ANNEXURE-1B TO PY55294

STANDARD SPECIFICATION FOR NUMERICAL RELAYS AND SUBSTATION AUTOMATION SYSTEM (SAS)

PROJECT	**75MW VISAKH REFINERY MODERNIZATION PROJECT (VRMP)**
CUSTOMER	**M/S HINDUSTAN PETROLEUM CORPORATION LIMITED,VIZAG,A.P**
CONSULTANT	**ENGINEERS INDIA LIMITED**

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1.0 SCOPE

The intent of this specification is to define the minimum requirement of design, manufacture, testing, packing and dispatch of Numerical relays and Substation Automation System. The specification also defines the requirement of communication and integration for Substation Automation System.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of following IEC standards / equivalent Indian Standards, unless otherwise specified:

IEC 60068	: Environmental Testing
IEC 60073	: Basic safety principles for man machine interface, marking & identification — Coding principles for indicators and actuators
IS/IEC 60529	: Degree of protection provided by enclosure (IP Code)
IEC 60255	: Electrical relays
IEC 61000	: Electromagnetic compatibility (EMC)
IEC 61850	: Communication networks & systems in substations

2.2 In case of imported equipment, standards of the country of origin shall be applicable; if there, standards are equivalent or more stringent than the applicable IEC / Indian standards.

2.3 The equipment shall also conform to the provisions of CEA regulations and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC / BS / VDE / IEEE / NEMA or equivalent agency shall be applicable.

2.5 In case of any contradiction between various referred standard/ specification/ data sheet and statutory regulation, most stringent requirements shall prevail. However, Owner's decision in this regard will be final and binding.

3.0 SITE CONDITIONS

3.1 The relay shall be tropicalised, for satisfactory operation when installed in a panel located in a pressurized substation with restricted natural air ventilation, in tropical humid and corrosive atmosphere. Relay shall be designed to perform all its functions and operate under site conditions specified in the main specification PY55294.

4.0 GENERAL REQUIREMENTS

4.1 The equipment offered shall be brand new with state of the art technology with proven field track record of similar type and model or model in same series with additional features. No prototype equipment shall be offered.

4.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply.

4.3 Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to enable the end user for placement of order for spares and services.

4.4 In case of relays manufactured outside India, the relay manufacturer through his Indian establishment or associate in India shall provide application, testing, commissioning, after sales service and other necessary support for minimum of 15 years to customer. Their Indian establishment or associate company in India shall also maintain adequate inventory of each type of relay or spares to meet the requirement arising during project execution and plant operation. Relay manufacturer shall possess a signed Memorandum of Understanding with their Indian associate for providing customer support

5.0 TECHNICAL REQUIREMENTS

5.1 Auxiliary Power Supply

Unless otherwise specified, numerical relays, data concentrator, Ethernet switches, gateway & HMI shall be suitable to accept both AC/DC supplies with range 110V to 240V with tolerance of ± 15%. The auxiliary power supply shall preferably be site-selectable requiring no additional hardware.

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5.2 Basic Requirement and Construction Details

5.2.1 Relay shall be suitable for flush mounting. The relay enclosure front shall be dust tight having degree of protection minimum as IP5X.

5.2.2 Relay terminals shall be suitable for termination of 1.5/2.5/4 sq mm wires, for all hardwired connections.

5.2.3 Relay shall be modular with plug in type PCB for easy replacement. The relay terminals shall be easily accessible for testing and commissioning.

5.2.4 Current operated relay shall have provision for minimum 3 number phase CT inputs & 1 no. earth fault. Voltage operated relay shall have provision of minimum 3 numbers 1-phase PT inputs. The exact number of CT and PT inputs shall be based on the schematic requirements, relays shall be selected accordingly. Incase of comprehensive single numerical relay, the relay shall have provision for both current and voltage inputs.

5.2.5 CT shorting link shall be provided at terminal block as required.

5.2.6 All numerical relays shall have key pad/ keys to allow relay setting from relay front. All hand-reset relays shall also have reset button on relay front. Self reset or hand reset feature of the relay shall be software selectable and password protected.

5.2.7 Relay shall be suitable for 1 A or 5A CT secondary. CT secondary 1A or 5A shall either be software selectable or by providing suitable link. Selection between IA or 5A should be possible at site.

5.2.8 Relays shall have self-diagnostic feature with indication of relay failure on relay front. Relay faults (Self- diagnostic) shall be communicated and annunciated to substation automation system.

5.2.9 Relays shall have functions as per single line diagram in Annexure-03, numerical relay data sheet and as mentioned specifications PY55294 & annexures.

5.2.10 All relay shall be communicable type with dual redundant ports communicable on IEC61850HSR protocol.

5.2.11 All relays shall have inbuilt disturbance recording function with high resolution

5.3 Software Security

The relays shall be provided with suitable security (password protection) against unauthorized WRITE ACCESS for change in relay setting. However, it should be possible to view metering, protection settings, status and event data as READ ONLY without password protection.

5.4 Display and Indication

5.4.1 All relays shall have LCD display along with LED indications for display of settings, status, faults and events. Relays for generator protection, switchyard and GIS shall be provided with medium size LCD display having facility for graphical display of mimic with upto 15 objects on each page.

5.4.2 LCD display shall be backlit and temperature compensated up to 55°C for contrast and legibility.

5.4.3 Relays shall have 3 fixed LEDs for Relay ON/Control supply ON, fault trip & relay unhealthy apart from freely configured LEDs.

5.5 Protection Functions

5.5.1 Over Current/Earth Fault Protection

i) This section describes over current & earth fault protection function, which mainly include different setting stages such as low set, high set and high set instantaneous (51, 50, 51N,50N). Over current protection function provided should have IDMTL characteristic for low set and high set stages and definite time delay for high set instantaneous stage.

