

	BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION PROJECTS ENGINEERING MANAGEMENT										
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SECTION I

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, engg, manufacturing and assembly , supply, testing at manufacturer's works, packing and dispatch of complete control & relay panels and Substation Automation system as per this specification for 400/220/132 kV GIS substation at shamli (UP) complete with accessories as listed in BOQ below. Testing and Commissioning of all SAS equipments including Protective relays shall be done by the OEM Engineer along with on-site local training to Customer's engineers as specified in respective **SECTION-2**.

The fitments offered shall be of UPPTCL approved make or its subsequent approval from UPPTCL shall be bidder's responsibility, with no commercial or delivery implications to BHEL. If any of the make offered by the bidder is not acceptable to M/s UPPTCL, the bidder has to supply alternate UPPTCL approved make, meeting the specification, with no commercial or delivery implications to BHEL.

All auxiliary relays, timers, counters, aux CTs, switches etc required for completeness of the scheme & good engineering are deemed to be included in the offer and no claim whatsoever shall be entertained at contract stage.

In case of any conflict between the technical details mentioned in this section and the remaining sections of this document, then Section-1 and Section-2 shall prevail and is to be considered as binding requirement.

The specification comprises of following sections:

- Section-1: Scope, Specific Technical Requirements and Quantities
- Section-2: Equipment Specification
- Section-3: Project Details & General Specification
- Section-4: GTP
- Section-5: Enclosures to Technical Specification

1.1 The equipment is required for the following Project.

Name of Costumer : Uttar Pradesh Power Transmission Corporation Limited

Name of the Project : 400/220/132 kV GIS substation at UPPTCL Shamli(UP)

Refer Section - 3 for Project Details and General Specifications.

2.0 SPECIFIC TECHNICAL PARTICULARS

2.1 400/220/132kV GIS S/s:

- I) Engineering, design, Testing, commissioning of substation automation system including hardware and software for the bays (bay as per attached SLD). The SAS shall be based on a **decentralized architecture** and on a concept of bay oriented, distributed intelligence.
- II) The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from remote control centre (RCC) as well as from local control centre. The Bay Control and Protection IEDs shall communicate on the **IEC61850** standard for Communication Networks and shall comply with the
- **IEC61850-5** for communication data modeling,
 - **IEC61850-6** for Sub-station Configuration Description Language for communication & **IEC61850-7-1 to 7-4** for Data Model and Services
- III) Gateway for remote control via industrial grade hardware (to RCC) through **IEC60870-5-101/IEC 61850** protocol.
- Gateway for State Load Dispatch Centre (to SLDC), the gateway should be able to communicate with SLDC on IEC 60870-5-101 & 104 protocol. The specific protocol to be implemented shall be handed over to successful bidder. It shall be the bidder's responsibility to integrate his offered system with existing SLDC system for exchange of desired data. The exact I/O point shall be decided during detailed engineering.
- IV) Complete relay and protection system as defined (Control and Relay panels) under present scope. Integrated Switches (built in bay IEDs) are not acceptable. All the IEDs shall be directly connected to Ethernet Interbay LAN without use of any gateways. The use of Ethernet Hubs shall not be permitted. The bidder shall ensure that proposed automation system is compatible with the existing SCADA network. The bidder will quote for the equipment required for data transfer to the existing SCADA network, including SCADA equipment for which PLCC/ optic fiber shall be used for communication with SLDC and the other adjoining stations.
- V) The **CSD** for 400kV bays (402,406,408) provided (i.e. for ICT & Bus reactor). CSD's are being procured separately. Details of CSD (make and scheme) shall be given to the successful bidder during detailed engineering.
- The controller shall be mounted on the respective relay panel in Switchyard Panel room. Necessary space shall be considered on the panel. The actual dimension of the controller shall be furnished to successful bidder during detailed engineering.
- VI) The general concept is to have two fast operating distance protection scheme preferably with two different operating principles. The Main-I and Main-II will generally be operated from signal from different cores of line VT. In case line VT is out due to any reason manual selection for Bus VT will be made. Two main protections Main-I and Main-II having equal performance requirement specially in respect of time as called Main-I and Main-II for 400KV and 220KV transmission lines and Main and back up protection for 132KV transmission lines. In case of 400KV and 220KV XLPE cables Distance protection will be used as Main-I whereas the current differential protection will be used as Main-II protection. In case of

132KV XLPE cables current differential protection will be used as Main protection. The general concept is to have distance protection for 33kV line feeder as main protection.

- VII) The bidder shall confirm that the instruments, recorders along with transducers and energy meters offered by them are suitable for connecting to the instrument transformers having the technical particulars given in the associated schedule of details of instrument transformers. Energy meters shall be static type conforming to **IEC: 60687-2000** with latest amendments and suitable for inter utility EHV bi-directional power flow and for CT/VT connection.
separate panel has to be considered dedicated for energy meters.

- VIII) **400kV and 220 kV Autotransformers** are being provided with digital RTCC (Applicable for Auto-transformer) ,optical temperature sensors, insulating oil drying system & online DissolvedGas Analyzer (DGA) – multi gas. These equipment's are IEC 61850 compliant & required to be integrated with Substation AutomationSystem (SAS). Above equipment is being supplied in a separate package (not in bidders scope), shall be connected to managed Ethernet switch (not in bidders scope) compliant to IEC61850. This Ethernet switch shall be mounted in Common Marshalling Box (CMB) of the Transformer/Reactor. However, to connect this Ethernet switch to Bay Ethernet switch (mounted in relay panel), all accessories and Optical fiber cable from CMB to relay room shall be **in the scope of Bidder**. The signals from Optical sensors measuring unit and online DGA for transformer/reactor are as follows.-

- a) Temperature of optical sensors (16 probes for transformer)
- b) H₂, CH₄, C₂H₆, C₂H₄, C₂H₂, CO, CO₂, O₂, and H₂O gas content
- c) Alarm, watchdog from both the equipment

Approx. distance between CMB and Switchyard panel room is 650m.

The Actual requirement of FO/Twisted cable for integration of Online DGA , Oil drying system, RTCC etc shall be finalized during detailed engineering.

The cable mentioned in BOQ is tentative. **The FO cable supply is in scope of bidder** as per actual site requirement.

- IX) **400kV Class Line and Bus reactors** are being provided with digital optical temperature sensors, insulating oil drying system & online Dissolved Gas Analyzer (DGA) – multi gas. These equipment's are IEC 61850 compliant & required to be integrated with Substation Automation System (SAS). Above equipment is being supplied in a separate package (not in bidders scope) , shall be connected to managed Ethernet switch (not in bidders scope) compliant to IEC61850. This Ethernet switch shall be mounted in Common Marshalling Box (CMB) of the Transformer/Reactor. However, to connect this Ethernet switch to Bay Ethernet switch (mounted in relay panel), all accessories and Optical fiber cable from CMB to relay room shall be **in the scope of Bidder**.

The signals from Optical sensors measuring unit and online DGA for transformer/reactor are as follows.-

- a) Temperature of optical sensors (8 probes for reactor)
- b) H₂, CH₄, C₂H₆, C₂H₄, C₂H₂, CO, CO₂, O₂, and H₂O gas content
- c) Alarm, watchdog from both the equipment

Approx. distance between CMB and Switchyard panel room is 500m.

The Actual requirement of FO/Twisted cable for integration of Online DGA , Oil drying system, RTCC etc shall be finalised during detailed engineering.

The cable mentioned in BOQ is tentative. **The FO cable supply is in scope of bidder** as per actual site requirement

X) Integration of IEC61850 communication based monitoring equipments like Online dissolved Gas analyzer, Insulating Oil drying system, Optical temperature sensor, Digital RTCC for 400kV, 3-ph Shunt Reactor unit with substation automation system is included in the present scope. Further the integration of IEC61850 communication based monitoring equipments like Online dissolved Gas analyzer, Insulating Oil drying system, Digital Optical temperature sensor provided with substation automation system is also included in the present scope.

XI) Control & Relay panels along with PLCC panels shall be placed inside kiosk panel room.

XII) Kindly refer corrigendum (Annexure-B attached) and follow the points which is applicable for CRP.

3.0 TECHNICAL QUALIFYING REQUIREMENT:

The Substation Automation System shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system which must be in satisfactory operation on **400kV** system or higher for at least **2 (two) years** as on the date of bid opening (**07-09-2018**). KEMA certificate/ equivalent certificate from development centre authorized by UCA working group for having products including all IEDs and Ethernet switches conforming to IEC 61850 must be furnished.

Please Note: Bidder shall provide all necessary documentary proof against the above requirements along with their offer. The qualification of the bidder shall be assessed based on the documentary proof attached in their offer. No further communication in this regard is envisaged.

General Notes :

- a) If any additional item/service other than that specified in the BOQ above, is required to meet technical specification requirement the same shall be clearly indicated in the offer. Otherwise the same shall be deemed to be included in the offer and no additional price implication will be entertained at later stages for the same.
- b) Itemized price for the breakup of Substation Automation System to be submitted when required by TBMM.
- c) BCUs shall be offered as part of respective protection panel.
- d) Bidder shall estimate the actual requirement of FO cable during contract stage any additional quantity required in this regard for completion of SAS, Bus- Bar system shall be supplied by successful bidder free of cost.
- e) During detailed engineering if any of the item supplied by bidder is found not meeting the technical specification requirement, the item shall be replaced without any price implication and the technical requirement shall be met.
- f) Any site visit if required for collecting the inputs shall also be in scope of bidder.
- g) Refer section-2 and Single Line Diagram & Key Protection and Metering SLD enclosed with section-5(The key protection and metering Single Line Diagram is for tender purpose only)

4.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

The equipment supplied shall be type tested as per type tests specified in Section II.

The type testing requirements shall be in line with Section II of this technical specification.

5.0 DEVIATIONS :

The bidder shall fill nil deviation sheet.the offers should be complied with TS

6.0 MANUFACTURING QUALITY PLAN:

Bidder has to follow UPPTCL approved Manufacturing Quality Plan, SAT /FAT procedure at contract stage (as per section-II).

7.0 DRAWINGS and SCHEME

The documentation requirements detailed under Section-III shall be submitted to BHEL at various stages of contract. Softcopy of the drawings and schemes are to be submitted at contract stage. Preparation of AS- BUILT drawings is also in the scope of the bidder.

8.0 TRAINING:

**The bidder shall impart training to employer's personal as mentioned in section-2.
The charges for tutorials & other training materials for the trainees shall be included in the prices quoted by bidder. No price implication shall be entertained at later stage.**

Refer clause no 10.0 (SAS) in section-2

9.0 DOCUMENTS REQUIRED WITH OFFER

- a) Clause-wise confirmation/ comments.
- b) Bill of Material.
- c) Un-priced schedule as per BOQ.
- d) Catalogue and Technical Leaflets for the offered Equipments
- e) Documentary proof against qualifying requirement.

10) BILL OF QUANTITY: kindly Refer below table-

Main Quantitiy

S.N	Discription	Unit	Quantity
	Sub-Station Automation System and relay & Protection Panels		
1	400kV Relay and Protection Panels (With Automation)		
a.	Circuit Breaker Relay Panel with Auto Reclose	Nos.	4
b.	Circuit Breaker Relay Panel without Auto Reclose	Nos.	4
c	Line Protection Panel	Nos.	4
d	Transformer Protection panel (for both HV & MV side)	Nos.	2
e	Reactor Protection Panel	No.	3
f	Bus Coupler Protection panel	No.	1
g.	Bus Bar Protection Panel (Duplicate Bus Bar Protection)	Set	1
2	220kV Relay and Protection Panels (With Automation)		
a.	Circuit Breaker Relay Panel with Auto Reclose	Nos.	6
b.	Circuit Breaker Relay Panel without Auto Reclose	Nos.	5
c	Line Protection Panel	Nos.	6
d	Transformer Protection panel (for both HV & MV side)	Nos.	4
e	Bus Coupler Protection panel	Nos.	1
f	Bus Bar Protection Panel (Single Bus Bar Protection)	Nos.	1
3	132kV Relay and Protection Panels (With Automation)		
a.	Circuit Breaker Relay Panel with Auto Reclose	Nos.	9
b	Circuit Breaker Relay Panel without Auto Reclose	Nos.	3
c	Line Protection Panel	Nos.	9
d	Bus Coupler Protection panel	No.	2
e	Bus Bar Protection Panel (Single Bus Bar Protection)	No.	1

			1
4	Common equipments Pertaining to C & R System		
a	Common Equipments (Voltage & Frequency recorder, Digital Voltage and Frequency meters)	Set	1
b	Universal RelayTest Kit 6x35A @ 450VA each (King Sine make)	No.	1
c	Time Synchronization equipment	Nos.	2
5	Substation Automation System & SCADA		
a	Complete Substation Automation System including hardware and software for the substation & remote control stations alongwith Optic Fibre Cable and other interface/ converter equipments for 400KV, 220KV, 132KV bays and for Auxiliary system as per technical specification.	Set	1
b	Testing & Maintenance equipment	Set	1
c	Inverter of suitable capacity for station HMI and peripheral devices i.e. printer etc. (3 kVA or higher as per power requirement)	Set	1
d	Armoured fibre optic cable	KM	6
6	Energy Meters and CMRI		
a	Microprocessor based three phase four wire 0.2s accuracy class Panel mounted static electronic trivector ABT Energy Meters, as per technical specification(4nos. Main Meters & 4nos. Check Meters)	Set	2
b	Common Meter Reading Instrument (CMRI), as per technical specification.	Nos.	2

S.N	Discription	Unit	Quantity
7	Services for S/s: Supervision of Testing and Commissioning of protection relays , Busbar system & Substation automation system at site. Scope shall be as follows : a) Testing & commissioning of main protection relays and Numerical Busbar protection including Relay parameterization and configuration. b) Testing & commissioning of SAS system including termination of network/optical cables (complete with all end connectors, tees etc as required). c) For network/optical cables which are in the bidder's scope of supply, its laying shall be in BHEL scope. However, Optical cable will be laid under bidder's supervision. Splicing and termination shall be in bidder's scope. d) Site acceptance Tests(SAT), Availability Test as per Section II. e) Arranging all necessary tools, tackles and equipment for protection and communication testing including automatic relay test kit shall be bidder's responsibility. f) Maintenance services as per Section II . g) Site visits for collection of inputs for SAS & Busbar System. h) Sketch showing routing of F.O Cable & GI Conduit Pipe giving BOQ (as per Section I) i) Relay Setting Calculation , Application checks. j) Documentation as per Section –II. k) Incorporation of complete primary equipment interface in the CRP Schemes submitted by bidder. l) Integration with RSCC and NTAMC,SLDC , as applicable. m) Integration of Disturbance recorder, Event logger , Bus-bar protection (as applicable)	LOT	31

<u>Mandatory spares</u>			
<u>sl.n.</u>	<u>discription</u>	<u>unit</u>	<u>quantity</u>
A	Relay and Protection Panels		
A.1	Breaker Relay Panel		
a)	Breaker failure Relay (numerical type), LBB	No.	1
b)	Trip/Close Circuit Supervision Relay	Nos.	2
c)	Self reset trip relay of each type	No.	1
d)	Auto Reclose relay with check synchronizing relay and dead line charging relay	No.	1
e)	Timer relay of each type	No.	1
f)	DC Supervision relays	No.	1
g)	Hand reset Trip Relay of each type	No.	1
h)	Flag relays of each type	No.	1
i)	Auxiliary relays of each type	No.	1
A.2	Line Protection Panel		
a)	Main-1 Numerical distance relay (excluding external trip relays) with software and cable for front panel communication to PC	Set	1
b)	Main-2 Numerical distance relay (excluding external trip relays) with software and cable for front panel communication to PC	Set	1
A.3	Transformer Protection Panel		
a)	Transformer differential protection relay, associated software and cable for front panel communication to PC (in case of numerical relay)	No.	1
b)	Restricted Earth Fault protection relay with non linear resistor and associated software in case of numerical relay	No.	1
c)	Back up protection relay with 3 O/C and E/F element and associated software in case of numerical relay	Set	1
d)	Over fluxing relay	Set	1
e)	Over load relay with timer	Set	1
A.4	Common Spares		
a)	Power supply module for Bus Bar Protection	Set	1
b)	Metrosil (Non Linear resistor) each type	Set	1
c)	Inter-posing CTs & PTs each type	Set	1

B.	Substation Automation system		
1	Hard disk of each type used in Master station, HMI, Printer server (one set each type & capacity)	Set	1
2	Cable & connectors used in Bay control unit, Master station, HMI, printer server (one set each type)	Set	1
3	Applicable RAM (DIMM / SIMM card) used in Master station, HMI, Printer server (one each type)	Set	1
4	Mouse (one set each type)	Set	1
5	Keyboard (one no. each type)	No.	1
6	SMPS used for Master station, HMI, Printer server (one set each type)	Set	1
7	Fan assembly used for Master station, HMI, Printer server (one set each type)	Set	1
8	Mass storage device i.e. Optical drive/ CD writer etc. with driver (one set each type)	Set	1
9	Network card with driver (one set of each type)	Set	1
10	VDU with driver (one set of each type)	Set	1
11	Bay control unit with configuration software	Set	2
12	Operating systems of Master station, HMI, Printer server with the specified software version in CDROM(i.e. WIN NT, Unix etc.) with manual and device drivers	Set	1
13	Source code and compiler of Application software with detailed manual for Master station, HMI, Printer server.	Set	1
14	Auxiliary relays used in bay control unit for control applications (10% of of each type)	Set	1
15	Printer with driver and manual (one set of each type)	Set	1
16	Cartridge for Printer (one set of each type)	Set	2
17	Terminal connectors (male/ female) for optical fibers (one set of each type)	Set	5
18	Special tool for making joints and termination in optical fiber with relevant couplers (one set of each type)	Set	1
19	Optical loss measuring kit with relevant accessories and visual Fiber Optic cable inspection aid	Set	1

SECTION-2

SUBSTATION AUTOMATION SYSTEM

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	2. HMI View Node/DR/RCC Workstation Computer/Server
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RELAY & PROTECTION PANELS

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13.0	General Specification of Bay Protection Unit (BPU)
14.0	Various Elements of Protection System/ Schemes
15.0	Time Synchronization Equipment
16.0	Trip Circuit Supervision Relays
17.0	High Speed Tripping Relay
18.0	Flag Relays
19.0	Auxiliary Monitoring Relays
20.0	D.C. Supply Supervision Relay
21.0	Non-Directional Over Current Relay for Back Up Protection
22.0	Directional Earth Fault Relay for Back Up Protection (For Lines and Transformers)
23.0	Detailed Description of Protections
24.0	Relay Test Kit
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SUBSTATION AUTOMATION SYSTEM

1.0 General

- 1.1.** The Substation Automation System shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system which must be in satisfactory operation on 400/220/132kV system or higher for at least 2 (two) years as on the date of bid opening.

KEMA certificate/ equivalent certificate from development center authorized by UCA working group for having products including all IEDs and Ethernet switches conforming to IEC 61850 must be furnished.

The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from remote control centre (RCC) as well as from local control centre. The Bay Control and Protection IEDs shall communicate on the IEC61850 standard for Communication Networks and shall comply with the

- IEC61850-5 for communication data modeling,
- IEC61850-6 for Sub-station Configuration Description Language for communication & IEC61850-7-1 to 7-4 for Data Model and Services.

The SAS shall contain the following main functional parts:

- Bay Control Intelligence Electronic Devices (IEDs) for control and monitoring.
- Bay Protection Intelligent Electronic Devices (IEDs) for protection.
- Station Human Machine Interface (HMI)
- Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby.
- Gateway for remote control via industrial grade hardware (to RCC) through IEC60870-5-101/IEC 61850 protocol.
- Gateway for State Load Dispatch Centre (to SLDC), the gateway should be able to communicate with SLDC on IEC 60870-5-101 & 104 protocol. The specific protocol to be implemented shall be handed over to successful bidder. It shall be the bidder's responsibility to integrate his offered system with existing SLDC system for exchange of desired data. The exact I/O point shall be decided during detailed engineering.
- Remote HMI.
- Peripheral equipment like printers, display units, key boards, Mouse etc.

- Integrated Switches (built in bay IEDs) are not acceptable. All the IEDs shall be directly connected to Ethernet Interbay LAN without use of any gateways. The use of Ethernet Hubs shall not be permitted.
- 1.3. It shall enable local station control via a PC by means of human machine interface (HMI) and control software package, which shall contain an extensive range of supervisory control and data acquisition (SCADA) functions.
 - 1.4. It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure. An architecture drawing for SAS is enclosed at **Appendix-A**.
 - 1.5. The communication gateway shall facilitate the information flow with remote control centre. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.
 - 1.6 Following information is required to be communicated to RCC/ALDC/SLDC for **400/220/132kV** substation.

Analog Data	
MW & MVAR	All feeders & Transformers
MWH(units) & MVAR(units) <i>if required by ALDC/SLDC</i>	All feeders, Transformers, Capacitor bank
Voltage (kV) & Freq. (Hz.)	1 measured per Main Bus
Current (Amps)	All feeders & Transformers
Transformer Tap Position	All Transformers
Oil / Winding Temperature	For all Transformers
Digital Data	
CB- Double status information.	All Circuit Breakers
ISO- single status information.	All Bus and Line isolators
Master Trip Relays - Single Status Information	All feeders, Transformers, Reactors and Bus Bar
Control	Presently not Required – future if Required provision shall be available.

- 1.7 The bidder shall ensure that proposed automation system is compatible with the existing SCADA network. The bidder will quote for the equipment required for data transfer to the existing SCADA network, including SCADA equipment for which **PLCC**/ optic fiber shall be used for communication with SLDC and the other adjoining stations.

Layout details of Automation equipment has been considered to be as follows:

Bay level intelligent electronic devices (IED) for protection and control shall be provided for each bay. Each IED will be directly connected to the Hot – Standby

Server PC of the Station Automation System (SAS) through a **Single Fault Tolerant** Ethernet LAN on fiber optic media and shall communicate as per the IEC 61850 standard. The SAS shall be equipped with the gateway for remote communication as detailed further in the specification. SCADA details will be communicated to nearest SLDC via adjoining sub stations and signal will be carried by digital **PLCC**/ optic fibre either OPGW for transmission line or optic fibre cable laid in the ground alongwith under ground XLPE cable. The Contractor will make arrangement for supplying terminal equipment required for communication and for converting optic fibre signals into **PLCC** in case of requirement. The existing communication system works on IEC-60870 protocol and the inter operability document is enclosed in **Annexure-II**. Besides complying with interoperability document, it will be responsibility of the contractor to ensure proper communication of the offered system with existing system.

1.8 All the numerical IEDs must be fully IEC 61850 compliant and must have the following features.

- Have peer-to-peer communication using GOOSE messages (IEC 61850) for interlocking.
- Should be interoperable with third party IEC 61850 compliant devices
- Should generate XML file for integration/engineering with vendor independent SCADA systems.
- Should be directly connected to the inter bay bus on IEC 61850 without the use of any gateways. Connections of bay protection IEDs to the IEC 61850 bus through the bay control units is not acceptable.

2.0 System design

2.1 General system design

The Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including future extensions as given in single line diagram (SLD).

The systems shall be of the state-of-the art suitable for operation under electrical environment present in Extra high voltage substations, follow the latest engineering practice, ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.

The offered SAS shall support remote control and monitoring from Remote Control centers via gateways.

The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signaling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

Bidder shall offer the bay level unit (a bay comprises of one circuit breaker and associated disconnecter, earth switches and instrument transformer), bay mimic along with relay and protection panels and **PLCC** panels (described in other sections of technical specifications) and station HMI housed in air-conditioned Control Room building for overall optimization in respect of cabling and control room building.

Ethernet Topology

The Ethernet communication infrastructure to ensure a certain level of quality, performance and availability at least the following described criteria's have to be fulfilled concerning the Ethernet switches and the topology.

Ethernet Switches

Ethernet switches that fulfill the hardened requirements concerning temperature, EMC, power supply (**220V DC** from the Station Battery) and **complying to 61850 part 3 of the specification** suitable to be installed in substations shall be provided, i.e. the same data as common for numerical protection. The use of Ethernet Hubs is not permitted as they do not provide collision free transmission. The switches shall support priority tagging and open standards for ring management like fast scanning tree to ensure that e.g. for later system extension utility has not to rely on one switch supplier only. External switches are preferred as they have the advantage that there is no interruption or reconfiguration of the Ethernet ring if one or several bay devices are taken out of service.

2.2 System architecture

The SAS shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence.

Functions shall be decentralized, object-oriented and located as close as possible to the process.

The main process information of the station shall be stored in distributed databases. The typical SAS architecture shall be structured in two levels, i.e. in a station and a bay level. At bay level, the IEDs shall provide all bay level functions regarding control, monitoring and protection, inputs for status indication and outputs for commands. The IEDs should be directly connected to the switchgear without any need for additional interposition or transducers. But in case of Circuit

Breaker SF6 Gas Pressure, Operating Mechanism Pressure (i.e. Air/ Pneumatic, Hydraulic and SF6 Pressures), if SF6 CTs are Utilizing the Pressure of SF6 Gas, Transformer/ Reactor Oil/ Winding temperatures, OLTC Tap Position & Operation (not AVR) can be interfaced with BCU or any Other device interface through Transducers. These parameters shall appear in Substation Automation System at Local and RCC and should be monitored regularly.

Each bay control IED shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

The data exchange between the electronic devices on bay and station level shall take place via the communication infrastructure. This shall be realized using fiber-optic cables, thereby guaranteeing disturbance free communication. The fiber optic cables shall be run in G.I conduit pipes. Data exchange is to be realized using IEC 61850 protocol with a redundant managed switched Ethernet communication infrastructure.

The communication shall be made in 1+1 mode, excluding the links between individual bay IEDs to switch, such that failure of one set of fiber shall not affect the normal operation of the SAS. However it shall be alarmed in SAS. Each fiber optic cable shall have four (4) spare fibers.

At station level, the entire station shall be controlled and supervised from the station HMI. It shall also be possible to control and monitor the bay from the bay level equipment at all times.

Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. RCC, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

The station level contains the station-oriented functions, which cannot be realized at bay level, e.g. alarm list or event list related to the entire substation, gateway for the communication with remote control centers.

The **GPS time synchronizing signal** (as specified in the section relay & protection) as per IEC 61850 standard SNTP (**Simple Network Time Protocol**) for the synchronization of the entire system shall be provided.

The SAS shall contain the functional parts as described in Para 1.2 above.

2.1 Functional Requirements

The high-voltage apparatus within the station shall be operated from different places:

- Remote control centers
- Station HMI.
- Local Bay controller IED (in the bays)

Operation shall be possible by only one operator at a time.

The operation shall depend on the conditions of other functions, such as interlocking, synchrocheck, etc. (See description in “Bay level control functions”).

2.3.1 Select-before-execute

For security reasons the command is always to be given in two stages: selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated.

2.3.2 Command supervision Bay/station interlocking and blocking

Software Interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are to be provided for Bus Earth switch Interlocking.

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.

A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

2.3.3 Run Time Command cancellation

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

2.3.4 Self-supervision

Continuous self-supervision function with self-diagnostic feature shall be included.

2.3.5 User configuration

The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

It shall also be possible to interconnect and derive input and output signals, logic functions, using built-in functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers). Multi activation of these additional functions should be possible.

The Functional requirement shall be divided into following levels:

- a. Bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer) Level Functions
- b. System Level Functions

3.1. Bay level functions

In a decentralized architecture the functionality shall be as close to the process as possible. In this respect, the following functions can be allocated at bay level:

- Bay control functions including data collection functionality.
- Bay protection functions

Separate IEDs shall be provided for bay control function and bay protection function.

3.1.1 Bay control functions

3.1.1.1 Overview

Functions

- Control mode selection
- Select-before-execute principle
- Command supervision:
 - Interlocking and blocking
 - Double command
- Synchrocheck, voltage selection
- Run Time Command cancellation

- Transformer tap changer control (for power transformer bays)
- Operation counters for circuit breakers and pumps
- Hydraulic pump/ Air compressor control and runtime supervision
- Operating pressure supervision through digital contacts only
- Display of interlocking and blocking
- Breaker position indication per phase
- Alarm annunciation
- Measurement display (Electrical Parameters & Transformer/ Reactor Parameters)
- Local HMI (local guided, emergency mode) protected access.
- Interface to the station HMI.
- Data storage for at least 200 events
- Extension possibilities with additional I/O's inside the unit or via fiber optic communication and process bus

3.1.1.2 Control mode selection Bay level Operation

As soon as the operator receives the operation access at bay level the operation is normally performed via bay control IED. During normal operation bay control unit allows the safe operation of all switching devices via the bay control IED.

Emergency Operation

It shall be possible to close or open the selected Circuit Breaker with ON or OFF push buttons even during the outage of bay IED.

Remote Mode

Control authority in this mode is given to a higher level (Remote Control Centre) and the installation can be controlled only remotely. Control operation from lower levels shall not be possible in this operating mode.

3.1.1.3 Synchronism and energizing check

The synchronism and energizing check functions shall be bay-oriented and distributed to the bay control and/or protection devices. These features are:

- Settable voltage, phase angle, and frequency difference.
- Energizing for dead line - live bus, live line - dead bus or dead line dead bus with no synchro-check function.

- Synchronizing between live line and live bus with synchro-check function

Voltage Selection

The voltages relevant for the Synchrocheck functions are dependent on the station topology, i.e. on the positions of the circuit breakers and/or the isolators. The correct voltage for synchronizing and energizing is derived from the auxiliary switches of the circuit breakers, the isolator, and earthing switch and shall be selected automatically by the bay control and protection IEDs.

3.1.1.4 Transformer Tap Changer Control

Raise and lower operation of OLTC taps of transformer shall be facilitated through Bay controller IED.

3.1.2 Bay Protection functions

3.1.2.1 General

The protection functions are independent of bay control function. The protection shall be provided by separate protection IEDs (numerical relays) and other protection devices as per section Relay & Protection.

IEDs, shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of the various IEDs shall be compatible with the overall system communication and data exchange requirements.

All the IEDs must be fully IEC61850 compliant and shall be directly connected to the Ethernet Interbay LAN without use of any gateways.

Event and Disturbance Recording Function

Each IED should contain an event recorder capable of storing at least 200 time-tagged events. This shall give alarm if 70% memory is full. The **disturbance recorder** function shall be as per detailed in section Relay and Protection.

3.1.2.2 Bay Monitoring Function:

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (U) and current (I) shall be calculated in the Bay control/protection unit.

3.2. System Level Functions

3.2.1 Status Supervision

Continuous monitoring of switching objects i.e. the position of each switchgear, e.g. circuit breaker, isolator, earthing switch, transformer tap changer etc., shall be supervised continuously. Every detected change of position shall be immediately displayed in the single-line diagram on the station HMI screen, recorded in the event list, and a hard copy printout shall be produced. Alarms shall be initiated in the case of spontaneous position changes.

The switchgear positions shall be indicated by two auxiliary switches, normally closed (NC) and normally open (NO), which shall give ambivalent signals. An alarm shall be initiated if these position indications are inconsistent or if the time required for operating mechanism to change position exceeds a predefined limit.

The SAS shall also monitor the status of sub-station auxiliaries. The status and control of auxiliaries shall be done through separate one or more IED and all alarm and analogue values shall be monitored and recoded through this IED.

3.2.2 Measurements

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms, Max / Min values for voltage (U) and current (I) shall be calculated.

In case of Circuit Breaker SF6 Gas Pressure, Operating Mechanism Pressure (i.e. Air/ Pneumatic, Hydraulic and SF6 Pressures), if SF6 CTs are Utilizing the Pressure of SF6 Gas, Transformer/ Reactor Oil/ Winding temperatures, OLTC Tap Position can be interfaced with BCU or any Other device interface through Transducers. Max/ Min values for the above parameters shall be calculated. These parameters shall be appear in Substation Automation System at Local and RCC and can monitor regularly.

The measured values shall be displayed locally on the station HMI and in the control centre. The abnormal values must be discarded. The analogue values shall be updated every 2 seconds.

Threshold limit values shall be selectable for alarm indications.

3.2.3 Event and Alarm Handling

Events and alarms are generated either by the switchgear, by the control IEDs, or by the station level unit. They shall be recorded in an event list in the station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All, or a freely selectable group of events and alarms shall also be printed out on an event

printer. The alarms and events shall be time-tagged with a time resolution of 1 ms. The tentative list for various feeders and systems are enclosed as **Annexure-I**

3.2.4 Station HMI

3.2.4.1 Substation HMI Operation:

On the HMI the object has to be selected first. In case of a blocking or interlocking conditions are not met, the selection shall not be possible and an appropriate alarm annunciation shall occur. If a selection is valid the position indication will show the possible direction, and the appropriate control execution button shall be pressed in order to close or open the corresponding object.

Control operation from other places (e.g. REMOTE) shall not be possible in this operating mode.

3.2.4.2 Presentation and Dialogues

General

The operator station HMI shall be a redundant with hot standby and shall provide basic functions for supervision and control of the substation. The operator shall give commands to the switchgear on the screen via mouse clicks or keyboard commands.

The HMI shall give the operator access to alarms and events displayed on the screen. Aside from these lists on the screen, there shall be a printout of alarms or events in an event log.

