	H194-I-D-0040
136	2Y-046	BPR	979	O/C INTERNAL FAIL	DI	PCS-9705C	SCADA	H194-I-D-0040
137	2Y-047	BPR	981	TCS 1 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0040
138	2Y-048	BPR	983	TCS 1 OK	DI	PCS-9705C	SCADA	H194-I-D-0040
139	2Y-049	BPR	985	TCS 2 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0040
140	2Y-050	BPR	987	TCS 2 OK	DI	PCS-9705C	SCADA	H194-I-D-0040

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
141	2Y-051	DS1	103	DS 1 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0039
142	2Y-052	DS1	113	DS 1 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0039
143	2Y-053	DS2	103	DS 2 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0039
144	2Y-054	DS2	113	DS 2 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0039
145	2Y-055	DS3	103	DS 3 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0039
146	2Y-056	DS3	113	DS 3 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0039
147	2Y-057	BCU	GY901	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0040
148	2Y-058	BCU	GY903	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0040
149	2Y-059	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
150	2Y-060	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
151	2Y-061	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
152	2Y-062	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0038
153	2Y-063	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0038
154	2Y-064	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0038
155	2Y-065	CT3	A431	MAIN PROTECTION CURRENT(PHASE A)	AI	REL650	SCADA	H194-I-D-0038
156	2Y-066	CT3	B431	MAIN PROTECTION CURRENT(PHASE B)	AI	REL650	SCADA	H194-I-D-0038
157	2Y-067	CT3	C431	MAIN PROTECTION CURRENT(PHASE C)	AI	REL650	SCADA	H194-I-D-0038
158	2Y-068	CT4	A441	FAULT RECORDER CURRENT(PHASE A)	AI	PCS-996	SCADA	H194-I-D-0038
159	2Y-069	CT4	B441	FAULT RECORDER CURRENT(PHASE B)	AI	PCS-996	SCADA	H194-I-D-0038
160	2Y-070	CT4	C441	FAULT RECORDER CURRENT(PHASE C)	AI	PCS-996	SCADA	H194-I-D-0038
161	2Y-071	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	REF610	SCADA	H194-I-D-0038
162	2Y-072	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	REF610	SCADA	H194-I-D-0038
163	2Y-073	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	REF610	SCADA	H194-I-D-0038
164	2Y-074	CT6	A310	BUSBAR PROTECTION CURRENT(PHASE A)	AI	PCS-915	SCADA	H194-I-D-0038
165	2Y-075	CT6	B310	BUSBAR PROTECTION CURRENT(PHASE B)	AI	PCS-915	SCADA	H194-I-D-0038
166	2Y-076	CT6	C310	BUSBAR PROTECTION CURRENT(PHASE C)	AI	PCS-915	SCADA	H194-I-D-0038
167	2Y-077	VT1	A710II	PROTECTION VOLTAGE(PHASEA)	AI	REF610 & REL650	SCADA	H194-I-D-0038
168	2Y-078	VT1	B710II	PROTECTION VOLTAGE(PHASEB)	AI	REF610 & REL650	SCADA	H194-I-D-0038
169	2Y-079	VT1	C710II	PROTECTION VOLTAGE(PHASEc)	AI	REF610 & REL650	SCADA	H194-I-D-0038
170	2Y-080	VT2	A630Y	BUSBAR 1 MEASURE VOLTAGE(PHASEA)	AI	PCS-9705C	SCADA	H194-I-D-0038
171	2Y-081	VT2	B630Y	BUSBAR 1 MEASURE VOLTAGE(PHASEB)	AI	PCS-9705C	SCADA	H194-I-D-0038
172	2Y-082	VT2	C630Y	BUSBAR 1 MEASURE VOLTAGE(PHASEC)	AI	PCS-9705C	SCADA	H194-I-D-0038
173	2Y-083	VT3	A640Y	BUSBAR 2 MEASURE VOLTAGE(PHASEA)	AI	PCS-9705C	SCADA	H194-I-D-0038
174	2Y-084	VT3	B640Y	BUSBAR 2 MEASURE VOLTAGE(PHASEB)	AI	PCS-9705C	SCADA	H194-I-D-0038
175	2Y-085	VT3	C640Y	BUSBAR 2 MEASURE VOLTAGE(PHASEC)	AI	PCS-9705C	SCADA	H194-I-D-0038
176	2Y-086	VT4	A710J	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
177	2Y-087	VT4	B710J	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
178	2Y-088	VT4	C710J	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0038
179	2Y-089	LINE VT 25	B609	LINE MEASURE VOLTAGE (PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0038
180	2Y-090	LINE VT (25,79)	B609	LINE PROTECTION VOLTAGE (PHASE B)	AI	REL650	SCADA	H194-I-D-0038
MAIN TRANSFORMER								
1	1B-001	CB	901	CB CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
2	1B-002	CB	903	CB OPEN POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
3	1B-003	CB	905	SF6 LOW PRESSURE ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
4	1B-004	CB	907	SF6 LOW PRESSURE LOCK	DI	PCS-9705C	SCADA	H194-I-D-0053
5	1B-005	CB	909	TEMPERATURE AND HUMIDITY SENSOR POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
6	1B-006	CB	911	SOCKET POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
7	1B-007	CB	913	LIGHT POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
8	1B-008	CB	915	MOTER POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
9	1B-009	CB	917	MOTOR TIME-DELAY FAULT ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
10	1B-010	CB	919	NON-SPRING SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
11	1B-011	CB	921	LOCAL STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
12	1B-012	CB	923	REMOTE STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
13	1B-013	CB	925	UNLOCKING STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
14	1B-014	DS1	927	DS1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
15	1B-015	DS1	929	DS1 REMOTE STATE	DI	PCS-9705C	SCADA	H194-I-D-0053
16	1B-016	DS1	931	DS1 AC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
17	1B-017	DS1	933	DS1 DC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
18	1B-018	DS2	935	DS2 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
19	1B-019	DS2	937	DS2 REMOTE STATE	DI	PCS-9705C	SCADA	H194-I-D-0053
20	1B-020	DS2	939	DS2 AC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
21	1B-021	DS2	941	DS2 DC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
22	1B-022	DS3	943	DS3 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
23	1B-023	DS3	945	DS3 REMOTE STATE	DI	PCS-9705C	SCADA	H194-I-D-0053
24	1B-024	DS3	947	DS3 AC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
25	1B-025	DS3	949	DS3 DC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
26	1B-026	ES1	951	ES1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
27	1B-027	ES2	953	ES1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
28	1B-028	ES3	955	ES1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
29	1B-029	PCS-9671	957	DIFF. REALY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
30	1B-030	PCS-9671	959	DIFF. REALY ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
31	1B-031	PCS-9671	961	DIFF. TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
32	1B-032	F50 PCS-9611	963	HVS OC REALY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
33	1B-033	F50 PCS-9611	965	HVS OC REALY ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
34	1B-034	F50 PCS-9611	967	HVS OC TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
35	1B-035	F51 PCS-9611	969	LVS OC REALY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
36	1B-036	F51 PCS-9611	971	LVS OC REALY ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
37	1B-037	F51 PCS-9611	973	LVS OC TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
38	1B-038	TRANSFORMER	975	HIGH OIL TEMP. TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
39	1B-039	TRANSFORMER	977	BUCHHOLZ TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
40	1B-040	TRANSFORMER	979	WINDING TEMP. TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
41	1B-041	TRANSFORMER	981	OLTC BUCHHOLZ TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
42	1B-042	TRANSFORMER	983	PRESSURE RELIEF VALVE TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
43	1B-043	-K8XX LOCKOUT RELAY	985	LOCKOUT RELAY 1 OPERATED	DI	PCS-9705C	SCADA	H194-I-D-0053
44	1B-044	-K8XX LOCKOUT RELAY	987	LOCKOUT RELAY 2 OPERATED	DI	PCS-9705C	SCADA	H194-I-D-0053
45	1B-045	-K7XX TRIP CIRCUIT SUPERVISION RELAY	989	TCS 1 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
46	1B-046	-K7XX TRIP CIRCUIT SUPERVISION RELAY	991	TCS 1 HEALTHY	DI	PCS-9705C	SCADA	H194-I-D-0053
47	1B-047	-K7XX TRIP CIRCUIT SUPERVISION RELAY	993	TCS 2 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
48	1B-048	-K7XX TRIP CIRCUIT SUPERVISION RELAY	995	TCS 2 HEALTHY	DI	PCS-9705C	SCADA	H194-I-D-0053
49	1B-049	-K7XX TRIP CIRCUIT SUPERVISION RELAY	997	TCS 3 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
50	1B-050	-K7XX TRIP CIRCUIT SUPERVISION RELAY	999	TCS 3 HEALTHY	DI	PCS-9705C	SCADA	H194-I-D-0053
51	1B-051	-F2XX AC SUPPLY MCB	999'	AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
52	1B-052	-80A AC SUPERVISION RELAY	997'	AC SUPPLY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
53	1B-053	-F101 DC SUPPLY MCB	995'	DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
54	1B-054	-80B DC SUPERVISION RELAY	993'	DC 1 SUPPLY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
55	1B-055	-81C DC SUPERVISION RELAY	991'	DC 2 SUPPLY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
56	1B-056	ENERGY METER	987'	LOSS POWER	DI	PCS-9705C	SCADA	H194-I-D-0053
57	1B-057	ENERGY METER	985'	VT1 AND VT2 START	DI	PCS-9705C	SCADA	H194-I-D-0053
58	1B-058	CB1	803	NON-SPRING SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
59	1B-059	CB1	805	TEST POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
60	1B-060	CB1	807	WORK LOCATION	DI	PCS-9705C	SCADA	H194-I-D-0053
61	1B-061	CB1	809	CB1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
62	1B-062	CB1	811	CB1 OPEN POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
63	1B-063	CB1	813	REMOTE 1KK SWITCH	DI	PCS-9705C	SCADA	H194-I-D-0053
64	1B-064	PROTECTION	815	VT1 AND VT2 START	DI	PCS-9705C	SCADA	H194-I-D-0053
65	1B-065	PROTECTION	817	LOSS POWER	DI	PCS-9705C	SCADA	H194-I-D-0053
66	1B-066	MPR	819	MAIN OIL INDICATOR ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
67	1B-067	MPR	821	SWITCH OIL INDICATOR ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
68	1B-068	MPR	823	OIL THERMOSTAT 1 OIL TEMP. ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
69	1B-069	MPR	825	OIL THERMOSTAT 1 OIL TEMP. ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
70	1B-070	MPR	827	WINDING TEMP. ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
71	1B-071	MPR	829	MAIN PRESSURE RELIEVE 1 AND 2 ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
72	1B-072	MPR	831	SWITCH PRESSURE RELIEF ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
73	1B-073	MPR	833	TANK HEAVYGAS ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
74	1B-074	BCD	BCD0	BCD0	DI	PCS-9705C	SCADA	H194-I-D-0053
75	1B-075	BCD	BCD2	BCD2	DI	PCS-9705C	SCADA	H194-I-D-0053
76	1B-076	BCD	BCD4	BCD4	DI	PCS-9705C	SCADA	H194-I-D-0053
77	1B-077	BCD	BCD6	BCD6	DI	PCS-9705C	SCADA	H194-I-D-0053
78	1B-078	BCD	BCD8	BCD8	DI	PCS-9705C	SCADA	H194-I-D-0053
79	1B-079	BCD	BCD10	BCD10	DI	PCS-9705C	SCADA	H194-I-D-0053
80	1B-080	AIR-COOLED	701	POWER SUPPLY Ⅰ SHORT-CIRCUIT FAULT	DI	PCS-9705C	SCADA	H194-I-D-0053
81	1B-081	AIR-COOLED	703	POWER SUPPLY Ⅱ SHORT-CIRCUIT FAULT	DI	PCS-9705C	SCADA	H194-I-D-0053
82	1B-082	AIR-COOLED	705	POWER SUPPLY Ⅰ PHASE-FAILURE	DI	PCS-9705C	SCADA	H194-I-D-0053
83	1B-083	AIR-COOLED	707	POWER SUPPLY Ⅱ PHASE-FAILURE	DI	PCS-9705C	SCADA	H194-I-D-0053
84	1B-084	AIR-COOLED	709	POWER SUPPLY Ⅰ ON	DI	PCS-9705C	SCADA	H194-I-D-0053
85	1B-085	AIR-COOLED	711	POWER SUPPLY Ⅱ ON	DI	PCS-9705C	SCADA	H194-I-D-0053
86	1B-086	AIR-COOLED	713	SIGNAL FOR ALL FANS STOP	DI	PCS-9705C	SCADA	H194-I-D-0053
87	1B-087	ON-LOAD VOLTAGE REGULATION	737	SIGNAL MOTOR CIRCUIT	DI	PCS-9705C	SCADA	H194-I-D-0053
88	1B-088	ON-LOAD VOLTAGE REGULATION	739	TAP-CHANGER IN OPERATION	DI	PCS-9705C	SCADA	H194-I-D-0053
89	1B-089	ON-LOAD VOLTAGE REGULATION	741	LOCAL	DI	PCS-9705C	SCADA	H194-I-D-0053
90	1B-090	ON-LOAD VOLTAGE REGULATION	743	REMOTE	DI	PCS-9705C	SCADA	H194-I-D-0053
91	1B-091	DS1	103	DS 1 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0053
92	1B-092	DS1	113	DS 1 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0053
93	1B-093	DS2	103	DS 2 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0053
94	1B-094	DS2	113	DS 2 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0053
95	1B-095	DS3	103	DS 3 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0053
96	1B-096	DS3	113	DS 3 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0053
97	1B-097	BCU	GY901	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0016
98	1B-098	BCU	GY903	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0016
99	1B-099	BCU	GY905	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0016
100	1B-100	BCU	GY907	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0016