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ii) Over current relay shall be three-phase type with 4 elements; 3 elements for inverse and definite time delay over current and one element for inverse and definite time delay earth fault current. Selection of inverse or definite time feature shall be user selectable.

iii) The IDMTL characteristic (for 51 and 51N) shall be as per IEC. The inverse characteristics shall include normal inverse, very inverse, extremely inverse, long inverse and shall be soft ware selectable. Inverse element shall have two or more stages (low and high set) for selection of required inverse characteristic to achieve close protection as required. Definite time characteristic shall have minimum 2 stages with adjustable current and time setting.

iv) Relay shall also have separate current input from CBCT for measured earth fault current element. It shall be possible to connect earth fault element either through CBCT or to be connected residually. Minimum setting current for sensitive earth fault element shall be 1%.

v) Directional overcurrent & earth fault element shall be provided, wherever required.

vi) Voltage biased overcurrent / earth fault element shall be provided wherever required.

vii) Relay 51V voltage controlled over current relay shall be provided as indicated in the single line diagram in Annexure-03 of specification PY55294.

5.5.2 Transformer Protection

i) In addition to overcurrent & earth fault function, wherever required, the main numerical relay shall also include standby earth fault protection function (51G) for the transformer. The standby earth fault shall operate from a separate neutral CT input and shall have definite time / IDMTL characteristics as per IEC.

ii) Wherever the transformer requires restricted earth fault protection (64R), separate numerical relay shall be provided. For details of transformer differential protection relay refer Cl. 5.5.6.

iii) Transformer auxiliary protection (OTI/WTI/Buchholz/MOG etc) shall be included as a part of numerical relay.

iv) Transformer differential protection shall be provided, wherever specified.

5.5.3 Voltage Operated Protection Functions

i) These functions include under voltage (27), over voltage (59), ON delay and OFF delay timers, phase sequence voltage, neutral displacement and Synchro-check functions etc.

ii) The under voltage and overvoltage protective function shall have different stages with IDMTL and definite time characteristics.

iii) If specified in single line diagram, the relay shall have under and over frequency function along with frequency supervised Rate of change or average rate of change of frequency function.

5.5.4 Differential Protection

5.5.5 Suitable differential protection shall be provided as required as per single line diagram in Annexure-03 of specification PY55294 for the specific application such as for transformer, feeder, bus section etc. The following requirements, as applicable, shall be complied:

i) Differential protection shall be either high impedance or low impedance type. In case of high impedance type, suitable non linear resistor shall be provided to limit the peak overvoltage.

ii) Transformer differential protection shall have suitable harmonic restraint feature to avoid mal tripping during switching.

iii) For transformer differential protection, necessary correction for ratio error and for transformer primary and secondary vector grouping shall be taken care in the relay itself without additional ICTs. The required relay setting for this shall be programmable.

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iv) Bus differential relay shall have feature for CT supervision and check differential.

v) In case separate hard-wired relay is used for check differential, the status/ event of same shall be communicated through the numerical relay provided for main differential application.

vi) Unless otherwise specified, the differential relays such as transformer differential, feeder differential etc. shall be suitable for cable connection between CTs and relay using 2.5 sq.mm., Cu conductor, PVC insulated, armoured cable. However, for differential protections provided for feeders having long lengths, armoured FO cable may be considered. In cases where FO cable is not suitable, shielded twisted pair cable of conductor size 1.5sqmm copper shall be specifically mentioned by the bidder in the offer for EIL/Owner's acceptance on case to case basis.

5.6 Metering Functions

The metering function shall be provided as required and same shall be built inside the numerical relays.

5.7 Control Functions

5.7.1 The control function shall be built inside the numerical relays. For this purpose relays shall have all graphical PLC/Boolean logic functions such that complete control logic of the feeder along with all necessary interlocks as required can be developed inside the relay.

5.7.2 Relays shall have sufficient integral I/Os to take care of complete feeder logic. External I/O module for implementation of logics is not acceptable.

5.8 Lock Out (86), Trip Circuit Supervision (95), Auxiliary Relays and Timer Functions

5.8.1 Unless otherwise specified the numerical relays shall have built in lock out function. The numerical relays shall have built in trip circuit supervision function, unless otherwise specified.

5.8.2 Auxiliary relays/ Timers function etc. as required for control schematics shall be programmable as a part of numerical relay. The number of such elements as required for schematic shall be considered.

5.8.3 Timer function shall be programmable for both ON/OFF delays.

5.9 Disturbance/ Event Recording and Data Storage

5.9.1 Breaker trip/ close status, relay faults, trip values, event data and disturbance record data shall be stored in the relay in non-erasable memory or memory backed up by lithium battery. Under no circumstances such as withdrawal of power to the relays shall the status, data and events in the memory get erased. Unless otherwise specified, it should be possible to store total 10 seconds of disturbance recording and 200 sequence of event records. Subsequent events shall be overwritten following principle of FIFO.

5.9.2 All disturbances/ events shall be time stamped within the relay.

5.10 Input/ Output Interface, Filters and Galvanic Isolation

5.10.1 Voltage (through PT) input to relay, shall be 110V +/- 10%, unless otherwise specified.

5.10.2 Output relays shall have 4 numbers spare NO contacts; each shall separately be programmable for either hand reset or self- reset.

5.10.3 All I/Os shall have galvanic isolation. Analog inputs shall be protected against switching surges, harmonics etc.

5.11 Relay Communication

5.11.1 All numerical relay shall have RS232/RJ45/USB port on the front for hooking laptop. The rear numerical relays shall have FO Ethernet (IEC 61850 HSR based) communication port for communication with data concentrator/ HMI/ Station bus.