An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- Single-line diagram showing the switchgear status, pressure values (wherever required) and measured values including OLTC Tap Position, WTI, OTI, Hydran DGA & Analog set values.
- Control dialogues with interlocking and blocking details. This control dialogue shall tell the operator whether the device operation is permitted or blocked and Tap changer operation & Select before Execute.
- Measurement dialogues, Statistics & Trends
- Alarm list, station / bay-oriented
- Event list, station / bay-oriented
- System status

3.2.4.3 HMI Design Principles

Consistent design principles shall be adopted with the HMI concerning labels, colours, dialogues and fonts. Non-valid selections shall be dimmed out.

The object status shall be indicated using different status colours for:

- Selected object under command
- Selected on the screen
- Not updated, obsolete values, not in use or not sampled
- Alarm or faulty state
- Warning or blocked
- Update blocked or manually updated
- Control blocked
- Normal state

3.2.4.4 Process Status Displays and Command Procedures

The process status of the substation in terms of actual values of currents, voltages, frequency, active and reactive powers as well as the positions of circuit breakers, isolators and transformer tap-changers shall be displayed in the station single-line diagram.

In addition to above Transformer WTIs, OTI, SF6 gas Pressures of Circuit breakers , CTs and CB Operating mechanism Pressures shall also be displayed.

In order to ensure a high degree of security against undesired operation, a "select-before-execute" command procedure shall be provided. After the "selection" of a switch, the operator shall be able to recognize the selected device on the screen, and all other switchgear shall be blocked. As communication between control centre and device to be controlled is established, the operator shall be prompted to confirm the control action and only then final execute command shall be accepted. After the "execution" of the command the operated switching symbol shall flash until the switch has reached its new position.

The operator shall be in a position to execute a command only, if the switch is not blocked and if no interlocking condition is going to be violated. The interlocking statements shall be checked by the interlocking scheme implemented at bay and station level.

After command execution the operator shall receive a confirmation that the new switching position has been reached or an indication that the switching procedure was unsuccessful with the indication of the reason for non-functioning.

3.2.4.5 System Supervision & Display

The SAS system shall be comprehensively self-monitored such that faults are immediately indicated to the operator, possibly before they develop into serious situations. Such faults are recorded as a faulty status in a system supervision display. This display shall cover the status of the entire substation including all switchgear, IEDs, communication infrastructure and remote communication links, and printers at the station level, etc.

3.2.4.6 Event List

The event list shall contain events that are important for the control and monitoring of the substation.

The event and associated time (with 1 ms resolution) of its occurrence has to be displayed for each event.

The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it.

A printout of each display shall be possible on the hard copy printer/Dot matrix Printer / Line Printer of 132 Column.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer for at least one month. The information shall be obtainable also from a printed event log.

The chronological event list shall contain:

- Position changes of circuit breakers, isolators and earthing devices
- Indication of protective relay operations
- Fault signals from the switchgear
- Indication when analogue measured values exceed upper and lower limits. Suitable provision shall be made in the system to define two level of alarm on either side of the value or which shall be user defined for each measurand.
- Loss of communication.
- Hourly time Stamping

Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

- Date and time
- Bay

- Device
- Function e.g. trips, protection operations etc.
- Alarm class

3.2.4.7 Alarm List

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control centre. The alarm list shall substitute a conventional alarm tableau, and shall constitute an evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults. The date and time of occurrence shall be indicated.

The alarm list shall consist of a summary display of the present alarm situation. Each alarm shall be reported on one line that contains:

- The date and time of the alarm
- The name of the alarming object
- A descriptive text
- The acknowledgement state

Whenever an alarm condition occurs, the alarm condition must be shown on the alarm list and must be displayed in a flashing state along with an audible alarm. After acknowledgement of the alarm, it should appear in a steady (i.e. not flashing) state and the audible alarm shall stop. The alarm should disappear only if the alarm condition has physically cleared and the operator has reset the alarm with a reset command. The state of the alarms shall be shown in the alarm list (Unacknowledged and persistent, Unacknowledged and cleared, Acknowledged and persistent).

Filters for selection of a certain type or group of alarms shall be available as for events.

3.2.4.8 Object Picture

When selecting an object such as a circuit breaker or isolator in the single line diagram, the associated bay picture shall be presented first. In the selected object picture, all attributes like

- Type of blocking
- Authority
- Local / remote control
- ALDC / SLDC /SAS control

- Errors
- etc.,

shall be displayed.

3.2.4.9 Control Dialogues

The operator shall give commands to the system by means of mouse click located on the single-line diagram. It shall also be possible to use the keyboard for command activation. Data entry is performed with the keyboard. Dedicated control dialogues for controlling at least the following devices shall be available:

- Breaker and disconnector
- Transformer tap-changer

3.2.5 User-Authority Levels

It shall be possible to restrict activation of the process pictures of each object (bays, apparatus...) within a certain user authorization group. Each user shall then be given access rights to each group of objects, e.g.:

- Display only
- Normal operation (e.g. open/close of switchgear)
- Restricted operation (e.g. by-passed interlocking)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorization levels shall be available :

- No engineering allowed
- Engineering/configuration allowed
- Entire system management allowed

The access rights shall be defined by passwords assigned during the login procedure. Only the system administrator shall be able to add/remove users and change access rights.

3.2.6 Reports

The reports shall provide time-related follow-ups of measured and calculated values. The data displayed shall comprise:

➤ Trend reports:

- Day (mean, peak)
- Month (mean, peak)
- Semi-annual (mean, peak)
- Year (mean, peak)

➤ Historical reports of selected analogue Values:

- Day (at 15 minutes interval)
- Week
- Month
- Year

It shall be possible to select displayed values from the database in the process display on-line. Scrolling between e.g. days shall be possible. Unsure values shall be indicated. It shall be possible to select the time period for which the specific data are kept in the memory.

Following printouts shall be available from the printer and shall be printed on demand:

- i. Daily voltage and frequency curves depicting time on X-axis and the appropriate parameters on the Y-axis. The time duration of the curve is 24 hours.
- ii. Weekly trend curves for real and derived analogue values.
- iii. Printouts of the maximum and minimum values and frequency of occurrence and duration of maximum and minimum values for each analogue parameter for each circuit in 24 hr period.
- iv. Provision shall be made for logging information about breaker status like number of operation with date and time indications.
- v. Equipment operation details shift wise and during 24 hours.
- vi. Printout on adjustable time period as well as on demand for MW, MVAR, Current, Voltage on each feeder and transformer as well as Tap Positions, temperatures (WTI, OTI) and status of pumps and fans for transformers.
- vii. Printout on adjustable time period as well as on demand system frequency and average frequency.
- viii. Print hourly/daily log sheet of the sub-station based on available input parameters (format will be decided/finalized during detailed engineering).

- ix. Reports in specified formats (formats will be decided/finalized during detailed engineering) shall be handed over to successful bidder for implementation. The bidder has to develop these reports.

3.2.7 Trend Display (Historical Data)

It shall be possible to illustrate all types of process data as trends - input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 10 trends per screen. Adjustable time span and scaling ranges must be provided.

It shall be possible to change the type of value logging (direct, mean, sum, or difference) on-line in the window. It shall also be possible to change the update intervals on-line in the picture as well as the selection of threshold values for alarming purposes.

3.2.8 Automatic Disturbance File Transfer

All recorded data from the IEDs with integrated disturbance recorder as well as dedicated disturbance recording systems shall be automatically uploaded (event triggered or once per day) to a dedicated computer and be stored on the hard disc.

3.2.9 Disturbance Analysis

The PC-based work station shall have necessary software to evaluate all the required information for proper fault analysis.

3.2.10 IED Parameter Setting

It shall be possible to access all protection and control IEDs for reading the parameters (settings) from the station HMI or from a dedicated monitoring computer. The setting of parameters or the activation of parameter sets shall only be allowed after entering a password.

3.2.11 Automatic Sequences

The available automatic sequences in the system should be listed and described, (e.g. sequences related to the bus transfer). It must be possible to initiate pre-defined automatic sequences by the operator and also define new automatic sequences.

3.3 Gateway

3.3.1 Communication Interface

The Substation Automation System shall have the capability to support simultaneous communications with multiple independent remote master stations.

The Substation Automation System shall have communication ports as follows:

- (a) Two ports for Remote Control Centre
- (b) Two ports for Area Load Dispatch Center / State Load Dispatch Centre (ALDC/SLDC)

The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for each control centre. The substation automation system shall simultaneously respond to independent scans and commands from Purchaser's control centres (RCC & ALDC/ SLDC). The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote control centre. Also, each control centre's data scan and control commands may be different for different data points within the substation automation system's database.

3.3.2 Remote Control Centre Communication Interface

Purchaser will supply communication channels between the Substation Automation System and the remote control centre. The communication channels provided by Purchaser will consist either of power line carrier, microwave, optical fibre, VSAT or leased line, the details of which shall be provided during detailed Engineering.

3.3.3 Interface Equipment:

The Bidder shall provide interface equipment for communicating between Substation Automation system and Remote control centre and between Substation Automation system and Area Load Dispatch Center / State Load Dispatch Centre (ALDC/SLDC). However, the communication channels available for this purpose are specified in section elsewhere.

In case of **PLCC** communication any modem supplied shall not require manual equalization and shall include self-test features such as manual mark/space keying, analogue loop-back, and digital loop-back. The modems shall provide for convenient adjustment of output level and receive sensitivity. **The modem should be stand alone complete in all respects including power supply to interface the SAS with communication channel.** The configuration of tones and speed shall be programmable and maintained in non-volatile memory in the modem. All necessary hardware and software along with communication equipment shall also be in the scope of bidder except the communication link between substation control room and Remote Control Centre.

If **PLCC** / Microwave / Optical fibre /VSAT/ Leased Line equipment should have Modbus or any open Protocol system and this can be connected to SAS for monitoring, Events & Alarms and password for configuration. The

communication Equipment system supervision & display as mentioned in clause 3.2.4.5.

If the Protection Couplers also should have Modbus or any open Protocol system and this can be connected to SAS for monitoring the send and receive commands all channels along with Events & Alarms and password for configuration. The protection coupler Equipment system supervision & display as mentioned in clause 3.2.4.5

3.3.4 Communication Protocol

The communication protocol for gateway to control centre must be open protocol and shall support IEC 60870-5-101 & 104 and IEC 61850 for all levels of communication for sub-station automation such as Bay to station HMI, gateway to remote station etc..

4.0 System Hardware:

4.1 Redundant Station HMI, HMI View Node and Disturbance Recorder Work station(Laptop):

The Bidder shall provide redundant station HMI in hot standby mode.

It shall be capable to perform all functions for entire substation including future requirements as indicated in the SLD. It shall use industrial grade components. Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features. **The RAM, Hard Disk and Bus should be of latest version and should have maximum capacity.**

The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

1. Storage of all analogue data (at 15 Minutes interval) and digital data including alarm, event and trend data for thirty(30) days.
2. Storage of all necessary software
3. **100 GB** space for PURCHASER'S use.

Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

4.1.1 HMI (Human Machine Interface)

The VDU shall show overview diagrams (Single Line Diagrams) and complete details of the switchgear with a colour display. All event and alarm annunciation shall be selectable in the form of lists. Operation shall be by a user friendly function keyboard and a cursor positioning device. The user interface shall be

based on WINDOWS concepts with graphics & facility for panning, scrolling, zooming, de-cluttering etc.

4.1.1.1 Visual Display Units/ TFT's (Thin Film Technology)

The Bidder shall provide three display units, one for station HMI, one for DR workstation(Laptop) and one for redundant HMI. These shall have high resolution and reflection protected picture screen. High stability of the picture geometry shall be ensured. The screen shall be at least **25" diagonally (3:4)** in size and capable of colour graphic displays.

The display shall accommodate resolution of 1280 x 1024 pixels.

The HMI shall be able to switch the key board and cursor positioning device, as unit among all the monitors at a console via push button or other controls.

4.1.3 Printer

It shall be robust & suitable for operation with a minimum of 132 characters per line for Line Printer and Dot Matrix Printer. The printing operation shall be quiet with a noise level of less than 45 dB suitable for location in the control room. Printer shall accept and print all ASCII characters via master control computer unit interface.

The printer shall have in built testing facility. Failure of the printer shall be indicated in the Station HMI. The printer shall have an off line mode selector switch to enable safe maintenance. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

All printers mounted in the control room shall be provided with a separate printer enclosure each. The enclosure shall be designed to permit full enclosure of the printers at a convenient level. Plexiglas windows shall be used to provide visual inspection of the printers and ease of reading. The printer enclosures shall be designed to protect the printers from accidental external contact & each should be removable from hinges at the back and shall be provided with lock at the front.

All reports and graphics prints shall be printed on laser printer (preferably MFD).

One Dot Matrix Printer (DMP) shall be exclusively used for hourly log printing.

Line printer for Events and Alarms Printing.

All printers shall be continuously online.

4.1.4 Mass Storage Unit

The mass storage unit shall be built-in to the Station HMI. All operational measured values, and indications shall be stored in a mass-storage unit of CD-

ROM / DVD-ROM with 700 MB or more capacity i.e CD Writer & DVD Writer (Both). The unit should support at least Read (48X), Write(24X), and Re-Write (10X) operations, with Multi-Session capability. It should support ISO9660, Rockridge and Joliet File systems. It should support formatting and use under the operating system provided for Station HMI. The monthly back up of data shall be taken on disc. The facility of back up of data shall be inherent in the software.

The All the data pertaining to Substation is to stored in a system year/ month / day wise. The daily data is stored in a day file of Particular Month and Year automatically from 00.00Hrs to 24.00Hrs.

4.1.5 Switched Ethernet Communication Infrastructure:

The bidder shall provide the redundant switched optical Ethernet communication infrastructure for SAS. The bidder shall keep provision of 100% spare capacity for Purchaser use. Each switch shall have atleast two spare ports for connecting bay level IEDs and one spare port for connecting station bus. The necessary switches are provided to communication infrastructure as follows.

- One switch shall be provided to connect all IEDs for 400kV, 220kV & 132kV bays .
- One switch shall be provided to connect all IEDs for Bus Coupler, Bus Sectionaliser and Bus Bar for 400kV, 220kV & 132kV bays.

4.2 Bay Level Unit

The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. They shall be directly connected to the switchgear. The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in sub-station automation system. In addition, this shall receive the operation commands from station HMI and control centre. The bay unit shall have the capability to store all the data for at least 24 hours. The bay control unit shall be fully compliant to IEC 61850 standard.

One no. Bay level unit shall be provided for supervision and control of each bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer). The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel,

with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the Station HMI is out of service.

The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

4.2.1 Input/Output (I/O) Modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear. The measured values of voltage and current shall be from the secondaries of instrument transformers. The digital inputs shall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state.

4.3. Air-Conditioning System

Bay level units, bay mimic, relay and protection panels, Bus bar Protection panels, **PLCC** panels etc. shall be housed in a Air- Conditioned Room adjacent to respective GIS room. The layout for placement of equipments / panels in Control Room shall be subject to Purchaser's approval. The control room shall be provided with illuminations, fire alarm system with at least two detectors with necessary power supply if required and it shall be wired to SAS. **The Air Conditioners provided in room shall be controlled and monitored from substation automation system. Two Air Conditioners shall be in running mode and one will be in standby mode in each room** housing bay level IEDs.

4.4 Extendibility in future

Offered substation automation system shall be suitable for extension in future for additional bays. During such requirement, all the drawings and configurations, alarm/event list etc. displayed shall be designed in such a manner that its extension shall be easily performed by the Purchaser. During such event, normal operation of the existing substation shall be unaffected and system shall not require a shutdown. The bidder shall provide all necessary software tools along with source codes to perform addition of bays in future and complete integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future with IEDs of same manufacturer/ different manufacturer.

5.0 Software Structure

The software package shall be structured according to the SAS architecture and strictly divided in various levels. Necessary firewall shall be provided at suitable points in software to protect the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a shut-down of the parts of the system which are not affected by the system adaptation.

5.1.1 Station Level Software

5.1.1.2 Human-Machine Interface (HMI)

The base HMI software package for the operator station shall include the main SAS functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements. Systems shall contain a library with standard functions and applications.

5.1.2 Bay Level Software

5.1.2.1 System Software

The system software shall be structured in various levels. This software shall be placed in a non-volatile memory. The lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage. In case of restoration of links after failure, the software along with hardware shall be capable of automatically synchronising with the remaining system without any manual interface. This shall be demonstrated by contractor during integrated system test.

5.1.2.2 Application Software

In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They form part of a library.

The application software within the control/protection devices shall be programmed in a functional block language.

5.1.2.3 Network Management System

The contractor shall provide a network management system software for following management functions:

- a. Configuration Management
- b. Fault Management
- c. Performance Monitoring

This system shall be used for management of communication devices and other IEDs in the system. This NMS can be loaded in DR work-station and shall be easy to use, user friendly and menu based. The NMS shall monitor all the devices in the SAS and report if there is any fault in the monitored devices. The NMS shall :

- (a) Maintain performance, resource usage, and error statistics for all managed links and devices and present this information via displays, periodic reports and on demand reports.
- (b) Maintain a graphical display of SAS connectivity and device status.
- (c) Issue alarms when error conditions occurs
- (d) Provide facility to add and delete addresses and links

5.1.2.4 The Bidder shall provide each software in two copies in CD to load into the system in case of any problem related with Hardware/Communication etc.

6.0 Tests

The substation automation system offered by the bidder shall be subjected to following tests to establish compliance with IEC 61850 for EHV sub station equipment installed in sheltered area in the outdoor switchyard an specified ambient conditions:

6.1 Type Tests:

6.1.1 Control IEDs and Communication Equipment

- a. Power Input:**
 - i. Auxiliary Voltage
 - ii Current Circuits
 - iii. Voltage Circuits
 - iv. Indications
- b. Accuracy Tests :**
 - i. Operational Measured Values
 - ii. Currents
 - iii. Voltages
 - iv. Time resolution
- c. Insulation Tests:**
 - i. Dielectric Tests

- ii. Impulse Voltage withstand Test
- d. **Influencing Quantities**
 - i. Limits of operation
 - ii. Permissible ripples
 - iii. Interruption of input voltage
- e. **Electromagnetic Compatibility Test:**
 - i. 1 MHZ. burst disturbance test
 - ii. Electrostatic Discharge Test
 - iii. Radiated Electromagnetic Field Disturbance Test
 - iv. Electrical Fast transient Disturbance Test
 - v. Conducted Disturbances Tests induced by Radio Frequency Field
 - vi. Magnetic Field Test
 - vii. Emission (Radio interference level) Test.
 - viii. Conducted Interference Test
- f. **Function Tests :**
 - i. Indication
 - ii. Commands
 - iii. Measured value Acquisition
 - iv. Display Indications
- g. **Environmental tests**
 - i. Cold Temperature
 - ii. Dry Heat
 - iii. Wet heat
 - iv. Humidity (Damp heat Cycle)
 - v. Vibration
 - vi. Bump
 - vii. Shock

6.2 Factory Acceptance Tests:

The supplier shall submit a test specification for Factory Acceptance Test (FAT) and Commissioning Tests of the station automation system for approval. For the individual bay level IED's applicable type test certificates shall be submitted.

The manufacturing phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. If the FAT comprises only a certain portion of the system for practical reason, it has to be assured that this test configuration contains at least one unit of each and every type of equipment incorporated in the delivered system.

If the complete system consists of parts from various suppliers or some parts are already installed on site, the FAT shall be limited to sub-system tests. In such a case, the complete system test shall be performed on site together with the Site Acceptance Test (SAT).

6.3 Integrated Testing;

The integrated system tests shall be performed as detailed in subsequent clauses as per following configuration:

- Redundant Station HMI, DR work station, two switches (i.e. for two diameter) along with all IEDs for the Dia and printers.

All other switches for complete sub-station as detailed in **Section-I** shall be simulated as needed.

6.3.1 Hardware Integration Tests:

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests.

6.3.2 Integrated System Tests:

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

6.4 Field Tests:

The field tests shall completely verify all the features of SAS hardware and software.

7.0 SYSTEM OPERATION

7.1 Substation Operation

7.1.1 NORMAL OPERATION

Operation of the system by the operator from the remote RCC or at the substation shall take place via industry standard HMI(Human Machine interface) subsystem consisting of graphic colour VDU, a standard keyboard and a cursor positioning device (mouse).

The coloured screen shall be divided into 3 fields :

- i) Message field with display of present time and date
- ii) Display field for single line diagrams
- iii) Navigation bar with alarm/condition indication

For display of alarm annunciation, lists of events etc a separate HMI View node shall be provided.

All operations shall be performed with mouse and/or a minimum number of function keys and cursor keys. The function keys shall have different meanings depending on the operation. The operator shall see the relevant meanings as function tests displayed in the command field (i.e. operator prompting). For control actions, the switchgear (i.e. circuit breaker etc.) requested shall be selectable on the display by means of the cursor keys. The switching element selected shall then appear on the background that shall be flashing in a different color. The operator prompting shall distinguish between:-

- Prompting of indications e.g. fault indications in the switchgear, and
- prompting of operational sequences e.g execution of switching operations

The summary information displayed in the message field shall give a rapid display of alarm/message of the system in which a fault has occurred and alarm annunciation lists in which the fault is described more fully.

Each operational sequence shall be divided into single operation steps which are initiated by means of the function keys/WINDOW command by mouse. Operator prompting shall be designed in such a manner that only the permissible keys are available in the command field related to the specific operation step. Only those switching elements shall be accessed for which control actions are possible. If the operation step is rejected by the system, the operator prompting shall be supported by additional comments in the message field. The operation status shall be reset to the corresponding preceding step in the operation sequence by pressing one of the function keys. All operations shall be verified. Incorrect operations shall be indicated by comments in the message field and must not be executed.

The offer shall include a comprehensive description of the system. The above operation shall also be possible via WINDOWS based system by mouse.

8.0 Power Supply

Power for the substation automation system shall be derived from substation **220V DC system**.

Inverter of suitable capacity (3 kVA or higher as per power requirement) shall be provided for DR Workstation, station HMI and its peripheral devices e.g. printer etc. In the event of Power failure, necessary safeguard software shall be built for proper shutdown and restart.

9.0 Documentation

The following documents shall be submitted for Purchaser's approval during detailed engineering:

- (a) System Architecture Drawing
- (b) Hardware Specification
- (c) Sizing Calculations of various components
- (d) Response Time Calculation
- (e) Functional Design Document
- (f) Clear procedure describing how to add an IED/bay/diameter in future covering all major supplier

The following documentation to be provided for the system in the course of the project shall be consistent, CAD supported, and of similar look/feel. All CAD drawings to be provide in "dxf" format and also in acrobat format.

List of Drawings

- Substation automation system architecture
- Block Diagram
- Guaranteed technical parameters, Functional Design Specification and Guaranteed availability and reliability
- Calculation for power supply dimensioning
- I/O Signal lists
- Schematic diagrams
- List of Apparatus
- List of Labels
- Logic Diagram (hardware & software)
- **Control Room Lay-out**
- Test Specification for Factory Acceptance Test (FAT)
- Product Manuals
- Assembly Drawing
- Operator's Manual
- Complete documentation of implemented protocols between various elements
- Listing of software and loadable in CD ROM

- Other documents as may be required during detailed engineering

Two sets of hard copy and Four sets of CD ROM containing all the as built documents/drawings shall be provided.

10.0 TRAINING, SUPPORT, SERVICES, MAINTENANCE AND SPARES

10.1 Training

Bidder personnel who are experienced instructors and who speak understandable English shall conduct training. The contractor shall arrange on its own cost all hardware training platform required for successful training and understanding in India. The Contractor shall provide all necessary training material. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Purchaser at least two months before the scheduled commencement of the particular training course. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Purchaser. Purchaser reserves the right to copy such materials, but for in-house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Purchaser.

For all training courses the travel and pre-diem expenses will be borne by the participants. However the *lodging, boarding, local transport and such other charges for the engineers sent for such training shall be borne by the bidder*. The bid price offered is deemed to have included this. Training offered shall be free of cost to the purchaser.

The schedule, location, and detailed contents of each course will be finalized during Employer and Contractor discussions.

10.2 Computer System Hardware Course

A computer system hardware course shall be offered, but at the system level only. The training course shall be designed to give Purchaser hardware personnel sufficient knowledge of the overall design and operation of the system so that they can correct obvious problems, configure the hardware, preventive maintenance run diagnostic programs, and communicate with contract maintenance personnel. The following subjects shall be covered:

- System Hardware Overview:** Configuration of the system hardware.
- Equipment Maintenance:** Basic theory of operation, maintenance techniques and diagnostic procedures for each element of the computer system, e.g. processors, auxiliary memories, LANs, routers and printers. Configuration of all the hardware equipments.
- System Expansion:** Techniques and procedures to expand and add equipment such as loggers, monitors and communication channels.

- d) **System Maintenance:** Theory of operation and maintenance of the redundant hardware configuration, failover hardware, configuration control panels and failover switches. Maintenance of protective devices and power supplies.
- e) **Subsystem Maintenance:** Theory of design and operation, maintenance techniques and practices, diagnostic procedures, and (where applicable) expansion techniques and procedures. Classes shall include hands-on training for the specific subsystems that are part of Purchaser's equipment or part of similarly designed and configured subsystems. All interfaces to the computing equipment shall be taught in detail.
- f) **Operational Training:** Practical training on preventive and corrective maintenance of all equipment, including use of special tools and instruments. This training shall be provided on Purchaser equipment, or on similarly configured systems.

10.3 Computer System Software Course

The Contractor shall provide a computer system software course that covers the following subjects:

- (a) **System Programming :** Including all applicable programming languages and all stand-alone service and utility packages provided with the system. An introduction to software architecture, Effect of tuning parameters (OS software, Network software, database software etc.) on the performance of the system.
- (b) **Operating System:** Including the user aspects of the operating system, such as program loading and integrating procedures; scheduling, management, service, and utility functions: and system expansion techniques and procedures
- (c) **System Initialization and Failover:** Including design, theory of operation, and practice.
- (d) **Diagnostics:** Including the execution of diagnostic procedures and the interpretation of diagnostic outputs,
- (e) **Software Documentation:** Orientation in the organization and use of system software documentation.
- (f) **Hands-on Training:** One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

10.4 Application Software Course

The Contractor shall provide a comprehensive application software courses covering all applications including the database and display building course. The training shall include:

- (a) **Overview:** Block diagrams of the application software and data flows. Programming standards and program interface conventions.
- (b) **Application Functions:** Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques.
- (c) **Software Development:** Techniques and conventions to be used for the preparation and integration of new software functions.
- (d) **Software Generation:** Generation of application software from source code and associated software configuration control procedures.
- (e) **Software Documentation:** Orientation in the organization and use of functional and detailed design documentation and of programmer and user manuals.
- (f) **Hands-on Training:** One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

10.5 Requirement of training:

The contractor shall provide training for two batches for two weeks each for following courses.

S. No.	Name of Course
1	Computer System Hardware
2	Computer System Software
3	Application Software

11.0 Maintenance

11.1 Maintenance Responsibility during the Guaranteed Availability Period.

During Guaranteed Availability Period, the Bidder shall take continual actions to ensure the guaranteed availability and shall make available all the necessary resources such as specialist personnel, spare parts, tools, test devices etc. for replacement or repair of all defective parts and shall have prime responsibility for keeping the system operational.

12.0 RELIABILITY AND AVAILABILITY

The SAS shall be designed so that the failure of any single component, processor, or device shall not render the system unavailable. The SAS shall be designed to satisfy the very high demands for reliability and availability concerning:

- Mechanical and electrical design
- Security against electrical interference (EMI)
- High quality components and boards
- Modular, well-tested hardware
- Thoroughly developed and tested modular software
- Easy-to-understand programming language for application programming
- Detailed graphical documentation and application software
- Built-in supervision and diagnostic functions
- Security
 - Experience of security requirements
 - Process know-how
 - Select before execute at operation
 - Process status representation as double indications
- Distributed solution
- Independent units connected to the local area network
- Back-up functions
- Panel design appropriate to the harsh electrical environment and ambient conditions
- Panel grounding immune against transient ground potential rise

Outage Terms

1) Outage

The state in which substation automation system or a unit of SAS is unavailable for Normal Operation as defined in the clause 7.1 due to an event directly related to the SAS or unit of SAS. In the event, the Purchaser has taken any equipment system other than Sub-station Automation System for schedule/forced maintenance, the consequent outage to SAS shall not be considered as outage for the purpose of availability.

2) Actual outage duration (AOD)

The time elapsed in hours between the start and the end of an outage. The time shall be counted to the nearest 1/4th of an hour. Time less than 1/4th of an hour shall be counted as having duration of 1/4th of an hour.

3) Period Hours (PH)

The number of hours in the reporting period. In a full year the period hour are 8760h (8784h for a leap year).

4) Actual Outage hours (AOH)

The sum of actual outage duration within the reporting period
 $AOH = \sum AOD$

5) Availability:

Each SAS shall have a total availability of 99.98 % i.e. the ratio of total time duration minus the actual outage duration to total time duration.

12.1 Guarantees Required

The availability for the complete SAS shall be guaranteed by the Contractor. Bidder shall include in their offer the detailed calculation for the availability. The contractor shall demonstrate their availability guaranteed by conducting the availability test on the total sub-station automation system as a whole after commissioning of total Sub-station Automation system. The test shall verify the reliability and integrity of all sub-systems. Under these conditions the test shall establish an overall availability of 99.98%. After the lapse of 1000 Hours of cumulative test time, test records shall be examined to determine the conformance with availability criterion. In case of any outage during the availability test, the contractor shall rectify the problem and after rectification, the 1000 Hours period start after such rectification. If test object has not been met the test shall continue until the specified availability is achieved.

The contractor has to establish the availability in a maximum period of three months from the date of commencement of the availability test.

After the satisfactory conclusion of test both contractor and Purchaser shall mutually agree to the test results and if these results satisfy the availability criterion, the test is considered to be completed successfully. After that the system shall be taken over by the Purchaser and then the guarantee period shall start.

13.0 Spares

13.1 Consumables:

All consumables such as paper, cartridges shall be supplied by the contractor till the SAS is taken over by the Purchaser.

13.2 Availability Spares:

The bidder is required to list the spares, which may be required for ensuring the guaranteed availability during the guaranteed availability period. The final list of spares shall form part of scope of supply and accordingly the price thereof shall be quoted by the bidder and shall be considered in the evaluation of the bids. During the guaranteed availability period, the spare parts supplied by the Contractor shall be made available to the Contractor for usage subject to replenishment at the earliest. Thus, at the end of availability period the inventory of spares with the Purchaser shall be fully replenished by the Contractor. However, any additional spares required to meet the availability of the system (which are not a part of the

above spares supplied by the Contractor) would have to be supplied immediately by the Contractor free of cost to the Purchaser.

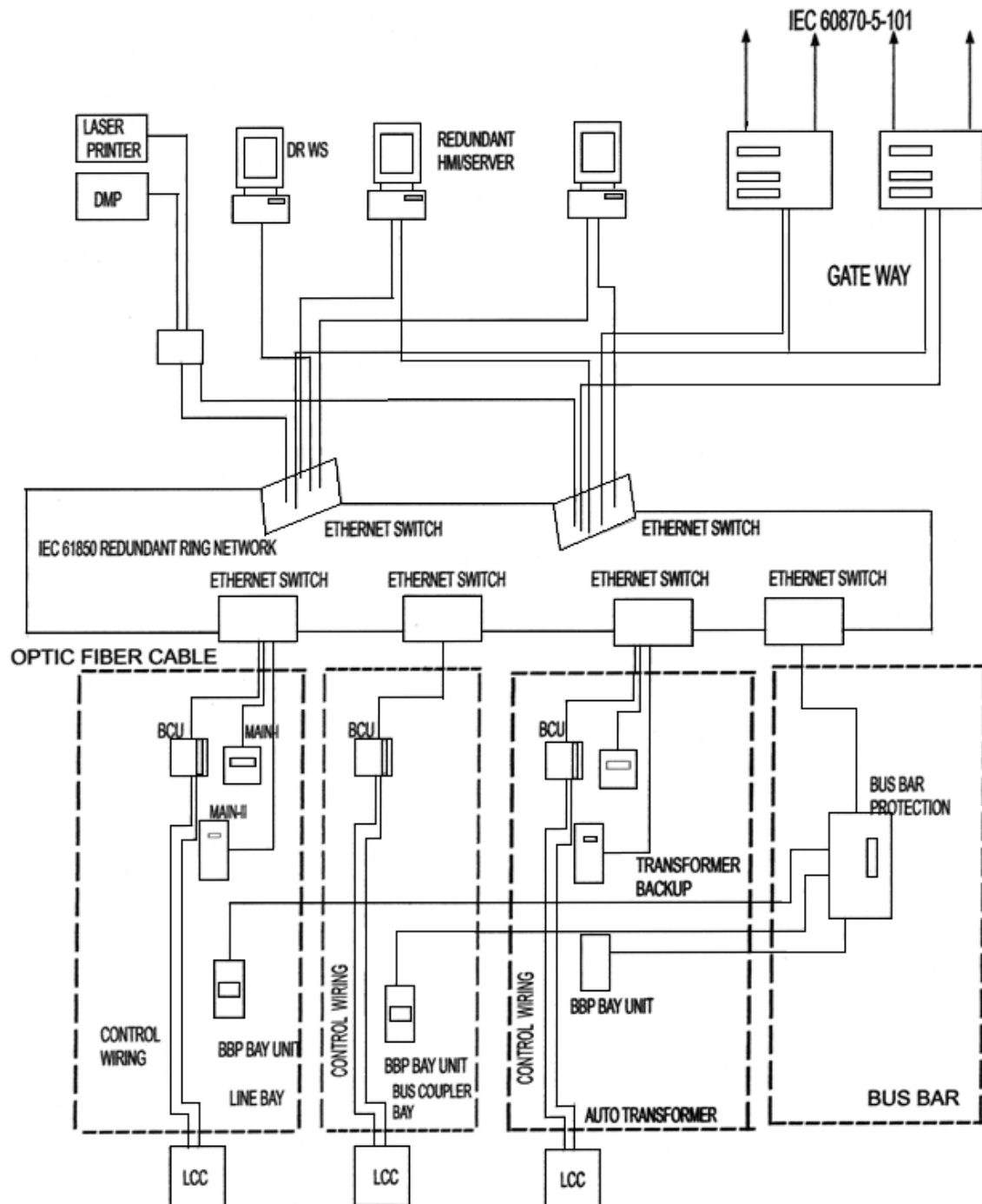
14.0 LIST OF EQUIPMENTS

Quantity of equipments shall be decided by bidder in order to achieve guaranteed reliability and availability as declared by bidder.