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
101	1B-101	BCU	GY909	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0016
102	1B-102	BCU	GY911	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0016
103	1B-103	BCU	GY913	LOSS POWER	DO	PCS-9705C	SCADA	H194-I-D-0016
104	1B-104	BCU	GY915	VT1 AND VT2 START	DO	PCS-9705C	SCADA	H194-I-D-0016
105	1B-105	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
106	1B-106	CT1	B412	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
107	1B-107	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
108	1B-108	CT1	B412	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
109	1B-109	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
110	1B-110	CT1	C412	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
111	1B-111	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0050
112	1B-112	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0050
113	1B-113	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0050
114	1B-114	CT3	A431	MAIN PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0050
115	1B-115	CT3	B431	MAIN PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0050
116	1B-116	CT3	C431	MAIN PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0050
117	1B-117	CT4	A441	FAULT RECORDER CURRENT(PHASE A)	AI	PCS-996	SCADA	H194-I-D-0050
118	1B-118	CT4	B441	FAULT RECORDER CURRENT(PHASE B)	AI	PCS-996	SCADA	H194-I-D-0050
119	1B-119	CT4	C441	FAULT RECORDER CURRENT(PHASE C)	AI	PCS-996	SCADA	H194-I-D-0050
120	1B-120	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0050
121	1B-121	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0050
122	1B-122	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0050
123	1B-123	CT6	A310	BUSBAR PROTECTION CURRENT(PHASE A)	AI	PCS-915	SCADA	H194-I-D-0050
124	1B-124	CT6	B310	BUSBAR PROTECTION CURRENT(PHASE B)	AI	PCS-915	SCADA	H194-I-D-0050
125	1B-125	CT6	C310	BUSBAR PROTECTION CURRENT(PHASE C)	AI	PCS-915	SCADA	H194-I-D-0050
126	1B-126	VT1	A630Y''	BUSBAR 1 PROTECTION VOLTAGE(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0050
127	1B-127	VT1	B630Y''	BUSBAR 1 PROTECTION VOLTAGE(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0050
128	1B-128	VT1	C630Y''	BUSBAR 1 PROTECTION VOLTAGE(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0050
129	1B-129	VT2	A640Y''	BUSBAR 2 PROTECTION VOLTAGE(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0050
130	1B-130	VT2	B640Y''	BUSBAR 2 PROTECTION VOLTAGE(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0050
131	1B-131	VT2	C640Y''	BUSBAR 2 PROTECTION VOLTAGE(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0050
132	1B-132	VT3	A630Y	BUSBAR 1 MEASURE VOLTAGE(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0050
133	1B-133	VT3	B630Y	BUSBAR 1 MEASURE VOLTAGE(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0050
134	1B-134	VT3	C630Y	BUSBAR 1 MEASURE VOLTAGE(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0050
135	1B-135	VT4	A640Y	BUSBAR 2 MEASURE VOLTAGE(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0050
136	1B-136	VT4	B640Y	BUSBAR 2 MEASURE VOLTAGE(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0050
137	1B-137	VT4	C640Y	BUSBAR 2 MEASURE VOLTAGE(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0050
138	2B-001	CB	901	CB CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
139	2B-002	CB	903	CB OPEN POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
140	2B-003	CB	905	SF6 LOW PRESSURE ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
141	2B-004	CB	907	SF6 LOW PRESSURE LOCK	DI	PCS-9705C	SCADA	H194-I-D-0053
142	2B-005	CB	909	TEMPERATURE AND HUMIDITY SENSOR POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
143	2B-006	CB	911	SOCKET POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
144	2B-007	CB	913	LIGHT POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
145	2B-008	CB	915	MOTER POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
146	2B-009	CB	917	MOTOR TIME-DELAY FAULT ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
147	2B-010	CB	919	NON-SPRING SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
148	2B-011	CB	921	LOCAL STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
149	2B-012	CB	923	REMOTE STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
150	2B-013	CB	925	UNLOCKING STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
151	2B-014	DS1	927	DS1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
152	2B-015	DS1	929	DS1 REMOTE STATE	DI	PCS-9705C	SCADA	H194-I-D-0053
153	2B-016	DS1	931	DS1 AC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
154	2B-017	DS1	933	DS1 DC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
155	2B-018	DS2	935	DS2 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
156	2B-019	DS2	937	DS2 REMOTE STATE	DI	PCS-9705C	SCADA	H194-I-D-0053
157	2B-020	DS2	939	DS2 AC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
158	2B-021	DS2	941	DS2 DC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
159	2B-022	DS3	943	DS3 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
160	2B-023	DS3	945	DS3 REMOTE STATE	DI	PCS-9705C	SCADA	H194-I-D-0053
161	2B-024	DS3	947	DS3 AC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
162	2B-025	DS3	949	DS3 DC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
163	2B-026	ES1	951	ES1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
164	2B-027	ES2	953	ES1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
165	2B-028	ES3	955	ES1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
166	2B-029	PCS-9671	957	DIFF. REALY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
167	2B-030	PCS-9671	959	DIFF. REALY ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
168	2B-031	PCS-9671	961	DIFF. TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
169	2B-032	F50 PCS-9611	963	HVS OC REALY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
170	2B-033	F50 PCS-9611	965	HVS OC REALY ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
171	2B-034	F50 PCS-9611	967	HVS OC TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
172	2B-035	F51 PCS-9611	969	LVS OC REALY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
173	2B-036	F51 PCS-9611	971	LVS OC REALY ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
174	2B-037	F51 PCS-9611	973	LVS OC TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
175	2B-038	TRANSFORMER	975	HIGH OIL TEMP. TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
176	2B-039	TRANSFORMER	977	BUCHHOLZ TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
177	2B-040	TRANSFORMER	979	WINDING TEMP. TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
178	2B-041	TRANSFORMER	981	OLTC BUCHHOLZ TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
179	2B-042	TRANSFORMER	983	PRESSURE RELIEF VALVE TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
180	2B-043	-K8XX LOCKOUT RELAY	985	LOCKOUT RELAY 1 OPERATED	DI	PCS-9705C	SCADA	H194-I-D-0053
181	2B-044	-K8XX LOCKOUT RELAY	987	LOCKOUT RELAY 2 OPERATED	DI	PCS-9705C	SCADA	H194-I-D-0053
182	2B-045	-K7XX TRIP CIRCUIT SUPERVISION RELAY	989	TCS 1 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
183	2B-046	-K7XX TRIP CIRCUIT SUPERVISION RELAY	991	TCS 1 HEALTHY	DI	PCS-9705C	SCADA	H194-I-D-0053
184	2B-047	-K7XX TRIP CIRCUIT SUPERVISION RELAY	993	TCS 2 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
185	2B-048	-K7XX TRIP CIRCUIT SUPERVISION RELAY	995	TCS 2 HEALTHY	DI	PCS-9705C	SCADA	H194-I-D-0053
186	2B-049	-K7XX TRIP CIRCUIT SUPERVISION RELAY	997	TCS 3 FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
187	2B-050	-K7XX TRIP CIRCUIT SUPERVISION RELAY	999	TCS 3 HEALTHY	DI	PCS-9705C	SCADA	H194-I-D-0053
188	2B-051	-F2XX AC SUPPLY MCB	999'	AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
189	2B-052	-80A AC SUPERVISION RELAY	997'	AC SUPPLY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
190	2B-053	-F101 DC SUPPLY MCB	995'	DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0053
191	2B-054	-80B DC SUPERVISION RELAY	993'	DC 1 SUPPLY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
192	2B-055	-81C DC SUPERVISION RELAY	991'	DC 2 SUPPLY FAIL	DI	PCS-9705C	SCADA	H194-I-D-0053
193	2B-056	ENERGY METER	987'	LOSS POWER	DI	PCS-9705C	SCADA	H194-I-D-0053
194	2B-057	ENERGY METER	985'	VT1 AND VT2 START	DI	PCS-9705C	SCADA	H194-I-D-0053