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5.11.2 Communication between relays and IEC61850 HSR Box/switches shall be provided as Redundant communication architecture as per attached architecture.

Each Numerical Relay shall be provided with dual port for ensuring full redundant communication with required number of redundant Ethernet switches, provided in switchboard.

Numerical relays shall communicate using IEC 61850-HSR protocol. For hooking up to Data Concentrator/ HMI/gateway for upper level connectivity, redundant communication link through two switches within the ring. Ethernet switch shall have dual DC power supply.

Ethernet switches shall be suitable for satisfactory operation inside the switchboards taking account of switchboard temperature rise and the site conditions specified. 20% ports in each Ethernet switch shall be kept as spare.

5.11.3 Numerical Relays shall be of latest version, communicable type with non-volatile memory, comprehensive unit providing protection, metering and control.

5.11.4 Laptop shall be of the latest configuration and processor as available at the time of purchase subject to approval by BHEL. The minimum configuration shall be i5 processor, 3GHz, 500GB HDD, Windows 7 or higher OS, DVD writer, colour LCD screen or latest available.

5.11.5 The no. of Digital Inputs (DIs) / Digital Outputs (DOs) in the Numerical Relays shall be sufficient for implementing all necessary logics (see Annexure-2A) and providing signals indicated in I/O Lists (see Annexures-4 & 2B). In view of the possibility of change in breaker logics during detailed engineering, 20% extra DIs/DOs shall be considered in Numerical Relays over what is deemed sufficient to implement the supplied logic diagrams. No price/time implication on account of change in breaker logics or change in NR DIs/DOs during detailed engineering will be entertained. However, minimum 24 DIs and 12 DOs shall be provided for numerical relays envisaged in incomers, bus coupler and outgoing feeders.

5.11.6 All cables and associated accessories required for implementing a functional Ethernet Switch with the prescribed architecture shall be provided by the Vendor.

All cabling required for the interconnection of Numerical Relays with the Ethernet Switches shall be done at the vendor works itself.

6.0 SUBSTATION AUTOMATION SYSTEM

Substation automation system broadly comprises of numerical relays, data concentrator panels (as required), HMI, laptop, printers and their associated software for monitoring of the electrical system.

Following systems are part of Substation Automation System (SAS) in IEC61850HSR

a) GTG Generator
b) STG Generator
c) Grid transformers
d) Generator Transformers
e) Power Transformers
f) Distribution Transformer
g) Customer ECS
h) Interfaced with DCS
i) 66kV GIS
j) 33kV GIS
k) 11kV AIS Switchgear
l) 11kV DG sets
m) 415V PMCCs & MCCs
n) 415V MCC Motor protection relays
o) DC System, UPS, VFDs etc.
p) Solar Panels PCUs,
q) Thyristor panels of Electric heaters
r) Capacitor banks with APFC

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Key Functions for above mentioned equipment shall be from SAS

a) Monitoring of equipments
b) Measurements
c) Control Functions
d) Relay parameterization
e) Annunciations (Alarms/Trip)
f) Disturbance record and analysis
g) Data Logging
h) Monitoring of Hardwired signals
i) Other functions if any as per spec.

6.1 Communication

Communication is the backbone of any substation automation system. It is through this medium, the monitoring of various parameters takes place effectively.

6.1.1 IEC-61850HSR based Communication

i) Ethernet switches shall provide error free communication in harsh substation environment and shall be immune to EMI. The Ethernet switches shall comply to IEC 61850-3 and shall be KEMA approved or equivalent.
ii) For real time deterministic performance, managed Ethernet switch shall be considered in the Ethernet network. The switch shall support following features:
- Full duplex operation
- Priority Queuing
- Virtual LAN (VLAN)
- Rapid Spanning tree
- Multicast filtering
iii) Dedicated Ethernet switches shall be provided for each switchboard. 20% spare ports shall be provided in each Ethernet switch.
iv) Ethernet switch shall have dual DC power supply facility.

v) Communication between relay and HMI shall be provided as follows: Redundant LAN on IEC61850HSR communication protocol as per attached basic architecture. Numerical relays shall be hooked up to Switch/ red HSR box in ring topology and further these switches shall be connected to managed Ethernet in redundant configuration. Further, these switches shall be connected to DC on redundant LAN.
For hooking up to HMI/gateway for upper level connectivity, redundant communication link either from any two switches within the ring shall be further extended and hooked up to two numbers master Ethernet switches dedicated for hooking HMI/gateway/printers/GPS etc. From HMI redundant communication link shall be extended to the master Ethernet switches.

vi) Supply of communication FO cables/copper cables within the relays of switchboard (33kV board) and cables from switch/red boxes to the further connection (upper level) is included in the 33kV GIS vendor scope

6.2 Data Concentrator

6.2.1 Data concentrator shall be supplied to facilitate communication with relays onIEC61850HSR Protocol.
6.2.2 As a minimum data concentrator shall have separate power supply module, CPU module and I/0 module. To achieve redundant architecture, either separate data concentrator shall be considered or data concentrator shall have redundant power supply module and redundant CPU module. The CPU module shall have sufficient communication ports depending on relay LAN requirement.
6.2.3 Data concentrator shall provide gateway to upper level control system 1EC61850 protocol or protocol as specified in the data sheet. The communication to upper level control system shall be redundant as per data sheet/ system architecture.
6.2.4 Data concentrator shall have binary and analog (4 to 20mA) I/0 cards suitable for interface requirement specified in data sheet. Unless otherwise specified, 20% 1/0s shall be considered as spare. Alternatively, a separate Data Acquisition Unit may be supplied for binary and analog interface.