- i) Station HMI
- ii) Redundant Station HMI (in Hot-stand by mode)
- iii) Bay level units along with bay mimic (BCU) with an automatic change over facility if one of the power supply fails. (This is the Part of CB Control & Relay Panel)
- iv) Portable Engineering Station & Disturbance Recorder Work Station (Maintenance HMI/Laptop)
- v) List of Printers with / without Printer server
 1. Colour Laser Printer with MFD – 1 No. (Print, Scan, Fax & Xerox) (For Reports & Disturbance records),
 2. Line Printer - (For Alarms and Sequence of Event recorder)
 3. Dot matrix printer Multi sheet paper Model – preferably TVS 5 in 1 Printer (For log sheets, regular parameters at 15 min duration).
 4. Necessary Furniture.
- vi) All interface equipment for gateway to RCC and ALDC/SLDC. 2 Ports for RCC & 2 Ports for ALDC/SLDC.
- vii) Communication infrastructure between Bay level units, Station HMI, Printers, gateways, redundant LAN etc. as required. (FO Cables) as required.
- viii) BCUs for Sub Station Auxiliaries.
- ix) Remote workstation including HMI and along with one printer
- x) LCD Projector with necessary auxiliaries.
- xi) Any other equipment as necessary.

SYSTEM ARCHITECTURE 220 KV SAS

Appendix-A



NOTES:

1. CONTROL WIRING SHALL BE DONE FROM LCC/ EQUIPMENT UPTO BCU.
2. ALL OTHER WIRING SHALL BE OF OPTIC FIBER CABLE

Annexure-I

List of Analogue and Digital Inputs

Basic Monitoring requirements are:

- Switchgear status indication
- Measurements (U, I, P, Q, f)
- Event
- Alarm
- OIL & Winding temperature of transformers
- Ambient temperature
- Status and display of 415V LT system, 220V & 48V DC system
- Status of display of Fire protection system and Air conditioning system.
- Acquisition of all counters for inter-tripping, counting the receive/send commands.
- Acquisition of alarm and fault record from protection relays
- Disturbance records
- Monitoring the state of batteries by displaying DC voltage, charging current and load current etc.
- Tap-position of Transformer

List of Inputs

The list of input for typical bays is as below:-

Analogue inputs

i) For line

Current	R phase
	Y phase
	B phase
Voltage	R-Y phase
	Y-B phase
	B-R phase

ii) For transformer

Current	R phase
	Y phase
	B phase

WTI (for transformer)

Tap position (for transformer)

- iii) For bus coupler
 - Current
 - R phase
 - Y phase
 - B phase
- iv) Common
 - a) Voltage for Bus-1, Bus-II
 - Voltage
 - R-Y phase
 - Y-B phase
 - B-R phase
 - b) Frequency for Bus-1 and Bus-II
 - c) Ambient temperature (switchyard).
 - d) LT system
 - i) Voltage R-Y, Y-B, B-R of Main Switch Board section-I
 - ii) Voltage R-Y, Y-B, B-R of Main Switch Board section-II
 - iii) Voltage R-Y, Y-B, B-R of Diesel Generator
 - iv) Current from Diesel Generator
 - v) Voltage of 220V DCDB-I
 - vi) Voltage of 220V DCDB-II
 - vii) Current from 220V Battery set-I
 - viii) Current from 220V Battery set-II
 - ix) Current from 220V Battery charger-I
 - x) Current from 220V Battery charger-II
 - xi) Voltage of 48V DCDB-I
 - xii) Voltage of 48V DCDB-II
 - xiii) Current from 48V Battery set-I
 - xiv) Current from 48V Battery set-II
 - xv) Current from 48V Battery charger-I
 - xvi) Current from 48V Battery charger-II
 - xvii) Current from LT Tfr.-1
 - xviii) Current from LT Tfr.-2

Digital Inputs

The list of input for various bays/SYSTEM is as follows:

1. Line bays

- i) Status of each pole of CB
- ii) Status of Isolator, Earth switch
- iii) CB trouble
- iv) CB operation/closing lockout
- v) Pole discrepancy optd
- vi) Trip coil faulty
- vii) LBB optd

- viii) Bus bar protn trip relay optd
- ix) Main bkr auto recloser operated
- x) Auto Recloser operated
- xi) A/R lockout
- xii) Direct trip-I/II sent
- xiii) Direct trip-I/II received
- xiv) Main 1/11 blocking
- xv) Main 1/II-Inter trip send
- xvi) Main 1/II-Inter trip received
- xvii) O/V STAGE – I operated
- xviii) O/V STAGE – II operated
- xix) FAULT LOCATOR FAULTY
- xx) MAIN-1/11 VT FUSE FAIL
- xxi) MAIN-1 PROTN TRIP
- xxii) MAIN-11 PROTN TRIP
- xxiii) MAIN-1 PSB ALARM
- xxiv) MAIN-1 SOTF TRIP
- xxv) MAIN-1 R-PH TRIP
- xxvi) MAIN-1 Y-PH TRIP
- xxvii) MAIN-1 B-PH TRIP
- xxviii) MAIN-1 START
- xxix) MAIN-1/11 Carrier aided trip
- xxx) MAIN-1/11 fault in reverse direction
- xxxi) MAIN-1/11 ZONE-2 TRIP
- xxxii) MAIN-1/11 ZONE-3 TRIP
- xxxiii) MAIN-1/11 weak end infeed optd
- xxxiv) MAIN-11 PSB alarm
- xxxv) MAIN-11 SOTF TRIP
- xxxvi) MAIN-1 R-PH TRIP
- xxxvii) MAIN-11 Y-PH TRIP
- xxxviii) MAIN-11 B-PH TRIP
- xxxix) MAIN-11 start
- xl) MAIN-11 aided trip
- xli) MAIN-1/11 fault in reverse direction
- xlii) Back-up O/C optd
- xliii) Back-up E/F optd
- xliv) 220V DC-I/II source fail
- xlv) 48V DC-I/II source fail
- xlvi) SPEECH CHANNEL FAIL
- xlvii) PLCC Protection Channel-1 FAIL
- xlvi) PLCC Protection Channel-11 FAIL

2. Transformer bays

- i) Status of each pole of CB, Isolator, Earth switch
- ii) CB trouble
- iii) CB operation/closing lockout

- iv) Pole discrepancy optd
- v) Trip coil faulty
- vi) LBB optd
- vii) Bus bar protn trip relay optd
- viii) REF OPTD
- ix) DIF OPTD
- x) OVERFLUX ALARM (MV)
- xi) OVERFLUX TRIP (MV)
- xii) OVERFLUX ALARM (HV)
- xiii) OVERFLUX TRIP (HV)
- xiv) HV BUS VT 1/2 FUSE FAIL
- xv) MV BUS VT 1/2 FUSE FAIL
- xvi) OTI ALARM/TRIP
- xvii) PRD OTPD
- xviii) OVERLOAD ALARM
- xix) BUCHOLZ TRIP
- xx) BUCHOLZ ALARM
- xxi) OLTC BUCHOLZ ALARM
- xxii) OLTC BUCHOLZ TRIP
- xxiii) OIL LOW ALARM
- xxiv) Back-up O/C (HV) optd
- xxv) Back-up E/F (HV) optd
- xxvi) 220V DC-I/II source fail
- xxvii) TAP MISMATCH
- xxviii) GR-A PROTN OPTD
- xxix) GR-B PROTN OPTD
- xxx) Back-up O/C (MV) optd
- xxxi) Back-up E/F (MV) optd

3. Busbar Protection

- i) Bus bar main-I trip
- ii) Bus bar main-II trip
- iii) Bus bar zone-I CT open
- iv) Bus bar zone-II CT open
- v) Bus transfer CT sup. Optd
- vi) Bus transfer bus bar protn optd
- vii) Bus protection relay fail

4. Auxiliary system

- i) Incomer-I On/Off
- ii) Incomer-II On/Off
- iii) 415V Bus-I/II U/V
- iv) 415V Bus coupler breaker on/off
- v) LT Transformer-I Buchholz Alarm and Trip
- vi) LT Transformer-II Buchholz Alarm and Trip

- vii) LT Transformer-I WTI Alarm and Trip
- viii) LT Transformer-II WTI Alarm and Trip
- ix) LT Transformer-I OTI Alarm and Trip
- x) LT Transformer-II OTI Alarm and Trip
- xi) DG set bkr on/off
- xii) Alarm/trip signals as listed in Techn.Specn: DG set
- xiii) **PLCC exchange fail**
- xiv) Time sync. Signal absent
- xv) Alarm trip signals as listed in Techn.Specn: Battery and Battery charger
- xvi) **220V DC-I** earth fault
- xvii) **220V DC-II** earth fault
- xviii) Alarm/trip signals as listed in Techn.Specn: Fire protection system (NIFPES)

The exact number and description of digital inputs shall be as per detailed engineering requirement. Apart from the above mentioned digital inputs, minimum of 200 inputs shall be kept for UPPTCL use in future.

INTEROPERABILITY PROFILE OF IEC 60870-5-101 PROTOCOL FOR NR, NER AND ER

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be marked in the white boxes as follows:

☐	Function of ASDU is not used
☒	Function of ASDU is used as standardized (default)

Note : In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

1.1 SYSTEM OR DEVICE

(System-specific parameter, indicate the definition of a system or a device by marking one of the following with an '■')

- ☐ System definition
- ☐ Controlling station definition (master)
- ☒ Controlled station definition (Slave)

1.2 NETWORK CONFIGURATION

(Network-specific parameter, all configurations that are used are to be marked with ☒)

- ☒ Point-to-point ☒ Multipoint-party line
- ☒ Multiple point-to-point ☐ Multipoint-star

1.3 PHYSICAL LAYER (Network-specific parameter)

Transmission speed (control direction) :

*Unbalanced interchange
circuit V.24/V.28
Standard*

- ☐ 100 bit/s
- ☒ 200 bit/s
- ☒ 300 bit/s
- ☒ 600 bit/s
- ☒ 1 200 bit/s

(for unbalanced transmission only)

*Unbalanced interchange
circuit V.24/V.28
Recommended if >1 200 bit/s*

- ☒ 2 400 bit/s (ERLDC only)
- ☐ 4 800 bit/s
- ☐ 9 600 bit/s

*Balanced interchange
circuit X.24/X.27*

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s
- ☐ 9 600 bit/s
- ☐ 19 200 bit/s
- ☐ 38 400 bit/s
- ☐ 56 000 bit/s
- ☐ 64 000 bit/s

Transmission speed (monitor direction) :

*Unbalanced interchange
circuit V.24/V.28
Standard*

- ☐ 100 bit/s
- ☒ 200 bit/s

*Unbalanced interchange
circuit V.24/V.28
Recommended if >1 200 bit/s*

- ☒ 2 400 bit/s(ERLDC only)
- ☐ 4 800 bit/s

*Balanced interchange
circuit X.24/X.27*

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s

- | | | |
|---|--------------------------------------|---------------------------------------|
| ☒ 300 bit/s | ☐ 9 600 bit/s | ☐ 9 600 bit/s |
| ☒ 600 bit/s | | ☐ 19 200 bit/s |
| ☒ 1 200 bit/s | | ☐ 38 400 bit/s |
| | | ☐ 56 000 bit/s |
| | | ☐ 64 000 bit/s |
- (for unbalanced transmission only)

1.4 LINK LAYER (*Network-specific parameter*)

Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

Link transmission procedure

- ☐ Balanced transmission
- ☒ Unbalanced transmission

Address field of the link

- ☐ Not present (balanced transmission only)
- ☒ One octet
- ☐ Two octets
- ☐ Structured
- ☒ Unstructured

Frame length

255 Maximum length L (number of octets)

1.5 APPLICATION LAYER

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter)

- ☒ One octet
- ☐ Two octets

Information object address

(system-specific parameter)

- | | |
|--|--|
| ☐ One octet | ☐ Structured |
| ☒ Two octets | ☒ Unstructured |
| Three octets | |

Cause of transmission
(system-specific parameter)

- One octet □ Two octets (with originator address)

Selection of standard ASDUs
(station-specific parameter)

■ <1> := Single-point information	M_SP_NA_1
■ <2> := Single-point information with time tag	M_SP_TA_1
■ <3> := Double-point information	M_DP_NA_1
■ <4> := Double-point information with time tag	M_DP_TA_1
□ <5> := Step position information	M_ST_NA_1
□ <6> := Step position information with time tag	M_ST_TA_1
□ <7> := Bitstring of 32 bit	M_BO_NA_1
□ <8> := Bitstring of 32 bit with time tag	M_BO_TA_1
■ <9> := Measured value, normalized value	M_ME_NA_1
□ <10> := Measured value, normalized value with time tag	M_ME_TA_1
■ <11> := Measured value, scaled value	M_ME_NB_1
□ <12> := Measured value, scaled value with time tag	M_ME_TB_1
□ <13> := Measured value, short floating point value	M_ME_NC_1
□ <14> := Measured value, short floating point value with time tag	M_ME_TC_1
■ <15> := Integrated totals	M_IT_NA_1
□ <16> := Integrated totals with time tag	M_IT_TA_1
□ <17> := Event of protection equipment with time tag	M_EP_TA_1
□ <18> := Packed start events of protection equipment with time tag	M_EP_TB_1
□ <19> := Packed output circuit information of protection equipment with time tag	M_EP_TC_1
□ <20> := Packed single-point information with status change detection	M_PS_NA_1
□ <21> := Measured value, normalized value without quality descriptor	M_ME_ND_1

Process information in control direction
(station-specific parameter)

■ <45> := Single command	C_SC_NA_1
■ <46> := Double command	C_DC_NA_1
□ <47> := Regulating step command	C_RC_NA_1
□ <48> := Set point command, normalized value	C_SE_NA_1
■ <49> := Set point command, scaled value (required only for analog output command)*	C_SE_NB_1
□ <50> := Set point command, short floating point value	C_SE_NC_1
□ <51> := Bitstring of 32 bit	C_BO_NA_1

System information in monitor direction
(station-specific parameter)

■ <70> := End of initialization	M_EI_NA_1
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System information in control direction
(station-specific parameter)

■ <100> := Interrogation command	C_IC_NA_1
■ <101> := Counter interrogation command	C_CI_NA_1
□ <102> := Read command	C_RD_NA_1
■ <103> := Clock synchronization command (optional, if GPS is used for time synch. of the RTU)*	C_CS_NA_1
□ <104> := Test command	C_TS_NA_1
■ <105> := Reset process command	C_RP_NA_1
■ <106> := Delay acquisition command (optional, if GPS is used for time synch. of the RTU)*	C_CD_NA_1

Parameter in control direction
(station-specific parameter)

□ <110> := Parameter of measured value, normalized value	P_ME_NA_1
□ <111> := Parameter of measured value, scaled value	P_ME_NB_1
□ <112> := Parameter of measured value, short floating point value	P_ME_NC_1
□ <113> := Parameter activation	P_AC_NA_1

File transfer *(may not be required)**
(station-specific parameter)

■ <120> := File ready	F_FR_NA_1
■ <121> := Section ready	F_SR_NA_1
■ <122> := Call directory, select file, call file, call section	F_SC_NA_1
■ <123> := Last section, last segment	F_LS_NA_1
■ <124> := Ack file, ack section	F_AF_NA_1
■ <125> := Segment	F_SG_NA_1
■ <126> := Directory	F_DR_TA_1

Special use
(private range)

■ <137> := Regulating delay command (for Raise/Lower command of OLTC .May not be required)*	C_RC_NB_1
--	-----------

1.6 BASIC APPLICATION FUNCTIONS

Station initialization (station-specific parameter)

- Remote initialization

General interrogation (system or station-specific parameter)

■ Global		
■ Group 1	■ Group 7	■ Group 13
■ Group 2	■ Group 8	■ Group 14
■ Group 3	■ Group 9	■ Group 15
■ Group 4	■ Group 10	■ Group 16
■ Group 5	■ Group 11	
■ Group 6	■ Group 12	Addresses per group have to be defined

Clock synchronization (station-specific parameter)

- Clock synchronization (optional, if GPS is used for time synch. of the RTU)*

Command transmission (Required only when control command is envisaged)* (object-specific parameter)

- ☒ Direct command transmission
- ☒ Select and execute command
- ☒ Direct set point command transmission
- ☒ Select and execute set point command
- ☐ C_SE ACTTERM used
- ☒ No additional definition
- ☐ Short pulse duration (duration determined by a system parameter in the outstation)
- ☐ Long pulse duration (duration determined by a system parameter in the outstation)
- ☐ Persistent output

Transmission of integrated totals

(station or object-specific parameter)

- ☒ Counter request
- ☒ General request counter
- ☒ Counter freeze without reset
- ☐ Request counter group 1
- ☒ Counter freeze with reset
- ☐ Request counter group 2
- ☐ Counter reset
- ☐ Request counter group 3
- ☐ Request counter group 4

Addresses per group have to be defined

Parameter loading

(object-specific parameter)

- ☐ Threshold value
- ☐ Smoothing factor
- ☐ Low limit for transmission of measured value
- ☐ High limit for transmission of measured value

Parameter activation

(object-specific parameter)

- ☐ Act/deact of persistent cyclic or periodic transmission of the addressed object

File transfer

(station-specific parameter)

- ☒ File transfer in monitor direction (for SOE data file from RTU to RLDC, may not be required)*
- ☒ File transfer in control direction (for downloading of RTU database from RLDC-May not be required)*

2. ADDITIONAL INFORMATION ON IEC 60870-5-101 FOR NRLDC, NERLDC AND ERLDC

A. Telemetred Data and ASDU mapping

The following table explains the type of the telemetered data and corresponding ASDUs used to transmit this data as per IEC 60870-5-101 protocol. These are same for all the above three RLDCs.

Type of Data	Data Unit type as per IEC	Description as per IEC	Data polling method	Interrogation group	Transmitted after Class-X request	Info Obj. Address range
Analog inputs (P, Q, V, f, OLTC tap position)	ASDU-11	Measured value scaled value	As cyclic data on Class 2 polls		Class 2	8448-
Digital inputs — Single status (Isolators, Protection signals) A single status object uses the same IOA address when being sent as ASDU-1 or ASDU-2 or as a file transfer	ASDU-1	Single point information	By exception (spontaneous) and on periodic Group scan	Group-1	Class 1 on exception, Class 1 after Group 1 scan	376
	ASDU-2	Single point information with time tag	By exception (spontaneous)		Class 1 on exception	376-
Digital inputs — Double status (Circuit breakers) A double status object uses the same IOA address when being sent as ASDU-3 or ASDU-4 or as a file transfer	ASDU-3	Double point information	By exception (spontaneous) and on periodic Group scan	Group-1	Class 1 on exception, Class 1 after Group 1 scan	256-
		ASDU-4 Double point information with time tag	By exception (spontaneous)		Class 1 on exception	256-
Pulse	ASDU-15	Integrated	By periodic	Group-	Class 2	12544-

accumulators		totals	counter interrogation	1 (counter interrog ation)		
Analog Outputs (Setpoint)	ASDU-48 Set point command Normalized value					37120
Digital Control command (CB Trip/Close)	ASDU 46	Double command				33024-
SOE (Digital inputs with Time)	File* transfer	See the file format enclosed				

B. DATA POLLING METHOD

1. The RTU shall respond to the Master stations request for the at least the following commands as per the protocol:
 - Status of Link
 - Reset of Link
 - Delay acquisition command *
 - Clock synchronization command *
 - General interrogation command
 - Interrogation of Scan group 1 command (all status data)
 - Interrogation of Scan group 2 command (all analog data)
 - Class 1/2 data polling
 - File transfer in Monitor direction (SOE file)*
 If supervisory control commands are envisaged, then SBO procedure is to be used.
2. RTU shall send all Analog and status data in response to the General interrogation command.
3. All digital inputs are to be assigned to Scan group-1.
4. Analogs are defined as periodic data and are sent to RLDC on Class 2 request. The periodicity varies from 10 seconds to 15 seconds depending upon the quantity of data and available bandwidth.
5. Digital input state changes are to be reported spontaneously by RTU as Class 1 data. The Digital input data have higher priority than Analog values. An integrity

scan is performed for all the digital inputs using Scan group-1 at every 10 minutes interval.

6. The SOE (Sequence of Events) information is stored in a file in the RTU. The format of SOE data is enclosed in a separate file (please see the details in ***SOE_erldc_nerldc_nrldc.pdf*** document). This file is transferred using the file transfer feature of IEC 60870-5-101 protocol.

** These features may not be required*

INTEROPERABILITY PROFILE OF IEC 60870-5-101 PROTOCOL FOR SR

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be marked in the white boxes as follows:

☐	Function of ASDU is not used
☒	Function or ASDU is used as standardized (default)

Note : In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

1.1 SYSTEM or DEVICE

(System-specific parameter, indicate the definition of a system or a device by marking one of the following with an 'X')

- ☐ System definition
- ☐ Controlling station definition (master)
- ☒ Controlled station definition (Slave)

1.2 NETWORK CONFIGURATION

(Network-specific parameter, all configurations that are used are to be marked with ☐)

- ☒ Point-to-point
- ☒ Multiple point-to-point
- ☒ Multipoint-party line
- ☐ Multipoint-star

1.3 PHYSICAL LAYER (Network-specific parameter)

Transmission speed (control direction) :

*Unbalanced interchange
circuit V.24/V.28
Standard*

- ☐ 100 bit/s
- ☒ 200 bit/s
- ☒ 300 bit/s
- ☒ 600 bit/s
- ☒ 1 200 bit/s

(for unbalanced transmission only)

*Unbalanced interchange
circuit V.24/V.28
Recommended if >1 200 bit/s*

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s
- ☐ 9 600 bit/s

*Balanced interchange
circuit X.24/X.27*

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s
- ☐ 9 600 bit/s
- ☐ 19 200 bit/s
- ☐ 38 400 bit/s
- ☐ 56 000 bit/s
- ☐ 64 000 bit/s

Transmission speed (monitor direction) :

*Unbalanced interchange
circuit V.24/V.28
Standard*

- ☐ 100 bit/s
- ☒ 200 bit/s

*Unbalanced interchange
circuit V.24/V.28
Recommended if >1 200 bit/s*

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s

*Balanced interchange
circuit X.24/X.27*

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s

- | | | |
|---|--------------------------------------|---------------------------------------|
| ☒ 300 bit/s | ☐ 9 600 bit/s | ☐ 9 600 bit/s |
| ☒ 600 bit/s | | ☐ 19 200 bit/s |
| ☒ 1 200 bit/s | | ☐ 38 400 bit/s |
| | | ☐ 56 000 bit/s |
| | | ☐ 64 000 bit/s |
- (for unbalanced transmission only)

1.4 LINK LAYER (*Network-specific parameter*)

Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

Link transmission procedure Address field of the link

- | | |
|---|---|
| ☐ Balanced transmission | ☐ Not present (balanced transmission only) |
| ☒ Unbalanced transmission | ☒ One octet |
| | ☐ Two octets |
| | ☐ Structured |
| | ☒ Unstructured |

Frame length

255 Maximum length L (number of octets)

1.5 APPLICATION LAYER

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter)

- | | |
|---|-------------------------------------|
| ☒ One octet | ☐ Two octets |
|---|-------------------------------------|

Information object address

(system-specific parameter)

- | | |
|--|--|
| ☐ One octet | ☐ Structured |
| ☒ Two octets | ☒ Unstructured |

☐ Three octets

Cause of transmission

(system-specific parameter)

■ One octet

☐ Two octets (with originator address)

Selection of standard ASDUs

(station-specific parameter)

■ <1> :=	Single-point information	M_SP_NA_1
■ <2> :=	Single-point information with time tag	M_SP_TA_1
☐ <3> :=	Double-point information	M_DP_NA_1
☐ <4> :=	Double-point information with time tag	M_DP_TA_1
☐ <5> :=	Step position information	M_ST_NA_1
☐ <6> :=	Step position information with time tag	M_ST_TA_1
■ <7> :=	Bitstring of 32 bit	M_BO_NA_1
☐ <8> :=	Bitstring of 32 bit with time tag	M_BO_TA_1
■ <9> :=	Measured value, normalized value	M_ME_NA_1
☐ <10> :=	Measured value, normalized value with time tag	M_ME_TA_1
☐ <11> :=	Measured value, scaled value	M_ME_NB_1
☐ <12> :=	Measured value, scaled value with time tag	M_ME_TB_1
☐ <13> :=	Measured value, short floating point value	M_ME_NC_1
☐ <14> :=	Measured value, short floating point value with time tag	M_ME_TC_1
■ <15> :=	Integrated totals	M_IT_NA_1
☐ <16> :=	Integrated totals with time tag	M_IT_TA_1
☐ <17> :=	Event of protection equipment with time tag	M_EP_TA_1
☐ <18> :=	Packed start events of protection equipment with time tag	M_EP_TB_1
☐ <19> :=	Packed output circuit information of protection equipment with time tag	M_EP_TC_1
☐ <20> :=	Packed single-point information with status change Detection	M_PS_NA_1
☐ <21> :=	Measured value, normalized value without quality descriptor	M_ME_ND_1

Process information in control direction

(station-specific parameter)

■ <45> :=	Single command	C_SC_NA_1
□ <46> :=	Double command	C_DC_NA_1
□ <47> :=	Regulating step command	C_RC_NA_1
■ <48> :=	Set point command, normalized value (required only for analog output command)*	C_SE_NA_1
□ <49> :=	Set point command, scaled value	C_SE_NB_1
□ <50> :=	Set point command, short floating point value	C_SE_NC_1
□ <51> :=	Bitstring of 32 bit	C_BO_NA_1

System information in monitor direction

(station-specific parameter)

■ <70> :=	End of initialization	M_EI_NA_1
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System information in control direction

(station-specific parameter)

■ <100> :=	Interrogation command	C_IC_NA_1
■ <101> :=	Counter interrogation command	C_CI_NA_1
□ <102> :=	Read command	C_RD_NA_1
■ <103> :=	Clock synchronization command (optional, if GPS is used for time synch. of the RTU)*	C_CS_NA_1
□ <104> :=	Test command	C_TS_NA_1
□ <105> :=	Reset process command	C_RP_NA_1
■ <106> :=	Delay acquisition command (optional, if GPS is used for time synch. of the RTU)*	C_CD_NA_1

Parameter in control direction

(station-specific parameter)

□ <110> :=	Parameter of measured value, normalized value	P_ME_NA_1
□ <111> :=	Parameter of measured value, scaled value	P_ME_NB_1
□ <112> :=	Parameter of measured value, short floating point value	P_ME_NC_1
□ <113> :=	Parameter activation	P_AC_NA_1

File transfer (for downloading of database from RLDC, may not be required) *

(station-specific parameter)

■ <120> :=	File ready	F_FR_NA_1
■ <121> :=	Section ready	F_SR_NA_1
■ <122> :=	Call directory, select file, call file, call section	F_SC_NA_1
■ <123> :=	Last section, last segment	F_LS_NA_1
■ <124> :=	Ack file, ack section	F_AF_NA_1
■ <125> :=	Segment	F_SG_NA_1
□ <126> :=	Directory	F_DR_TA_1

1.6 BASIC APPLICATION FUNCTIONS

Station initialization

(station-specific parameter)

- Remote initialization

General interrogation

(system or station-specific parameter)

- Global

■ Group 1	■ Group 7	■ Group 13
■ Group 2	■ Group 8	■ Group 14
■ Group 3	■ Group 9	■ Group 15
■ Group 4	■ Group 10	■ Group 16
■ Group 5	■ Group 11	
■ Group 6	■ Group 12	Addresses per group have to be defined

Clock synchronization

(station-specific parameter)

- Clock synchronization (optional, if GPS is used for time synch. of the RTU)*

Command transmission (Required only when control command is envisaged)*

(object-specific parameter)

■ Direct command transmission	■ Select and execute command
■ Direct set point command transmission	■ Select and execute set point
	□ C_SE ACTTERM used

■ No additional definition

Short pulse duration (duration determined by a system parameter in the outstation)

Long pulse duration (duration determined by a system parameter in the outstation)

Persistent output

Transmission of integrated totals

(station or object-specific parameter)

■ Counter request

☐ General request counter

■ Counter freeze without reset

☐ Request counter group 1

■ Counter freeze with reset

☐ Request counter group 2

☐ Counter reset

☐ Request counter group 3

☐ Request counter group 4

Addresses per group have to be defined

Parameter loading

(object-specific parameter)

☐ Threshold value

☐ Smoothing factor

☐ Low limit for transmission of measured value

☐ High limit for transmission of measured value

Parameter activation

(object-specific parameter)

☐ Act/deact of persistent cyclic or periodic transmission of the addressed object

File transfer

(station-specific parameter)

☐ File transfer in monitor direction

■ File transfer in control direction (*For downloading of database from RLDC, May not be required*)*

2. ADDITIONAL INFORMATION ON IEC 60870-5-101 FOR SRLDC

A. Telemetred Data and ASDU mapping

The following table explains the type of the telemetred data and corresponding ASDUs used to transmit this data as per IEC 60870-5-101 protocol

Type of power system Data	Data Unit type as per IEC	Description as per IEC	Data polling method	Interr ogation group	Transmitted after Class-X request	Info Obj. Address range
Analog inputs (P,Q, V, f)	ASDU-9	Measured value normalized value	By periodic Group scan	Group-2	Class 2	2001-3000
Digital inputs– Single status(Circuit breakers, Isolators, Protection signals)	ASDU-1	Single point information	By exception (spontaneous) and on periodic Group scan	Group-1	Class 1 after exception, Class 2 after Group 1 scan	1-1000
	ASDU-2 (for SOE)	Single point information with time tag	By exception (spontaneous)		Class 1 after exception	1001-2000
Pulse accumulators	ASDU-15	Integrated totals	By periodic counter interrogation	Group-1 (count er interro gation)	Class 2	4001-5000
Analog Outputs (Setpoint)	ASDU-48	Set point command Normalized value				5001-6000
Digital Control command (CB Trip/Close)	ASDU 45	Single command				3001-4000

B. DATA POLLING METHOD

1. The RTU shall respond to the Master stations request for the at least the following commands as per the protocol:
 - Status of Link

- Reset of Link
- Delay acquisition command *
- Clock synchronization command *
- General interrogation command
- Interrogation of Scan group 1 command (all status data)
- Interrogation of Scan group 2 command (all analog data)
- Class 1/2 data polling

If supervisory control commands are envisaged, then SBO procedure is to be used.

2. Normal data polling is by Scan groups
3. All digital inputs are assigned to Scan group-1 and all Analog values are assigned to Scan group-2
4. Analog values are acquired periodically by using the Scan group-2 polling. This periodicity is ranging from 10-15 seconds based on the quantity of analogs and the communication channel bandwidth.
5. Digital input state changes are reported spontaneously by RTU as class 1 data and a integrity scan is performed for all the digital inputs using Scan group-1 at every 10 minutes interval.
6. Double bit digital status data are to be sent as two single-point information from the RTU.