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
195	2B-058	CB1	803	NON-SPRING SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0053
196	2B-059	CB1	805	TEST POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
197	2B-060	CB1	807	WORK LOCATION	DI	PCS-9705C	SCADA	H194-I-D-0053
198	2B-061	CB1	809	CB1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
199	2B-062	CB1	811	CB1 OPEN POSITION	DI	PCS-9705C	SCADA	H194-I-D-0053
200	2B-063	CB1	813	REMOTE 1KK SWITCH	DI	PCS-9705C	SCADA	H194-I-D-0053
201	2B-064	PROTECTION	815	VT1 AND VT2 START	DI	PCS-9705C	SCADA	H194-I-D-0053
202	2B-065	PROTECTION	817	LOSS POWER	DI	PCS-9705C	SCADA	H194-I-D-0053
203	2B-066	MPR	819	MAIN OIL INDICATOR ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
204	2B-067	MPR	821	SWITCH OIL INDICATOR ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
205	2B-068	MPR	823	OIL THERMOSTAT 1 OIL TEMP. ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
206	2B-069	MPR	825	OIL THERMOSTAT 1 OIL TEMP. ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
207	2B-070	MPR	827	WINDING TEMP. ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
208	2B-071	MPR	829	MAIN PRESSURE RELIEVE 1 AND 2 ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
209	2B-072	MPR	831	SWITCH PRESSURE RELIEF ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
210	2B-073	MPR	833	TANK HEAVYGAS ALARM	DI	PCS-9705C	SCADA	H194-I-D-0053
211	2B-074	BCD	BCD0	BCD0	DI	PCS-9705C	SCADA	H194-I-D-0053
212	2B-075	BCD	BCD2	BCD2	DI	PCS-9705C	SCADA	H194-I-D-0053
213	2B-076	BCD	BCD4	BCD4	DI	PCS-9705C	SCADA	H194-I-D-0053
214	2B-077	BCD	BCD6	BCD6	DI	PCS-9705C	SCADA	H194-I-D-0053
215	2B-078	BCD	BCD8	BCD8	DI	PCS-9705C	SCADA	H194-I-D-0053
216	2B-079	BCD	BCD10	BCD10	DI	PCS-9705C	SCADA	H194-I-D-0053
217	2B-080	AIR-COOLED	701	POWER SUPPLY Ⅰ SHORT-CIRCUIT FAULT	DI	PCS-9705C	SCADA	H194-I-D-0053
218	2B-081	AIR-COOLED	703	POWER SUPPLY Ⅱ SHORT-CIRCUIT FAULT	DI	PCS-9705C	SCADA	H194-I-D-0053
219	2B-082	AIR-COOLED	705	POWER SUPPLY Ⅰ PHASE-FAILURE	DI	PCS-9705C	SCADA	H194-I-D-0053
220	2B-083	AIR-COOLED	707	POWER SUPPLY Ⅱ PHASE-FAILURE	DI	PCS-9705C	SCADA	H194-I-D-0053
221	2B-084	AIR-COOLED	709	POWER SUPPLY Ⅰ ON	DI	PCS-9705C	SCADA	H194-I-D-0053
222	2B-085	AIR-COOLED	711	POWER SUPPLY Ⅱ ON	DI	PCS-9705C	SCADA	H194-I-D-0053
223	2B-086	AIR-COOLED	713	SIGNAL FOR ALL FANS STOP	DI	PCS-9705C	SCADA	H194-I-D-0053
224	2B-087	ON-LOAD VOLTAGE REGULATION	737	SIGNAL MOTOR CIRCUIT	DI	PCS-9705C	SCADA	H194-I-D-0053
225	2B-088	ON-LOAD VOLTAGE REGULATION	739	TAP-CHANGER IN OPERATION	DI	PCS-9705C	SCADA	H194-I-D-0053
226	2B-089	ON-LOAD VOLTAGE REGULATION	741	LOCAL	DI	PCS-9705C	SCADA	H194-I-D-0053
227	2B-090	ON-LOAD VOLTAGE REGULATION	743	REMOTE	DI	PCS-9705C	SCADA	H194-I-D-0053
228	2B-091	DS1	103	DS 1 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0053
229	2B-092	DS1	113	DS 1 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0053
230	2B-093	DS2	103	DS 2 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0053
231	2B-094	DS2	113	DS 2 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0053
232	2B-095	DS3	103	DS 3 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0053
233	2B-096	DS3	113	DS 3 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0053
234	2B-097	BCU	GY901	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0016
235	2B-098	BCU	GY903	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0016
236	2B-099	BCU	GY905	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0016
237	2B-100	BCU	GY907	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0016
238	2B-101	BCU	GY909	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0016
239	2B-102	BCU	GY911	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0016
240	2B-103	BCU	GY913	LOSS POWER	DO	PCS-9705C	SCADA	H194-I-D-0016
241	2B-104	BCU	GY915	VT1 AND VT2 START	DO	PCS-9705C	SCADA	H194-I-D-0016