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6.2.5 Data concentrator shall have required number of ports for relay LAN/ star couplers. Number of relay LAN/ star couplers shall be as per project requirement. 20% or minimum 2 Nos. spare ports whichever is maximum shall be provided for future extensions.

6.2.6 Data concentrator shall have required number of RS232/ RS422/RJ45 ports for connection to Laptop PC and substation HMI having operator's work station and engineering station PC.

6.2.7 Data concentrator shall have redundant RS485/ FO/ Ethernet port for communication to substation HMI and upper level ECS-RTU. Hook up to upper level system shall be carried out by extending serial connectivity from each communication ports in two CPU modules.

6.3 Gateway

6.3.1 Gateway for upper level connectivity if separately provided shall have redundancy in power supply module, CPU module. Alternatively, redundant gateways can be provided.

6.3.2 In case of IEC-61850 based communication, if gateway is envisaged, gateway shall have binary and analog (4 to 20mA) I/0 cards suitable for interface requirement specified in datasheet. Unless otherwise specified, 20% 1/0s shall be considered as spare. Alternatively, a separate Data Acquisition Unit may be supplied for binary and analog interface with communicates to ethernet switch on IEC-61850 protocol.

6.4 Human Machine Interface (HMI)

6.4.1 HMI shall have necessary software & hardware & following function, as a minimum shall be possible from HMI:

- Multi-window based display of substation SLDs,
- Continuous polling, feeder status monitoring,
- Alarm Handling
- Daily & monthly data logging
- Relay parameterization
- Event handling, motor starting transients, fault analysis etc.
- Annunciation
- View of historical data and generating trends
- Generating reports
- Preparation of maintenance schedule
- Display of electrical system parameters
- Relay supervision
- Tripping features
- Fault disturbance record of each relay
- Graphic representation and trending of data etc.Human machine interface shall include engineering and operator function. Engineering and operator workstations shall be separate.

6.4.2 The offered system shall comply with standard IEC 60073 Basic and safety principles for human-machine interface, marking and identification. Coding principles for indication devices and actuators.

6.4.3 HMI shall be of industrial grade suitable for continuous operation at design ambient temperature with restricted natural ventilation.

6.4.4 HMI shall be of latest version of industrial grade PC and the same shall be provided with 21" color monitor (TFT flat screen) with non glare glass filters to minimize glare from external lighting.

6.4.5 Operator workstation shall have user friendly software for interactive display of substation data in multiwindow feature. Software shall have capability to display substation single line diagrams, display of electrical system parameters, reports, alarm annunciation, daily and monthly data logging, continuous polling, relay monitoring, relay supervision, fault disturbance record of each relay, graphic representation and trending of data etc. The offered system shall comply with requirements of IEC for basic and safety requirements for Human-machine interface.

6.4.6 Engineering workstation shall have software for engineering, detailed self-diagnostic for maintenance, trouble shooting and changing parameters. Further, it shall also have facility to program and configure numerical relays, data concentrator and other intelligent devices. In addition, engineering workstation shall have all the facilities as provided for operator workstation.

6.4.7 The HMI system shall be provided with color laser jet A3 printer for generating hardcopy of alarm, event and logging report. The printing shall be on demand, unless otherwise agreed. Printer shall be

suitable for connecting HMI, with 32/64MB memory, 8 to 10 ppm printing speed,IEEE-1284 compatible bi-directional parallel port and with resolution of 600x600 dpi or better.

6.4.8 2 nos. laptop shall be provided. The laptop shall include all functionalities as specified for HMI system and the same shall be provided with required licensed software, hardware, accessories and material. System configuration shall be latest proven model and upgradable.

6.4.9 HMI system shall be provided with all associated furniture for PC, printer table, chairs etc.

6.4.10 Dedicated UPS (2x100%) with UPS Rack trolley for above systems. UPS shall be powered up with 240V, 1phase,50Hz AC power supply. UPS shall have back up time of ½ hour & of reputed make. UPS shall have 20% extra capacity above total load requirement of data concentrator, HMI & GPS equipment.

6.5 Time Synchronization

6.5.1 All internal clocks of numerical relay, data concentrator, SOE modules, HMI etc. shall always work in synchronism such that there is one and only one system-wide time. GPS shall be considered to synchronize with an external satellite clock. The time synchronization accuracy shall be ± 1.0 msec or better.

6.5.2 The GPS system shall consist of GPS antenna, lightning arrestor, GPS receiver/server and associated cables.

6.5.3 The time synchronization shall be carried out either through communication over substation relay LAN or by considering dedicated time synchronization channel. In case of synchronization through relay LAN, the communication protocol shall support to carry time synchronization message to the relays/data concentrator/HMI and maintain the desired accuracy. In case of time synchronization through dedicated time synchronization channel, relays, data concentrator and HMI shall be provided with IRIG- B port and the same shall be directly hooked up to GPS receiver.

6.5.4 In Ethernet based communication network, GPS receiver shall be directly hooked up to Ethernet LAN and all internal clocks of HMI and numerical relays shall be updated using SNTP protocol.

7.0 TESTING AND ACCEPTANCE :

7.1 Numerical Relays shall have been type tested as per relevant Indian/ international standards. Type tests shall include as minimum but not be limited to the following:

- Temperature withstand
- Disturbance immunity
- Electromagnetic compatibility (EMC)
- HV withstands test for insulation
- Impulse voltage test
- Functional tests and Communication integrity
- Relay characteristics verification
- Degree of protection
- Mechanical stress/ vibration test

7.2 During assembly, owner/BHEL or his authorized representative shall be permitted to assess the progress of work as well as to ascertain quality raw materials are used for the same. All assistance as required during inspection shall be given to inspector.