** These features may not be required*

INTEROPERABILITY PROFILE OF IEC 60870-5-101 PROTOCOL FOR WR

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters. The selected parameters should be marked in the white boxes as follows:

☐	Function of ASDU is not used
☒	Function or ASDU is used as standardized (default)

Note : In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

1.1 SYSTEM or DEVICE

(System-specific parameter, indicate the definition of a system or a device by marking one of the following with an 'X')

- ☐ System definition
- ☐ Controlling station definition (master)
- ☒ Controlled station definition (Slave)

1.2 NETWORK CONFIGURATION

(Network-specific parameter, all configurations that are used are to be marked with _)

- ☒ Point-to-point
- ☒ Multipoint-party line
- ☐ Multiple point-to-point
- ☐ Multipoint-star

1.3 PHYSICAL LAYER (Network-specific parameter)

Transmission speed (control direction) :

*Unbalanced interchange
circuit V.24/V.28
Standard*

*Unbalanced interchange
circuit V.24/V.28
Recommended if >1 200 bit/s*

*Balanced interchange
circuit X.24/X.27*

- ☐ 100 bit/s
- ☐ 200 bit/s
- ☒ 300 bit/s
- ☒ 600 bit/s
- ☒ 1 200 bit/s

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s
- ☐ 9 600 bit/s

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s
- ☐ 9 600 bit/s
- ☐ 19 200 bit/s
- ☐ 38 400 bit/s
- ☐ 56 000 bit/s
- ☐ 64 000 bit/s

(for unbalanced transmission only)

Transmission speed (monitor direction) :

*Unbalanced interchange
circuit V.24/V.28
Standard*

*Unbalanced interchange
circuit V.24/V.28
Recommended if >1 200 bit/s*

*Balanced interchange
circuit X.24/X.27*

- ☐ 100 bit/s
- ☐ 200 bit/s
- ☒ 300 bit/s

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s
- ☐ 9 600 bit/s

- ☐ 2 400 bit/s
- ☐ 4 800 bit/s
- ☐ 9 600 bit/s

- ☒ 600 bit/s
- ☒ 1 200 bit/s

(for unbalanced transmission only)

- ☐ 19 200 bit/s
- ☐ 38 400 bit/s
- ☐ 56 000 bit/s
- ☐ 64 000 bit/s

1.4 LINK LAYER *(Network-specific parameter)*

Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

Link transmission procedure

- ☐ Balanced transmission
- ☒ Unbalanced transmission

Address field of the link

- ☐ Not present (balanced transmission only)
- ☒ One octet
- ☐ Two octets
- ☐ Structured
- ☒ Unstructured

Frame length

255 Maximum length L (number of octets)

1.5 APPLICATION LAYER

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter)

- ☒ One octet
- ☐ Two octets

Information object address

(system-specific parameter)

- ☐ One octet
- ☒ Two octets
- ☐ Three octets
- ☐ Structured
- ☒ Unstructured

Cause of transmission

(system-specific parameter)

■ One octet

□ Two octets (with originator address)

Selection of standard ASDUs
(station-specific parameter)

■ <1> :=	Single-point information	M_SP_NA_1
■ <2> :=	Single-point information with time tag	M_SP_TA_1
■ <3> :=	Double-point information	M_DP_NA_1
■ <4> :=	Double-point information with time tag	M_DP_TA_1
□ <5> :=	Step position information	M_ST_NA_1
□ <6> :=	Step position information with time tag	M_ST_TA_1
■ <7> :=	Bitstring of 32 bit	M_BO_NA_1
□ <8> :=	Bitstring of 32 bit with time tag	M_BO_TA_1
■ <9> :=	Measured value, normalized value	M_ME_NA_1
□ <10> :=	Measured value, normalized value with time tag	M_ME_TA_1
□ <11> :=	Measured value, scaled value	M_ME_NB_1
□ <12> :=	Measured value, scaled value with time tag	M_ME_TB_1
□ <13> :=	Measured value, short floating point value	M_ME_NC_1
□ <14> :=	Measured value, short floating point value with time tag	M_ME_TC_1
■ <15> :=	Integrated totals	M_IT_NA_1
□ <16> :=	Integrated totals with time tag	M_IT_TA_1
□ <17> :=	Event of protection equipment with time tag	M_EP_TA_1
□ <18> :=	Packed start events of protection equipment with time tag	M_EP_TB_1
□ <19> :=	Packed output circuit information of protection equipment with time tag	M_EP_TC_1
□ <20> :=	Packed single-point information with status change detection	M_PS_NA_1
□ <21> :=	Measured value, normalized value without quality descriptor	M_ME_ND_1

Process information in control direction
(station-specific parameter)

■ <45> :=	Single command	C_SC_NA_1
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■ <46> :=	Double command	C_DC_NA_1
□ <47> :=	Regulating step command	C_RC_NA_1
■ <48> :=	Set point command, normalized value (required only for analog output command)*	C_SE_NA_1
□ <49> :=	Set point command, scaled value	C_SE_NB_1
□ <50> :=	Set point command, short floating point value	C_SE_NC_1
□ <51> :=	Bitstring of 32 bit	C_BO_NA_1

System information in monitor direction

(station-specific parameter)

■ <70> :=	End of initialization	M_EI_NA_1
-----------	-----------------------	-----------

System information in control direction

(station-specific parameter)

■ <100> :=	Interrogation command	C_IC_NA_1
■ <101> :=	Counter interrogation command	C_CI_NA_1
□ <102> :=	Read command	C_RD_NA_1
■ <103> :=	Clock synchronization command (optional, if GPS is used for time synch. of the RTU)*	C_CS_NA_1
□ <104> :=	Test command	C_TS_NA_1
□ <105> :=	Reset process command	C_RP_NA_1
■ <106> :=	Delay acquisition command (optional, if GPS is used for time synch. of the RTU)*	C_CD_NA_1

Parameter in control direction

(station-specific parameter)

□ <110> :=	Parameter of measured value, normalized value	P_ME_NA_1
□ <111> :=	Parameter of measured value, scaled value	P_ME_NB_1
□ <112> :=	Parameter of measured value, short floating point value	P_ME_NC_1
□ <113> :=	Parameter activation	P_AC_NA_1

File transfer (for downloading of database from RLDC, may not be required)*

(station-specific parameter)

■ <120> :=	File ready	F_FR_NA_1
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■ <121> :=	Section ready	F_SR_NA_1
■ <122> :=	Call directory, select file, call file, call section	F_SC_NA_1
■ <123> :=	Last section, last segment	F_LS_NA_1
■ <124> :=	Ack file, ack section	F_AF_NA_1
■ <125> :=	Segment	F_SG_NA_1
□ <126> :=	Directory	F_DR_TA_1

1.6 BASIC APPLICATION FUNCTIONS

Station initialization

(station-specific parameter)

■ Remote initialization

General interrogation

(system or station-specific parameter)

■ Global

■ Group 1	■ Group 7	■ Group 13
■ Group 2	■ Group 8	■ Group 14
■ Group 3	■ Group 9	■ Group 15
■ Group 4	■ Group 10	■ Group 16
■ Group 5	■ Group 11	
■ Group 6	■ Group 12	Addresses per group have to be defined

Clock synchronization

(station-specific parameter)

■ Clock synchronization (optional, if GPS is used for time synch. of the RTU)*

Command transmission (Required only when control command is envisaged)*

(object-specific parameter)

□ Direct command transmission	■ Select and execute command
□ Direct set point command transmission	■ Select and execute set point
	□ C_SE ACTTERM used

■ No additional definition

Short pulse duration (duration determined by a system parameter in the outstation)

Long pulse duration (duration determined by a system parameter in the outstation)

Persistent output

Transmission of integrated totals

(station or object-specific parameter)

- | | |
|--|--|
| ☒ Counter request | ☐ General request counter |
| ☒ Counter freeze without reset | ☐ Request counter group 1 |
| ☒ Counter freeze with reset | ☐ Request counter group 2 |
| ☐ Counter reset | ☐ Request counter group 3 |
| | ☐ Request counter group 4 |

Addresses per group have to be defined

Parameter loading

(object-specific parameter)

- ☐ Threshold value
- ☐ Smoothing factor
- ☐ Low limit for transmission of measured value
- ☐ High limit for transmission of measured value

Parameter activation

(object-specific parameter)

- ☐ Act/deact of persistent cyclic or periodic transmission of the addressed object

File transfer

(station-specific parameter)

- ☐ File transfer in monitor direction
- ☒ File transfer in control direction (*For downloading of database from RLDC, May not be required*)*

ADDITIONAL INFORMATION ON IEC 60870-5-101 FOR WRLDC**A. Telemetred Data and ASDU mapping**

The following table explains the type of the telemetred data and corresponding ASDUs used to transmit this data as per IEC 60870-5-101 protocol

Type of power system Data	Data Unit type as per IEC	Description as per IEC	Data polling method	Scan group	Transmitted after Class-X request	Info Obj. Address range
Analog inputs (P,Q, V, f)	ASDU-9	Measured value normalized value	By periodic Group scan	Group-3	Class 2	3001-4000
Digital inputs – Single status (Isolators, Protection signals)	ASDU-1	Single point information	By exception (spontaneous) and on periodic Group scan	Group-1	Class 1 after exception, Class 1 after Group 1 scan	1-1000
	ASDU-2 (for SOE)	Single point information with time tag	By exception (spontaneous)		Class 1 after exception	1001-2000
Digital inputs - Double status (Circuit breaker)	ASDU-3	Double point information	By exception (spontaneous) and on periodic Group scan	Group 2	Class 1 after exception, Class 1 after Group 1 scan	2001-3000
	ASDU-4	Double point information with time tag	By exception (spontaneous)		Class 1 after exception	Same address range as above
Pulse accumulators	ASDU-15	Integrated totals	By periodic counter interrogation	Group-1 (counter interrogation)	Class 2	5001-6000
Analog Outputs (Setpoint)	ASDU-48	Set point command Normalized Value				6001-7000
Digital Control	ASDU 45	Single command				4501-5000

command (CB Trip/Close)						
Digital Control command (CB Trip/Close)	ASDU 46	Double command				4001- 4500

B. DATA POLLING METHOD

1. The RTU shall respond to the Master stations request for the at least the following commands as per the protocol:
 - Status of Link
 - Reset of Link
 - Delay acquisition command *
 - Clock synchronization command *
 - General interrogation command
 - Interrogation of Scan group 1 command (all single status digital data)
 - Interrogation of Scan group 2 command (all double status digital data analog data)
 - Interrogation of Scan group 3 command (all analog data)
 - Class 1/2 data polling

If supervisory control commands are envisaged, then SBO procedure is to be used.
2. Normal data polling is by Scan groups
3. All single digital inputs are assigned to Scan group-1, all double digital inputs are assigned to Scan group-2 and all Analog values are assigned to Scan group-3
4. Analog values are acquired periodically by using the Scan group-3 polling. This periodicity is ranging from 10-15 seconds based on the quantity of analogs and the communication channel bandwidth.
5. Digital input state changes are reported spontaneously by RTU as class 1 data and a integrity scan is performed for all the digital inputs using Scan group-1 and Scan group-2 at every 10 minutes interval.

** These features may not be required*

List of IO Points to be transmitted to RSCC

- a) MW and MVAR for all lines, transformers, reactors and Capacitors
- b) Voltage of all buses
- c) Frequency of all 400kV and 765kV Buses
- d) Frequency of one 220kV Bus
- e) All Breakers
- f) All isolators
- g) Tap Position for all transformers
- h) Master protection signal for all feeders, transformers Units and Bus Bar
- i) Loss of Voltage signal for Bus bar
- j) All the points identified in point (e),(h) and (i) above as GPS Time stamped.
- k) Temperature value per substation.
- l) Any other point decided during detailed engineering

Bill Of Material For Substation Automation System

Sl.No.	Item Description	Qty No.
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1.	Simplex type panels equipped with the following: SCADA Pro based Control and monitoring system, including system configuration, database engineering, IEC 61850 communication system. The following hardware is included: • 2 nos. : of HP/Dell/Compaq/Laxsons/equivalent make PC with Core 2 Duo Processor, 1GB RAM, 1 x 320 GB HDD, 1x 24x DVD Combo Drive, OS: Windows Vista Professional for station servers. • 2 nos. Ruggedcom make Managed IEC 61850 compliant 16/8 port Ethernet switches for interbay bus LAN connected in fault tolerant ring configuration, including fiber optic cable. • 1no DR workstation. • 1no. Remote HMI. • 1 no. APC/equivalent UPS with 30 mins battery back up (1x1000VA) • 1 no: 80 column Dot Matrix Printer incl. cable • 1 no A4 size Laser Printer for Graphics & reports • 1x Printer server. Functionality All Basic Monitoring functions All Basic Control functions Advanced monitoring functions: • Measuring reports and trends • Remote parameter setting and reading • Uploading disturbance fault record files • Disturbance record analysis	1 set
	Communication with RLDC } integrated gateway on Communication with DCS } IEC101/104 protocol. of Power plant. Advanced control functions: Automatic sequence control	
2.	Meinberg/Arbiter/equivalent make GPS receiver on SNTP protocol including antenna and cable with following ports for time synchronization: • RJ45 - 2 nos. • RS232 port - 1 no.	1 set
3.	FO Cables for connecting IEDs to Switches	1 set

TECHNICAL SPECIFICATION OF VARIOUS AUXILIARY ITEMS AND TRANSDUCERS:

The detailed technical particulars of the auxiliary items and transducers mentioned to be supplied and installed by the successful bidder are given hereunder:

1. HMI (Human Machine Interface) Main and Hot Stand by Computer/Server:

The HMI (for Main and Hot Standby) Computer/ Server shall be rugged and industrial heavy duty [for 24 hours continuous trouble free operations] construction and have following and better specifications mentioned as follows:

Power supply:	230 V + / - 10 V , 50 Hz AC
Processor Type:	Intel Pentium Core 2 Quad Processor, 2.8 GHz or Higher, Standard L2 2MB, 800 MHz front side bus.
Chipset:	INTEL 945 GC chipset
Memory Type:	DDR2-Synch DRAM PC2-5300 @ 667 MHz
Standard Memory:	4 GB
Hardware monitoring:	System Monitor (fan, temp., voltage)
Memory upgrade:	Expandable
Internal hard disk drive:	320 GB
Hard disk drive speed:	7200 rpm
Optical drives:	16 X DVD-ROM (Combo)
Flexible disk drive:	1.44 MB Diskette drive
Mounting:	Rack mountable 4U Height
Chassis type:	19" 4U Industrial Rack mount BP chassis
Fans, Air filter, cables:	One 12cm & one 8 cm cooling fans with removable filter and lockable front door. ON/OFF, HDD, FDD, RESET with all power and interconnecting cables.
Video adapter, bus:	PCI Express TM X16
Expansion slots:	Two full -height PCI 2.3 slots, one full-height PCI Express x1 slot and one full-height PCI x 16 slot.
Audio Integrated:	Audio with External speakers & Microphone
Modem Integrated:	56 PCI Modem
Network Interface:	Integrated 10/100/1000 Gigabit Fast Ethernet-WOL, Dual RJ-45 with Two LED indicators.
External I/O ports:	1 x Parallel port, 1 x Serial port, 1 x PS/2 mouse, 6 x USB 2.0 ports (2 front, 4 rear), 2 x VGA [suitable for Dual Monitor VGA Output], 1 x RJ-45, 3 Audio ports (rear: audio-in, audio-out/headphone, mic-in)
Monitor:	25" LCD TFT

Keyboard Standard:	PS/2 Soft touch Keyboard.
Pointing Device:	2-Button Optical Scroll Mouse (USB)
Operating system installed:	System and Application Software
Other Preloaded:	Antivirus s/w Registered standard latest Anti-virus software

2. HMI View Node/DR/RCC Workstation Computer/Server:

The HMI View Node/DR/RCC Workstation Computer/ Server shall be rugged and industrial heavy duty [for 24 hours continuous trouble free operations] construction and have following and better specifications mentioned as follows:

Power supply:	230 V + / - 10 V , 50 Hz AC
Processor Type:	Intel Pentium Core 2 Quad Processor, 2.8 GHz or Higher, Standard L2 2MB, 800 MHz front side bus.
Chipset:	INTEL 945 GC chipset
Memory Type:	DDR2-Synch DRAM PC2-5300 @ 667 MHz
Standard Memory:	2 GB
Memory slots:	2 DIMM
Memory upgrade:	Expandable
Internal hard disk drive:	320 GB
Hard disk drive speed:	7200 rpm
Optical drives:	16 X DVD-ROM (Combo)
Flexible disk drive:	1.44 MB Diskette drive & 2 GB Flash Drive
Chassis type:	Microtower
Video adapter, bus:	PCI Express TM X16
Expansion slots:	Two full -height PCI 2.3 slots, one full-height PCI Express x1 slot and one full-height PCI x 16 slot.
Audio:	Integrated Audio with External speakers & Microphone
Modem:	Integrated 56 PCI Modem
Network Interface:	Integrated 10/100/1000 Gigabit Fast Ethernet-WOL, Dual RJ-45 with Two LED indicators.
External I/O ports:	1 x Parallel port, 1 x Serial port, 1 x PS/2 mouse, 6 x USB 2.0 ports (2 front, 4 rear), 2 x VGA [suitable for Dual Monitor VGA Output], 1 x RJ-45, 3 Audio ports (rear: audio-in, audio-out/headphone, mic-in)
Monitor:	25" LCD TFT
Keyboard Standard:	PS/2 Soft touch Keyboard.
Pointing Device:	2-Button Optical Scroll Mouse (USB)
Operating system installed:	System and Application Software

Other Preloaded:	Antivirus s/w Registered standard latest Anti-virus software
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3. Industrial Gateway:

The Gateway for RCC and RTU (for SLDC communication) Computer/ Server shall be industrial, rugged heavy duty [for 24 hours continuous trouble free operations] construction and have following and better specifications mentioned as follows:

3.1 Industrial Gateway- RCC

Power supply:	230 V + / - 10 V , 50 Hz AC
Processor Type:	Intel Pentium Core 2 Quad Processor, 2.8 GHz or Higher, Standard L2 2MB, 800 MHz front side bus.
Chipset:	INTEL 945 GC chipset
Memory Type:	DDR2-Synch DRAM PC2-5300 @ 667 MHz
Standard Memory:	4 GB
Memory slots:	2 DIMM
Hardware monitoring:	System Monitor (fan, temp., voltage)
Memory upgrade:	Expandable
Internal hard disk drive:	160 GB
Hard disk drive speed:	7200 rpm
Optical drives:	16 X DVD-ROM (Combo)
Flexible disk drive:	1.44 MB Diskette drive
Mounting:	Rack mountable 4U Height
Chassis type:	19" 4U Industrial Rack mount BP chassis
Fans, Air filter, cables:	One 12cm & one 8 cm cooling fans with removable filter and lockable front door. ON/OFF, HDD, FDD, RESET with all power and interconnecting cables.
Video adapter, bus:	PCI Express TM X16
Expansion slots:	Two full -height PCI 2.3 slots, one full-height PCI Express x1 slot and one full-height PCI x 16 slot.
Audio Integrated:	Audio with External speakers & Microphone
Modem Integrated:	56 PCI Modem
Network Interface:	Integrated 10/100/1000 Gigabit Fast Ethernet-WOL, Dual RJ-45 with Two LED indicators.
External I/O ports:	1 x Parallel port, 2 x Serial port, Selectable RS-232/422/485 x 1, 6 x USB 2.0 ports, 4 x RJ-45,
Operating system installed:	Gateway software
Antivirus s/w:	Registered standard latest Anti-virus software
Vibration & Shock proof:	Tested

3.1 Industrial Gateway- RTU

Power supply:	230 V + / - 10 V , 50 Hz AC
Processor Type:	Intel Pentium Core 2 Quad Processor, 2.8 GHz or Higher, Standard L2 2MB, 800 MHz front side bus.
Chipset:	INTEL 945 GC chipset
Memory Type:	DDR2-Synch DRAM PC2-5300 @ 667 MHz
Standard Memory:	4 GB
Memory slots:	2 DIMM
Hardware monitoring:	System Monitor (fan, temp., voltage)
Memory upgrade:	Expandable
Internal hard disk drive:	160 GB
Hard disk drive speed:	7200 rpm
Optical drives:	16 X DVD-ROM (Combo)
Flexible disk drive:	1.44 MB Diskette drive
Mounting:	Rack mountable 4U Height
Chassis type:	19" 4U Industrial Rack mount BP chassis
Fans, Air filter, cables:	One 12cm & one 8 cm cooling fans with removable filter and lockable front door. ON/OFF, HDD, FDD, RESET with all power and interconnecting cables.
Video adapter, bus:	PCI Express TM X16
Expansion slots:	Two full -height PCI 2.3 slots, one full-height PCI Express x1 slot and one full-height PCI x 16 slot.
Audio Integrated:	Audio with External speakers & Microphone
Modem Integrated:	56 PCI Modem
Network Interface:	Integrated 10/100/1000 Gigabit Fast Ethernet-WOL, Dual RJ-45 with Two LED indicators.
External I/O ports:	1 x Parallel port, 2 x Serial port, Selectable RS-232/422/485 x 1, 6 x USB 2.0 ports, 4 x RJ-45,
Operating system installed:	Gateway software
Antivirus s/w:	Registered standard latest Anti-virus software
Vibration & Shock proof:	Tested

4. Laptop:

Make: Reputed Indian / International Manufacturer having ISO 9001 certification (Design & Mfg.)

System Software: Licensed & preloaded as per the requirement of the Application Software

Mobile Intel Core 2 Duo Processor T7200 2.0 GHz (or better), 2 GB DDR2 SDRAM, 39.1 cm TFT Active Matrix Display (1280 x 800 WXGA Resolution), 160 GB HDD, Integrated Graphic Card with 128 MB dedicated memory,

Integrated DVD- Writer 8X, 56Kbps V.90 Modem, 10/100/1000 Fast Ethernet, 2USB, IEEE Std, Ports, Built in Speakers, Weight: Approx 2.5 -3.0 Kg, Battery Life: Approx. 4 hrs., Associated Accessories (Such as Carry bag, adapter etc. with one external optical mouse & 1 GB USB Pen Drive).

5. Printers:

5.1 A3 Size Color Laser Printer:

Color Printer, Print Speed: 16 ppm, Laser Technology, Print Resolution: 600X600 dpi, 125 Sheet input tray, Processor: 300 MHz or better, Printer Memory: 64 MB, Interface: IEEE 1284-compliant bidirectional parallel LIO adapter, USB 1.1 port and RJ-45 Fast Ethernet Port for Network Connectivity, System: Compatible to proposed workstation operating system, Printer Software & Drivers on CD-Media, Print Language: PCL6, PCL5c, PS3.

5.2 Dot Matrix Printer:

Model:	Plug & Play
Power Supply:	170-270 V AC, 50 Hz.
Printable Columns:	136 Columns
Printing method:	Impact Dot Matrix
Printing Direction:	Bi-directional
Printing head pins:	24 pins
Printing Speed:	360 CPS @ 12 CPI
Interface:	RS 232 serial interface
Buffer size:	200 KB

5.3 Ethernet Switches:

The Ethernet network shall be formed as per specification requirements with industrial grade Ethernet switches suitable for IEC-61850 based communications. The indicative specifications for the Ethernet switches are given below, however the selection of more/type of ports shall be provided by successful bidder for meeting the functional requirement of the specifications:

5.3.1 Ethernet switch (Type-A)

Area Network Type	LAN Capable
Power Supply	220V DC without fan
Protocol/ Network:	10/100 Ethernet: Fast Ethernet Gigabit Ethernet
Module:	19" Chassis
No. of Ports:	24 ports 10/100/1000 TX + 4 Uplink 10/100/1000 FX
Ports/Interfaces:	Tx & Rx Copper/ fiber

Features LED indicator: Full duplex

5.3.2 Ethernet switch (Type-B)

Area Network Type LAN Capable

Power Supply 220/110 V DC without fan

Protocol/ Network: 10/100 Ethernet: Fast Ethernet Gigabit Ethernet

Module: 19" Chassis

No. of Ports: 24 ports 10/100/1000 FX + 4 Uplink 10/100/1000 FX

Ports/Interfaces: Tx & Rx fiber

Features LED indicator: Full duplex

6. Inverter:

The inverter shall have following features:

Input Characteristics:

AC:

Phase: Single (AC)

Voltage: 175-295 V

Frequency: 50 Hz ± 3 Hz

DC:

DC Voltage: **220 V**

Output Characteristics:

Waveform: Sinusoidal

Phase: Single

Voltage: 230 V ± 5 %

Frequency: 50 Hz ± 3 Hz

Capacity: 1/3 kVA or higher as per the power requirement of quoted items.

Transfer time: Bumpless

Alarm/ Indication: On Battery/ Over Load/ Battery Low

7. Computer Furniture:

A suitable compact standard make control desk computer furniture of appropriate dimensions be provided for mounting/ housing of HMI Monitors, HMI View Node, DR Workstation, Printers, Working Space for operator, Telephones etc., Please refer **Technical Specification-Civil Works** for details.

8. Transducers:

8.1 OLTC Transducer: The existing tap position signals have a variable resistance output. The contractor shall supply transducers, which shall take input as variable resistance and shall give output to BCU for display/ logging. The transducers shall have the following characteristics:

- The input measuring ranges shall be from 0 to 200 ohm.
- Output signal for RTU + 4 to 20 mA.

8.2 Pressure Transducer: These shall be used for monitoring of pneumatic pressure in SF6 Circuit breakers installed in switchyard. A suitable range (0-50 kg/Sq. cm, 110/220 V DC, Accuracy: 0.5 %) transducers having outputs (4-20 mA) compatible with the input of offered BCU be quoted for this project.

8.3 Temperature Transducer: These shall be used for the measurement of winding temperatures and oil temperatures in Power Transformers and ambient temperature. A suitable range transducers having outputs compatible with the input of offered BCU be quoted for this project.

8.4 DC Transducer: These shall be used for the measurement of substation DC Supply voltage (48, 220V DC) and currents. A suitable range transducers having outputs compatible with the input of offered BCU be quoted for this project.

9. Large Video Display System:

9.1 The system is required to display the HMI Screens to the operator. The system shall be complete with the Display Wall (3x2 cubes), Rear Projection Controller System, Software and other required accessories etc. to meet the functional requirement of displaying the SCADA/HMI Screens on Large Display.

9.2 It shall be made up of multiple rear projection modules stacked up in rows and columns to achieve a display wall in linear or curved configuration.

9.3 The diagonal size of each visual display unit/rear projection module shall be 67" or more with a native resolution of at least 1400 x 1050 pixels and shall offer in excess of 16 million colors.

9.4 The visual display unit/rear projection modules shall have in-built dual lamp system and shall have dual lamps to ensure redundancy at the lamp level.

9.5 The system shall be capable of automatic detection of lamp failure and automatic lamp switching after lamp failure detection. However there should be no mechanical motion during the lamp switchover as this may create alignment issues or unwanted failures.

9.6 The lamp shall be hot swappable.

9.7 The brightness uniformity shall not be less than 95% & the contrast ratio shall be minimum 1800:1

- 9.8 Each of the Rear projection modules shall have brightness settings capability to adjust the brightness of individual projection module.
- 9.9 The screen shall be high contrast and wide viewing angle.
- 9.10 The input to projection module shall be Digital Visual Interface-D (DVI-D) to have a flicker free image on the large screen display wall.
- 9.11 Each lamp shall be Ultra High Pressure lamp with minimum luminance of 500 cd/sq m. or higher. The life of the lamp shall not be less than 6000 hours.
- 9.12 The Contractor shall be in an industrial 19" rack mounted casing based on Intel Core Duo (or higher) processor having,
- i) The minimum random access memory of 1024 MB (standard) expandable upto 2 GB.
 - ii) The unit shall be equipped with a 48X or better CD RROM.
 - iii) The hard Disk supplied shall be of more than 60 GB, 7200 rpm.
 - iv) The display controller shall have dual redundant hot swappable power supply.
 - v) It shall have two 10/100/1000 Mbps Ethernet ports for LAN connection.
 - vi) It shall be supplied with a Keyboard and mouse.
 - vii) It shall operate on WINDOWS XP/Vista.
 - viii) It shall give multiple DVI graphics outputs to be connected to the multiple rear projection modules and the no. of each graphics outputs shall be equal to the no. of rear projection modules.
- 9.13 The software shall be able pre configure various display layouts and access them at any time with a simple mouse click or based on the timer. The software shall copy the screen content of the workstation/PC connected to the Ethernet, on the large screen display wall in scalable and moveable windows in real time environment.
- 9.14 The system shall be suitable for critical 24/7 operation environment.
- 9.15 The Display wall shall have 180 deg. viewing angle.

**TECHNICAL SPECIFICATION OF RELAY AND
PROTECTION PANELS**
(APPLICABLE FOR SUBSTATION WITH AUTOMATION SYSTEM)

1.0 SCOPE

- 1.1 The overall scope of work proposed to be assigned on complete responsibility basis to the successful bidder according to this specification covers the following aspects:
- 1.1.1 The design, manufacture, testing at manufacturer's works, supply, mounting and complete wiring up of all the equipments as detailed in the equipment schedule of Bay Protection and Control Units/ Panels and associated interface works with substation Automation System, FOR destination supply thereof and testing and commissioning at site.
- 1.1.2 Erection, Testing and Commissioning (ETC) at site of Protection System panels, Bay Control units, Substation Automation System and associated co-ordination works.
- 1.1.3 Preparation and furnishing of all the required drawings including schematic wiring, internal wiring, external cable connection drawings and co-ordination with existing scheme(s) where needed, alongwith PVC re-producible of all drawings.
- 1.1.4 Preparation and furnishing of co-ordinated control and protection cable schedule for complete control, protection and SAS system.

2.0 STANDARDS

Unless otherwise specified elsewhere in this specification, the design, manufacture rating, performance and testing of all the equipments and material supplied, shall generally conform to the latest revisions, available at the time of placement of order, of all relevant standards listed below:

Sl. No.	Standard No.	Title
1.	IS: 3231, IEC: 255 Part I to 3	Electrical relays for power system protection
2.	IS: 1248, IS: 2419, BS: 89	Indicating instruments
3.	IS: 6236, BS:90	Recorders
4.	IS: 722, IS: 6875, IEC: 337	Energy meters, control switches (LV switching devices for control and auxiliary circuits)
5.	IS: 1885 (Part-I & II)	Electro-Technical Vocabulary, Electrical Relays & Electrical Power System Protection

6.	IS: 2705, IEC: 185	Current Transformers
7.	IS: 3156, IEC: 186	Voltage Transformers
8.	IS: 375	Marking & Arrangements for Switchgear, Busbar, Main connection and Auxiliary wiring
9.	IS: 8686, IEC: 255 Part-V & VI, IEC: 801-4	Specification for static protective relays & tests
10.	IS: 2147, IEC: 529	Degrees of Protection provided by enclosures for LV switchgear and control gear
11.	IEC:297 (Part 1-3)	Dimensions of mechanical structures of the 482.6 mm (19") series.
12.	IS: 5, BS: 142	Colours for ready mixed paints and channels stability tests
13.	IS: 1554 (Part-I)	PVC insulated cables up to and including 1000 Volts.
14.	IS: 3842 (Part-I to VIII)	Application guide for Protective Relays
15.	IS: 4483 (Part-I & II)	Preferred Panel Controls and Dimensions
16.	IS: 9224 (Part-II)	HRC Cartridge fuse links.
17.	IS: 6005	Code of practice for phosphating iron and steel.
18.	IS: 4237	General requirement of switchgear and control gear for voltages not excluding 1.1 kV
19.	IS: 5578	Guide for marking of insulated conductors
20.	IS: 11353	Guide for uniform system of marking and identification of conductor & apparatus terminals
21.	IS: 13010	Energy Meters
22.	CBIP Pub No. 274	Manual on Protection of Generators, Generator Transformers and 220kV & 400kV network
23.	CBIP Pub No. 296	Manual on Reliable fault clearance and Back up protection of EHV & UHV Transmission Networks
24.	IEC: 60870	Communication Protocol
25.	IEC: 61850	Substation Automation Standard Protocol

3.0 GENERAL TECHNICAL REQUIREMENTS

- 3.1 The Bidder's scope of work shall include the design, engineering, supply delivery, installation, testing and commissioning of the following :

The Substation Automation System (SAS) for the proposed substation including Workstations, MIMIC display, Control Room furniture and all other equipment required for the SMS for the proposed substation as defined in this specification.

Bay protection panels, bay control units (BCU) to be located in each bay cubicle, associated cabling, interconnections and integration of these panels.

Laying and integration of Fiber optics cable between all BCUs and bay cubicles and Substation Automation System at Control Room.

- 3.2 Dedicated Bay Control Units and Bay Protection Units (BPU) shall be provided for each bay for Control and Protection functionality on IEC-61850 standard for **400, 220 and 132 kV Bays**. The offered protection and control unit will comply with the logical node structure as per IEC-61850 and the trip and priority messages viz. interlocking data shall be on GOOSE. Combined Bay Protection and Control Unit shall not be acceptable for **400, 220 and 132 kV Bays**. The required Control functions in BCU and Protection functions in BPU shall be as per the details given in this specification.
- 3.3 One Bay Control Unit shall provide complete functionality for **one 400, 220 kV and 132 kV Bay**. Each set of BCU's shall have sufficient digital inputs to acquire the status of each and every circuit breakers, isolator, earth switch etc. covered in that bay. Similarly the digital output shall be sufficient all the switchgears in one bay.

4.0 Constructional Features

- 4.1 Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear for control panels and either front or rear for relay panels. In case of panel having width more than **800mm**, double leaf-doors shall be provided. Doors shall have handles with either built-in locking facility or will be provided with pad-lock.

These panels shall be of the following approximate dimensions: -

Height: 2250mm + 15mm (anti vibration pad) + 50 mm (base)

Depth: 800 mm to 1000 mm

Width: 800 mm to 1000 mm

- 4.2 The Control and Relay panels shall be of simplex type design having overall dimensions as indicated. It is the responsibility of the Bidder to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protection/control schemes is properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed.

However, the width of panels that are being offered to be placed in GIS room, should be in conformity with the space availability in the GIS room.