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
242	2B-105	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
243	2B-106	CT1	B412	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
244	2B-107	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
245	2B-108	CT1	B412	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
246	2B-109	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
247	2B-110	CT1	C412	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0050
248	2B-111	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0050
249	2B-112	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0050
250	2B-113	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0050
251	2B-114	CT3	A431	MAIN PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0050
252	2B-115	CT3	B431	MAIN PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0050
253	2B-116	CT3	C431	MAIN PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0050
254	2B-117	CT4	A441	FAULT RECORDER CURRENT(PHASE A)	AI	PCS-996	SCADA	H194-I-D-0050
255	2B-118	CT4	B441	FAULT RECORDER CURRENT(PHASE B)	AI	PCS-996	SCADA	H194-I-D-0050
256	2B-119	CT4	C441	FAULT RECORDER CURRENT(PHASE C)	AI	PCS-996	SCADA	H194-I-D-0050
257	2B-120	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0050
258	2B-121	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0050
259	2B-122	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0050
260	2B-123	CT6	A310	BUSBAR PROTECTION CURRENT(PHASE A)	AI	PCS-915	SCADA	H194-I-D-0050
261	2B-124	CT6	B310	BUSBAR PROTECTION CURRENT(PHASE B)	AI	PCS-915	SCADA	H194-I-D-0050
262	2B-125	CT6	C310	BUSBAR PROTECTION CURRENT(PHASE C)	AI	PCS-915	SCADA	H194-I-D-0050
263	2B-126	VT1	A630Y''	BUSBAR 1 PROTECTION VOLTAGE(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0050
264	2B-127	VT1	B630Y''	BUSBAR 1 PROTECTION VOLTAGE(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0050
265	2B-128	VT1	C630Y''	BUSBAR 1 PROTECTION VOLTAGE(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0050
266	2B-129	VT2	A640Y''	BUSBAR 2 PROTECTION VOLTAGE(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0050
267	2B-130	VT2	B640Y''	BUSBAR 2 PROTECTION VOLTAGE(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0050
268	2B-131	VT2	C640Y''	BUSBAR 2 PROTECTION VOLTAGE(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0050
269	2B-132	VT3	A630Y	BUSBAR 1 MEASURE VOLTAGE(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0050
270	2B-133	VT3	B630Y	BUSBAR 1 MEASURE VOLTAGE(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0050
271	2B-134	VT3	C630Y	BUSBAR 1 MEASURE VOLTAGE(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0050
272	2B-135	VT4	A640Y	BUSBAR 2 MEASURE VOLTAGE(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0050
273	2B-136	VT4	B640Y	BUSBAR 2 MEASURE VOLTAGE(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0050
274	2B-137	VT4	C640Y	BUSBAR 2 MEASURE VOLTAGE(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0050
BUS COUPLER								
1	YML-001	CB	901	CB CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0028
2	YML-002	CB	903	CB OPEN	DI	PCS-9705C	SCADA	H194-I-D-0028
3	YML-003	CB	905	SF6 LOW PRESSURE ALARM	DI	PCS-9705C	SCADA	H194-I-D-0028
4	YML-004	CB	907	SF6 LOW PRESSURE LOCK	DI	PCS-9705C	SCADA	H194-I-D-0028
5	YML-005	CB	909	TEMPERATURE AND HUMIDITY SENSOR POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0028
6	YML-006	CB	911	SOCKET POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0028
7	YML-007	CB	913	LIGHT POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0028
8	YML-008	CB	915	MOTOR POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0028
9	YML-009	CB	917	MOTOR TIME-DELAY FAULT ALARM	DI	PCS-9705C	SCADA	H194-I-D-0028
10	YML-010	CB	919	NON-SPRING SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0028
11	YML-011	CB	921	LOCAL STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0028
12	YML-012	CB	923	REMOTE STATE SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0028
13	YML-013	CB	925	UNLOCKING SIGNAL	DI	PCS-9705C	SCADA	H194-I-D-0028

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
14	YML-014	DS1	927	DS1 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0028
15	YML-015	DS1	929	REMOTE SIGNAL DS1	DI	PCS-9705C	SCADA	H194-I-D-0028
16	YML-016	DS1	931	DS1 AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0028
17	YML-017	DS1	933	DS1 DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0028
18	YML-018	DS2	935	DS2 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0028
19	YML-019	DS2	937	REMOTE SIGNAL DS2	DI	PCS-9705C	SCADA	H194-I-D-0028
20	YML-020	DS2	939	DS2 AC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0028
21	YML-021	DS2	941	DS2 DC MCB TRIP	DI	PCS-9705C	SCADA	H194-I-D-0028
22	YML-022	ES1	943	ES1 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0028
23	YML-023	ES2	945	ES2 CLOSE	DI	PCS-9705C	SCADA	H194-I-D-0028
44	YML-024	DS1	103	DS1 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0027
45	YML-025	DS1	113	DS1 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0027
46	YML-026	DS2	103	DS2 REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0027
47	YML-027	DS2	113	DS2 REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0027
48	YML-028	BCU	GY901	FAIL	DO	PCS-9705C	SCADA	H194-I-D-0016
49	YML-029	BCU	GY903	ALARM	DO	PCS-9705C	SCADA	H194-I-D-0016
53	YML-030	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9705C	SCADA	H194-I-D-0026
54	YML-031	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9705C	SCADA	H194-I-D-0026
55	YML-032	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9705C	SCADA	H194-I-D-0026
59	YML-033	CT4	A441	FAULT RECORDER CURRENT(PHASE A)	AI	PCS-996R	SCADA	H194-I-D-0026
60	YML-034	CT4	B441	FAULT RECORDER CURRENT(PHASE B)	AI	PCS-996R	SCADA	H194-I-D-0026
61	YML-035	CT4	C441	FAULT RECORDER CURRENT(PHASE C)	AI	PCS-996R	SCADA	H194-I-D-0026
62	YML-036	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0026
63	YML-037	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0026
64	YML-038	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0026
65	YML-039	CT6	A310	BUSBAR PROTECTION CURRENT(PHASE A)	AI	PCS-915	SCADA	H194-I-D-0026
66	YML-040	CT6	B310	BUSBAR PROTECTION CURRENT(PHASE B)	AI	PCS-915	SCADA	H194-I-D-0026
67	YML-041	CT6	C310	BUSBAR PROTECTION CURRENT(PHASE C)	AI	PCS-915	SCADA	H194-I-D-0026
68	YML-042	VT1	A630Y	BUSBAR I MEASURE VOLTAGE(PHASEA)	AI	PCS-9705C	SCADA	H194-I-D-0026
69	YML-043	VT1	B630Y	BUSBAR I MEASURE VOLTAGE(PHASEB)	AI	PCS-9705C	SCADA	H194-I-D-0026
70	YML-044	VT1	C630Y	BUSBAR I MEASURE VOLTAGE(PHASEC)	AI	PCS-9705C	SCADA	H194-I-D-0026
71	YML-045	VT2	B640Y	BUSBAR II MEASURE VOLTAGE(PHASEB)	AI	PCS-9705C	SCADA	H194-I-D-0026
BUSBAR PT 1&2								
1	1PT-001	DS	GY901	DS REMOTE STATE	DI	PCS-9705C	SCADA	H194-I-D-0081
2	1PT-002	DS	GY903	DS CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0081
3	1PT-003	DS	GY909	AC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0081
4	1PT-004	DS	GY911	DC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0081
5	1PT-005	DS	11B	DS CLOSE POSITION	DI	RCS-9663D	SCADA	H194-I-D-0080
6	1PT-006	DS	13B	DS OPEN POSITION	DI	RCS-9663D	SCADA	H194-I-D-0080
7	1PT-007	DS	103	DS REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0016
8	1PT-008	DS	113	DS REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0016
9	1PT-009	ES1	GY905	ES1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0081
10	1PT-010	ES2	GY907	ES2 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0081
11	1PT-011	VT1	A630Y	BUSBAR I MEASURE VOLTAGE(PHASEA)	AI	RCS-9663D	SCADA	H194-I-D-0081
12	1PT-012	VT1	B630Y	BUSBAR I MEASURE VOLTAGE(PHASEB)	AI	RCS-9663D	SCADA	H194-I-D-0081
13	1PT-013	VT1	C630Y	BUSBAR I MEASURE VOLTAGE(PHASEC)	AI	RCS-9663D	SCADA	H194-I-D-0081
14	1PT-014	VT2	A630Y'	BUSBAR I METERING VOLTAGE(PHASEA)	AI	RCS-9663D	SCADA	H194-I-D-0081