7.3 Final acceptance tests shall be carried out at manufacturer/ assembler's works under his care and expense. Manufacturer shall also arrange instruments and equipment as required for testing. Owner's/BHEL's representative shall be given minimum 2 weeks prior notice for witnessing the tests. Manufacturer shall furnish test certificates indicating test results. Acceptance tests shall include visual checks, insulation checks, heat run tests and functional tests as a minimum or as per the manufacturer's quality plan.

7.4 In case of fully assembled and tested relays sourced from abroad, manufacturer shall furnish type, routine and acceptance test certificates along with the supply of numerical relays for owner's/BHEL's perusal.

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8.0 PACKING AND DESPATCH

The equipment shall be properly packed for transportation by ship/rail or trailer. All equipments shall be wrapped in polyethylene sheets before being placed in wooden crates/ cases with fillers to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as `Fragile', `This side up', `centre of gravity', `weight', `Owner's particulars', PO nos.' etc. shall be clearly marked on the package together with other details as per purchase order.

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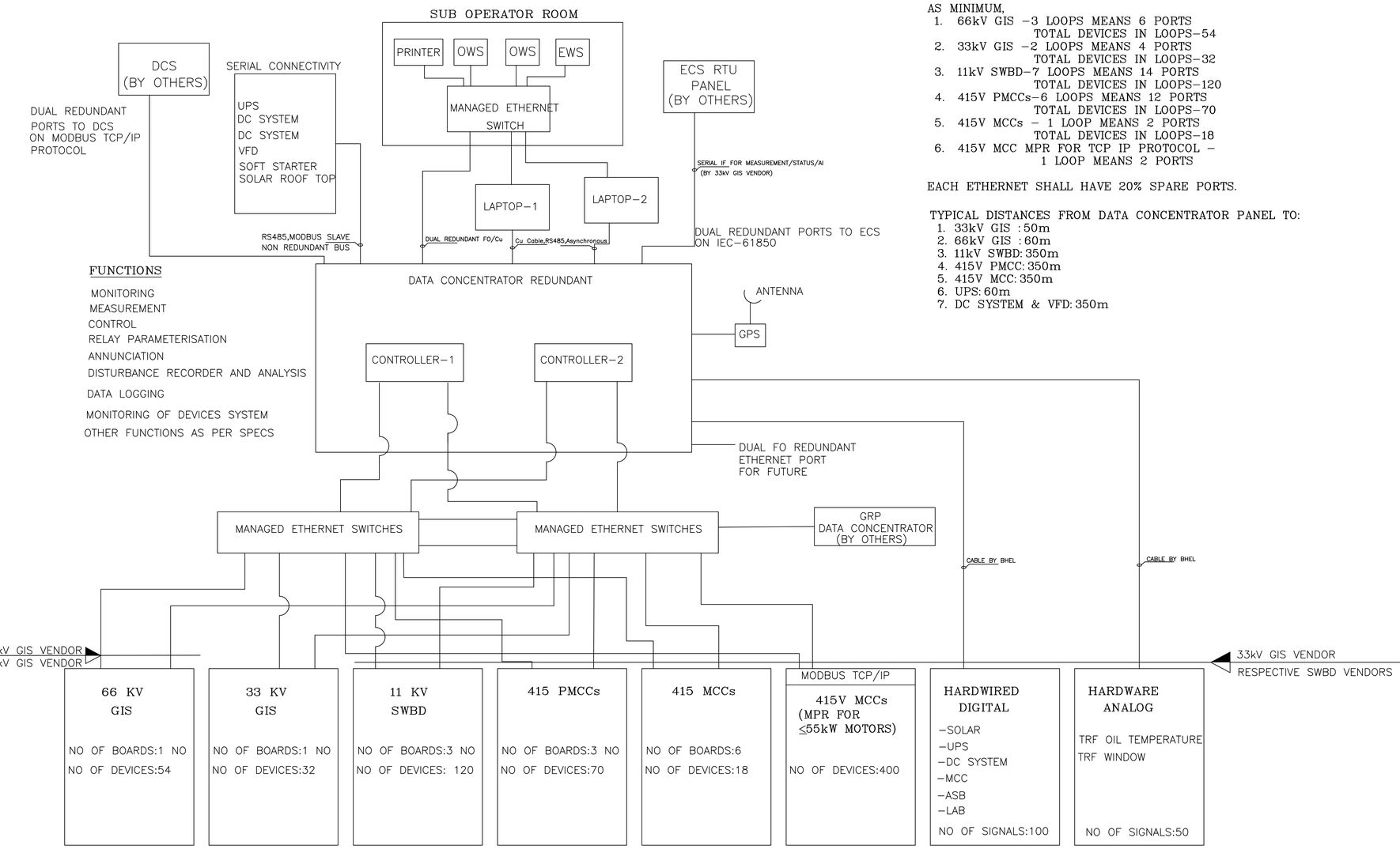
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

ESP-001-11A

DRG. NO. | SH. OF

SUBSTATION AUTOMATION SYSTEM (SAS) ARCHITECTURE



FUNCTIONS

- MONITORING
- MEASUREMENT
- CONTROL
- RELAY PARAMETERISATION
- ANNUNCIATION
- DISTURBANCE RECORDER AND ANALYSIS
- DATA LOGGING
- MONITORING OF DEVICES SYSTEM
- OTHER FUNCTIONS AS PER SPECS