- 4.3 Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP 31 in accordance with IS-2147.
- 4.4 Panels shall be free standing, floor mounting type and shall comprise rigid, structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than **3 mm** for weight bearing members of the panels such as base frame, front sheet and door frames, and **2.5mm** for

sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

- 4.5 All doors, removable covers and panels shall be gasketed all around with synthetic rubber gaskets, neoprene/EPDM generally conforming to provision of IS 11149. However, XLPE gaskets can also be used for fixing protective toughened glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.
- 4.6 Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces true and smooth.
- 4.7 Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Metal sills in the form of metal channels properly drilled shall be furnished by the Bidder along with anchor bolts and all necessary hardware for mounting the panels. Intervening layers of anti vibration strips made of shock absorbing materials shall be supplied by the bidder, and shall be placed between panel and base frame.
- 4.8 All control cables shall be laid in a cable gallery or trench under the control room. Cable entries to the panels shall be from the bottom. The bottom plates of the panels shall be fitted with removable gland plates for fixing the cable glands, the size of which shall suit the purchaser's external cables to the panels. Cable gland plates shall be fitted without glands. Cable gland plate fitted in the bottom of the panel shall be connected to the earthing of panel/station through a flexible braided copper conductor rigidly. Necessary foundation drawings showing cables entry positions and foundation bolt locations shall be supplied by the Bidder. All necessary arrangements shall be made inside the control panel to hold the cables so that no load comes on terminals due to the weight of hanging cable. Purchaser's external cable connections will be terminated on the terminal blocks to be provided by the Bidder.
- 4.9 Relay/protection panels of modern modular construction of standard 19" (483 mm) width racks in accordance with the IEC-297 shall also be acceptable. The relays shall be suitable to form composite relay assemblies in 19" racks to form complete protection schemes with minimum external wiring involved. Ancillary components like switches, lamps etc. whatever needed, for protection schemes shall be installed on plates suitable for mounting in 19" racks. The relay panel shall have full transparent (Perspex) front door. The slots for inter panel wiring shall be spaced at 300 mm from top of the side panel and their size shall be 80 mm (H) x 300 mm (W).

5.0 Mounting

- 5.1 All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush. No equipment shall be mounted on the doors.

- 5.2 Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.
- 5.3 The Bidder shall carry out cut out, mounting and wiring of the free issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.
- 5.4 The centre lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel
- 5.5 The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like wise the top lines of all meters, relays and recorders etc. shall be matched.
- 5.6 No equipment shall be mounted on the doors.
- 5.7 All the equipment connections and cabling shall be designed and arranged to minimise the risk of fire and damage which may be caused by fire.

6.0 PANEL INTERNAL WIRING

- 6.1 Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally. These adjacent inter panel wiring shall be clearly indicated in the drawing furnished by the Bidder.
- 6.2 All wiring shall be carried out with **1100V** grade, single core, stranded copper conductor wires with PVC insulation and shall be low smoke flame retardant grade and vermin and rodent proof, which shall have oxygen index not less than **29** and temperature index not less than **250 deg. C**. The minimum size of the multi-stranded copper conductor used or internal wiring shall be as follows:
- All circuits except current transformer circuits and voltage transfer circuits meant for energy metering - one **1.5mm** sq. per lead.
 - All current transformer circuits one **2.5 sq.mm** lead.
 - Voltage transformer circuit (for energy meters): Two **2.5 mm** sq. per lead.
- 6.3 All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.

- 6.4 Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels. These buses shall have a nominal cross section equivalent to a copper diameter of 6 mm and shall be suitably insulated all along their run. D.C. buses shall be divided into two sections to permit two independent supply points.
- 6.5 Wire termination shall be made with solder less crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks.
- All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule. Numbers **6 and 9** shall not be included for ferrule purposes. The wire numbers shown in the wiring diagram shall be as per IS 305.
- 6.6 Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires. Arrangements shall permit easy inter-connections to adjacent panels at site and wires for this purposes provided by Bidder shall be looped and bunched properly inside the panel.
- 6.7 Bidder shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipments.

7.0 Terminal Blocks

- 7.1 All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be **1100 V** grade and have 10 Amps. continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Terminal block design shall include a white fiber markings strip with clear plastic slip-on/ clip-on terminal covers. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.
- 7.2 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.
- 7.3 At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

- 7.4 Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side
- i) All circuits except CT and PT circuits: minimum of two of 2.5 sq.mm copper.
 - ii) AC/DC Power Supply Circuits : One of 6 sq.mm aluminium.
 - iii) All other circuits: minimum of one of 2.5 sq.mm copper.
- 7.5 There shall be a minimum clearance of **250mm** between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of terminal blocks edges shall be minimum of **150mm**.
- 7.6 Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the Purchaser's external cable connections if any. All adjacent terminal blocks shall also share this field wiring corridor. A steel strip shall be connected between adjacent terminal block rows at **450 mm** intervals for support of incoming cables. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.
- 7.7 The number and sizes of the Purchaser's multi core incoming external cables if any, will be furnished to the Bidder after placement of the order. All necessary cable terminating accessories such as gland plates, packing glands, crimp type tinned copper lugs, supporting clamps and brackets, wiring troughs and gutters etc. shall be included in the Bidder's scope of supply.

8.0 Painting

- 8.1 All sheet steel work shall be phosphated in accordance with the IS: 6005 "Code of practice for phosphating iron and steel".
- 8.2 Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
- 8.3 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with a slightly alkaline hot water and drying.
- 8.4 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.
- 8.5 The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.
- 8.6 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall

be of a slightly different shade to enable inspection of the painting. The panel shall have colour conforming to shade 631 of IS-5 for outside. The inside of the panel shall be glossy white colour. The paint thickness shall not be less than fifty (50) microns.

- 8.7 A small quantity of finished paint shall be supplied for minor touching up required at site after installation of the panels.
- 8.8 In case the bidder proposes to follow any other established painting procedure like electrostatic painting, the procedure shall be submitted for UPPTCL's review and approval.

8.9 MIMIC DIAGRAM

- 8.9.1 Coloured mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels.
- 8.9.2 Mimic diagram shall be made preferably of anodised aluminium or plastic of approved fast colour material, which shall be screwed on to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable. The mimic bus shall be 2mm thick. The width of the mimic bus shall be 10mm for bus bars and 7mm for other connections.
- 8.9.3 Mimic bus colour will be decided by the UPPTCL and shall be furnished to the successful Bidder during Engineering.
- 8.9.4 When semaphore indicators are used for equipment position, they shall be so mounted in the mimic that the equipment in close position shall complete the continuity of mimic.
- 8.9.5 Indicating lamp, one for each phase, for each bus shall be provided on the mimic to indicate bus charged condition

9.0 Name Plates And Markings

- 9.1 All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold nameplates shall be provided for circuit/feeder designation. These circuit labels shall be larger than the other name plates.
- 9.2 All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring. The name plates shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.
- 9.3 Each instrument and meter shall be prominently marked with the quantity measured e.g. kV, A, MW etc. All relays and other devices shall be clearly marked

with manufacturer's name, manufacturer's type, serial number and electrical rating data.

- 9.4 Name Plates shall be made of non-rusting metal or 3 ply lamicoid. Name plates shall be black with white engraving lettering.
- 9.5 Each switch shall bear clear inscription identifying its function e.g. 'BREAKER' '52A', "SYNCHRONISING" etc. Similar inscription shall also be provided on each device whose function is not other-wise identified. If any switch device does not bear this inscription separate name plate giving its function shall be provided for it. Switch shall also have clear inscription for each position indication e.g. "Trip-Neutral-Close", "ON-OFF", "R-Y-B-OFF" etc.
- 9.6 All the panels shall be provided with name plate mounted inside the panel bearing LOA No & Date, Name of the Substation and feeder and reference drawing number.

10.0 Miscellaneous Accessories

- 10.1 **Plug Point:** 240V, single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.
- 10.2 **Interior Lighting:** Each panel shall be provided with a fluorescent lighting fixture rated for 240 Volts, single phase, 50 Hz AC supply for the interior illumination of the panel during maintenance. The fittings shall be complete with switch-fuse unit and switching of the lighting shall be controlled by the respective panel door switch.
- 10.3 **Switches and Fuses:** Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall conform to IS: 13947. Each MCB shall be provided with one potential free contact and the same shall be wired for annunciation purpose. However voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS: 13703 mounted on plug-in type fuse bases. Fuse carrier base as well as MCBs shall have imprints of the fuse 'rating' and 'voltage'.
- 10.4 **Space Heater:** Tubular space heaters of adequate capacity and suitable for connection to single phase, 240V, 50Hz AC supply shall be provided inside each panel to prevent condensation of moisture on the wiring and panel mounted equipment when the panel is not in operation. These shall not be mounted close to the wiring or any panel mounted equipment. Heaters shall be complete with isolating switches, HRC fuse on phase and link on the neutral of the heater supply and its switching shall be controlled by a thermostat.

- 10.5 **Other Accessories:** Test link, special terminal boards and other accessories normally required for testing operation and maintenance of all relays and meters shall be furnished by the Bidder.

11.0 Earthing

- 11.1 All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least **25 x 6 sq. mm** copper with threaded holes at a gap of **50mm** with a provision of bolts and nuts for connection with cable armours and mounted equipment etc. for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Bidder. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.
- 11.2 Provision shall be made on each bus bar of the end panels for connecting substation earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of Bidder. The size of Purchaser's earthing grid connections will be furnished later to the Bidder. The earth wire or screens should be clearly bonded and earthed at the gland plate. The earthing scheme shall be got approved.
- 11.3 All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus preferably by independent copper wires of size not less than **2.5 sq. mm**. The colour code of earthing wires shall be green. Earthing wire shall be connected on terminals with suitable clamp connectors and soldering shall not be permitted.
- 11.4 Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided. Earthing may be done in such a manner that no circulating current shall flow in the panel.
- 11.5 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.
- 11.6 An electrostatic discharge point shall be provided in each panel connected to earth bus via 1 Mega Ohm resistor.
- 11.7 The detailed earthing scheme shall be submitted for approval.

12.0 GENERAL SPECIFICATION FOR BAY CONTROL UNIT (BCU)

- 12.1 The bay control IED based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions such as protection commands, bay interlocking, data acquisition, data storage, event and disturbance recording and shall provide inputs and status indication and outputs for commands. They shall be directly connected to the switchgear without any need for separate interposing equipment or transducers.
- 12.2 The numerical bay control IED shall be provided with a configurable (current or voltage) analogue input channels and adequate number of binary input and output channels which are galvanically isolated from the SA system. HV switchgear and instrument transformers shall be directly connected to the bay level IED without any interposing equipment (except test switches/plugs required for testing purposes).
- 12.3 The devices shall meet the requirements for withstanding electromagnetic interference according to relevant parts of **IEC 60255** to conform to the high requirements for operation on the secondary system of HV switchgear.
- 12.4 The **400, 220 & 132 kV** bay control & protection IED shall have the following features:
- Configurable analogue channels
 - Power functions which can be configured to measure forward or reverse active or reactive power.
 - Four(4) independently settable parameter setting groups settable/selectable locally or remotely via the HMI programme.
 - The offered IED shall have a comprehensive **local MMI** for interface.

It shall have the following minimum elements so that the features of the relay can be accessed and setting changes can be done locally.

 - Alphanumeric backlit LCD display unit
 - Fixed LEDs for indication of relay in & out of service. Programmable 14 LEDs for trip/alarm conditions.
 - Keypad for browsing, setting the relay parameters
 - Sequence of Event recorder with a buffer for minimum 200 events and a resolution of 1 m sec. The events that are to be recorded should be freely programmable. These could be alarm/ trip signals, external signals connected to **opto-coupler inputs**, etc. Once events are defined they are recorded in chronological order as they occur.
 - Comprehensive self-supervision.

- Battery-free memory back-up of Events and Disturbance records
 - Logic functions (AND, OR, bi-stable flip flop etc.)
 - Delay Integrator function.
- 12.5 The numerical bay control IEDs shall be mounted in cubicles of **Protection Class IP54** or better. Back-up control mimics and associated switchgear with two years proven field experience for HV applications. Emergency control facility also to be provided to handle the bay controller fail situations. The distributed back-up control mimic shall be installed alongwith the bay controller IED which can be used in case of maintenance or emergency or if bay control IED fails. Local bay control via the back-up control mimic on the control and protection cubicles shall incorporate the same user safety measures e.g. bay interlocking, synchro-check, user guidance etc. as the station HMI local bay emergency control shall be key-locked and the control either from station HMI or from remote shall be disabled if the local/ remote selector switch is in the local position.
- 12.6 The bay IED shall have atleast two communication ports viz. Front Ethernet **RJ45/RS-232 port** for local communication for relay settings, modifications, extraction and analysis of fault/event/disturbance records from a **laptop** and a **Rear fibre optic port on IEC 61850** standard for remote communication to SCADA system.
- 12.7 The electronic system has to be provided with functions for self-supervision and testing. Each circuit board shall contain circuits for automatic testing of its own function.
- 12.8 Faults in the bay control IED shall be indicated on a front HMI and a message shall be sent to the station level HMI. The time for the fault tracing and the replacement of a faulty unit shall be reduced to a minimum. The supervision shall also cover the power supply system, the internal system bus and the ability of the central processing module to communicate with different printed circuit boards.
- 12.9 Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown. The n-1 criteria must be maintained in worst case scenario also. Further, a single failure must not have any affect on the primary system, which is monitored and controlled.
- 12.10 All IEDs shall have **two years** of successful proven field experience in HV application and MTBF for the offered unit shall be provided.
- 13.0 GENERAL SPECIFICATION OF BAY PROTECTION UNIT (BPU)**
- 13.1 Each Bay Protection Unit shall comprise one or more numerical relays to meet the protection requirement specified for each type of feeder.

- 13.2 Bay Protection Units for 400, 220 & 132 kV Switchyard Bays shall interact with BCUs over 400, 220 & 132 kV inter bay Network Bus to share information related to Bay Level Interlocking, fault data, alarms/events etc. However, the trip commands from Bay Protection Units shall be hard-wired directly to appropriate switchyard equipment. Also, critical interlocking data between Bay Protection Units and Bay Control Units, including the substation level interlocks such as bus earth switch etc. shall also be hard-wired to ensure complete bay level functionality even in case of failure of substation LAN. The interlocking information to be hard-wired between Bay Protection Units and Bay Control Units shall be decided by Purchaser during detailed engineering stage.
- 13.3 The Bay Protection Units shall be arranged to provided two independent, high performance and reliable systems with separate DC supplies, separate CT/VT cores, separate cables and trip relays to obtain 100% redundancy. Associated trip relays of the two systems shall be separate, having a sufficient number of contacts for all the functions. The DC Changeover scheme shall be realized externally via the auxiliary AC/DC Relays.
- 13.4 The offered relays shall be completely numerical with Protection elements realized using software algorithm. Hardware based/Analog measurement shall not be acceptable.
- 13.5 The relay should have high immunity to electrical and electromagnetic interference. It should be compatible with all the IS/IEC standards as listed above.
- 13.6 The offered relay shall have a comprehensive local MMI for interface. It shall have the following minimum elements so that the features of the relay can be accessed and setting changes can be done locally.
- Alphanumeric backlit LCD display unit.
 - Fixed LEDs for indication of relay in & out of service. Programmable 14 LEDs for trip/alarm conditions.
 - Keypad for browsing, setting the relay parameters.
- 13.7 The bay IED shall have atleast two communication ports viz. Front Ethernet RJ45/RS-232 port for local communication for relay setting, modifications, extraction and analysis of fault/event/disturbance records from a laptop and a Rear fiber optic port on IEC 61850 standard for remote communication to SCADA system.
- 13.8 The relays shall have the following tools for fault diagnostics.
- Fault record—The relay shall have the facility to store fault records with information on cause of trip, data, time, trip values of electrical parameters.

- Event record—The relay shall have the facility to store time stamped event records with 1ms resolution.
 - Disturbance records—At least 5 secs of disturbance records shall be provided in the offered Numerical relays. Each record shall store data from analogue channels and digital channels. The data from DR function shall be available in **IEEE/ COMTRADE** format and shall be compatible with the **relay tests kit** being supplied under this contact.
- 13.9 It shall be possible to store this information in the event of an auxiliary supply failure with the help of a **battery back up**.
- 13.10 The relay setting shall be provided with password protection.
- 13.11 It shall be possible to change the relay setting from the front panel using the keypads.
- 13.12 The relay shall have comprehensive self-diagnostic feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure detected shall be annunciated through a output **watchdog contact**. The fault diagnosis information shall be displayed on the LCD and also through the communication port.
- 13.13 The Numerical Relays shall be provided with 1 set of common support Windows based software which will allow easy setting of relays in addition to uploading of event, fault, disturbance records, measurements. The relay settings shall also be changed from local or remote using the same software.

14.0 VARIOUS ELEMENTS OF PROTECTION SYSTEM/ SCHEMES

The details of auxiliary relays, schemes, functions, etc. have been described below. It shall be the bidders responsibility to use the same for the completion of schemes. Few of the functionalities such as **measuring/ indicating meters, semaphores, voltage & frequency recording instrumrnts, disturbance recording, event logging, synchronization, annuciation, trip circuit supervision, DC supply supervision, switches etc.** are normally part of the Bay Control/ Bay Protection Units. The bidder is required to design the scheme/ system so as to meet the functional requirments and reliable operations. The integrated functionalities are acceptable subject to few exceptions such as master trip relays, auxiliary relays LBB, DC supervision, revenue meters, timers, emergency controls etc. are required to be provided/ installed external to BCU/ BPU.

Therefore, the C&R Panels shall be designed by the bidder for optimized configuration and if designated functionalites are to be achieved using external devices/ equipments the same shall be deemed to be included in the cost of C&R Panels mentioned in the price scedules. It will be the bidders responsibility to ensure the completeness of the shcheme.

14.1 Instruments and Meters

- a) All instruments, meters, recorders and transducers shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. They shall be calibrated to read directly the primary quantities. They shall be accurately and calibrated at works and shall have means of calibration, check and adjustment at site. **The bidder shall confirm that the instruments, recorders along with transducers and energy meters offered by them are suitable for connecting to the instrument transformers having the technical particulars given in the associated schedule of details of instrument transformers.** Watt and Var meters shall have an indication of (+) and (-) to indicate EXPORT and IMPORT respectively. Digital voltage and frequency meters shall be of class: 0.5 and shall have digital display of **5 and 4 digits** respectively, with display size, not less than **25 mm (height)**. All accessories including test switches and test plugs, where applicable shall be furnished. Their elements shall be shock resistant and shielded from external magnetic fields.
- b) Indicating Instruments : Digital instruments shall have digital display of not less than **25 mm (height)**. Instrument shall have **four digit display**.
 - i) Unless otherwise specified all electrical indicating instruments shall be of 96 sq.mm size. They shall be suitable for flush mounting.
 - ii) The dial shall be free from warping, fading and discoloring. The dial shall also be free from parallax error.
 - iii) Instruments shall conform to **IS: 1248** and shall have **accuracy class of 1.0** or better. The design of the scaled shall be such that it can read to a resolution corresponding to 50% of the accuracy class index.
 - iv) Instrument covers shall be of shadow proof design, utilizing all available light. The indicating instruments shall have red marks on the dial corresponding to rated values of the associated primary equipment.
 - v) Ammeters and current coils of WATT meters and VAR meters shall continuously withstand **120% of rated current and 10 times the rated current for 0.5 sec.** without loss of accuracy. Voltmeters and potential coils of WATT meters and VAR meters shall withstand **120% of rated voltage for 0.5 seconds** without loss of accuracy.

c) Metering Instruments

1. Ammeters

All ammeters shall be of digital type and provided with direct reading triple range scale. Scale value of ammeters shall be equal to 1 to 1.3 times the rated primary current of the current transformer feeding it. The rated current shall be 1.0 Amp. Accurate reading of ammeter shall be possible at the lowest limit of 5% of the rated current.

2. Voltmeter

Voltmeter shall be digital type. Rated voltage shall be $110/\sqrt{3}$ Volts. Maximum value of voltage scale shall be 20% in excess of the normal voltage.

3. Watt meters and VAR meters

These meters shall be suitable for indicating flow of power in both directions and shall be of 2 elements type for use in 3 phase 3 wire unbalanced system or 3 element type for 3 phase 4 wire unbalanced system. Current coil shall be rated or 1 A and the voltage coil for $110/\sqrt{3}$ volts.

4. Energy Meters

Energy meters shall be static type conforming to IEC: 60687-2000 with latest amendments and suitable for inter utility EHV bi-directional power flow and for CT/VT connection. The static meter shall carryout measurement of active energy (both import and export) and reactive energy (both import and export) by 3-phase four wire principle suitable for balanced/unbalanced 3-phase load. The accuracy of energy measurement shall be 0.2 for active energy and 1 for reactive energy. The active and reactive energy shall be directly computed in CT & VT primary ratings and stored in four different registers of the memory of the meter as MWH(E), MHH(I), MVARH(E) and MVARH(I) along with a plus sign for export and minus sign for import. Meters shall compute the energy sentout/received from/to the station bus bar during each successive 15 minute block and store in the respective registers. Meter shall display on demand the energy sentout/received during the previous 15 minute block. Further the meter shall continuously integrate the energy readings of each register upto that time. All these readings shall be displayed on demand. Cumulative reading of each register shall be stored in non-volatile memory at the end of each hour of the day starting from 0100 hrs. These readings shall be stored for a period of 40 days before being erased. The static meter shall have a built-in clock and calendar having an accuracy of atleast 1 minute per month or better. Date/time shall be displayed on demand. The clock shall be synchronised by GPS time synchronising equipment being provided or other time signals.

Each meter shall have a unique identification code provided by purchaser and shall be marked permanently on the front and also on the non-volatile memory. The voltage monitoring of all the three voltages shall be provided. The meter shall normally operate with power drawn from VT supplies. The power supply to the meter shall be healthy even with a single phase VT supply. An automatic backup shall be provided by a built-in life time battery and shall not need replacement for atleast ten years with a continuous VT interruption of atleast two years. Date and time of VT interruption and restoration shall be automatically stored in non-volatile memory. The static meter shall have an optical port at the front of the meter for data collection by a hand held device. The necessary software shall be provided to accept the data from DCD and

store in memory and on a floppy diskette and also to print the same. The meter shall have means to communicate with sub-station monitoring system. The meter shall have means to test MWH accuracy and for connecting it to time-of-day tariff equipment. Pulse rate shall be **100 pulses per MWH** and 100 pulses per MVARH from to separate devices.

5. Bus Voltage & Frequency Recording Instruments

- Recording instruments shall be square or rectangular in shape and shall be suitable for flush mounting on panels. They shall be of 'draw out' type and suitable for back connection.
- Recorders shall be furnished in dust tight metal cases with gasketed doors and they shall be designed so as to require minimum maintenance.
- They shall have fast response and critical dumping.
- The recorder shall
 - i) be double pen type employing potentiometric servo drive principle.
 - ii) be with a manual on/off switch.
 - iii) be of continuous recording type with disposable fibre tip cartridge pens, employing ink on paper.
 - iv) have a Calibrated Chart width of at least 100 mm and a viewing area of 100 x 50 mm, atleast.
 - v) have an accuracy of +1.0% span. The accuracy class of recorder shall be 1.5 for the measured quantity or 1.0 for time keeping.
 - vi) have full span response time of less than 2 seconds.
 - vii) have maximum chart speed facility of 60mm per hour.
 - viii) be directly calibrated for CT and PT ratios in use. Be provided with a facility for automatic shorting of CT leads if and when the recorder is drawn out.
 - ix) be provided with chart rolls of adequate length requiring replacement, not earlier than **27 days**. The quantity of chart rolls and ink included with the offer shall be 1000 meter length of paper and five pens with each recorder. There shall be provision for advance indication towards replacement of chart paper and replenishing of ink.
 - x) be suitable for operation with station DC source, in case of AC supply (240 volts, 1 phase, 50 Hz) failure (**inverter may be included, if required**).

Alternatively, Static / Digital type frequency recorder and voltage recorder either as individual units or composite unit for total substation with time tagged information shall also be acceptable if it meets the accuracy of +1.0% span and full span response time of less than 2 seconds. The static / digital shall also meet the high voltage susceptibility test, impulse voltage with stand test, high frequency disturbance test–class III and fast transient disturbance test–level III as per IEC 60255. Feeding chart paper or

removal of chart paper shall be simple. Chart rolls and ink required for two years shall be supplied.

6) Multifunction Meter

- i) It shall be able to do measurement for 3-Phase, 4- Wire unbalanced loads.
- ii) It shall be of 0.5 Class accuracy and shall be able to measure following parameters mentioned below,
- Phase to Phase and Phase to Neutral Voltages.
 - Phase Currents.
 - Neutral Current
 - Frequency
 - Power Factor
 - Reactive Power
 - Active Power
 - Apparent Power
 - Per phase : KW, KVAR, KVA, PF
 - Total Harmonic Distortion of Voltage and Currents
 - Import / Export (MWh, MVarh & MVAh)
 - Max/Min. Voltages, Currents
 - Max MW / MVA
- iii) Input Requirements:
- Voltage :
- Input : 500 V (P-P) and 280 V (P-N)
Burden : <0.15 VA
- Current :
- Range : 1 A or 5 A
Continuous : 1A CT: 3A
5A CT: 12A
- Surge with-stand: 1A CT: 80A for 1 Sec.
5A CT: 200A for 1 Sec.
- iv) The device shall be able to accommodate the ratios of installed CT/PT (as shown in the single diagrams enclosed with these specifications) and have adequate reading range for the substations under consideration.
- v) The device shall have the communication port RS-232/RS-485 having Modbus Protocol or any other open protocol.

- vi) Power Supply : **AC/DC 110-230V.**
- vii) The device shall conform to ISO/IEC/UL/CE/ANSI standard/quality norms for Electrostatic Discharge, Radio Frequency Interference, Electrical Fast Transients, Surge withstand Capability, Electromagnetic Interference etc. so that it shall perform satisfactorily in Electrically hostile environment of EHV substation.

d) Disturbance Recorder

- A. For line
 - B. For Transformer
- i) Disturbance recorder shall be **microprocessor based** and shall be used to record the graphic form of instantaneous values of voltage and current in all three phases, open delta voltage & neutral current, open or closed position of relay contacts and breakers during the system disturbances and built in feature of Line Distance relay, Transformer, and Bus bar Protection and shall be activated in Both Numerical Protections is acceptable provided the requirements of following clauses are met.
 - ii) The Disturbance recorder shall consist of individual acquisition units, or as a part of distance protection and an Evaluation unit which is common for the entire Sub-Station. Whenever, more than one acquisition units are connected to an Evaluation unit, necessary hardware and software shall also be supplied for on line transfer of data from all acquisition units of Evaluation unit. If there are any constraints for one Evaluation unit to accept the data from number of acquisition units under the present scope, adequate number of Evaluation units shall be supplied.
 - iii) Disturbance recorder shall have minimum **9 analog and 32 digital** channels for each feeder/Transformer.
 - iv) Acquisition units shall acquire the fault data for the fault and post fault period and transfer them to Evaluation unit automatically to store in the hard disk. The acquisition units shall be located in the protection panels of the respective feeders.
 - v) The acquisition unit shall be suitable for inputs from current transformers with 1A rated secondary and voltage transformers with 63.5V (phase to neutral voltage) rated secondary. Any device required for processing of input signals in order to make the signals compatible to the Disturbance recorder equipment shall form an integral part of it. However, such processing of input signals shall in no way distort it waveform.

- vi) The equipment shall be carefully screened, shielded, earthed and protected as may be required for its safe functioning. Also, the disturbance recorder shall have stable software, reliable hardware, simplicity of maintenance and immunity from the effects of the hostile environment of EHV switchyard which are prone to various interference signals typically from large switching transients.
- vii) The Evaluation unit shall consist of a **desktop personal computer** (including **VGA colour monitor**, mouse and key board) and printer. The desktop PC shall have Pentium-IV processor or better and having a clock speed **3.2GHz** or better. The hard disk capacity of PC shall not be less than **120 GB** and RAM capacity shall not be less than **1 GB**.
- viii) Necessary software for transferring the data automatically from local evaluation unit to a remote station and receiving the same at the remote station through Purchaser's optical fiber shall be provided.
- ix) Evaluation software shall be provided for the analysis and evaluation of the recorded data made available in the PC under WINDOWS environment. The software features shall include repositioning of analog and digital signals selection and amplification of time and amplitude scales of each analog and digital channel, calculation of MAX/MIN frequency, phase difference values, recording of MAX/MIN values etc. of analog channel, group of signal to be drawn on the same axis etc. listing and numbering of all analog and digital channels and current, voltage, frequency and phase difference values at the time of fault/tripping. Also, the software should be capable of carrying out Fourier/Harmonic analysis of the current and voltage wave forms. The Disturbance recorder shall have a facility to Transfer the Analog values during pre fault, during fault and post fault and time taken for each digital values activated after fault occurred. It shall have a facility to calculate the fault locator and Transfer the data. The disturbance records shall also be available in COMTRADE format (IEEE standard– Common Format for Transient data Exchange for Power System).
- x) The Evaluation unit shall be connected to the printer to obtain the graphic form of disturbances whenever desired by the operator.
- xi) Disturbance recorder acquisition units shall be suitable to operate from **220V DC** as available at Sub-Station Evaluation unit along with the printer shall normally be connected to 240V, single phase AC supply. In case of failure of AC supply, Evaluation unit and printer shall be switched automatically to the station DC through Inverter of adequate capacity which shall form a part of Disturbance recorder system.
- xii) The acquisition unit shall have the following features:

- 1) Facility shall exist to alarm operator in case of any internal faults in the acquisition units such as power supply fail, processor/memory fail etc. and same shall be wired to annunciation system.
- 2) The frequency response shall be 5 Hz on lower side and 250 Hz or better on upper side.
- 3) Scan rate shall be **1000 Hz/channel** or better and data shall not be lost on failure auxiliary power supply.
- 4) Pre-fault time shall not be less than 100 milliseconds and the post fault time shall not be less than 2 seconds (adjustable). If another system disturbance occurs during one post-fault run time, the recorder shall also be able to record the same. However the total memory of acquisition unit shall not be less than 5.0 seconds.
- 5) The open delta voltage and neutral current shall be derived either through software or externally by providing necessary auxiliary transformers.
- 6) The acquisition unit shall be typically used to record the following digital channels:

In Case of Line

1. HV MAIN CB OPEN
2. HV TIE TIE CB OPEN
3. MAIN1 RELAY OPERATED
4. MAIN2 RELAY OPERATED
5. BUSBAR RELAY OPERATED
6. MAIN CB A/R OPERATED
7. TIE CB A/R OPERATED
8. PSB OPERATED
9. SOTF OPERATED
10. O/V STG-1 OPERATED
11. O/V STG-2 OPERATED
12. STUB-1/2 OPERATED
13. HZ / LZ TEED-1/2 OPERATED
14. MAIN CB LBB OPERATED
15. TIE CB LBB OPERATED
16. **DIRECT TRIP CH-1/2 RECEIVED TRIP**
17. **M1 CARRIER RECEIVE**
18. **M2 CARRIER RECEIVE**
19. GR-A/B RELAY OPERATED
20. DEF/TEF RLY OPERATED
21. DF/DT RELAY OPERATED

In Case of Transformer

1. HV MAIN CB OPEN
 2. HV TIE TIE CB OPEN
 3. LV CB OPEN
 4. HZ DIFF RLY OPERATED
 5. LZ DIFF RLY OPERATED
 6. REF OPERATED
 7. HV 67 ABCN OPERATED
 8. LV 67 ABCN OPERATED
 9. O/L RLY OPERATED
 10. NDR RLY OPERATED
 11. HV GR-A/B RELAY OPTD
 12. LV GR-A/B RELAY OPTD
 13. OIL TEMP HIGH TRIP
 14. WNDG TEMP HV/IV/LV TRIP
 15. BUCHHOLZ MAIN/OLTC TRIP
 16. PRD 1/ 2 TRIP
 17. AT/F NEUTRAL CURRENT TRIP
- 7) In case the disturbance recorder is in-built part of line distance protection, above digital channels may be interfaced either externally or internally.
- 8) Any digital signal can be programmed to act as trigger for the acquisition unit. Analog channels should have programmable threshold levels for triggers and selection for over or under levels should be possible.
- xiii) The printer shall be compatible with the desktop PC and shall use Plain paper. The printout shall contain the Feeder identity, Date and time (in hour, minute and second up to 100th of a second), identity of trigger source and Graphic form of analog and digital signals of all the channels. Ten packets of Z-fold paper (500 Sheets in each packet) suitable for printer shall be supplied.
- xiv) Each disturbance recorder shall have its own time generator. The clock of the time generator shall be such that the drift is limited to +/- 0.5 seconds / day, if allowed to run with out synchronization.
- xv) Disturbance recorder shall have facility to synchronize its time generator from Time Synchronization Equipment compliant with IEC 61850 communication standard having output in SNTP format (specified in this section). The recorder shall give annunciation in case of absence of synchronizing pulse within a specified time. In case Disturbance Recorder has in-built function of Bay Protection units (BPU) and the SAS is implementing in IEC 61850, Time Synchronization is achieved through SNTP network protocol.

- xvi) If time synchronization equipment is not available/faulty, time generator of any one of the disturbance recorders can be taken as master and time generators of other disturbance recorders and event loggers in that station shall be synchronized to follow the master.

e) Fault Locator

- i) electronic or microprocessor based type.
- ii) 'ON-LINE' type.
- iii) Suitable for breaker operating time of 2 cycles i.e., the measurement time for fault locator shall not exceed 2 cycles (40 ms).
- iv) Built-in display unit.
- v) The display shall be directly in % of line length or kilometers without requiring any further calculations.
- vi) An accuracy of 3% or better for all types for faults and fault levels.
- vii) The above accuracy should not be impaired under the following conditions:
 - a) Presence of remote end in-feed.
 - b) predominant D.C. component in fault current.
 - c) high fault ARC resistance.
 - d) Severe VT transients.
 - e) magnitude of line loading before occurrence of faults.
- viii) Facility for remote data transmission
- ix) Shall meet IEC-255 or any other equivalent internationally recognized standards.
- x) Shall have mutual zero sequence compensation unit if fault locator is to be used on double circuit line.
- xi) Have built in supervision and testing facility.
- xii) Built in feature of line distance relay is acceptable provided the requirements of above clauses are met.

f) Event Logging

1. The event logging function shall be part of BCU/BPU and will be used to record open and close states of switchyard equipment, relays and changes of alarms.
2. The equipment is used to record changes in digital events. When such changes occur in display in HMI as well as print out on printer should result.
3. The printout of the events shall contain at least the station identification, date & time (in hour, minutes, seconds & milliseconds). Event number and event description (at least 40 characters).