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
15	1PT-015	VT2	B630Y'	BUSBAR I METERING VOLTAGE(PHASEB)	AI	RCS-9663D	SCADA	H194-I-D-0081
16	1PT-016	VT2	C630Y'	BUSBAR I METERING VOLTAGE(PHASEC)	AI	RCS-9663D	SCADA	H194-I-D-0081
17	1PT-017	VT3	A630Y''	BUSBAR I PROTECTION VOLTAGE(PHASEA)	AI	RCS-9663D	SCADA	H194-I-D-0081
18	1PT-018	VT3	B630Y''	BUSBAR I PROTECTION VOLTAGE(PHASEB)	AI	RCS-9663D	SCADA	H194-I-D-0081
19	1PT-019	VT3	C630Y''	BUSBAR I PROTECTION VOLTAGE(PHASEC)	AI	RCS-9663D	SCADA	H194-I-D-0081
21	2PT-001	DS	GY901	DS REMOTE STATE	DI	PCS-9705C	SCADA	H194-I-D-0081
22	2PT-002	DS	GY903	DS CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0081
23	2PT-003	DS	GY909	AC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0081
24	2PT-004	DS	GY911	DC POWER TRIP	DI	PCS-9705C	SCADA	H194-I-D-0081
25	2PT-005	DS	15B	DS CLOSE POSITION	DI	RCS-9663D	SCADA	H194-I-D-0080
26	2PT-006	DS	17B	DS OPEN POSITION	DI	RCS-9663D	SCADA	H194-I-D-0080
27	2PT-007	DS	103	DS REMOTE CLOSE	DO	PCS-9705C	SCADA	H194-I-D-0016
28	2PT-008	DS	113	DS REMOTE OPEN	DO	PCS-9705C	SCADA	H194-I-D-0016
29	2PT-009	ES1	GY905	ES1 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0081
30	2PT-010	ES2	GY907	ES2 CLOSE POSITION	DI	PCS-9705C	SCADA	H194-I-D-0081
31	2PT-011	VT1	A640Y	BUSBAR II MEASURE VOLTAGE(PHASEA)	AI	RCS-9663D	SCADA	H194-I-D-0081
32	2PT-012	VT1	B640Y	BUSBAR II MEASURE VOLTAGE(PHASEB)	AI	RCS-9663D	SCADA	H194-I-D-0081
33	2PT-013	VT1	C640Y	BUSBAR II MEASURE VOLTAGE(PHASEC)	AI	RCS-9663D	SCADA	H194-I-D-0081
34	2PT-014	VT2	A640Y'	BUSBAR II METERING VOLTAGE(PHASEA)	AI	RCS-9663D	SCADA	H194-I-D-0081
35	2PT-015	VT2	B640Y'	BUSBAR II METERING VOLTAGE(PHASEB)	AI	RCS-9663D	SCADA	H194-I-D-0081
36	2PT-016	VT2	C640Y'	BUSBAR II METERING VOLTAGE(PHASEC)	AI	RCS-9663D	SCADA	H194-I-D-0081
37	2PT-017	VT3	A640Y''	BUSBAR II PROTECTION VOLTAGE(PHASEA)	AI	RCS-9663D	SCADA	H194-I-D-0081
38	2PT-018	VT3	B640Y''	BUSBAR II PROTECTION VOLTAGE(PHASEB)	AI	RCS-9663D	SCADA	H194-I-D-0081
39	2PT-019	VT3	C640Y''	BUSBAR II PROTECTION VOLTAGE(PHASEC)	AI	RCS-9663D	SCADA	H194-I-D-0081
SWITCHGEAR								
1	1U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
2	1U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
3	1U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
4	1U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
5	1U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
6	1U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
7	1U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
8	1U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
9	1U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
10	1U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
11	1U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
12	1U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
13	1U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
14	1U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
15	1U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
16	1U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
17	1U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
18	1U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
19	1U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
20	1U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
21	1U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
22	1U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
23	1U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
24	1U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
25	1U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
26	1U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
27	2U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
28	2U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
29	2U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
30	2U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
31	2U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
32	2U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
33	2U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
34	2U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
35	2U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
36	2U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
37	2U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
38	2U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
39	2U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
40	2U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
41	2U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
42	2U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
43	2U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
44	2U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
45	2U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
46	2U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
47	2U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
48	2U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
49	2U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
50	2U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
51	2U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
52	2U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
53	3U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
54	3U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
55	3U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
56	3U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
57	3U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
58	3U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
59	3U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
60	3U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
61	3U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
62	3U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
63	3U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
64	3U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
65	3U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
66	3U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
67	3U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
68	3U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
69	3U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
70	3U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
71	3U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
72	3U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
73	3U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
74	3U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
75	3U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
76	3U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
77	3U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
78	3U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
79	4U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
80	4U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
81	4U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
82	4U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
83	4U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
84	4U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
85	4U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
86	4U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
87	4U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
88	4U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
89	4U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
90	4U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
91	4U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
92	4U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
93	4U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
94	4U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
95	4U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
96	4U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
97	4U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
98	4U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
99	4U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
100	4U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
101	4U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
102	4U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
103	4U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
104	4U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
105	5U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
106	5U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
107	5U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
108	5U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
109	5U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
110	5U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
111	5U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
112	5U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
113	5U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
114	5U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
115	5U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
116	5U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
117	5U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
118	5U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
119	5U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
120	5U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
121	5U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
122	5U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
123	5U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
124	5U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
125	5U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
126	5U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
127	5U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
128	5U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
129	5U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
130	5U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
131	6U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
132	6U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
133	6U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
134	6U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
135	6U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
136	6U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
137	6U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
138	6U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
139	6U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
140	6U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
141	6U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
142	6U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
143	6U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
144	6U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
145	6U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
146	6U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
147	6U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
148	6U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
149	6U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
150	6U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
151	6U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
152	6U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
153	6U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
154	6U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
155	6U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
156	6U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
157	7U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
158	7U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
159	7U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
160	7U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
161	7U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
162	7U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
163	7U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
164	7U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
165	7U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
166	7U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
167	7U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
168	7U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
169	7U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
170	7U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
171	7U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
172	7U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
173	7U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
174	7U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
175	7U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
176	7U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
177	7U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
178	7U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
179	7U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
180	7U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
181	7U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
182	7U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
183	8U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
184	8U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
185	8U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
186	8U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
187	8U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
188	8U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
189	8U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
190	8U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
191	8U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
192	8U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
193	8U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
194	8U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
195	8U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
196	8U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
197	8U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
198	8U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
199	8U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
200	8U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
201	8U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
202	8U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
203	8U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
204	8U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
205	8U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
206	8U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
207	8U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
208	8U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
209	9U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
210	9U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
211	9U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
212	9U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
213	9U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
214	9U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
215	9U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
216	9U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
217	9U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
218	9U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
219	9U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
220	9U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
221	9U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
222	9U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
223	9U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
224	9U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
225	9U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
226	9U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
227	9U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
228	9U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
229	9U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
230	9U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
231	9U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
232	9U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
233	9U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
234	9U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
235	10U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
236	10U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
237	10U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
238	10U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
239	10U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
240	10U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
241	10U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
242	10U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
243	10U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
244	10U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
245	10U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
246	10U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
247	10U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
248	10U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
249	10U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
250	10U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
251	10U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
252	10U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
253	10U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
254	10U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
255	10U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
256	10U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
257	10U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
258	10U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
259	10U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
260	10U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
261	11U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
262	11U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
263	11U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
264	11U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
265	11U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
266	11U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
267	11U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
268	11U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
269	11U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
270	11U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
271	11U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
272	11U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
273	11U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
274	11U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
275	11U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
276	11U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
277	11U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
278	11U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
279	11U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
280	11U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
281	11U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
282	11U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
283	11U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
284	11U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
285	11U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
286	11U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
287	12U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
288	12U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
289	12U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
290	12U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
291	12U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
292	12U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
293	12U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
294	12U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
295	12U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
296	12U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
297	12U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
298	12U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
299	12U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
300	12U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
301	12U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
302	12U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
303	12U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
304	12U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
305	12U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
306	12U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
307	12U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
308	12U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
309	12U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
310	12U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
311	12U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
312	12U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
313	13U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
314	13U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
315	13U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
316	13U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
317	13U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
318	13U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
319	13U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
320	13U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
321	13U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
322	13U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
323	13U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
324	13U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
325	13U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
326	13U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
327	13U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
328	13U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
329	13U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
330	13U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
331	13U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
332	13U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
333	13U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
334	13U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
335	13U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
336	13U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
337	13U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
338	13U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
339	14U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
340	14U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
341	14U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
342	14U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
343	14U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
344	14U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
345	14U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
346	14U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
347	14U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
348	14U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
349	14U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
350	14U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
351	14U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
352	14U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
353	14U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
354	14U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
355	14U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
356	14U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
357	14U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
358	14U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
359	14U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
360	14U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
361	14U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
362	14U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
363	14U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
364	14U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
365	15U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
366	15U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
367	15U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
368	15U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
369	15U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
370	15U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
371	15U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
372	15U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
373	15U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
374	15U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
375	15U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
376	15U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
377	15U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
378	15U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
379	15U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
380	15U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
381	15U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
382	15U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
383	15U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
384	15U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
385	15U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
386	15U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
387	15U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
388	15U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
389	15U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
390	15U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
391	16U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
392	16U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
393	16U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
394	16U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
395	16U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
396	16U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
397	16U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
398	16U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
399	16U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
400	16U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
401	16U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
402	16U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
403	16U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
404	16U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
405	16U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
406	16U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
407	16U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
408	16U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
409	16U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
410	16U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
411	16U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
412	16U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
413	16U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
414	16U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
415	16U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
416	16U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
417	17U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
418	17U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
419	17U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
420	17U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
421	17U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
422	17U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
423	17U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
424	17U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
425	17U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
426	17U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
427	17U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
428	17U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
429	17U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
430	17U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
431	17U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
432	17U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
433	17U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
434	17U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
435	17U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
436	17U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
437	17U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
438	17U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
439	17U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
440	17U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
441	17U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
442	17U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
443	18U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
444	18U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
445	18U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
446	18U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
447	18U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
448	18U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
449	18U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
450	18U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
451	18U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
452	18U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
453	18U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
454	18U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
455	18U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
456	18U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
457	18U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
458	18U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
459	18U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
460	18U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
461	18U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
462	18U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
463	18U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
464	18U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
465	18U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
466	18U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
467	18U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
468	18U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
469	19U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
470	19U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
471	19U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
472	19U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
473	19U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
474	19U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
475	19U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
476	19U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
477	19U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
478	19U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
479	19U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
480	19U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
481	19U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
482	19U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
483	19U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
484	19U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
485	19U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
486	19U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
487	19U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
488	19U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
489	19U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
490	19U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
491	19U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
492	19U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088