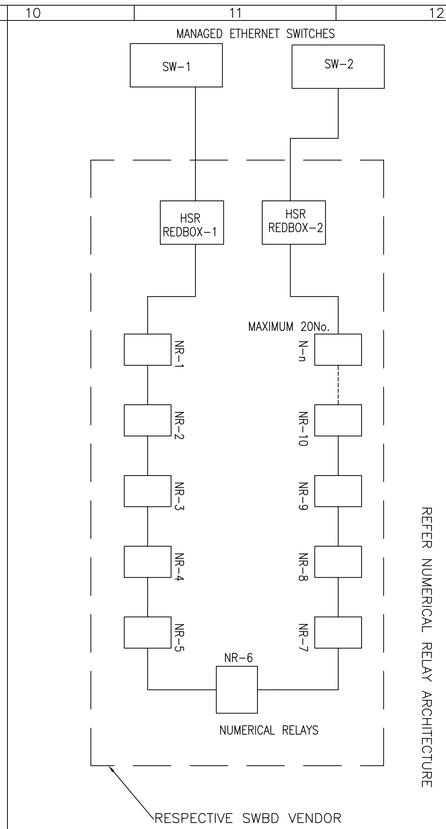
FOLLOWING NO.OF LOOPS CONNECTED TO MANAGED ETHERNET SWITCHES AS MINIMUM,

1. 66kV GIS -3 LOOPS MEANS 6 PORTS
   TOTAL DEVICES IN LOOPS-54
2. 33kV GIS -2 LOOPS MEANS 4 PORTS
   TOTAL DEVICES IN LOOPS-32
3. 11kV SWBD-7 LOOPS MEANS 14 PORTS
   TOTAL DEVICES IN LOOPS-120
4. 415V PMCCs-6 LOOPS MEANS 12 PORTS
   TOTAL DEVICES IN LOOPS-70
5. 415V MCCs - 1 LOOP MEANS 2 PORTS
   TOTAL DEVICES IN LOOPS-18
6. 415V MCC MPR FOR TCP IP PROTOCOL -
   1 LOOP MEANS 2 PORTS

EACH ETHERNET SHALL HAVE 20% SPARE PORTS.

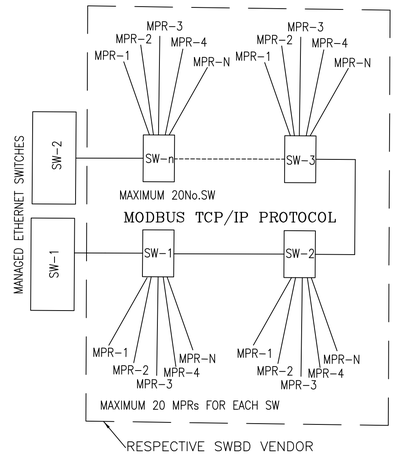
TYPICAL DISTANCES FROM DATA CONCENTRATOR PANEL TO:

1. 33kV GIS : 50m
2. 66kV GIS : 60m
3. 11kV SWBD: 350m
4. 415V PMCC: 350m
5. 415V MCC: 350m
6. UPS: 60m
7. DC SYSTEM & VFD: 350m



REFER NUMERICAL RELAY ARCHITECTURE

MOTOR PROTECTION RELAYS (<55kW MOTORS) INTERNAL ARCHITECTURE BY MODBUS TCP/IP PROTOCOL



NOTES: -

1. COMPLETE DESIGN, ENGINEERING AND SUPPLY OF SUBSTATION AUTOMATION SYSTEM INCLUDING NETWORK CABLES (FO/Cu) IS IN THE SCOPE OF 33KV GIS VENDOR. IT IS RESPONSIBILITY OF SAS VENDOR FOR INTEGRATION WITH OTHER VENDORS SWITCHGEAR RELAYS/SWITCHES/RED BOX.
2. SYSTEM ARCHITECTURE DEFINES BASIC REQUIREMENT OF NUMERICAL RELAYS AND OTHER EQUIPMENT INTEGRATION WITH DATA CONCENTRATOR, HMI, ELECTRICAL CONTROL SYSTEM (ECS) AS A PART OF SUBSTATION AUTOMATION. DETAILED ARCHITECTURE SHALL BE DEVELOPED BY VENDOR OR THEIR SELECTED MANUFACTURER TO MEET IEC 61850 HSR PROTOCOL SHALL BE DONE BY VENDOR. VENDOR SHALL FURNISH THE DETAILED ARCHITECTURE DRAWING GIVING EXPLICIT DETAIL OF PROTOCOL, REDUNDANCY, AND TOPOLOGY DURING DETAILED ENGINEERING FOR REVIEW AND APPROVAL.
3. MORE THAN 20 DEVICES IN A HSR LOOP CAN BE ALLOWED WITHOUT EFFECTING NETWORK SPEED, RELIABILITY AND PERFORMANCE. THIS SHALL BE MUTUALLY DISCUSSED WITH CUSTOMER AND AGREED UPON WITHOUT ANY IMPLICATION. FURTHER, SAS SYSTEM SHALL BE ENGINEERED SUCH THAT ANY BOARD CAN BE TAKEN OUT FOR MAINTENANCE OR REMOVED WITHOUT AFFECTING COMMUNICATION WITH OTHER BOARDS.
4. EACH NUMERICAL RELAY SHALL HAVE SUFFICIENT HARDWIRED DI/DO TO ENGINEER SOFT CONTROL LOGIC AS A PART OF RELAY. HARDWIRED INTERLOCKS SHOULD BE MINIMIZED.
5. PROTOCOL SHALL BE IEC 61850HSR PROVIDING ALL FUNCTIONALITY SUCH AS PROTECTION, CONTROL, RELAY PARAMETERIZATION, TIME SYNCHRONIZATION, DOWN LOADING DISTURBANCE RECORD ETC.
6. DEVICES AS SHOWN SHOULD HAVE PROVISION FOR LAPTOP CONNECTIVITY.
7. DATA CONCENTRATOR SHALL HAVE HARD DISK FOR STORING DAILY LOG, DISTURBANCE RECORD ETC. SO THAT THESE DATA SHOULD BE AVAILABLE TO DOWNLOAD ON LAPTOP DURING OUTAGES OF HMI.
8. LAPTOP ALONG WITH PROGRAMMING AND APPLICATION SOFTWARE SHALL BE SUPPLIED AS REQUIRED WITH LICENSE.
9. GPS AND ANTENNA SHOULD BE PROVIDED IN EACH SUBSTATION FOR TIME SYNCHRONIZATION WITH RESOLUTION OF +/- 0.1 MSEC.
10. THE SUPPLIED ARCHITECTURE SHOULD, IN ADDITION TO THIS ARCHITECTURE, MEET THE REQUIREMENT OF NUMERICAL RELAY DATA SHEET, DATA CONCENTRATOR DATA SHEET AND NUMERICAL RELAY SPECIFICATION ATTACHED WITH THE BID DOCUMENT.
11. THE NETWORK CABLES WHICH ARE GOING OUT OF SWGR/HSR BOX /SW SHALL BE FO CABLE. NETWORK CABLES WITHIN THE SWGR LOOPING CAN BE FO/CAT6.