14.2 Relays

- 14.2.1 All relays shall conform to the requirements of IS: 3231/IEC-60255/IEC 61000 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear.
- 14.2.2 All main protective relays shall be of numerical type and communication protocol shall be as per IEC 61850. Further, the test levels of EMI as indicated in IEC 61850 shall be applicable to these. All the relays shall be directly connected to the interbay bus using fiber optic cables and shall support peer to peer communication. The relay shall generate **GOOSE** messages as per IEC 61850 standards for interlocking and shall also ensure interoperability with 3rd Party relays. Each relay shall also generate an ICD file in XML format for engineering / integration to a vendor independent SCADA System. The relays should have a port for local communication for relay settings, modifications etc.
- 14.2.3 All protective relays shall be in draw out or plug-in type/modular cases with proper testing facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in bidder's scope of supply. Test block and switches shall be located immediately below each relay for testing. As an alternative to test block and test plug arrangements the Bidder shall also quote alternative testing facility of protective relays by providing push button which when pressed connects the testing equipment to the relay coils and injects current in the coil and automatically disconnects the trip circuits and on operation of relay gives a signal that the equipment and the circuits are healthy. The above tests shall be carried out without short circuiting the CT secondary connections. The Purchaser reserves the right for accepting any one of the above two testing facilities. Unless otherwise specified all auxiliary relays and timers shall be supplied in non-draw out cases/plug in type modular cases.
- 14.2.4 All AC operated relays shall be suitable for operation at 50 Hz AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.
- 14.2.5 The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme; contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts. Relay case size shall be so chosen as not to introduce any

limitations on the use of available contacts on the relay due to in-adequacy of terminals. Paralleling of contacts, if any shall be done at the terminals on the casing of the relay.

- 14.2.6 All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relays and timers shall be provided with externally hand reset positive action operation indicators, provided with inscription, subject to Purchaser's approval. All protective relays which do not have built-in hand-reset operation indicators shall have additional auxiliary relays with operating indicators (Flag relays) for this purpose. Similarly, separate operating indicator (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as Buchholz relays, oil and winding temperature protection, fire protection etc.
- 14.2.7 Timers shall be of solid state type. Pneumatic timers are not acceptable. Short time delays in terms of milli seconds may be obtained by using copper slugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not acceptable.
- 14.2.8 No control relay which shall trip the power circuit breaker when the relay is de-energised shall be employed in the circuits.
- 14.2.9 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.
- 14.2.10 All relays shall withstand a test voltage of 2.5 KV, 50 Hz, rms voltage for one second. In case of static relays the **Clause 14.2.13** shall be applicable.
- 14.2.11 Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:
 - (a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
 - (b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.
 - (c) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the D.C. Supply Voltage is minimum.
 - (d) Trip-circuit seal-in is required for all trip outputs, irrespective of the magnitude of the interrupted current. The trip-circuit seal-in logic shall not only seal-in the trip output(s), but also the relevant initiation signals to other scheme functions, (e.g. initiate signals to the circuit-breaker failure function, reclosing function etc.), and the alarm output signals.

- (e) Two methods of seal-in are required, one based on the measurement of AC current, catering for those circumstances for which the interrupted current is above a set threshold, and one based on a fixed time duration, catering for those circumstances for which the interrupted current is small (below the set threshold).
 - (f) For the current seal-in method, the seal-in shall be maintained until the circuit breaker opens, at which time the seal-in shall reset and the seal-in method shall not now revert to the fixed time duration method. For this seal-in method, the sealing shall be maintained for the set time duration. For the line protection schemes, this time duration shall be independently settable for single- and three-pole tripping.
 - (g) Seal-in by way of current or by way of the fixed duration timer shall occur irrespective of whether the trip command originates from within the main protection device itself (from any of the internal protection functions), or from an external device with its trip output routed through the main protection device for tripping. Trip-circuit seal-in shall not take place under sub-harmonic conditions (e.g. reactor ring down).
- 14.2.12 All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.
- 14.2.13 Wherever solid state relays are used the following requirements shall be met with:
- a) The printed circuit cards shall be of fibreglass type and the contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuit boards shall be encapsulated or covered with varnish.
 - b) The components shall be adequately rated to carry at least twice the normal expected loads. The resistors shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes. The relays must withstand the requirements of IEC 255-4 appendix-E Class III regarding HF disturbance tests, IEC 255-4 regarding impulse test at 5KV and fast transient test as per IEC 801-4. Insulation barriers shall be provided to ensure that transients present, in CT & VT connections due to extraneous sources do not cause damage to static circuits.
 - c) All relays shall be designed for satisfactory performance under tropical and humid conditions specified under **Section-III (GTR)**. Special mention shall be made in the technical deviations schedule of the bid for those relays, if any, that Bidder proposes to use which differ from specified requirements.
 - d) All devices required for correct operation of each relay shall be provided by Bidder without any extra cost.

- e) The Bidder shall ensure that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. The type of relay case size offered shall not create any restrictions on the availability of the contact terminals for wiring connections. All relay contacts used for remote annunciation shall be making type i.e. contacts should close to initiate annunciations.
- f) DC/DC converter shall be provided in the solid state protective relay wherever necessary in order to provide a stable auxiliary supply for relay operation. Provision of DC cells in the protective relays as reliable standby power supply will however not be acceptable.
- g) The relays shall be stable and suitably protected against transient/induced over voltages and noise signals. The Bidder shall state clearly in his bid, special requirements, if any, for DC input arrangement or cabling considered necessary for satisfactory operation of relays offered.
- h) All equipment shall be of modular construction and the modules and sub units shall be of plug in type for easy replacement. Equipment shall use solid state components and integrated circuits of latest design/techniques. The design shall permit rapid and positive recognition of defects and facilitate easy repair. Appropriate indications shall be available to enable speedy internal fault location. All components shall be readily accessible for easy disassembly and replacement.
- i) All components shall be clearly and unambiguously marked and complete wiring shall be column coded and tagged wires only in flat ribbon cable will be exempt from tagging.
- j) Readily accessible and clearly marked test prints shall be provided at all important points in the circuit.
- k) Screw clamp terminals shall be provided for interconnection with relaying equipment. It shall be possible to test the protection channels with the equipment fully operational without rendering the equipment ineffective for genuine signals. Safety equipment such as protection cover and interlocks shall be provided. Ground terminals with isolating links shall be provided where required.

14.2.14 ***Numerical relays***

- i) All Relays are Numerical relays, unless other wise wherever specified that alternatively solid state relays accepted. Numerical relays are acceptable as an alternative to solid state relays.

The following information / confirmation shall also be furnished in the bid.

All Numerical Relays should have following minimum features:

Shall have suitable communication facility for connectivity to SAS and shall be capable of supporting IEC-61850 protocol without any protocol converter. KEMA certificate confirming interoperability, GOOSE messaging as per IEC 61850 standard shall be submitted along with the Bid.

Shall have one no. front RJ45 or USB port for Local Relay Parameterization and one no. rear FO port for connectivity to SAS over IEC 61850 protocol.

Should have minimum 15 configurable LEDs.

Should have minimum 16 Binary Inputs and 24 Binary Outputs. I/Os shall be configurable.

Shall have front minimum 4 lines LCD display with Alpha numeric key pad.

- ii) Numerical relays are provided with built in Event / Disturbance / Fault Recorder features.
- iii) The bidder shall bring out in the bid that the Numerical relays providing different protection features / application in a single unit if any one of the application / feature goes out of service the other feature / application (s) will remain un-effected.
- iv) The necessary interface software for programming, interacting with the relays shall be provided free of cost. Necessary software and hardware to up/down load the data to / from the relay from to the computer installed in the substation shall be provided.
- v) The necessary hardware / software support shall be given for at least **15 years** beyond warrantee at reasonable prices.
- vi) The Bidder shall include in the bid a list of installations where the relays quoted have been in satisfactory operation.

14.3 Annunciation System

- a) Alarm annunciation system shall be provided for the control board by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operation of some protective devices. The annunciation equipment shall be suitable for operation with **220V DC** voltage.
- b) The visual annunciation shall be provided by annunciation facia, mounted flush on the top of the panels. The audible alarm shall be provided by alarm buzzer and bell for trip and non-trip alarm respectively.
- c) The annunciator facia shall be provided with translucent plastic window for alarm point with minimum size of 35 mm x 50 mm. The facia plates shall

be engraved in black lettering with respective inscriptions details of which will be furnished to the Contractor by the Purchaser.

Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5 mm.

- d) Facia windows shall be illuminated with LEDs. Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. The lamp circuit shall include series resistor of adequate rating. The cover plate of the facia windows shall be flush with the panel and shall be capable of easy removal to facilitate replacement of lamps. The transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (500 Lux), from the location of the Operator's desk.
- e) TRIP AND NONTRIP facia shall be differentiated. All TRIP shall have red colour and all NONTRIP facia shall have white colour.

The available alarm shall be provided by Buzzer / Hooter / Bell having different sounds and shall be used as follows :

Hooter – alarm annunciations

Bell – Annunciation of DC failure.

Buzzer – AC supply failure.

- f) Sequence of operation of the annunciator shall be as follows:

Alarm condition	Fault contact	Visual Annunciation	Audible Annunciation
1. Normal	Open	Off	Off
2. Abnormal	Close	Flashing	On
3. Acknowledge push Button is pressed	Close	Steady on	Off
4. Reset push button is pressed	Close/ Open	On/Off	Off
5. Lamp test push button pressed	Open	Steady on	Off

- g) Visual and audible annunciation for the failure of DC supply to the annunciation system shall also be provided and this annunciation shall operate on 240 Volts AC supply with separate fuses. On failure of the power supply to the annunciation system for more than 3 secs. (adjustable setting) an indicating lamp shall light up and a bell shall sound. A separate push button shall be provided for cancellation of this audible alarm alone but the indicating lamp shall remain steadily lighted till the supply to the annunciation system is restored. The sound of the audible alarm (bell)

provided for this annunciation shall be different from the audible alarm provided for the annunciation system.

- h) A separate voltage check relay shall be provided to monitor the failure of supply (240V AC) to the scheme mentioned above. If the failure of supply exists for more than 2 to 3 secs. This relay shall initiate visual and audible annunciation. The visual and audible annunciation for the failure of AC supply shall be connected to the annunciation system and this shall operated on DC and buzzers shall sound. The annunciation system described above shall meet the following additional requirements :
 - i) The annunciation system shall be capable of catering to all simultaneous signals at a time.
 - ii) One self resetting push button shall be provided on each panel for testing the facia window lamps. Push buttons for testing flasher and audible alarm circuit of annunciation supply failure monitoring circuit shall also be provided. These testing circuits shall be so connected that while test is being done it shall not prevent the registering of any new annunciation that may land during the test.
 - iii) One set each of the following push buttons shall be provided on each panel.
 - a) Reset push button for annunciation system.
 - b) Accept push button for annunciation system.
 - iv) The annunciation shall be repetitive type and shall be capable of registering the feeling signal. Minimum duration of the fleeting signal. Minimum duration of the fleeting signal registered by the system shall be 15 milli secs.
 - v) The annunciation shall be suitable for operation with normally open fault contacts which close on a fault. For fault contacts which open on a fault, it shall be possible at site to change annunciations from “close to fault” and vice versa.
 - vi) **Microprocessor** based alarm and annunciation relay schemes are preferable.
 - vii) In case of static annunciator scheme, special precaution shall be taken to ensure that spurious alarm condition does not appear due to influence of external electromagnetic / electrostatic interference on the annunciator wiring and switching disturbances from the neighboring circuits within the panels and the static annunciator shall meet the high voltage susceptibility test, impulse voltage with stand test, high frequency disturbance test–class III and fast transient disturbance test–level III as per IEC 60255.

14.4 Switches

- a) Control and Instrument switches shall be rotary operated type with Escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out. Handles of different shapes and suitable inscriptions on switches shall be provided as on aid switch identification. The connection shall be from the back. The contact assembly at the back of the back of the switch shall be enclosed in a dust removable covers. The access to the cover shall be from the back, by removal of nuts.
- b) The selection of operating handles for the different types of switches shall be as follows:
 - i. Breaker and isolator : Control switch with pistol grip (black)/control switch with discrepancy lamp, switches
 - ii. Selector switches : Oval or knob, black
 - iii. Instrument switches: Round, Knurled, black
 - iv. Protecting transfer : Pistol grip, lockable switch and black
 - v. Synchronizing switches : Oval, Black, keyed handle
- c) The control switch of breaker and isolator shall be of 3 position 12 ways spring return to neutral type, with lost motion device with locking facility. The spring return type shall be provided with target which shall indicate the last operation of the switch.

The control springs shall be strong and robust enough to prevent inadvertent operation due to light touch. The spring return type switch shall have spring return from close and trip positions to “after close” and “after trip” positions respectively. Adequate number of spare contacts shall be provided on breaker control switches for control, inter locking, annunciation and discrepancy.
- d) Instrument selection switches shall be of maintained contact (stay put) type Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondaries when changing the position of the switch. They shall be of 5 position type viz R-Y-B-N-Off. Voltmeter transfer switches for AC shall be suitable for reading all line-to-line and line-to-neutral voltage for non-effectively earthed system and for reading all line to line voltage for effectively earthed systems.
- e) Synchronizing selector switches shall be maintained contact (stay put) type and provided on the Synchronous Trolley. Synchronising sockets (12 pin type) matching with the 12 pin Plug of Synchronous Trolley cable shall be fixed on each breaker panel The synchronizing selector switch (on the trolley) and socket (on the panel) combination shall be arranged to connect the Synchronizing equipment when turned to the “ON” position. One

contact of each socket shall be connected in the closing circuit of the respective breaker so that the breaker cannot be closed until the switch is turned to the “ON” position.

- f) Lockable type of selector switch which can be locked in particular positions shall be provided on the trolley. The key locks shall be fitted on the operating handles.
- g) The contacts of all switches shall preferably open and close with snap action to minimize arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver. Spring shall not be used as current carrying parts.

The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme. The contact rating of the switches shall be as follows:

Description		Contact rating in Amps.		
		220V DC	50V DC	240 V AC
a)	Make and carry continuously	10	10	10
b)	Make and carry for 0.5 sec.	30	30	30
c)	Break			
	i) Resistive load	03	20	07
	ii) Inductive load with L/R=40m sec	0.2	16	07

Discrepancy Switches

As an alternate to the pistol grip type control switch the bidder can offer control switch with discrepancy lamp. Control switch with discrepancy lamp shall be used for the remote operations like closing and tripping the circuit breakers or closing and opening of the isolator. The built in lamp shall be connected to the annunciation for any discrepancy between the position of the switches and controlled objects. Suitable flasher relay shall also be included in the scope. The discrepancy switches shall be black in colour and knob type with in-built lamp. Wherever discrepancy switches are provided the bidder shall provide necessary auxiliary relays for interlock schemes.

14.5 Indicating Lamps

- a) Indicating lamps shall be panel mounting type with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp

covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resisting material. The lamps shall be of LED type. The supply for LED shall be from DC station batteries, unless stated otherwise, at **220V**.

- b) The wattage and resistance of the lamps shall be as follows:
 - i) 220/250 V – 5 to 10 W – 4000 to 8000 Ohms
 - ii) 110 V – 5 to 10 W – 1000 to 2000 Ohms
- c) Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.
- d) The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis.
- e) LED shall be furnished **20% in excess** of actual numbers required and caps shall be furnished **10% in excess** of actual numbers used for each colour. The corresponding breaker position of indicating lamps shall flash for condition of discrepancy between the last operation of circuit breaker (ON & OFF) and become steady when the switch is operated to correspond with the position of the circuit breaker. The discrepancy signal when the breaker is tripped shall also be followed by the sound signal.

14.6 Position Indicators

- a) Position indicators of ‘SEMAPHORE’ type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating / earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.
- b) Position indicator shall be suitable for either AC or DC operation as specified. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic bus bars, and at right angles to them when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure. The rating of the indicator shall not exceed **2.5 W**. It shall not be possible to displace the position of the indicator discs due to the accidental touch during the cleaning of the panel.
- c) The position indicators shall withstand **120% of rated voltage** on a continuous basis.

14.7 Synchronizing Equipments

- a) 1 No. Synchronizing switch and 1 No. 12 pin Synchronizing socket is to be provided on 400/220/132 kV feeder control panels and shall be supplied along with panels. Depending on the actual requirement either Synchronizing switch or Synchronizing sockets or both will have to be mounted and wired on the panel.
- b) The synchronizing instruments shall be mounted on a synchronizing trolley. The trolley shall be equipped with double voltmeter, double frequency meter, synchroscope and lamps fully wired. The trolley shall be of mobile type with four rubber padding wheels capable of rotating in 360° round the vertical axis. Suitable bumpers with rubber paddings shall be provided all round the trolley to prevent any accidental damage to any panel while the trolley is in movement.
- c) The trolley shall have 3 meter long flexible cord comprising stranded tinned copper conductors fully wired to the instruments and terminated in plug in order to facilitate connecting the trolley to any of the panels. The trolley shall be provided with all equipment/accessories necessary for proper synchronization.

Receptacle to accept the plug shall be provided on each control panel. Suitable auxiliary voltage transformers wherever necessary shall also be provided for synchronizing condition.

- d) Synchroscope shall be suitable for $110/\sqrt{3}$ V phase to neutral VT secondaries and shall be provided with integral synchronism indicating lamp employing bright bulb synchronizing method.

The synchroscope shall indicate synchronism between incoming and running supplies when pointer is at the time 'twelve O'clock' position only and shall have arrows on the face to show that the incoming supply frequency is fast or slow with respect to the running supply frequency when the pointer is moving clockwise or anti-clockwise respectively. The instrument pointer shall move at least 45° from the vertical position when either or both supplies are removed and then remain stationary without any tendency to creep.

The synchroscope shall be 360° type and preferably be large in size than other instruments. It shall be capable of withstanding sustained out-of-synchronism conditions.

In case the synchroscope is not continuously rated, a synchroscope cut-off switch shall be provided and an indicating lamp to indicate that the synchroscope is energized, shall also be provided.

- e) Synchro check relay with necessary ancillary equipment shall be provided which shall permit 132 kV breakers to close checking the requirements of synchronizing of incoming and running supply. The phase angle setting shall not exceed 35° and this angle shall be adjustable and take into account the circuit breaker closing system period. This relay shall have a response time of less than 200 milliseconds when the two system conditions are met with in present limits and with the timer disconnected. The relay shall have a frequency difference setting not exceeding 0.45% at rated value and at the minimum time setting. The relay shall have a voltage difference setting not exceeding 10% at rated value. The relay shall have a continuously adjusted time setting range 0.5 to 20 sec. A guard relay shall be provided to prevent the closing attempt by means of synchronizing check relay when control switch is kept in closed position long before the two systems are in synchronism. The synchronizing by pass switch shall also be provided.

14.8 Transducers

- 14.8.1 Transducers (for use with Indicating Instruments and Telemetry/Data Communication application) shall in general conform to IEC:688-1
- 14.8.2 The transducers shall be suitable for measurement of active power, reactive power, voltage, current and frequency in three phase four wire unbalanced system.
- 14.8.3 The input to the transducers will be from sub-station current & potential transformers. The output shall be in milli ampere D.C. proportional to the input & it shall be possible to feed the output current directly to the telemetry terminal or indicating instruments.
- 14.8.4 The transducer characteristic shall be linear throughout the measuring range.
- 14.8.5 The transducer output shall be load independent.
- 14.8.6 The input & output of the transducer shall be galvanically isolated.
- 14.8.7 Each transducer shall be housed in a separate compact case and have suitable terminals for inputs & outputs.
- 14.8.8 The transducers shall be suitably protected against transient high peaks of voltage & current.
- 14.8.9 The transducer shall withstand indefinitely without damage and work satisfactorily at 120% of the rated voltage and 120% of the rated input current as applicable.
- 14.8.10 All the transducers shall have an output of 4-20 mA.
- 14.8.11 The response time of the transducers shall be less than 1 second.
- 14.8.12 The accuracy class of transducers shall be 1.0 or better for voltage/current transducer, 0.5 or better for watt/VAR transducer and 0.2 or better for frequency transducer.

14.8.13 The transducers shall have a low AC ripple on output less than 1%.

14.8.14 The transducer shall have dual output.

15.0 TIME SYNCHRONIZATION EQUIPMENT

15.1 The Time synchronization equipment shall receive the co-ordinate Universal Time(UTC) transmitted through GEO Positioning Satellite System (GPS) and synchronize equipments to the Indian Standard Time in substation. The time synchronization shall be realized using the SNTP protocol at inter bay bus.

15.2 Time synchronization equipment shall include antenna, all special cables and processing equipment etc.

15.3 It shall be compatible for synchronization of Event Loggers, Disturbance recorders and **SCADA/SAS** at a substation through individual port or through Ethernet realized through optic fiber bus.

15.4 Equipment shall operate up to the ambient temperature of 50 degree centigrade and 100% humidity.

15.5 The synchronization equipment shall have 1 micro second accuracy. Equipment shall give real time corresponding to IST (taking into consideration all factors like voltage and temperature variations, propagation and processing delays etc.)

15.6 Equipment shall meet the requirement of IEC 60255 for storage and operation.

15.7 The system shall be able to track the satellites to ensure no interruption of synchronization signal.

15.8 The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement.

15.9 The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following :

- Potential free contact (minimum pulse duration of 50 milli Seconds)
- IRG-B
- RS232C
- SNTP Port
- 3 Nos. of Ethernet RJ45 port with link/activity and 10/100 Mbps.

15.10 The equipment shall have a periodic time correction facility of one second periodicity.

15.11 Time synchronization equipment shall be suitable to operate from **220V DC** as available at substation.

- 15.12 Equipment shall have real time digital display in hour, minute, second (24 hour mode) and have a separate time display unit to be mounted on the top of control panels having display size of approx. 100mm height.
- 15.13 The cable connecting Antenna and Time Synchronising unit should be run through HDPE pipe or GI pipe from the location of Antenna fixing to Time Synchronising panel with suitable fixtures and no provision to enter rain water and should not be affected by atmospheric conditions.

16.0 TRIP CIRCUIT SUPERVISION RELAYS

- a) Trip circuit shall be supervised by means of relays. The scheme shall continuously monitor each trip coil in both pre-close and after-close of the breaker. The scheme shall detect:
- i) Failure of DC supply to each trip coil.
 - ii) Open circuit of trip circuit wiring and
 - iii) Failure of mechanism to complete the tripping operation.
- b) i) The relays shall have necessary contacts to be connected to either the alarm bell or to the annunciator available in the control panel for visual and audible indication of the failure of trip circuit and for connection to event logger.
- ii) The relay shall have time delay on drop off of not less than 200 milli seconds and be provided with operation indications for each phase. Trip circuit supervision relay shall be provided for each pole of breaker for each DC source.
- c) Also 2Nos. indicating lamps to act in conjunction with trip circuit supervision relays for healthy trip indication of 2 sets of trip coils shall be supplied.
- d) Necessary external resistors for trip circuit supervision relays shall be supplied.

17.0 HIGH SPEED TRIPPING RELAY

High Speed Tripping Relay shall

- i) be instantaneous (operating time not to exceed 10 milli seconds)
- ii) be DC operated
- iii) have adequate hand resetting type contacts, preferably operated by push button. The resetting time shall be within 20 milli seconds for self resetting relays.
- iv) have necessary supervisory relays.
- v) be provided with operation indicators for each element/coil.
- vi) have adequate contacts to meet entire requirement of the scheme, with two spare contacts.

18.0 FLAG RELAYS

Flag relays shall have

- i) hand reset flag indication
- ii) two elements
- iii) have necessary NO/NC contacts for each element/coil to meet scheme requirements and other functions like event logger, disturbance recorders etc.

19.0 AUXILIARY MONITORING RELAYS

- a) Self reset auxiliary/monitoring voltages relays for specified DC Voltage shall be provided for use in the interlocking schemes for multiplication of contacts, and for monitoring of control supplied and circuit. Monitoring relays for lockout relay circuit shall be connected in series with lockout relay coils. The bidder shall be responsible to ensure that the monitoring relay rating are such that they shall positively pick-up through the breaker coils/lockout relay coils monitored, but the breakers/lockout relays shall not operate with such a connection.
- b) The supply and circuit monitoring relay shall be connected to initiate an alarm upon failure of respective supply circuit. They shall preferably have reverse flags. Which drop when the relay is de-energized. Otherwise, an indicating lamp shall be provided with each monitoring relay for indication of its operation.

20.0 D.C. SUPPLY SUPERVISION RELAY

The relay shall be capable of monitoring the failure of D.C. supply to which it is connected. It shall have adequate potential free contacts to meet the scheme requirement. The relay shall have a 'time delay on drop-off' of not less than 100 milliseconds and be provided with operation indicator / flag.

21.0 A. Non-directional Over Current relay for back up protection

- i) be single pole type
- ii) have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting.
- iii) have a variable setting range of 50-200% of rated current with adjustable time multiplier setting.
- iv) have a characteristic angle of 45° , directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 500-2000% of rated current. Both the inverse and high set relays shall be non-directional.
- v) include hand reset flag indicators per phase.
- vi) shall be numerical type.

B. Directional Over Current relay for back up protection (For transmission lines)

- i) be single pole type
- ii) have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting.
- iii) have a variable setting range of 50-200% of rated current with adjustable time multiplier settings.
- iv) have a characteristic angle of 45° , directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 500-2000% of rated current. Both the inverse and high set relays shall be directional.
- v) include hand reset flag indicators per phase.
- vi) shall be numerical type.

22.0 A. Directional earth fault relay for back up protection (for lines and transformers)

- i) be single pole type.
- ii) have IDMT characteristic with a definite time of 3.0 seconds at 10 times setting
- iii) have a variable setting range of 20-80% of rated current with adjustable time multiplier settings.
- iv) have a characteristic angle of 45° , directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 200-800% of rated current. Both the inverse and high set relays shall be directional.
- v) include hand reset flag indicators per phase.
- vi) shall be numerical type.

B. Non Directional earth fault relay for back up protection

- i) be single pole type.
- ii) have IDMT characteristic with a definite time of 3.0 seconds at 10 times setting
- iii) have a variable setting range of 20-80 % of rated current with adjustable time multiplier settings.
- iv) have a characteristic angle of 45° , directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 200-800% of rated current. Both the inverse and high set relays shall be directional.
- v) include hand reset flag indicators per phase.

- vi) shall be numerical type.

23.0 DETAILED DESCRIPTION OF PROTECTIONS

The protection, auxiliary relay and timers and other equipment that are required to be provided are included in the list of equipment. The detailed description of each protection and the associated equipment are described below:

The setting ranges of the equipment offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.

The Bidder shall quote the protection equipment meeting the following requirements. The Bidder may also quote for any alternative/additional protections or relays considered necessary by him for providing complete, effective and reliable protection. These equipment shall be quoted separately as an alternative/addition to the main offer stating the price separately. The choice of acceptance of this alternative/additional equipment shall rest with the Purchaser.

23.1 TRANSMISSION LINE PROTECTION

- 23.1.1 The line protection relays are required to protect the line and clear the faults on line within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines.
- 23.1.2 The general concept is to have two fast operating distance protection scheme preferably with two different operating principles. The Main-I and Main-II will generally be operated from signal from different cores of line VT. In case line VT is out due to any reason manual selection for Bus VT will be made. Two main protections Main-I and Main-II having equal performance requirement especially in respect of time as called **Main-I and Main-II for 400KV and 220KV transmission lines and Main and back up protection for 132KV transmission lines.** **In case of 400KV and 220KV XLPE cables Distance protection will be used as Main-I whereas the current differential protection will be used as Main-II protection. In case of 132KV XLPE cables current differential protection will be used as Main protection.** The general concept is to have distance protection for **33kV** line feeder as main protection.
- 23.1.3 The Transmission system for which the line protection equipment are required is shown in the reference drawing/document(s). The length of lines and the line parameters (Electrical Constants) shall be provided during detailed engineering.
- 23.1.4 The maximum fault current could be as high as **63 kA** but the minimum fault current could be as low as 20% of rated current of CT secondary. The starting & measuring relays characteristics should be satisfactory under these extremely varying conditions.
- 23.1.5 The protective relays shall be suitable for use with capacitor voltage transformers having non-electronic damping and transient response as per IEC.

- 23.1.6 It should be ensured that there is no additional delay in relay operating time created intentionally to have stable operation. The power supply unit if provided as an integral part of relay scheme shall be fully rated with liberal design in capacity.
- 23.1.7 The DC supply for solid state relay shall be from DC/DC converters and these shall be amply and fully rated for all operating conditions in service.
- 23.1.8 Insulation barriers shall be provided to ensure that transients present in CT & VT connections due to extraneous sources do not cause damage to static circuits. The circuits must comply with IEC recommendation for impulse withstand values. Adequate measures shall be taken to ensure that equipment is protected against voltage spikes occurring in Aux. DC supply.
- 23.1.9 Disturbance recorder and Distance to fault Locator and Over voltage relay (stage -1/2) functions if offered as an integral part of line protection relays, shall be acceptable provided these meet the technical requirements as specified in the respective clauses.
- 23.1.10 Auto reclose relay function if offered as an integral part of line distance protection relay, shall be acceptable for 220kV and 132 KV lines only provided the auto reclose relay feature meets the technical requirements as specified in the respective clause.
- 23.1.11 The following protections shall be provided for each of the Transmission lines.

23.2 400 KV and 220KV LINE PROTECTION

- 23.2.1 The protection scheme offered shall be suitable for 400KV and 220kV three phase lines (composite type i.e. Overhead and Underground EHV Cable Circuits).
- 23.2.2 The scheme shall be provided with following protection functions for each of the transmission lines.
 - i) Main – I : Numerical, Communicable Distance protection scheme.
 - ii) Main – II : Numerical, Communicable Line Current Differential with back up Distance protection scheme.
 - iii) Back-up Directional Over current and Earth fault protection (Numerical type) with non-directional facility.
- 23.2.3 The detailed specifications of the above line protection scheme is given here under:-
 - 23.2.3.1 **Main Protections**
 - Main-I : This protection
 - i) shall be numerical type and modular in construction.

- ii) shall be non-switched type with separate zone measurements for all phase to phase and phase to ground faults. Zone switching to extend the reach of the measuring elements is also not allowed.
- iii) shall be high speed full scheme distance relay for three phase systems to clear all type of line faults within the set reach of the relay.
- iv) shall have stepped time-distance characteristics and three independent zones (zonal-1, zone-2 and zone-3).
- v) shall have mho or quadrilateral or other suitably shaped characteristics for zone-1, zone-2, zone-3.
- vi) The relay shall have an adjustable characteristics angle setting range of 30 to 85° or shall have independent resistance and reactance (X) setting.
- vii) shall have two independent continuously variable time setting range of 0 to 3 seconds for zone-2 and 0 to 5 second for zone-3.
- viii) shall have resetting time of less than 55 milliseconds or lower (including the resetting time of trip relays).
- ix) shall have facilities for offset features with adjustable 10-20% of zone-3 setting.
- x) shall have variable residual compensation.
- xi) shall have memory circuits with defined characteristics in all three phases to ensure correct operations during close-up phase faults and other adverse conditions and shall operate instantaneously when circuit breaker is closed to zero volt 3 phase fault.
- xii) the resistive reach shall be separately settable for phase-phase and phase-ground faults for each zone.
- xiii) it shall also have a facility to store different settings suitable for different configurations to cater for mutual coupling on account of multi circuit line conditions.
- xiv) have the following built in features:-
 1. Power swing Block – which blocks tripping during power swing conditions and have suitable setting range to encircle the distance protection described above.
 2. Fuse failure protection shall-.
 - monitor all the three fuses of VT and associated cable against open circuit.
 - inhibit trip circuits on operation and initiate annunciation.
 - have an operating time less than 7 milliseconds. Remain inoperative for system earth faults.
 3. Weak and infeed and current reversal logic.
 4. Stub protection.
 5. Phase selection features for single pole auto-reclosure & cross country faults.
 6. Power system monitoring in terms of
 - a) Broken conductor detection
 - b) Overload
- xv) be suitable for single and three phase tripping.

- xvi) shall have following maximum operating time (including trip relay time, if any) under given set of conditions and with VT being used on line (with all filters included).

		400 KV lines	220 KV lines
1.	Source to Impedance Ratio (SIR)	4	15
2.	Relay setting (Ohms)	(10 or 20)	2
3.	Fault Location (as % of relay setting)	50%	50%
4.	Fault Resistance (Ohms)	0	0

Maximum operating time 40 for all faults 45 for 3 ph. Faults & 60 (Milliseconds) for all other faults

- xvii) the scheme shall be suitable for various overreaching, under-reaching and blocking communication schemes.
- xviii) the scheme shall be provided with continuous self supervision features along with self diagnostics feature.
- xix) the scheme shall provided the user with complete information on at least 5 disturbances. Facility for retrieving this information remotely shall have to be possible.
- xx) service values of voltage, current, frequency, active power and reactive power shall be available. Pre-fault and fault values of currents and voltages must be available for fault analyzing purposes. Facility to have remote communication for the purpose of parameterization and reading service values should be possible with suitable with software and hardware.
- xxi) shall have suitable number of potential free contacts for carrier aided Tripping, Auto reclosing, Event Logging, Disturbance recorder & data acquisition system.
- xxii) the scheme shall have built-in event recorder, which can recorder at least 100 events with the time resolution of 1 msec.
- xxiii) the scheme shall have capability to time synchronize with the external **GPS signal/SNTP**.
- xxiv) the scheme shall have adequate **serial and fibre optic communication** ports for communication. The ports shall be used for configuration of the relay and disturbance data monitoring from local/remote and for the purpose of communicating to substation **SCADA**. All the necessary software and hardware required for remote configuration and for disturbance analysis shall be in the scope of the supplier.
- xxv) the local and remote communications shall be as per internationally acceptable specified **IEC protocols**.
- xxvi) the scheme shall be provided with a front mounted menu driven human-machine-interface and/or local front port for local parameterization with suitable security provisions for local parameterization with suitable security provisions for unauthorized access to settings.