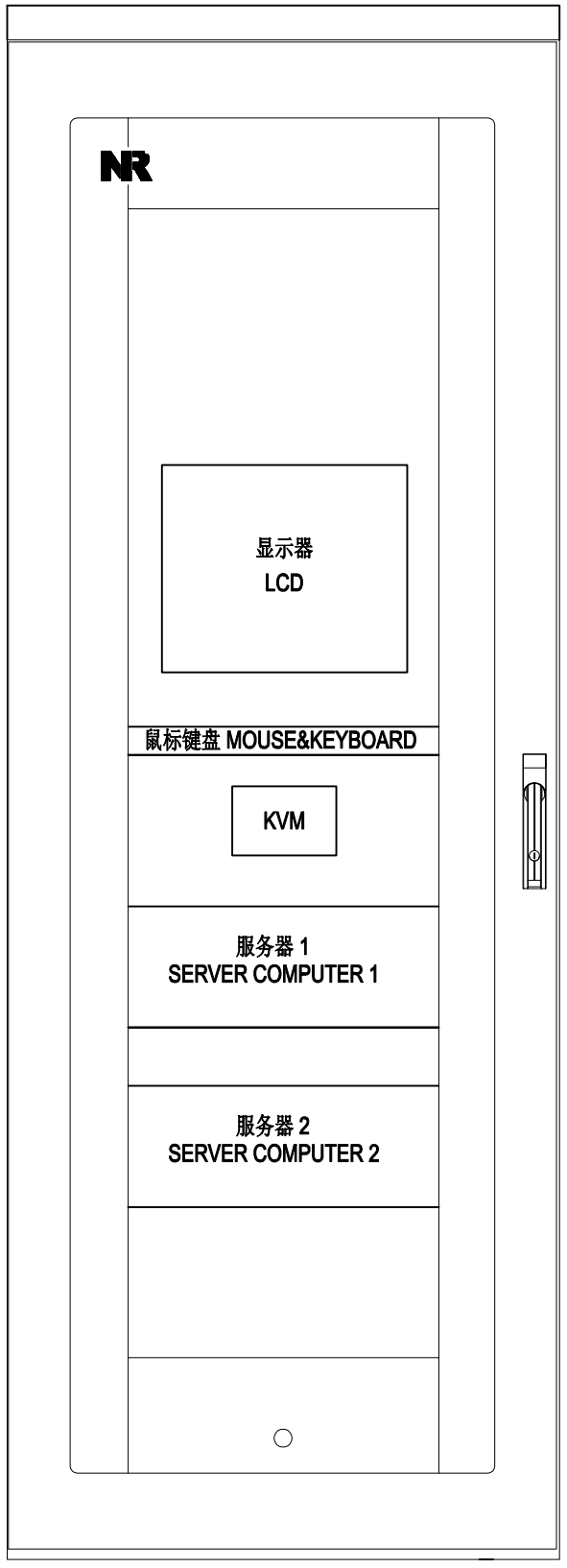
SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
493	19U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
494	19U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
495	20U-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
496	20U-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
497	20U-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
498	20U-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
499	20U-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
500	20U-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
501	20U-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0088
502	20U-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0088
503	20U-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0088
504	20U-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0089
505	20U-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
506	20U-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0089
507	20U-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0089
508	20U-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0089
509	20U-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0089
510	20U-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0089
511	20U-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0089
512	20U-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0089
513	20U-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0089
514	20U-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0089
515	20U-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0088
516	20U-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0088
517	20U-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0088
518	20U-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
519	20U-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
520	20U-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0088
521	1JDB-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0094
522	1JDB-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0094
523	1JDB-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0094
524	1JDB-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9671	SCADA	H194-I-D-0094
525	1JDB-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9671	SCADA	H194-I-D-0094
526	1JDB-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9671	SCADA	H194-I-D-0094
527	1JDB-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9671	SCADA	H194-I-D-0094
528	1JDB-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9671	SCADA	H194-I-D-0094
529	1JDB-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9671	SCADA	H194-I-D-0094
530	1JDB-014	TRANSFORMER	809	TRANSFORMER OVERHEAT TRIP	DI	PCS-9671	SCADA	H194-I-D-0095
531	1JDB-015	TRANSFORMER	811	TRANSFORMER OVERHEAT ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
532	1JDB-016	TRANSFORMER	813	TRANSFORMER FAULT ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
533	1JDB-017	CB	815	BREAKER OPEN	DI	PCS-9671	SCADA	H194-I-D-0095
534	1JDB-018	CB	817	BREAKER CLOSE	DI	PCS-9671	SCADA	H194-I-D-0095
535	1JDB-019	CB	819	SPRING DOES NOT STORE ENERGY	DI	PCS-9671	SCADA	H194-I-D-0095
536	1JDB-020	CB	821	SWITCH OPERATION POSITION	DI	PCS-9671	SCADA	H194-I-D-0095
537	1JDB-021	CB	823	SWITCHBOARD HANDCART IN	DI	PCS-9671	SCADA	H194-I-D-0095
538	1JDB-022	CB	825	SWITCHBOARD HANDCART OUT	DI	PCS-9671	SCADA	H194-I-D-0095
539	1JDB-023	CB	827	GROUND SWITCH CLOSE	DI	PCS-9671	SCADA	H194-I-D-0095

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
540	1JDB-024	BW-DZ	829	OVERCURRENT ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
541	1JDB-025	BW-DZ	831	GROUND ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
542	1JDB-026	BW-DZ	833	POWER FAILURE ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
543	1JDB-027	BW-DZ	835	CABINET OVERTEMPERATURE HUMIDITY ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
544	1JDB-028	PCS-9671	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0095
545	1JDB-029	PCS-9671	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0095
546	2JDB-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0094
547	2JDB-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0094
548	2JDB-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0094
549	2JDB-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9671	SCADA	H194-I-D-0094
550	2JDB-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9671	SCADA	H194-I-D-0094
551	2JDB-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9671	SCADA	H194-I-D-0094
552	2JDB-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9671	SCADA	H194-I-D-0094
553	2JDB-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9671	SCADA	H194-I-D-0094
554	2JDB-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9671	SCADA	H194-I-D-0094
555	2JDB-014	TRANSFORMER	809	TRANSFORMER OVERHEAT TRIP	DI	PCS-9671	SCADA	H194-I-D-0095
556	2JDB-015	TRANSFORMER	811	TRANSFORMER OVERHEAT ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
557	2JDB-016	TRANSFORMER	813	TRANSFORMER FAULT ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
558	2JDB-017	CB	815	BREAKER OPEN	DI	PCS-9671	SCADA	H194-I-D-0095
559	2JDB-018	CB	817	BREAKER CLOSE	DI	PCS-9671	SCADA	H194-I-D-0095
560	2JDB-019	CB	819	SPRING DOES NOT STORE ENERGY	DI	PCS-9671	SCADA	H194-I-D-0095
561	2JDB-020	CB	821	SWITCH OPERATION POSITION	DI	PCS-9671	SCADA	H194-I-D-0095
562	2JDB-021	CB	823	SWITCHBOARD HANDCART IN	DI	PCS-9671	SCADA	H194-I-D-0095
563	2JDB-022	CB	825	SWITCHBOARD HANDCART OUT	DI	PCS-9671	SCADA	H194-I-D-0095
564	2JDB-023	CB	827	GROUND SWITCH CLOSE	DI	PCS-9671	SCADA	H194-I-D-0095
565	2JDB-024	BW-DZ	829	OVERCURRENT ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
566	2JDB-025	BW-DZ	831	GROUND ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
567	2JDB-026	BW-DZ	833	POWER FAILURE ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
568	2JDB-027	BW-DZ	835	CABINET OVERTEMPERATURE HUMIDITY ALARM	DI	PCS-9671	SCADA	H194-I-D-0095
569	2JDB-028	PCS-9671	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0095
570	2JDB-029	PCS-9671	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0095
571	1UC-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
572	1UC-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
573	1UC-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
574	1UC-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0091
575	1UC-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0091
576	1UC-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0091
577	1UC-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0091
578	1UC-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0091
579	1UC-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0091
580	1UC-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0092
581	1UC-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0092
582	1UC-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0092
583	1UC-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0092
584	1UC-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0092
585	1UC-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0092
586	1UC-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0092