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GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY023026

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

PROJECT: CAPTIVE POWER PLANT (CPP) PACKAGE
VISAKH REFINERY MODERNIZATION PROJECT (VRMP)
JOB NO. B016

OWNER: HINDUSTAN PETROLEUM CORPORATION LIMITED

PMC: ENGINEERS INDIA LIMITED (EIL), NEW DELHI

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	GRM/AVS		12.05.18	
CHD.	P.SURESH		12.05.18	
APPD.	J.K.PATTANAIK		12.05.18	

DEPT.	UNTOL. DIMS.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD CODE. 450	GR. ~~C/M/F~~				-N.A.-	-N.A.-	-N.A.-

TITLE: SAS ARCHITECTURE

CARD CODE: N.A.

BHEL DRG NO. PY-FB-1-M104-8801-01

CUST DRG NO.

SHT. No | NO. OF SHT.

REV. 00

ESP-001-11A

Project Project Management Consultancy (PMC) Services for execution of VRMP **Client** HPCL

Unit CAPTIVE POWER PLANT (CPP) **Location** VIZAG **Job No.** B016 **Unit No.** 606

PURCHASER'S DATA

A.	Site Conditions		
1.	Maximum Ambient Temperature	°C	45
2.	Minimum Ambient Temperature	°C	12.5
3.	Design Ambient Temperature	°C	45
4.	Relative Humidity	%	95
5.	Altitude Above MSL	m	< 5.56
6.	Environment		Humid & highly corrosive
B.	RELAY SELECTION		
1.	RELAY FUNCTION		
a	Only Protection		☐
b	Protection and metering		☐
c	Protection and metering and control		☑
d	Ethernet communication		☑
e	Password protection		
	a. For write		☐
	b. For both read and write		☑
2	CONTRUCTION FEATURE		
a	Enclosure type		IP5X
b	Terminal size-sqmm for external wires		2.5 for control, 4 for CT/PT
c	Mounting		flush
d	Drawout feature		as per 6-51-0055
e	Display type		Alpha Numeric LCD + LED indication
3	SPECIAL REQUIREMENT IF ANY		
a	Applicable standards		IEC
b	Distance for cable capacitance for application where field		
	contacts are directly wired to relay e.g. Motor start/ stop, intertrip	m	1000
4	INPUT POWER SUPPLY		
a	Site selectable feature		☑
b	Input supply	V	110 DC
5	CT/ PT INPUT TO RELAY		
a	Current operated relays		☐
	a1 Main CT input		
	a2 CT for sensitive EF or back up EF		
b	Voltage operated relays		☐
	b1 PT input		
c	Comprehensive relay		☑
	c1 Main CT input		3 CTs, 4 wire
	c2 PT input		3 Phase, 4 Wire
	c3 CT for sensitive EF or back up EF		1 CT, 2 wire input (Yes for I/C & TR fdr)
d	CT Secondary current		1
C	RELAY PROTECTION/ METERING FUNCTIONS		
1	CURRENT OPERATED RELAYS		
a	3 phase O/C element (50, 51)		* I> ☑ * I>> ☑ * I>>> ☑
	Characteristics as per IEC		
	* Inverse (normal, very, extremely, long) and definite time for I > and I >>		

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Unit	CAPTIVE POWER PLANT (CPP)	Location	VIZAG
Job No.	B016	Unit No.	606

	* Definite time for I >>>	
b	E/F relay (50N, 51N, 51G)	* I> ☑ * I>> ☑ * I>>> ☑
	Characteristics as per IEC	
	* Inverse (normal, very, extremely, long) and definite time for IO >, IO >>	
	* Definite time for IO>>>	
c	Metering/ event recording	
	3 phase/ line currents	☑
	Disturbance record	☑
	Breaker trip/ close status	☑
	Relay faults	☑
	Trip Values	☑
2	**VOLTAGE OPERATED RELAYS**	
a	3 phase O/V element with time delay (59+2)	* OV> ☑ * OV>> ☑
b	3 phase U/V element with time delay (27+2)	* UV> ☑ * UV>> ☑
	Characteristics as per IEC	
	* Inverse (normal, very, extremely, long) and definite time for UV> ,UV>>	
c	Under/ Over Frequency element with time delay (81U/ 81O)	
	Settable under voltage restraint	☐
	df/dt element	☐
	Number of stages with u/f	
	Number of stages with df/dt	
d	Synchrocheck function	☑
e	Metering/ event recording	
	3 phase/ line Voltages	☑
	Disturbance record	☑
	Breaker trip/ close status	☑
	Relay faults	☑
	Trip Values	☑
3	**MOTOR PROTECTION RELAY**	
a	Protection elements	
	Thermal overload (49)	☑
	OC protection with doubling feature (50)	☑
	EF protection (50N)	☑
	Locked Rotor protection	☑
	Maximum start time	☑
	Maximum number of starts	☑
	Negative phase sequence	☑
	Under voltage delayed trip	☑
	EF Through CBCT	☐
	Single phasing	☑
b	Metering/ events	
	3 phase/ line current	☑
	Hour run	☑
	KW, KWH, pf	☑
	Disturbance record	☑
	Plot start characteristic	☑