- xxvii) shall have a continuous current rating of two times of rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage for a period of 1 sec.
- xxviii) shall be provided with necessary self reset type trip duty contacts for completion of the scheme (minimum number of these trip duty contacts shall be four per phase) either through built in or through separate high speed trip relays. Making capacity of these trip contacts shall be 30 Amps. For 0.2 seconds with an inductive load of $L/R > 10$ milliseconds. If separate high speed trip relays are used, the operating time of the same shall not be more than 10 milliseconds.
- xxix) suitable for multiplexed, route switched or dedicated fiber communication networks for remote end communication. [The bidders should offer the suitable communication module for protection scheme/IED considering that proposed communication mode between substation i.e. fiber optic/Digital PLCC]

Main-II : Line Current Differential protection with Back-up Distance Protection Scheme shall be / shall have

- (i) Numeric type protection.
- (ii) Suitable for protection of composite type line i.e. Overhead Line (ACSR Conductor) and Underground Cables (for cable circuit in the proposed substation single core XLPE Cable in solidly grounded networks. The communication shall be through Fiber Optic Cable/Digital PLCC. (i.e. Underground Fiber Cable and OPGW)).
- (iii) Phase segregated design for two line ends (terminations).
- (iv) Complete functionality for single breaker arrangement with single / three phase tripping.
- (v) Self supervision including analog channels.
- (vi) High sensitivity to internal faults and have excellent stability for external faults.
- vii) Restrained dual biased operate characteristic.
- viii) it shall be possible to transfer eight binary signal between the IEDs.
- ix) Operating time not more than 25 milli secs(Typical) at 0 to 10 xId
- x) Charging Current compensation to allow high sensitivity.
- xi) Back-up high speed full-scheme distance protection with the parameters as mentioned for Main-I protection above shall be included in order to get fault clearance in case of communication failure. The distance scheme shall be fully functional and continuously operable in relay as this feature shall be fully utilized on the lines on which the fiber communication will be made available in future for utilization of line different feature/function.
- xii) Instantaneous over current functions for phase faults and earth faults and time delayed directional/non directional over current functions with inverse and definite time characteristics with atleast three steps for phase and earth faults.

- xiii) Other current functions such as thermal over load with alarm and trip steps and breaker failure protection with short reset time in the IED.
- xiv) Over and Under voltage protection in the IED.
- xv) System supervision i.e. fuse failure and current circuit supervision.
- xvi) Inbuilt disturbance recorder which can handle at least 8 Nos. analog channels and atleast 32 Nos. binary signals.
- xvii) Inbuilt event recorder that can handle at-least 500 time tagged events.
- xviii) Capacity to store at-least 5 Nos. of recent disturbance records.
- xix) Time synchronization method shall be available on **SNTP, GPS** to be used in switched network with unequal channel delays in both directions.
- xx) The scheme shall have adequate serial and **fibre optic communication** ports for communication. The ports shall be used for configuration of the relay and disturbance data monitoring from local/remote and for the purpose of communicating to substation **SCADA**. All the necessary software and hardware required for remote configuration and for disturbance analysis shall be in the scope of the supplier.
- xxi) The local and remote communications shall be as per internationally acceptable specified **IEC protocols**.
- xxii) The scheme shall be provided with a front mounted menu driven human-machine-interface and/or local front port for local parameterization with suitable security provisions for unauthorized access to settings.
- xxiii) Suitable for multiplexed, route switched or dedicated fibre communication networks for remote end communication. **[The bidders should offer the suitable communication module for protection scheme/IED considering that proposed communication mode between substation i.e. fiber optic/Digital PLCC]**

23.2.3.2 Back-up Directional over Current and Earth fault Protection Scheme

This shall,

1. have three over current and one earth fault elements which shall be either independent or composite unit(s).
2. shall be numerical type.
3. shall include necessary VT fuse failure relays for alarm purposes.
4. **Directional over current relay (with facility of non-directional)**
 - Have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting.
 - Have a variable setting range of 50-200% of rated current.
 - Have a characteristic angle of 30/45 degree lead.
 - Include hand reset flag indicators or LEDs.
5. **Directional Earth fault relay (with facility of non-directional)**
 - Have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times.
 - Have a variable setting range 20-80% of rated current.
 - Have characteristic angle of 45/60 degree lag.

- Include hand reset flag indicator of LEDs
- Include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay.

23.2.3.3 LINE OVER VOLTAGE PROTECTION

1. This shall monitor all three phases.
2. Have two independent stages.
3. Have an adjustable setting range of 100-170% of rated voltage with an adjustable time delay range of 1 to 60 seconds for the first stage.
4. Have an adjustable setting range of 100-170% of rated voltage with a time delay of 100-200 milli seconds stage.
5. Be tuned to power frequency.
6. Provided with separate indicators (flag target) for each stage relays.
7. Have a drop-off to pick-up ratio greater than 95%.
8. Provide separate out-put contacts for each 'Phase' and stage for breaker trip relays, event logger and other scheme requirements.

23.2.3.4 DISTURBANCE RECORDING

The disturbance function shall have following features:

1. Disturbance recorder shall be able to record continuously and will have 8 analogue inputs and 32 digital inputs.
2. Disturbance Recorder shall have a scan rate of 1 KHz or better.
3. It should be possible to trigger the recorder from any analogue inputs (Over and/or Under Voltage/Current) and on any digital input.
4. Disturbance recorder shall have provision to accept external signals for triggering.
5. Disturbance recorder shall have adjustable pre-fault and post fault time settings.
6. Total recording time shall be 20 sec.

23.2.3.5 FAULT LOCATOR

The location function shall:

1. Microprocessor base type.
2. be "On-Line" type.
3. be suitable for breaker operating time of 2 cycles.
4. have built in display unit.
5. the display shall be directly in percent of line length or Kilometers without requiring the future calculations.
6. have an accuracy of 3% or better for the typical conditions defined for operating timing measurements of distance relay.
7. The above accuracy should not be impaired under the following conditions:
 - Presence of remote end infeed.
 - Predominant D.C. component in fault current.
 - High fault arc resistance.

- Severe VT Transients.
8. shall have mutual zero sequence compensation unit for fault locator to be used on double circuit lines.

23.3 **132 KV LINE PROTECTION**

The protection scheme offered shall be suitable for **132KV** three phase lines (composite type i.e. Overhead and Underground EHV Cable Circuits).

The scheme shall be provided with following protection functions for each of the transmission lines.

- i) Main : Numerical, Communicable Distance protection scheme.
- ii) Back-up: Directional Over current and Earth fault protection (Numerical type) with non-directional facility.

23.3.1 **Overhead Lines**

The detailed description for the Main and back up protection for **132 KV** feeder is given here under.

a) The Main distance protection shall be/ shall have

- i) Numeric type protection
- ii) The basic scheme shall have a Zone-I operating time up to trip impulse to breaker (complete protection time including the trip relay operating time) not more than 40 milli seconds.
- iii) Include power swing blocking protection which shall.
 - a) be of triple pole type
 - b) have suitable setting range to encircle the distance protection described above
 - c) have a continuously adjustable time delay on pick up of setting range 0-2 seconds
 - d) block tripping during power swing conditions.
- iv) include fuse failure protection which shall
 - a) Monitor all the three fuses of CVT and PT and associated cable against open circuit
 - b) inhibit trip circuits on operation and initiate annunciation
 - c) have an operating time less than 7 milli seconds.
 - d) remain inoperative or system earth faults.
- v) Operate instantaneously when circuit breaker is closed to Zero-volt 3 phase fault
- vi) be suitable for three phase tripping.
- vii) have a continuous current rating of two times rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage during a period of 1 sec.

- viii) be selective between internal and external faults.
- ix) protect 100% of the line section.
- x) suitable shaped characteristic to prevent relay operation during maximum load conditions without reducing the reach of relays
- xi) fourth zone back up timer with independent timing range of 0.5 to 5 seconds. The fourth zone setting shall have the facility to set for directional or non-directional operation.
- xii) be provided with necessary high speed relays for single phase faults and multiphase faults. Each of these shall have adequate contacts to meet the complete scheme requirement.
- xiii) Have high speed non switched distance relays for 3 phase system to clear all types of line faults within the set reach of the relay. Have 6 nos. non switched measuring elements for each zone of protection (3 for phase to phase fault and 3 for phase to earth faults.)
- xiv) **Disturbance recorder** shall be provided with all the features as mentioned in this specification.
- xv) **Distance to fault locator** shall be provided with all the features as mentioned in this specification.
- xvi) Necessary provision shall be made to add 3 phase auto-reclosing feature.
- xvii) be provided with voltage selection relay for the selection of Bus-Section I PT/Bus Section-II PT..

b) The back up protection shall consist of the following simple numerical relays separately (in separate device than main relay)

- i) 3 Nos. IDMT directional over current relays with high set as clause 21.0 B.
- ii) 1 No. IDMT directional earth fault relay with high set as per clause 22.0

23.3.2 Underground 132 KV EHV Cable Line

The detailed description for the Main and back up protection for 132 KV transmission cable circuit feeder is given here under.

a) Main Line Current Differential protection with Back-Up Distance Protection Scheme shall be/shall have

- i) Numeric type protection
- ii) Suitable for protection of underground cables (for 145 KV class Cable Circuit in the proposed under this project for incomer circuits) in solidly grounded networks/transmission Lines. The communication shall be through fiber optic cable/Digital PLCC.
- iii) Phase segregated design for two line ends (terminations).

- iv) Complete functionality for single breaker arrangement with single/three phase tripping.
- v) Self supervision including analog channels.
- vi) High sensitivity to internal faults and have excellent stability for external faults.
- vii) Restrained dual biased operate characteristic.
- viii) It shall be possible to transfer eight binary signals between the IEDs.
- ix) Operating time not more than 25 milli secs (Typical) at 0 to 10 x Id.
- x) Charging current compensation to allow high sensitivity.
- xi) Back-up high speed full-scheme distance protection with the parameters as mentioned for Main protection in Clause 23.3.1a) above shall be included in order to get fault clearance in case of communication failure. The distance scheme shall be fully functional and continuously operable in relay as this feature shall be fully utilized on the lines on which the fiber communication will be made available in future for utilization of line differential feature/function.
- xii) Instantaneous over current functions for phase faults and earth faults and time delayed directional/non directional over current functions with inverse and definite time characteristics with atleast three steps for phase and earth faults.
- xiii) Other current functions such as thermal over load with alarm and trip steps and breaker failure protection with short reset time in the IED.
- xiv) Over and Under voltage protection in the IED.
- xv) System supervision i.e. fuse failure and current circuit supervision.
- xvi) Inbuilt disturbance recorder which can handle at least 8 Nos. analog channels and atleast 32 Nos. binary signals.
- xvii) Inbuilt event recorder that can handle at-least 500 time tagged events.
- xviii) Capacity to store at-least 5 Nos. of recent disturbance records.
- xix) Time synchronization method shall be available on **SNTP,GPS** to be used in switched networks with unequal channel delays in both directions.
- xx) The scheme shall have adequate serial and **fibre optic communication ports** for communication. The ports shall be used for configuration of the relay and disturbance data monitoring from local/remote and for the purpose of communicating to substation **SCADA**. All the necessary software and hardware required for remote configuration and for disturbance analysis shall be in the scope of the supplier.
- xxi) The local and remote communications shall be as per internationally acceptable specified **IEC protocols**.
- xxii) The scheme shall be provided with a front mounted menu driven human-machine-interface and/or local front part or local

parameterization with suitable security provisions for unauthorized access to settings.

- xxiii) Suitable for multiplexed, route switched or dedicated fibre communication networks for remote end communication. [The bidders should offer the suitable communication module for protection scheme/IED considering that proposed communication mode between substation i.e. fiber optic/Digital PLCC]

b) The backup protection shall consist of the following simple numerical relays separately (in separate device than main relay)

- i) 3 Nos. IDMT directional over current relays with high set as per clause 21.0 B.
- ii) 1 No. IDMT directional earth fault relay with high set as per clause 22.0.

23.4 33 KV PROTECTION

23.4.1 The protection provided on 33KV system shall be inverse NON DIRECTIONAL IDMT relays for over current & earth fault.

23.4.2 The bay control unit (provided for control function) shall have following protection feature:

1. Over current Instantaneous protection (ANSI 50).
2. Over Current definite time & IDMT (51 high, 51 low & 51 IDMT)
3. Earth Fault Definite time & IDMT (51N High, 51N LOW, 51N IDMT)
4. Under-voltage instantaneous, definite time (27, 27 High, 27 Low)
5. Over-voltage Instantaneous, Definite time (59, 59 High, 59 Low)

23.4 400/ 220 KV/ 132 KV Bus Coupler protection

The protection provided on 400, 220KV and 132KV bus couplers shall be triple pole, non-directional IDMT over current relays and single pole non-directional IDMT earth fault relay. The over current and earth fault relays shall be numerical and communicable type.

Setting required:

O/C relay 0.5 to 2 amps.

E/F relay range 0.2 to 0.8 amps.

23.5 240/ 315/ 500 MVA 400/220/33 KV Auto Transformer and 100/160 MVA 220/132/11 KV Transformer Protection

The protection scheme proposed to be adopted for transformers will be as under:

- a) Main-I: Numerical full scheme Differential protection and have facility for connecting to substation control system/SCADA.

- b) Main-II: Numerical High Impedance Different Protection and have facility for connecting to **substation control system/SCADA**.
- c) Restricted earth fault protection
- d) Inverse over current back-up protection for phase faults with instantaneous attachment.
- e) Inverse backup protection for ground faults with instantaneous attachment.
- f) High temperature winding protection.
- g) High temperature oil protection.
- h) Buchholz protection for transformer and OLTC.
- i) Voltage Neutral displacement relay for tertiary protection.
- k) Over-fluxing protection.
- l) Pressure release device (PRD)

23.5.1 A. Numerical Transformer differential protection scheme shall

- a) be triple pole type, with faulty phase identification/indication
- b) have an operating time not greater than 30 milli seconds at 5 times the rated current.
- c) have three instantaneous high set over current units
- d) have an adjustable bias setting range of 20-50%
- e) be suitable for rated current of 1 Amp.
- f) have second harmonic or other inrush proof features and also should be stable under normal over fluxing conditions. Magnetizing inrush proof feature shall not be achieved through any intentional time delay e.g. use of timers to block relay operation or using disc operated relays.
- g) have an operating current setting of 15% or less.
- h) include necessary separate interposing current transformers for angle and ratio correction or have internal feature in the relay to take care of the angle and ratio correction
- i) have a disturbance recording feature to record graphic form of instantaneous values of current in all three windings in nine analogue channels in case of **400kV** class above transformers and 6 analogue channels for lower voltage transformers, during faults and disturbances for the pre fault and post fault period. The disturbance recorder shall have the facility to record the following external digital channel signals apart from the digital signals pertaining to differential relay.
 1. REF protection operated
 2. HV breaker status (Main and tie)
 3. LV breaker status
 4. Bucholz/OLTC Bucholz alarm/trip
 5. WTI/OTI/PRD alarm/trip of transformer

Necessary hardware and software for down loading the data captured by disturbance recorder to the **personal computer** available in the substation shall be included in the scope.

23.5.2 B. High Impedance Differential Protection

This differential protection shall be based on circulating current principle using high impedance differential relay of numerical type for transformer protection having functionalities/features as below:

- i) Provide separate indication for each phase.
- ii) High speed circulating current type.
- iii) Have current setting of 10-50% in minimum step of 10%
- iv) Tuned to supply frequency and reject harmonics.
- v) Provided with continuously adjustable stabilizing resistance.
- vi) Suitably protected against high voltages by suitable non-linear resistance.
- vii) Have alarm and trip output contacts.

23.5.3 Over fluxing protection Relays shall

- a) operate on the principle of voltage to frequency ratio and shall phase to phase connected.
- b) have inverse time characteristics, matching with transformer over fluxing withstand capability curve.
- c) provide an independent 'alarm' with the time delay continuously adjustable between 0.1 to 6.0 seconds at values of 'v/f between 100% to 130% of rated values.
- d) tripping time shall be governed by 'v/f vs. time characteristics of the relay.
- e) have a set of characteristics for various time multiplier settings. The maximum operating time of the relay shall not exceed 3 seconds and 1.5 seconds at 'v/f values of 1.4 and 1.5 times, the rated values, respectively.
- f) have an accuracy of operating time, better than $\pm 10\%$.
- g) have a resetting ratio of 95% or better.
- h) Be acceptable as a built in feature of **numerical transformer differential relay**.

23.5.4 Numerical Restricted Earth Fault Protection shall

- a) be single pole type.
- b) be of current/voltage operated high impedance type.
- c) have a current setting range of 10-40% of 1 Amp./ have a suitable voltage setting range.
- d) be tuned to the system frequency.

23.5.6 Numerical Back-up Over Current and Earth fault protection scheme with high set feature

- a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).
- b) The scheme shall include necessary **VT fuse failure relays** for alarm purposes.

Over current relay shall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current.
- have low transient, over reach high set instantaneous unit of continuously variable setting range 500-2000% of rated current.
- have a characteristic angle of 30/45 degree lead.
- include hand reset flag indicators of **LEDs**.

Earth fault relay shall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 20-80% of rated current
- have low transient, over reach high set instantaneous unit of continuously variable setting range 200-800% of rated current
- have a characteristic angle of 45/60 degree lag include hand reset flag indicators or **LEDs**.
- include necessary separate interposing voltage transformers or have internal feature in the relay for **open delta voltage** to the relay

23.5.7 Transformer Overload Protection Relay shall

- a) be of single pole type.
- b) be of definite time over-current type.
- c) have one set of over-current relay element, with continuously adjustable setting range of 50-200% of rated current.
- d) have one adjustable time delay relay for alarm having setting range of 1 to 10.0 seconds, continuously.
- e) have a drop-off/ pick-up ratio greater than 95%.
- f) be acceptable as built in feature of **numerical transformer differential relay**.

23.5.8 Tertiary Protection

Although tertiary is unloaded and or stabilizing purpose but all the 3 terminals of the tertiary shall be brought out for connection to PT/RVT. The primary of PT is star connected having earthed / floating neutral depending upon transformer design consideration. The PT will have two secondary winding, one star connected and another connected in open delta mode while over fluxing relay will be connected on the star secondary winding. Neutral displacement relay will be connected to the two open delta terminals of the 2nd secondary winding of PT. The neutral displacement relay (NDR) will have IDMT characteristics with setting range of 5% to 20% of rated voltage of 110 volt. The NDR relay shall be of Numerical type and complaint with **IEC-61850**. The windings of PT shall have following specification:

Secondary windings of PT

	Winding – 1	Winding – 2
1. Rated burden, VA	50	50
2. Accuracy class	0.5 & 3.0	3.0
3. Connection	Star Star point Earthed	Open delta
4. Purpose	For over Fluxing Relay	For Neutral displacement Relay
5. Voltage ratio	11000/110 V	11000/190 V

23.5.9 Auxiliary relays for transformer protection devices

Separate auxiliary relays for the following function for each transformer shall be provided:

- i) 4 Nos. for tripping on Buchholz alarms and trips.
- ii) 3 Nos. OLTC diverter switch oil surge trip and 1 common OLTC oil surge trip.
- iii) 2 Nos. winding temperature trip on two windings.
- iv) 1 No. oil temperature trip.
- v) 2 Nos. pressure release device trip.
- vi) 2 Nos. spares.

Two Gas detector relays have been provided with each of the above mentioned transformers and each relay will have one pair of alarm contacts and one pair of tripping contacts all of which shall be used for tripping the transformer.

OLTCs are equipped with oil surge type relays with tripping contacts. Similarly winding temperature indicators have been provided on HV & LV windings of the transformers which have two pairs of actuating contacts for winding temperature alarm and trip. The auxiliary tripping relays shall be provided to trip simultaneously the incoming and the outgoing circuits of the transformers in conjunction with the main tripping contacts.

The auxiliary relay should have relay connecting fingers/ strips/ Pins/ Plug capable of carrying 30A for 3 sec. & 5A continuously at 660 V.

23.5.10 Inter tripping relays

1 No. inter-trip relay to trip HV and LV breakers of the transformer and to isolate the transformer from supply shall be supplied. The inter trip relay shall be of high speed and shall be provided with hand reset operation indicator and 4 NO+2 NC hand reset contacts for **220KV** breaker.

23.6 **20 MVA / 40 MVA 132/33 KV TRANSFORMER**

a) Numerical Differential Protection

It shall be / shall have

- i) triple pole high speed percentage biased differential type.
- ii) an operating time not more than 30 milli secs. At 5 times operating current setting of 20%.
- iii) three instantaneous high set over current units.
- iv) second harmonic restraint feature and fifth harmonic by pass / restraint feature and also be stable under normal over fluxing conditions.
- v) an operating current setting of 20% or less.
- vi) suitable for rated current of 1 Ampere.
- vii) adjustable bias setting range of 20% to 50%.
- viii) two bias windings per phase.
- ix) stable on heavy through faults.
- x) include necessary separate interposing CTs for angle and ratio correction or have internal features in the relay to take care of angle and ratio correction.
- xi) have second harmonic or other inrush proof features and also should be stable under normal over fluxing conditions. Magnetizing inrush proof feature shall not be achieved through any intentional time delay e.g. use of timers to block relay operation or using disc operated relays.
- xii) shall have continuous self monitoring and diagnostic feature.

b) Over fluxing relay protection (Numerical)

It shall be/shall have

- i) Operate on the principle of voltage to frequency ratio
- ii) Inverse time characteristics compatible to transformer over fluxing withstand capability curve.
- iii) Provide an independent alarm with the time delay continuously adjustable between 0.1 to 60 seconds at a value of V/F adjustable between 100% to 130% of rated value.
- iv) Tripping time shall be governed by V/F vs time characteristic of the relay .
- v) An accuracy of operating time better than +10%
- vi) Resetting ratio of 98% or better.
- vii) Have a set of characteristics for various time multiplier settings. Maximum operating time for the relay shall not exceed 3 and 1.5 seconds at V/F values of 1.4 and 1.5 times rated value, respectively.
- viii) For 132/33KV Transformer Protection Over fluxing relay shall be provided only on HV side.

c) Restricted Earth Fault Protection (64)

- i) be single pole type.

- ii) be of voltage operated high impedance type with a suitable setting to cover at least 90% of winding.
- iii) have a current setting range of 10-40% of 1 Amp.
- iv) be tuned to the system frequency.
- v) have a suitable adjustable non-linear resistor to limit the peak voltage to 1000 Volts.
- vi) have alarm and trip output contacts.
- vii) have a high speed operation of 10-20 ms to trip.

NOTE: Each 132/33KV (YN, Yn O) Power transformer is provided with identical current transformers for R.E.F. protection in the following manner:

- i) 3 Nos. on H.V. bushing (one no. per phase)
- ii) 3 Nos. on L. V. bushing (one no. per phase)
- iii) 1 No. on neutral bushing.

d) Backup over current and earth fault protection on 132 KV side of 20 MVA/ 40 MVA transformer of numeric type

Triple pole non-directional IDMT over current relay with instantaneous high set unit shall be provided for backup over current protection on the HV side. The high set instantaneous units shall have suitable setting. For faults on the HV side involving heavy fault currents the high set units shall clear the faults instantaneously. Directional IDMT E/F relay with high set instantaneous unit with suitable setting shall be provided for backup protection on the HV side.

e) Backup over current protection and earth fault protection of 33 KV side of 20 MVA/ 40 MVA Transformer of numeric type

Triple pole non-directional IDMT over current relay with instantaneous high set and single pole non-directional IDMT earth fault relay with high set shall be provided for backup over current protection on the LV side of the transformer. Separate high speed trip relay shall be provided for LV protection.

There shall be high speed master trip hand reset lockout relay which shall receive inputs from all transformer protections and send the command to the trip coil of the circuit breaker directly.

f) Auxiliary relays for transformer protection devices

Auxiliary relays required for bucholtz trip, tap changer, bucholtz trip, HV winding temperature trip, LV winding temperature trip, oil temperature trip and low oil level trip PRV trip shall be provided. Each auxiliary relay shall have 2 pairs of contacts and one hand reset flag indicators. The auxiliary relays may be of non-draw out type.

g) Inter tripping relays

1 No. inter-trip relay to trip HV and LV breakers of the transformer and to isolate the transformer from supply shall be supplied. The inter trip relay shall be of high speed and shall be provided with hand reset operation indicator and 4NO+2NC hand reset contacts for 132 KV breaker.

h) Numerical Under Frequency Relay Scheme with df/dt feature

- i) Under frequency relay scheme shall consist of one number under frequency relay, one number timer relay and one number trip relay with 4 NO contacts of hand reset type.
- ii) Under frequency relay shall be suitable for operation with 110 V bus P.T. secondary rating between phases and **220V DC** supply. The relay shall have continuously adjustable setting range of 47 to 50 HZ with an accuracy 0.1 to 10 Hz per second in steps of 0.1 Hz per second. The relay shall not mal-operate due to any abrupt change in supply voltage from P.T. secondary.
- iii) Each frequency relay shall have 4 NO contacts. One for alarm and other for energizing the timer relay.
- iv) The timer relay shall have timing range of 0.1 to 0.5 seconds adjustable in steps of 0.05 secs. The timer relay shall have 4 NO contacts. One NO contact will be utilized to energize the trip relay. The other 3 NO contacts will be utilized for tripping **3 Nos. 33 KV feeders directly**.
- v) The trip shall have hand reset type 6 NO and 6 NC contacts for tripping **6 Nos. feeders**.

i) Neutral Displacement Relay

The voltage neutral displacement relay will be connected to the open delta terminals of the bus voltage transformer. The neutral displacement relay will have IDMT characteristics with setting range of 5% to 20% of rated voltage of 110 V.

j) Flag relays as per clause mentioned shall be provided.

23.7 CIRCUIT BREAKER PROTECTION

This shall include following function:

- 23.7.1 AUTO RECLOSING function shall be separate from Main-I and Main-II protection and shall
- (a) have single phase or/and three phase reclosing facilities.
 - (b) have a continuously variable single phase dead time range of 0.1-2 seconds.
 - (c) have a continuously variable three phase dead time range of 0.1-2 seconds.
 - (d) have a continuously variable reclaim time range of 5-300 seconds.
 - (e) incorporate a four-position selector switch/from which single phase/three phase/single and three phase auto reclosure and non-auto reclosure mode

can be selected. Alternatively, the mode of auto reclosing can be selected through programming.

- (f) have facilities for selecting check synchronizing or dead line charging features. It shall be possible at any time to change the required feature by reconnection of links.
- (g) be of single shot type.
- (h) have priority circuit to closing of both circuit breakers in case one and half breaker arrangements to allow sequential closing of breakers.
- (i) include check synchronizing relay which shall
 - have a time setting continuously variable between 0.5-5 seconds with a facility of additional 10 seconds.
 - have a response time within 200 milli seconds with the timer disconnected.
 - have a phase angle setting not exceeding 35 degree
 - have a voltage difference setting not exceeding 10%
 - include dead line charging relay which shall
 - have two sets of relays and each set shall be able to monitor the three phase voltage where one set shall be connected to the line VTs with a fixed setting of 20% of rated voltage and the other set shall be connected to the bus VTs with a fixed setting of 80% of rated voltage.
 - Incorporate necessary auxiliary relays and timers to give comprehensive scheme.

23.7.2 LOCAL BREAKER BACK-UP PROTECTION SCHEME shall

- (a) be triple pole type
- (b) have an operating time of less than 15 milli seconds
- (c) have a resetting time of less than 15 milli seconds
- (d) have three over current elements
- (e) be arranged to get individual initiation from the corresponding phase of main protections of line for each over current element. However, common three phase initiation is acceptable for other protections and transformer/reactor equipment protections
- (f) have a setting range of 20-80% of rated current
- (g) have a continuous thermal withstand two times rated current irrespective of the setting
- (h) have a timer with continuously adjustable setting range of 0.1-1 seconds
- (i) have necessary auxiliary relays to make a comprehensive scheme.

23.7.3 TRIP CIRCUIT SUPERVISION RELAY

- (a) The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.
- (b) The relay shall have adequate contacts for providing connection to alarm and event logger.

- (c) The relay shall have time delay on drop-off of not less than 200 milliseconds and be provided with operation indications for each phase.

23.8 REACTOR PROTECTION

23.8.1 Differential Protection Relay shall

- (a) be triple pole type
- (b) have operation time less than 25 milli-seconds at 5 times setting
- (c) be tuned to system frequency
- (d) have current setting range of 10 to 40% of 1 Amp. or a suitable voltage setting range
- (e) be high impedance / biased differential type
- (f) be stable for all external faults

23.8.2 Restricted Earth Fault Protection Relay shall

- (a) be single pole type
- (b) be of current/voltage operated high impedance type
- (c) have a current setting of 10-40% of 1 Amp./have a suitable voltage setting range
- (d) be tuned to system frequency
- (e) have a suitable non-linear resistor to limit the peak voltage to 1000 Volts

23.8.3 Back up impedance protection Relay shall

- (a) be triple pole type, with faulty phase identification/ indication
- (b) be single step polarised 'mho' distance/ impedance relay suitable for measuring phase to ground and phase to phase faults
- (c) have adequate ohmic setting range to cover at least 60% of the impedance of the reactor and shall be continuously variable
- (d) have an adjustable characteristic angle of 30-80 degree
- (e) have a definite time delay relay with a continuously adjustable setting range of 0.2-2.0 seconds
- (f) include VT failure relay which shall block the tripping during VT fuse failure condition.

23.9 BUSBAR PROTECTION

23.9.1 The scheme is required for busbar protection in the substations. Security and stability are key requirements of a busbar protection scheme. It shall be capable of accommodating different busbar configurations, operating quickly and reliably on internal (bus) faults and remaining stable during external faults. It shall be able to provide back up protection on circuit breaker/equipment failures, self supervision and monitoring and diagnostic features.

23.9.2 Redundant (1+1) numerical Bus Bar protection scheme for each bus system (Bus1 +Bus2+Transfer Bus wherever applicable) for 400kV shall be provided.

- 23.9.3 The scheme shall be engineered so as to ensure that operation of any one out of two schemes connected to main faulty bus shall result in tripping of the same.
- 23.9.4 Single bus bar protection scheme shall be provided for each main bus and transfer bus (as applicable) for 220KV and 132 KV voltage levels.
- 23.9.5 Each Bus Bar protection scheme shall
- (a) have maximum operating time up to trip impulse to trip relay for all types of faults of 25 milli seconds at 5 times setting value.
 - (b) operate selectively for each bus bar
 - (c) give hundred percent security up to 40 KA fault level up to 40 KA for fault level for 400KV and 220KV and 31.5 KA for 132 KV
 - (d) incorporate continuous supervision for CT secondary against any possible open circuit and if it occurs, shall render the relevant zone of protection inoperative and initiate an alarm
 - (e) not give false operation during normal load flow in bus bars
 - (f) incorporate clear zone indication
 - (g) be of phase segregated and triple pole type
 - (h) provide independent zones of protection (including transfer bus if any). If the bus section is provided then each side of bus section shall have separate set of bus bar protection schemes
 - (i) include individual high speed electrically reset tripping relays for each feeder. However, in case of distributed Bus bar protection, individual trip relay shall not be required if bay unit is having trip duty contacts for breaker tripping.
 - (j) be transient free in operation
 - (k) include continuous D.C. supplies supervision
 - (l) not cause tripping for the differential current below the load current of heaviest loaded feeder. Contractor shall submit application check for the same.
 - (m) shall include necessary C.T. switching relays wherever C.T. switching is involved and have 'CT' selection incomplete alarm
 - (n) include protection 'IN/OUT' switch for each zone
 - (o) shall include trip relays, CT switching relays(if applicable) , auxiliary CTs (if applicable) as well as additional power supply modules, input modules etc. as may be required to provide a Bus-bar protection scheme

for the complete bus arrangement i.e. for all the bays or breakers including future bays as per the Single line diagram for new substations.

- (p) In case of distributed Bus bar Protection, the bay units for future bays may be installed in a separate panel and the same shall be located in switchyard panel room where bus bar protection panel shall be installed.

23.9.6 Built-in Local Breaker Backup protection feature as a part of bus bar protection scheme shall also be acceptable.

23.9.7 The test terminal blocks (TTB) to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with boxes and barriers moulded integrally. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. Terminal block shall have shorting, disconnecting and testing facilities for CT circuits.

23.9.8 Numerical Busbar Protection Scheme

The scheme shall have following features:

23.9.8.1 STANDARDS

1. Dielectric Test :-

- i) IEC-60255-5, 2 kV rms for 1 min between all circuits and the case, and between all separate circuits.
- ii) ANSI / IEEE C37.90-1989, 1kV rms for 1 min across open contacts.
- iii) High voltage impulse : IEC 60255-5; 1977, 5 kV (peak), 1.2/50 ms, 0.5 J, 3 positive and 3 negative impulses between all terminals and all terminals and case earths.