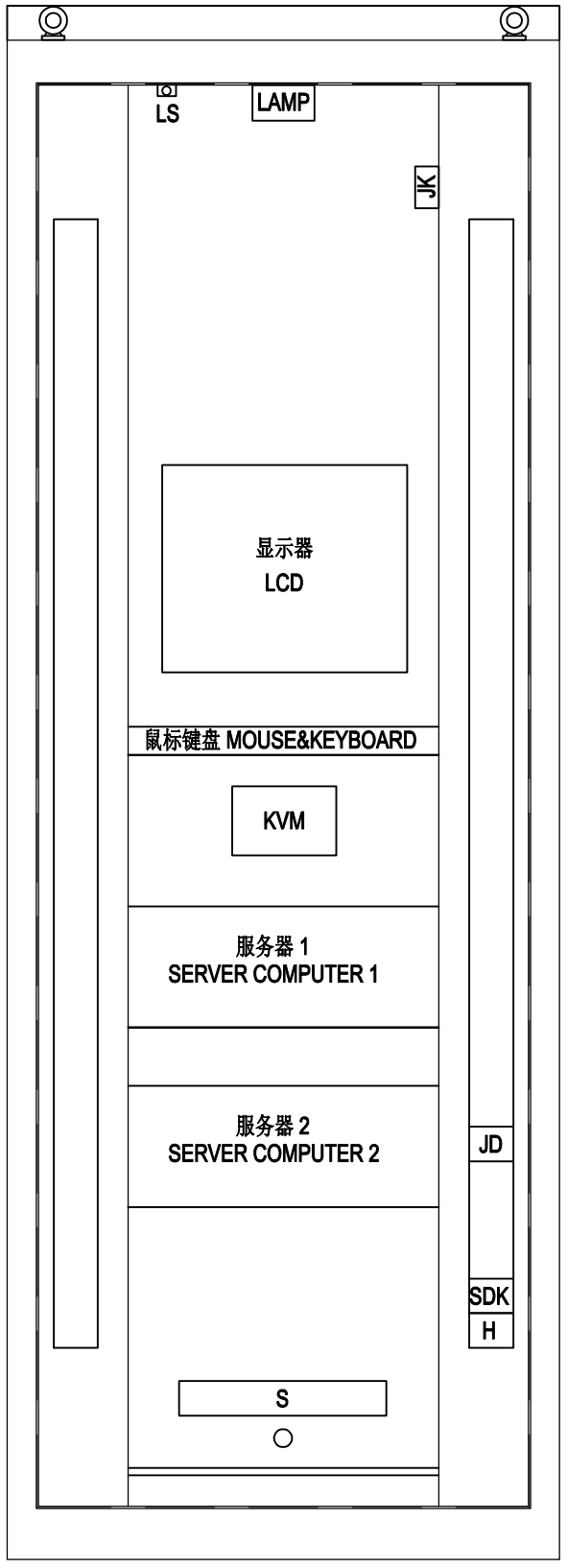
SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
587	1UC-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0092
588	1UC-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0092
589	1UC-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0092
590	1UC-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0092
591	1UC-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0091
592	1UC-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0091
593	1UC-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0091
594	1UC-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
595	1UC-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
596	1UC-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
597	2UC-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
598	2UC-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
599	2UC-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
600	2UC-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0091
601	2UC-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0091
602	2UC-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0091
603	2UC-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9611	SCADA	H194-I-D-0091
604	2UC-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9611	SCADA	H194-I-D-0091
605	2UC-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9611	SCADA	H194-I-D-0091
606	2UC-010	CB	813	BREAKER OPEN	DI	PCS-9611	SCADA	H194-I-D-0092
607	2UC-011	CB	815	BREAKER CLOSE	DI	PCS-9611	SCADA	H194-I-D-0092
608	2UC-012	CB	817	SPRING DOES NOT STORE ENERGY	DI	PCS-9611	SCADA	H194-I-D-0092
609	2UC-013	CB	819	SWITCH OPERATION POSITION	DI	PCS-9611	SCADA	H194-I-D-0092
610	2UC-014	CB	821	SWITCHBOARD HANDCART IN	DI	PCS-9611	SCADA	H194-I-D-0092
611	2UC-015	CB	823	SWITCHBOARD HANDCART OUT	DI	PCS-9611	SCADA	H194-I-D-0092
612	2UC-016	CB	825	GROUND SWITCH CLOSE	DI	PCS-9611	SCADA	H194-I-D-0092
613	2UC-017	CB	827	CIRCUIT BREAKER PRESSURE TOO LOW	DI	PCS-9611	SCADA	H194-I-D-0092
614	2UC-018	CB	829	CIRCUIT BREAKER PRESSURE INSUFFICIENT	DI	PCS-9611	SCADA	H194-I-D-0092
615	2UC-019	PCS-9611	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0092
616	2UC-020	PCS-9611	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0092
617	2UC-021	VT1	A630	PROTECTION AND MEASURE VOLTAGE(PHASEA)	AI	PCS-9611	SCADA	H194-I-D-0091
618	2UC-022	VT1	B630	PROTECTION AND MEASURE VOLTAGE(PHASEB)	AI	PCS-9611	SCADA	H194-I-D-0091
619	2UC-023	VT1	C630	PROTECTION AND MEASURE VOLTAGE(PHASEC)	AI	PCS-9611	SCADA	H194-I-D-0091
620	2UC-024	VT2	A630'	ENERGY METER VOLTAGE(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
621	2UC-025	VT2	B630'	ENERGY METER VOLTAGE(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
622	2UC-026	VT2	C630'	ENERGY METER VOLTAGE(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0091
623	ZYB-001	CT1	A411	ENERGY METER CURRENT(PHASE A)	AI	DTSD-3419DSF	SCADA	H194-I-D-0097
624	ZYB-002	CT1	B411	ENERGY METER CURRENT(PHASE B)	AI	DTSD-3419DSF	SCADA	H194-I-D-0097
625	ZYB-003	CT1	C411	ENERGY METER CURRENT(PHASE C)	AI	DTSD-3419DSF	SCADA	H194-I-D-0097
626	ZYB-004	CT2	A421	MEASURE CURRENT(PHASE A)	AI	PCS-9671	SCADA	H194-I-D-0097
627	ZYB-005	CT2	B421	MEASURE CURRENT(PHASE B)	AI	PCS-9671	SCADA	H194-I-D-0097
628	ZYB-006	CT2	C421	MEASURE CURRENT(PHASE C)	AI	PCS-9671	SCADA	H194-I-D-0097
629	ZYB-007	CT5	A451	BACK-UP PROTECTION CURRENT(PHASE A)	AI	PCS-9671	SCADA	H194-I-D-0097
630	ZYB-008	CT5	B451	BACK-UP PROTECTION CURRENT(PHASE B)	AI	PCS-9671	SCADA	H194-I-D-0097
631	ZYB-009	CT5	C451	BACK-UP PROTECTION CURRENT(PHASE C)	AI	PCS-9671	SCADA	H194-I-D-0097
632	ZYB-014	TRANSFORMER	809	TRANSFORMER OVERHEAT TRIP	DI	PCS-9671	SCADA	H194-I-D-0098
633	ZYB-015	TRANSFORMER	811	TRANSFORMER OVERHEAT ALARM	DI	PCS-9671	SCADA	H194-I-D-0098

SERIAL NO	TAG NO	LOCATION FROM	SEQUENCE NO	INSTRUMENT TYPE & DISCRIPTION	I/O TYPE	LOCATION TO	SYSTEM TYPE	REFERENCE DRAWING NO.
634	ZYB-016	TRANSFORMER	813	TRANSFORMER FAULT ALARM	DI	PCS-9671	SCADA	H194-I-D-0098
635	ZYB-017	CB	815	BREAKER OPEN	DI	PCS-9671	SCADA	H194-I-D-0098
636	ZYB-018	CB	817	BREAKER CLOSE	DI	PCS-9671	SCADA	H194-I-D-0098
637	ZYB-019	CB	819	SPRING DOES NOT STORE ENERGY	DI	PCS-9671	SCADA	H194-I-D-0098
638	ZYB-020	CB	821	SWITCH OPERATION POSITION	DI	PCS-9671	SCADA	H194-I-D-0098
639	ZYB-021	CB	823	SWITCHBOARD HANDCART IN	DI	PCS-9671	SCADA	H194-I-D-0098
640	ZYB-022	CB	825	SWITCHBOARD HANDCART OUT	DI	PCS-9671	SCADA	H194-I-D-0098
641	ZYB-023	CB	827	GROUND SWITCH CLOSE	DI	PCS-9671	SCADA	H194-I-D-0098
642	ZYB-024	PCS-9671	901	DEVICE LOCKING	DO	PCS-9705C	SCADA	H194-I-D-0098
643	ZYB-025	PCS-9671	903	DEVICE FAULT	DO	PCS-9705C	SCADA	H194-I-D-0098
644	1B-138	CT13	A4131	33KV LV PROTECTION CURRENT(PHASE A)	AI	PCS-996R	SCADA	H194-I-D-0163
645	1B-139	CT13	B4131	33KV LV PROTECTION CURRENT(PHASE B)	AI	PCS-996R	SCADA	H194-I-D-0163
646	1B-140	CT13	B4131	33KV LV PROTECTION CURRENT(PHASE C)	AI	PCS-996R	SCADA	H194-I-D-0163
647	2B-138	CT13	A4131	33KV LV PROTECTION CURRENT(PHASE A)	AI	PCS-996R	SCADA	H194-I-D-0163
648	2B-139	CT13	B4131	33KV LV PROTECTION CURRENT(PHASE B)	AI	PCS-996R	SCADA	H194-I-D-0163
649	2B-140	CT13	B4131	33KV LV PROTECTION CURRENT(PHASE C)	AI	PCS-996R	SCADA	H194-I-D-0163
650	33VT	VT1	A630U	33KV LV BUS-1 PROTECTION VOLTAGE(PHASE A)	AI	PCS-996R	SCADA	H194-I-D-0163
651	33VT	VT1	B630U	33KV LV BUS-1 PROTECTION VOLTAGE(PHASE B)	AI	PCS-996R	SCADA	H194-I-D-0163
652	33VT	VT1	C630U	33KV LV BUS-1 PROTECTION VOLTAGE(PHASE C)	AI	PCS-996R	SCADA	H194-I-D-0163
652	33VT	VT2	A640U	33KV LV BUS-2 PROTECTION VOLTAGE(PHASE A)	AI	PCS-996R	SCADA	H194-I-D-0163
652	33VT	VT2	B640U	33KV LV BUS-2 PROTECTION VOLTAGE(PHASE B)	AI	PCS-996R	SCADA	H194-I-D-0163
652	33VT	VT2	C640U	33KV LV BUS-2 PROTECTION VOLTAGE(PHASE C)	AI	PCS-996R	SCADA	H194-I-D-0163