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	Trip values	☑
	Start time	☑
	Start current	☑
c	Control	
	Breaker close in test mode	☑
	Reacceleartion logic	☑
	Breaker trip	☑
	RTD/BTD input	☑
4	**COMPREHENSIVE NUMERICAL RELAY**	
a	Current op elements (51, 50, 51N, 50N, 51G)	
b	Voltage op elements (59, 27, 2, 81U, 81O)	
c	Control function	
	Breaker close/ trip from relay	
	Breaker close/ trip on serial	
	PLC logic function for control scheme	
	Digital I/P & Digital O/P:	
	Motor Feeder control function	
5	**SPECIAL PROTECTION RELAYS (Refer Job Spec)**	
	Part of main relay	☐
	Separate relay	☑
a	Differential relays	☑
	BUS	Applicable
	Feeder	Required
	Trafo	as per Engineering Desgn Basis
	Machine	as per Engineering Design Basis
b	Directional relays (67, 67N)	☑
c	Restricted EF (64R)	☑
d	Generator protection	☑
e	Distance protection	☑
f	Reverse power relay	☑
6	**OTHER RELAY FEATURES**	
a	Analog inputs 4-20mA	
	RTD/ BTD-GPR	Required
	WTI/ OTI-Trafo relay	Required
	WTI= Winding temperature indicator	
	OTI= Oil temperature indicator	
b	Out put relays	
	Number of relays	As per 6-51-055
	Contact rating	
	Reset	
	FUNCTIONS part of numerical relay	
c	Lock out function (86)	☑
d	Trip circuit supervision(95)	☑
e	Watch dog	☑
f.	Time stamp	☑
g	Modular construction for easy and quick replacement of faulty PCB/circuit	☑
D	**ETHERNET COMMUNICATION AND RELAY INTEGRATION**	

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Unit	CAPTIVE POWER PLANT (CPP)	Location VIZAG	Job No.	B016	Unit No. 606

1	**RELAY INTEGRATION**	
a	Communication ports at Relay	
	Relay front	RS 232/ RJ45/USB
	Relay back	RJ45/FO
b	Protocol of relay LAN	~~IEC 61850~~ IEC-61850-HSR
c	Requirment of Integration	
	Integraton with DC	☑
	Directly to MMI	☐
d	Topology	~~as per 6-51-0055~~ IEC-61850-HSR
e	Data concentrators	YES
2	**REDUNDANCY**	
a	Relay LAN / serial	☑
	Redundant (serial)	☑
	Non redundant (star)	☑
b.	From DC to MMI	☑
	Redundant	☑
	Non redundant	☐
c	From DC to ECS-RTU	☑
	Redundant	☑
	Non redundant	☐
3	**REDUNDANCY REQUIREMENT FOR DC/ETHERNET SWITCH/MMI**	
a	Ports at STAR coupler	
	For each relay	Applicable
	For DC/Ethernet Switch	Applicable
b	Data concentrator / Ethernet Switch	
	Power supply card	Applicable
	Communication port for each relay LAN	Applicable
	Communication Processor	Dual redundant
4	**SERIAL COMMUNICATION FROM DC/ETHERNWT SWITCH ONWARDS**	
a	DC/Ethernet Switch to MMI	
	Topology	as per 6-51-0055
	Protocol	IEC 61850
b	DC to DCS	YES
c	DC/Ethernet Switch to ECS-RTU	YES
d	Scan time	as per 6-51-0055
5	**OTHER REQUIREMENT**	
a	Time synchronization	☑
b	Remote relay parameterization	☑
c	Annunciation at MMI	☑

MANUFACTURER'S DATA

1. NUMERICAL RELAY TYPES

	Relay Make/Model	Serial Ports	Analouge Inputs	No of DI/DO	Protocal	Any Other Data	Remarks
A	Incomer						
B	Buscoupler						

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Unit No.	606				

C	Generator						
D	Transformer						

2	DATA CONCENTRATOR / ETHERNET SWITCH AND RELAY INTEGRATION	
a	Model no.	
	Make	
b	Input power supply	
	Voltage	
	Power reqt	
c	Redundancy	
	Power supply	
	Communication processor	
	Communication port	
	Relay LAN/ Serial communication	
	ECS-RTU interface	
	MMI interface	
d	Serial interface/ Relay LAN	
	Topology	
	Protocol	
	Nos of relay in each	
	Topology	
	Type of port	
	Cable type	
e	Serial interface- MMI	
	Topology	
	Protocol	
	Type of Port	
	Cable type	
f	Serial Interface -ECS-RTU	
	Topology	
	Protocol	
	Type of Port	
	Cable type	
g	Number of Digital Input/ Aanalog Input (4-20mA)	
	DI for substation eqpt	
	Spare DI	
	AI as per project data sht	
	Spare AI	
h	Maximum Scan Time	
	Status	

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	events	
	Data acqusition (analog)	
	Disturbance record download time	
i	Other features	
	Spare capacity for additional devices for relay LAN	
	Time synchronization options	
	Power walk in time	
	Restoration time of communication of DC with NR & MMI	
3	**STANDARD FEATURES OF RELAY / SYSTEM ARCHITECTURE**	

Notes

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