ABBREVIATION LIST: 1.CB-CIRCUIT BREAKER 2.DS-DISCONNECTING SWITCH 3.ES-EARTH SWITCH 4.CT-CURRENT TRANSFORMER 5.VT-VOLTAGE TRANAFORMER 6.Y-132kV TRANSMISSION LINE 7.B-132kV TRANSFORMER 8.BCU- BAY CONTROL UNIT 9.BPR-BAKE-UP PROTECTION RELAY 10.MPR-MAIN PROTECTION RELAY 11.BCD-BINARY-CODED DECIMAL 12.U-35kV TRANSMISSION LINE 13.ZYB-AUXILIARY TRANSFORMER 14.UC-SVC(STATIC VAR COMPENSATION) 15.JDB-EARTH TRANSFORMER 16.AI-ANALOG INPUT 17.DO-DIGITAL OUTPUT 19.DI-DIGITAL INPUT



正视
Front View



背视
Rear View

MATERIAL TAKE OFF (MTO) / (材料清册)

序号 No.	符号 SYMBOL	名称 DESCRIPTION	型号 TYPE	数量 QTY.
1		服务器 SERVER COMPUTER	NEC GT110e	2
2		显示器 LCD		1
3		鼠标键盘层 Mouse&Keyboard		1
4	JK	交流开关 AC MCB	2P-C-16A	1
5	H	加热器 HEATER	150W	1
6	SDK	温湿度控制器 HUMIDIFIER	TH-D-11	1
7	S	交流电源插座 AC OUTLET	TZ-Y/TJ-08-43E-32	1
8	KVM	KVM切换器 KVM	ATEN-CS84U	1
9	LS	LIMIT SWITCH		1
10	LAMP	LIGHTING LAMP		1

NOTES

1. ALL LABLES IN THE PANEL SHOULD BE IN ENGLISH.
2. LIGHT INSTALLED IN PANEL FOR ILLUMINATION.
3. CUBICLE EQUIPPED WITH CROSS-SECTION OF NOT LESS THAN 100mm^2 COPPER GROUNDING.

REV./(版本)	DATE / (日期)	ISSUE OR SCOPE OF REVISION / (修改问题或范围)	PREPARED / (设计)	CHECKED / (校核)	APPROVED / (批准)
1	18.O4.2015	ISSUE FOR AS BUILT	ZHANG CHANGJUN	HU KE	LIU XIAOHON
0	02.11.2014	ISSUE FOR INFORMATION	ZHANG CHANGJUN	HU KE	LIU XIAOHON
A	26.O9.2014	ISSUE FOR APPROVAL	ZHANG CHANGJUN	HU KE	LIU XIAOHON

PROJECT /(项目名称):
100 MW PV POWER PLANT AT
QUAID-E-AZAM SOLAR PARK BAHAWALPUR

CLIENT /(业主):
QUAID-E-AZAM SOLAR POWER Pvt. (Ltd)

EPC / (EPC单位):
TBEA SUN OASIS Pvt. (Ltd)

CONSULTANT / (顾问):
ILF CONSULTING ENGINEERS

DRAWING TITLE / (图纸名称):
POWER PREDICTION SERVER PANEL FRONT VIEW LAYOUT
功率预测服务器屏屏面布置图

SCALE /(比例)	PROJECT NO.	DRAWING NO. /(图号):	SHEET
NTS	H194	H194-I-D-0240/H194-I0110-02	1 OF 1

ORIGINAL A3

PCS-9700F

Power Forecast System

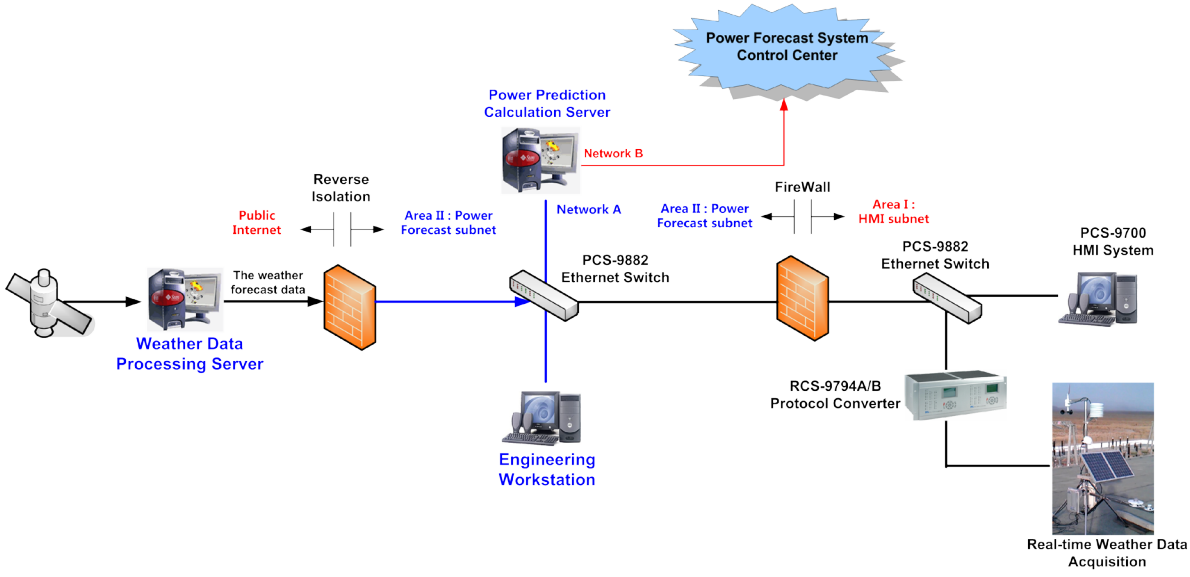
The power forecast system is used to predict the output power of renewable energy power station in an upcoming period. The system computes reliable forecast based on high accurate numerical weather prediction (NWP), with acquired site monitoring data, environment data and historical statistical data through the process of physical model and artificial neural network (ANN) model.

NR Electric's PCS-9700F power forecast system consists of two power forecast servers (main/standby), one weather data processor server, one WEB-based engineer workstation, one reverse isolation equipment, and one fire wall.

Environmental data such as ground radiation intensity, temperature, wind speed, etc;are required for solar power forecast. Therefore, the environmental monitor is provided,and is generally integrated into the solar power forecast supplier.

Features

- Advanced and mature software platform: The power forecast system is based on NR Electric's SOPHIC platform. The platform features such virtues as advanced architecture, mature and stable performance and has been applied to a series of national key projects.
- Advanced forecast algorithm: The physical model and ANN are used for power forecast to ensure forecast accuracy.
- The power forecast system is isolated from the public internet via reverse isolation device.
- The power forecast system is isolated from substation monitoring system via firewall.



PCS-9700R

AGC/AVC

Automatic Generation Control (AGC) and Automatic Voltage Control (AVC) are optional advanced functions for renewable energy Stations, such as solar power stations or wind power farms.

AGC is used to automatically maintain the system frequency or the power flow of interconnection lines within the target range. AGC operates based on the control of each generation unit in the farm dynamically and continuously. It regulates the power generation according to the entire plant power generation plan or strategies.

AVC is realized by controlling the reactive compensators installed in the power plant. In the control zone, reactive power or voltage control strategies are online calculated based on the real-time operation data of the power grid or the regulation targets given by the control center or grid dispatching center. Relying on the calculated strategies, reasonable reactive power or voltage operation states are realized through the automatic closed-loop control of the reactive power or voltage regulation equipment, such as SVC/STATCOM and capacitors, etc.

Features

- AGC/AVC realizes the optimal states of the renewable energy stations or farms following the regulation plan and strategies in realtime, helping to guarantee the reliable and safe operation of the power system
- AGC/AVC functions are developed based on the advanced and mature software platform. The advanced regulation system is developed based on NR Electric's SOPHIC platform and can keep the whole system operate in a safe and stable way. The platform features advanced architecture, mature and stable performance and has been proven in many global key projects.
- Based on visual logic programming technology, the logical process is clear and specific that it greatly shortens the debugging time and saves training time and cost.
- Based on smart and optimal regulation processes, AGC/AVC reduces system power losses and extends the service life of renewable generation units.
- The state information of AGC/AVC system, such as control block signals and standby power capacities, is transferred in realtime to the dispatching center or renewable power control center.
- AGC/AVC can realize the monitoring and control of renewable generation and improve the utilization of the renewable energy.