2. Electrical Environment :-

- i) High frequency disturbances IEC 60255-22-1: 1998 Class III.
- ii) Electrostatic discharge IEC 60255-22-2; 1996 Class3, IEC 60255-22-2 ; 1996 Class 4.
- iii) Surge Immunity IEC 61000-4-5.
- iv) EMC compliance, EN-50081-2:1994.
- v) Fast transient disturbance, IEC 60255-22-4 : 1992 Class IV.
- vi) Fast transient disturbance, IEC 60255-22-4 Class IV.
- vii) Power frequency magnetic field immunity IEC 61000-4-8, Class IV.
- viii) Radiated immunity / radio frequency immunity IEC 60255-4-3, Class III.

3. Atmospheric Environment:-

- i) Temperature, IEC 60255-6, -10°C to +55°C (in operation) & -25°C to +70°C (during transport & storage).
- ii) Humidity, IEC 60068-2-3 .
- iii) Climate tests, IEC 60068-2-1, 60068-2-2.
- iv) Enclosure protection IP 52.

4. Mechanical Environment :-

- i) Vibration IEC 60255-21-1.
- ii) Shock & Bump, IEC 60255-21-2.
- iii) Seismic, IEC 60255-21-3.

23.9.8.2 General Features :

The Bus bar protection scheme shall :-

- i) be high speed low impedance phase segregated biased differential current type and have operate and restrain characteristics.
- ii) be of **modular construction** and have features of self monitoring, supervision and diagnostic capabilities to ensure maximum availability of scheme.
- iii) have fully numerical signal processing.
- iv) operate selectively for each zone of bus bar.
- v) not give false operation during normal load flow in bus bars.
- vi) incorporate suitable algorithm to remain stable during external fault conditions.
- vii) have integrated check zone supervision element.
- viii) incorporate clear zone indication.
- ix) incorporate continuous supervision for CT secondaries against any possible open circuit and if it occurs, scheme shall render the relevant zone of protection in-operative and shall give facia annunciation for it, zonal protection contact shall be by-passed automatically and the effected zone shall be protected by check zone only.
- x) have through fault stability in spite of C.T. saturation.
- xi) be able to accommodate different / heterogeneous CT classes, constructions, ratios **without the need of auxiliary CT's** for ratio matching. It shall be capable to integrate existing CT's available or using the common secondary core of other protection also.
- xii) be transient free in operation.
- xiii) include continuous internal DC supply supervision.
- xiv) include protection "in/out" switch for each zone with atleast six contacts for each switch.
- xv) have built in local breaker failure protection for each feeder. It shall also have option to take initiation input from the other protective relays in the feeders.
- xvi) capability to detect fault in dead zone (between circuit breaker and the associated CT's) dynamically depending on system condition.
- xvii) option for centralized and distributed installation / configurations.

- xviii) have fiber optic wiring between central and peripheral / bay units to exchange data fast, reliability and immunity from electromagnetic interference.
- xix) have a separate sensitive earth fault protection for networks with high impedance earthing. It shall be controlled by bias current to ensure stability on external faults and phase segregated differential protection.
- xx) have a non-directional back-up over current and earth fault protection functions with definite / IDMT characteristics for individual feeders.
- xxi) have facility for recording fault, event and disturbance must be saved in **battery backed memory** for each feeder with time tagged to 1 ms using an internal real time clock.
- xxii) have facility to synchronize its time reference with external GPS signal. It shall be capable of synchronizing through **IRIG-B Signal of GPS / SNTP**.
- xxiii) give 100% security upto 40 kA fault level.
- xxiv) not require CT switching. It shall be capable of schematic replication of substation showing bus configuration with status of various equipments.
- xxv) have associated software(s) required for schematic replication, settings, configurations, logic programming, extraction and viewing of events, faults etc. It shall be loaded on the **Man-machine interface (MMI) i.e. PC**.
- xxvi) be capable of communicating with station **SCADA on IEC-61850**.
- xxvii) have all interbus communications, remote communications are to be made on universally acceptable IEC 60850-5-103 / open protocol. It shall also have suitable communication interfaces for connecting to local MMI.
- xxviii) ensure checking of multiple conditions like biased differential element, overall check zone, CT saturation, CT secondary open circuit, and individual feeder settings etc. before making trip decision.

23.9.8.3 Technical Parameters:

- i) Busbar Protection Operating Time : The maximum operating time upto trip impulse to trip relay for all types of faults is 15 m.sec or better at 5 times setting value.
- ii) Auxiliary Supply (both for Main and Peripheral / Bay Unit) : **220VDC**.
- iii) The sufficient numbers of opto-isolated binary inputs and durable output relays/contacts for tripping, annunciation, watchdog etc. (as per design requirement at each site) shall be provided in Main and Peripheral / Bay units. The voltage range for binary input shall be **24V to 250Vdc**. The relay contacts shall be heavy duty type and capable of,
 - Make : 30A and carry for 0.5 s.
 - Carry : 8A or better Continuous
- iv) Analog Inputs: AC Current (In) shall be 1 A/5A Dual rated types, with thermal withstand Capacity as Continuous: 4x In, for 10 S: 30 x In and 1S:100 x In.
- v) Rated frequency shall be 50 Hz.

- vi) The **Event Recording** of atleast 250 events shall be required.
- vii) The fault recorder shall be able to record at least last 4 Nos. of fault records.
- viii) The internal Disturbance recording shall be able to record disturbances at bay and main unit levels. Sufficient number of analog channels, binary inputs to record at least 15 Nos. of disturbances at the sampling speed of 600 Hz. The channels and trigger sources shall be user configurable. Disturbances can be extracted from the relay and saved in **COMTRADE** format for analysis on appropriate software utility.
- ix) User Interface: Main and Peripheral/Bay units shall have LCD Display with keypad for user configurations.
- x) LED Indications: Main and peripheral/bay units shall have sufficient number of LED (fixed as well as configurable) for system health/operation indication.
- xi) Communication Interface:
 - a. 1 No. of **RS-232 Interface** in Main and each Peripheral/Bay unit for connecting to **PC** for downloading/monitoring.
 - b. Sufficient number of ST Connectors/Interfaces in Main (2 Nos. Fiber Connectors for connecting to Substation SCADA and other as per requirement for connecting to peripheral/bay units) and Peripheral/Bay Units interconnections.
- xii) The Peripheral/Bay units are connected directly using two **820-850nm multi-mode optical fibers** for each signaling channel. **Multi-mode fiber type 62.5/125 μm** , max attenuation 8 dB with suitable and standard **BFOC/2.5 type (ST) fiber optic connectors** shall be used.

24.0 TEE PROTECTION DIFFERENTIAL RELAYS

24.1 TEE-1 differential protection relays shall

- (a) be triple pole type
- (b) have an operating time less than 30 milliseconds at 5 times the rated current.
- (c) have three instantaneous high set over current units
- (d) have an adjustable bias setting range of 20-50%
- (e) have an operating current setting of 15% of 1 Amp or less

24.2 TEE-2 Differential relay shall

- (f) be triple pole type
- (g) have operating time less than 25 milliseconds at 5 times setting
- (h) be tuned to system frequency
- (i) have current setting range of 20 to 80% of 1 Amp
- (j) be voltage operated, high impedance type
- (k) be stable for all external faults
- (l) be provided with suitable non linear resistors across the relay to limit the peak voltage to 1000 volts

25.0 RELAY TEST KIT

The equipment shall be supplied from reputed manufacturer. It should be got approved before inspection. It shall have provision for energy meter testing capability.

- a) Relay tools kits. - 3 sets.
- b) Test Plugs - 3 Nos
- c) Special Type Test Plugs for using with modular Type cases (if applicable).
- d) 1 No. Relay test kit **microprocessor based fully automatic**. It shall have the following features:
 - i) To test all types of Distance, Over Current, Transformer, Reactor and Bus Bar protection of major manufacturers in Automatic/ Semi Automatic as well as manual mode. And have necessary conversion software for testing of relays to suit to Test kit softwares like RIO or any other type.
 - ii) It shall include all the accessories required for making the complete test set up.
 - iii) It shall have three phase current output range 0-50 Amps. (rms) and three phase voltage range 0-230 voltage (Ph-N).
 - iv) It shall work on single phase 240V, 50 Hz $\pm 10\%$ variation.
 - v) Shall include necessary software and hardware
 - a) to accept transient fault data recorder by disturbance recorder/Numerical relay from pen drive and replay these on the relay under test.
 - b) to draw the relay characteristics.
 - vi) It shall be able to carry out the testing at power frequencies between 40-60 Hz.
 - vii) The accuracy of relay test kit shall be as follows:
1% on voltage and current output and resolution of time measurement of 1 ms or better.
 - viii) The kit also suitable to test Energy Meter. Necessary Clamp on CTs (1A or 5A) & PT Plugs and interfacing item, & software is to be provided. Interfacing item should catch LCD, LED or Disc of Energy Meter.
 - viii) 1 No. PC laptop with optical mouse and CD writer cum DVD writer with latest OS and office package.
 - a. 1 No. phase sequence indicator.
 - b. Test plugs for use with testing equipment.
 - c. Special type test plugs/test cards for using with modular type/static relays/static/numeric Distance schemes or other schemes quoted as Main I and Main II protection.
 - d. Ammeter with banana plug - 1 No.

25.0 ROTATIONAL UNDER FREQUENCY RELAY PANEL

The Rotational Under Frequency Panel having logic controls system programmable for load shedding of various feeders at S/s at different frequencies as well as rate of change of frequency shall also be provided as per following bill of material

1. PLC System

- SLC 5/03 (CPU) Module	1 Set
- Power Supply	1 No.
- 4 Slot I/O Rack	1 No.
- 4 Ch. Analog I/O Module	1 No
-16 Ch. Digital I/P Module 24 VDC	1 No
- Channel Output Module Relay	1 No
- EEPROM Memory Module	1 No
- Isolator Transformer	1 No
- Noise Filter	1 No

2. PLC Panel

-	
- Wiring of cabinet for PLC System	1 No
of	
14 Gauge CRC sheet duly painted	
mainly comprising of :-	
- Space for PLC ICAM hardware	1 No
- Trip Relays /Contractors Coil Volt.	1 No
220/110/48 VDC	
- 110V PT fail Relay	1 No.
- Contractors DC fail Relay (Main)	1 No
- Main DC fail Relay	1 No
- Terminal lugs, ferrule , PVC	
channel	
Wire, terminal block, fusible	1 Set
terminal	
Block, MCBs, indicators glass	
relays etc.	
For completion of the under	
frequency	
relay panel	

3. Under Frequency Relays 1 No.

- Make	ABB/ Siemens/ other standard make
- Cat. No.	
- Frequency setting range	45 -to- 55 Hz
- Least Count	0.0 1 Hz
- Input AC Voltage	110 VAC

- Relay operation Voltage	30% -90% of UN
- DC Auxiliary Supply	110 V
- Output Contacts	Four no for trip Four no for alarm
- Inherent time delay	Not more than 100 ms
- Time delay over inhere time delay	Settable from front face
- Immunity	Immune to harmonics & transients
- Trip indications	On face of relay
- DF/DC stage	Four stages each stage programmable for flat of df/dt
- DF/DT settings	0.1 Hz/Sec –9.9 Hz /sec
- Mode of operation	Rate of fall
- Operation delay	Settable from front face

WORKING PRINCIPLE OF ROTATIONAL LOAD SHEDDING SYSTEM

At any given day, if frequency falls to 48.1 Hz level, a load of substantial MW will be shed anywhere in the system depending on the time of the day.

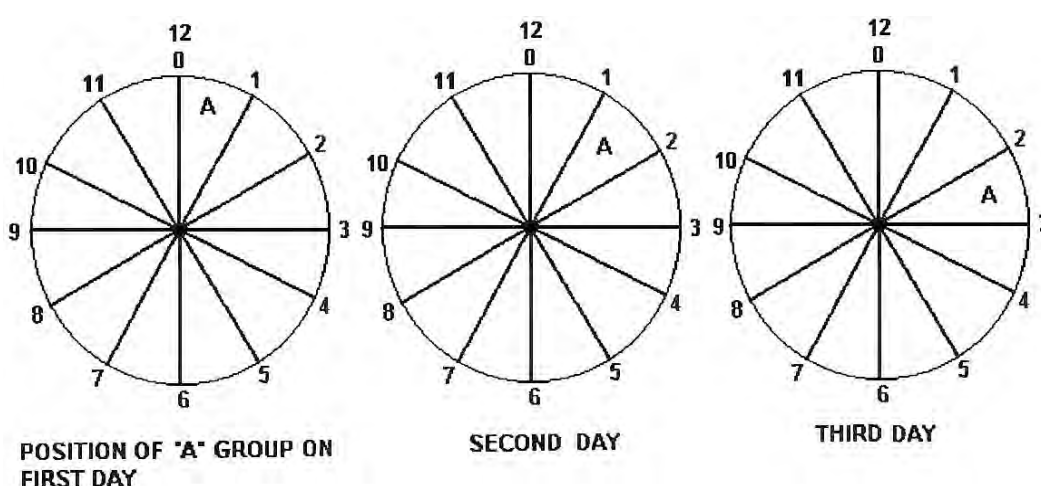
The load shedding can take place by tripping a group of feeders from the sub-station. The group is so selected, that 120MW is shed. At a time, in the entire system only this quantum of load shedding can be carried out.

The shedding for a group can be for a maximum period of up to one hour “slot”. In case frequency recovers, power can be switched on. Nevertheless if frequency sinks again, the power can trip again, but not beyond 1 hour slot. Thus in one hour's slot, if frequency improves, closing of breaker can be permitted as many times as and when frequency recovers.

The feeder tripped once during its slot time (1 hour), will not trip again if frequency sinks to 48.1 Hz but shedding will shift to another batch of feeders in the same station or some other station, in the next slot of 1 hour, depending on the time of the day.

Efforts will be made so that a group of feeders will trip only twice in a day. To achieve this, 12 groups have been formed and each group will be effected for one hour slot and shedding will repeat after 12 hours if frequency falls to 48.1 Hz. Thus, this programme is highly selective in nature and will cause minimum power interruption to every consumer. The complaint of continuous load shedding to a particular group of people/area will also be avoided.

The arrangement is such that the same group of feeders i.e. in a particular area does not suffer repeatedly, in the event of under frequency conditions. Instead the shedding is shared equally by all consumers or areas.



It may also be possible to rotate the shedding programme automatically so that a particular does not suffer costantly at the same time on all days. Instead a shift of 1 hour has been arranged so that all consumers undergo similar type of inconvenience. After 12 days of rotation, the shedding will come to its original state. An example of rotation is displayed in Figure 1.

It is also possible to incorporate another shedding programme pertaining to the next stage of under frequency i.e. at 48.0 Hz when additional about 300 MW is required to be shed. In this programme it will be possible to incorporate the second stage of under frequency control by way of clubbing tow groups either in one station or in different stations so that a total amount of about 420 MW is shed.

The programmes runs for 14 days. There are 12 groups explained above and each groups remains off for 2 hours, thus covering 24 hours of each day. To cover 12 groups in 14 days it becomes necessary to cover the distance between $14-12=2$ days. This is done by giving rest to each group after 6 days i.e. twice in a fortnight when covers all the 14 days. Thus a marix of $14/12$ is coverd.

26.0 ERECTION, TESTING AND MAINTENANCE EQUIPMENTS

All special instruments and equipments required for installation, testing and maintenance of the meters and those required for commissioning of C&R Panels shall be furnished in relevant schedule along with the Bid. The Bidder shall clearly state any additional equipment found necessary to give a complete and comprehensive offer. He shall however substantiate his reasons for such

additional equipment in his bid proposal. The prices of individual items shall be given. The details of each equipment and instrument shall also be furnished. This will not be considered for evaluation. However Purchaser reserves the right to order for the items and quantities at his discretion at the rates quoted in the bid.

27.0 TESTS

The equipment offered shall be fully type tested as per the relevant standards. Type testing of the relays shall be carried out based on general guide lines specified in CIGRE committee 34 report on simulator/Network Analyser /PTL for all relays offered including disturbance recorder, fault locator and event logger shall meet fast transmit level-III as per IEC-255-22-4 & IEC-1000.

The control and relay panels shall be completely assembled and subjected to the various type and routine and acceptance tests as per the relevant standards and respective equipment sections in the presence of the purchaser's representative if desired by the purchaser.

The Bidder shall, in his proposal, specifically state the details of testing facilities available at his own or at his principals works.

1. Control & Relay Panel shall also be subjected to following tests:
 - i) Mechanical operation Test.
 - ii) Verification of degree of protection as per IS:2147.
 - iii) High voltage test/Insulator Resistance Test.
 - iv) Electrical control, interlock & sequential operation test.
 - v) Verification of wiring as per approved schematic.
2. Bidder shall carry out H.F. Disturbance test, Impulse test and fast transient test (as per IEC 801-4) on principal numerical/static relays (of each type). Bidder shall carry out type tests on all principal relays fault locators, Disturbance recorder & event logger etc. as per relevant standards besides others as specified elsewhere in this specification.
3. Bidder shall carry out Burn out test at the variable voltages to prove the performance of Event logger/Disturbance recorder.
4. Six (6) certified copies of tests reports of the type and routine tests on the Relay panels as per the relevant standards shall be submitted by the Bidder along with the Bid.

27.1 A. Type Test:

27.1.1 The reports for following type tests shall be submitted by the bidder for the Protective relays, Fault locator, Disturbance recorder and Event Logger.

- a) Insulation tests as per IEC 60255-5
- b) High frequency disturbance test as per IEC 60255-4 (Appendix-E) Class III (not applicable for electromechanical relays)

- c) Fast transient test as per IEC 100-4, Level III (not applicable for electromechanical relays)
- d) Relays characteristics, performance and accuracy test as per IEC 60255
 - i) Steady state Characteristics and operating time
 - ii) Dynamic characteristics and operating time for distance protection relays and current differential protection relays.
 - iii) For Disturbance recorder and Event logger only performance tests are intended under this item.
- e) Tests for thermal and mechanical requirements as per IEC 60255-6
- f) Tests for rated burden as per IEC 60255-6
- g) Contact performance test as per IEC 60255-0-20 (not applicable for Event logger, Distance to fault locator and Disturbance recorder)
- h) The offered IED's shall have IEC-61850 conformance test conducted and certified from a Govt./Govt. approved/Govt. Recognized/ILAC recognized independent laboratory for IEC-61850.
- i) Reports of type tests other than tests at (h) above conducted at Manufacture's own lab shall be acceptable.
- j) The type test report of relay of the same family or series having same common hardware platform and common software for the configuration of relay for the purpose of communication as per IEC-61850 can be considered on the merit of the case.

Steady state & Dynamic characteristics test reports on the distance protection relays, as type test, shall be based on test programme specified in CIGRE committee 34 report on simulator/network analyser/PTL. Alternatively, the files generated using Electromagnetic transient Programme (EMTP) can also be used for carrying out the above tests. Single source Dynamic tests on transformer differential relays shall be/should have been conducted based on general guidelines specified in CIGRE committee 34 report on Evaluation of characteristics and performance of Power system protection relays and protective systems.

- 27.1.2 The equipment/material offered in the bid should have been successfully type tested in line with Standard and Technical Specification within the last 5 (five) years from the date of opening of the bid. The bidder shall be required to submit along with the offer 6 copies of the Type Test Reports duly conducted at manufacturer/independent laboratory.
- 27.1.3 If there is any change in the components or design in the equipment since after earlier passing of the Type Test, the bidder shall bring out in his offer all such changes made in components, materials, designs etc. In such case the bidder shall carry out the type tests at his cost and in presence of the purchaser's representative.
- 27.1.4 The purchaser reserves the right to conduct tests included in the list of Type Tests on requisite number of samples/items from any of the lots during the tenure of the supply, at purchaser's cost in the presence of purchaser's

representatives. If the equipment/material does not withstand the type test, then the equipment/material supplied till then will be liable for rejection. The supplier, in such eventuality, shall be allowed to modify the equipment and type test the same again at his cost in the presence of the purchaser's representative. These type tests shall however be conducted by the supplier within a reasonable time. After successful passing of the type tests, all the equipments/materials supplied earlier shall be modified in line with the equipment/material which have successfully passed the type test. In case supplier fails to carry out the Type Test within reasonable time or does not agree to carry test at his cost, his equipment/material supplied earlier shall be rejected and order placed shall be cancelled and payments made earlier for these suppliers shall be recovered by the purchaser.

27.1.5 If the equipment/material offered in the bid has been type tested beyond 5 years from the date of opening of the bid, the bidder has to arrange for type testing the equipment/material at no cost to the purchaser.

27.1.6 Notwithstanding anything stated above, the purchaser's decision in this regard shall be final and binding on the bidder.

27.2 B. Routine Tests

All routine tests as stipulated in the relevant standards shall be carried out by the supplier in presence of Purchaser's representative without any extra cost.

27.2.1 Immediately after finalization of the programme of routine testing the supplier shall give four weeks advance intimation to the purchaser to enable him to depute his representative for witnessing the tests.

27.2.2 The supplier shall carry out all the relevant physical verifications and functional tests at his works on all the finished Panels. Copies of these test certificates duly endorsed by the suppliers testing engineer shall be furnished to the Inspecting Officer of the Purchaser. The Inspecting Officer reserves the right to insist for repetition of functional tests on any or all the panels offered for inspection and the supplier shall arrange for the same.

28.0 QUALITY ASSURANCE, INSPECTION AND TESTING

- i) The Bidder shall finalise with UPPTCL the quality plan for manufacturing activities in UPPTCL format within 60days of Letter of Award, along with the total list of numeric, static and electromagnetic relays covered by the QP.
- ii) One control copy of quality manual will be submitted within one month of Letter of Award.
- iii) Bidder shall submit the Quality Plan for Bought Out items/imported items etc. in UPPTCL format.
- iv) UPPTCL reserves the right to carry out Quality Audit on quality management & manufacturing systems & procedures etc.

- v) Bidder shall furnish the QA document package in duplicate as per general terms & condition which shall include but not be limited to following:
 - a) Details of Inspection/Tests/Checks carried out as per agreed QP for main equipment.
 - b) Routine test & type test on all associated equipment including disturbance recorder & event recorders, meters, indicating instruments & cables etc. as per relevant Indian Standards/IEC Standard.

29.0 GUARANTEED TECHNICAL PARTICULARS

The Guaranteed Technical particulars for the equipment being supplied shall be provided with the bid as specified. The Bids received without guaranteed technical particulars shall be treated as non-responsive.

30.0 DOCUMENTATION

The bidder shall furnish the dimensioned drawings along with the bid indicating the details like components, make, quantity, ranges of meters, relays etc., in case the bidder quotes different makes of relays he shall furnish copies of wiring scheme and literature of all relays and sets of drawings and manuals shall be supplied along with each panel. For further details on drawings and documentation please refer to clause **20.0 of SPECIAL CONDITIONS OF SPECIFICATION (Section-II)**.

31.0 PACKING AND FORWARDING

- 31.1 The panels shall be packed in suitable sized strong and weather resistant wooden cases/ crates.
- 31.2 Suitable cushioning, protective padding or spacer shall be provided to prevent damage to or deformation of the components during transit and handling.
- 31.3 All packing cases shall be marked legibly and correctly with the contractors name and consignee's address so as to ensure their safe arrival at their destination and to avoid possibility of goods being lost or wrongly dispatched on account of faulty or illegible marking.
- 31.4 For further details refer to clause no. **25.0 of SPECIAL CONDITIONS OF SPECIFICATION (Section-II)**.

32.0 CO-ORDINATION

- 32.1 Details of Line configuration and other characteristics including communication facility will be furnished in detail to the successful bidder of this package, so that scheme of protection can be coordinated.

Any matching current transformers required may be provided and the scheme of protection made reliable in operation. The Secondary ratings of current transformers are of 1A/5 A and potential transformers' secondary voltages are: 110 V / 1.732 and 110 V.

32.2 The bidder shall also prepare and supply the coordination wiring diagrams between the control and relay panels and control switch gear as part of this contract.

32.3 The bidder shall furnish full detailed instructions, complete with drawings and leaflets to enable satisfactory erection and commissioning of the plant. Such instructions should reach the Purchaser sufficiently in advance of the receipt of the equipment in order that all the preliminary arrangement for the erection of the equipment can be made in advance so that there will be no delay in regard to erection as soon as the equipment is received.

33.0 TROPICALIZATION

Control room will be normally air- conditioned. All equipments shall however be suitable for installation in a tropical monsoon area having hot, humid climate and dry and dusty seasons with ambient conditions specified in the specification.

All equipment shall therefore, be suitably designed and treated for normal life and satisfactory operation under the hot and humid climatic conditions prevalent at site. All control wiring, equipment and accessories shall be protected against fungus growth, condensation and other harmful effects due to tropical environment and shall be dust and vermin proof. All parts and surfaces which are subject to corrosion shall be made of such material and shall be provided with such protective finishes as would protect the equipment installed from any injurious effects of excessive humidity. All electrical auxiliary equipment shall be specifically treated for tropical conditions, and the materials and methods for this treatment shall be approved by the Purchaser.

ANNEXURE -1

SCHEDULE OF DETAILED EQUIPMENT

A. GENERAL SPECIFICATION OF SIMPLEX PANEL

Each simplex type integrated control relay panel / control panel / relay panel shall consist of the following :

Circuit label :	1 Set
Door operated cubicle illumination :	1 No.
Terminal blocks with stud type terminal and 20% spare terminal:	1 Set
AC and DC fuses :	1 Set
Cable glands :	1 Set

3 pin 15 AC plug socket with switch control :	1 Set
Thermostat operated cubicle heater with switch control:	1 No.
Earth bus :	1 No.
Name plate for mounted equipment both on front panel and inside :	1 No.
Bell, Buzzer, Hooter :	1 Set

The No. of empty simplex/other types panels required to accommodate various equipment as specified in case of each of the panels designated below shall be supplied by the contractor at no extra cost. The price quoted for each type of panel is deemed to have included the price of number of empty panels required to accommodate above relays and protection.

B. CONFIGURATION OF CONTROL & RELAY PANELS

Item No. 1 – 400/ 220 KV FEEDER CONTROL PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Multifunction Panel Meter :	1 No.
iii)	Energy Meter (ABT Compliant Trivector meter, Accuracy: 0.2, SCADA Compatible)	1 No.
iv)	IEC-61850 Complaint Bay Control Unit : (having all functions such as control, supervisory, monitoring, Measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities/satisfactory operation of substation).	1 No.
v)	Trip circuit supervision relays suitable for both open and closed position of circuit breakers.	6 Nos.
vi)	Emergency Trip Switch for Circuit Breaker (in emergency conditions of bay IED outage)	1 No.
vii)	24/36 way facia annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell. (If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized. Combination of both can also be utilized by selecting the lower size annunciator scheme to meet the functionalities)	1 No.
viii)	Three phase 4 wire link type test terminal block of current rating 15 amp. For testing of trivector meters.	1 Set
ix)	Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer ii) Normal [If it is not achieved through the Soft Logics]	1 No.
x)	Indicating LEDs for Breaker Position, Auto Trip & Helthiness	1 Set

xi)	Terminal Blocks	1 Set
xii)	Auxiliary relay, CMR etc. as required by the scheme	1 LOT
xiii)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 2 – 400/ 220 KV FEEDER RELAY PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	IEC-61850 Compliant Bay Protection Unit (Main Protection as per specification) [MAIN-I]	1 No.
iii)	IEC-61850 Compliant Bay Protection Unit (Main Protection as per specification) [MAIN-II]	1 No.
iv)	High speed trip relay (3 phase trip unit) with adequate number of contacts for the complete scheme.	2 Set.
v)	IEC Compliant BPU (Back Up Protection as per specification) [Acceptable in Built Features of MAIN I&II]	1 Set
vi)	Voltage Selector Relay [If Applicable]	1 Set
vii)	IEC61850 Compliant LBB [Separate as per specification]	1 Set
viii)	IEC61850 Compliant Circuit Breaker Protection [As per specification] [with Check synchronization Relay, Auto Re-close functions]	1 Set
ix)	DR, Fault Locator[Acceptable in Built Features of MAIN I&II]	1 Set
x)	Lamp for DC fail Indication	1 No.
xi)	Push Button for DC fail accept	1 No.
xii)	Flag relays, Carrier Receive Relay, auxiliary relay, CMR, timers etc. as required by the Scheme.	1 LOT
xiii)	DC Supervision Relay	1 Set
xiv)	Under voltage Relay for Isolator/Earth Switch	2 Nos.
xv)	Overvoltage Protection Scheme (Stage – I & II are acceptable as in-built feature of Main-I & II respectively)	1 Set
xvi)	Test Blocks for relays	1 Set
xvii)	Carrier In/Out Switches / Lamps as required by the Scheme	1 Set
xviii)	Other general equipments / features as per general specification of simplex panels.	

Item No. 3 –220 KV TRANSFORMER CONTROL PANELS (132 KV SIDE)

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Multifunction Panel Meter :	1 No.
iii)	Energy Meter (ABT Compliant Trivector meter, Accuracy: 0.2, SCADA Compatible)	1 No.

iv)	IEC-61850 Complaint Bay Control Unit : (having all functions such as control, supervisory, monitoring, Measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities / satisfactory operation of substation).	1 No.
v)	Trip circuit supervision relays suitable for both open and closed position of circuit breakers.	6 Nos.
vi)	Emergency Trip Switch for Circuit Breaker (in emergency conditions of bay IED outage)	1 No.
vii)	24/36 way facia annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell. (If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized. Combination of both can also be utilized by selecting the lower size annunciator scheme to meet the functionalities)	1 No.
viii)	Three phase 4 wire link type test terminal block of current rating 15 amp. For testing of trivector meters.	1 Set
ix)	Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer	1 No.
ii)	Normal [If it is not achieved through the Soft Logics]	
x)	Indicating LEDs for Breaker Position, Auto Trip & Healthiness	1 Set
xi)	Terminal Blocks	1 Set
xii)	Auxiliary relay, CMR etc. as required by the scheme	1 LOT
xiii)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 4 – 220 KV TRANSFORMER RELAY PANELS (132 KV SIDE)

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	IEC-61850 Compliant Circuit Breaker Failure Protection (As per specification)	1 Set
iii)	High speed trip relay (1 phase & 3 phase trip unit) with adequate number of contacts for the complete scheme.	1 Set
iv)	Voltage Selector Relay	1 Set
v)	Lamp for DC fail Indication	1 No.
vi)	Push Button for DC fail accept	1 No.
vii)	Auxiliary relay, CMR, timers etc. as required by the Scheme.	1 LOT
viii)	DC Supervision Relay	1 Set
ix)	Test Blocks for relays	1 Set
x)	Flag relays, auxiliary relay, CMR, timers etc. as required by the Scheme	1 LOT
xi)	Other general equipments / features as per general	

specification of Simplex panels.

Item No. 5 – 220 KV TRANSFORMER CONTROL PANELS (220 KV SIDE)

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Multifunction Panel Meter :	1 No.
iii)	Energy Meter (ABT Compliant Trivector meter, Accuracy: 0.2, SCADA Compatible)	1 No.
iv)	IEC-61850 Compliant Bay Control Unit : (having all functions such as control, supervisory, monitoring, Measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities / satisfactory operation of substation).	1 No.
v)	Trip circuit supervision relays suitable for both open and closed position of circuit breakers.	6 Nos.
vi)	Emergency Trip Switch for Circuit Breaker (in emergency conditions of bay IED outage)	1 No.
vii)	24/36 way facia Annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell. (If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized. Combination of both can also be utilized by selecting the lower size annunciator scheme to meet the functionalities)	1 No.
viii)	Three phase 4 wire link type test terminal block of current rating 15 amp. For testing of trivector meters.	1 Set
ix)	Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer	1 No.
ii)	Normal [If it is not achieved through the Soft Logics]	
x)	Indicating LEDs for Breaker Position, Auto Trip & Healthiness	1 Set
xi)	Terminal Blocks	1 Set
xii)	Auxiliary relay, CMR etc. as required by the scheme	1 LOT
xiii)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 6 – 220 KV TRANSFORMER RELAY PANELS (FOR HV & MV)

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	IEC-61850 Compliant Bay Protection Unit (Main Protection as per specification) [MAIN-I]	1 No.
iii)	IEC-61850 Compliant Bay Protection Unit (Main Protection	1 No.

	as per specification) [MAIN-II]	
iv)	High speed trip relay (3 phase trip unit) with adequate number of contacts for the complete scheme.	2 Set.
v)	IEC Compliant BPU (Back Up Protection as per specification)	2 Set
vi)	Voltage Selector Relay	1 Set
vii)	IEC61850 Compliant CB Protection [Separate as per specification]	1 Set
viii)	Overfluxing Protection Scheme [Acceptable in Built Features of MAIN-I&II]	1 Set
ix)	Overload Protection Scheme [Acceptable in Built Features of MAIN I&II]	1 Set
x)	REF Protection [Acceptable in Built Features of MAIN I&II]	1 Set
xi)	Neutral Displacement Protection [Acceptable in Built Features of MAIN I&II]	1 Set
xii)	DR, Fault[Acceptable in Built Features of MAIN I&II]	1 Set
xiii)	Lamp for DC fail Indication	1 No.
xiv)	Push Button for DC fail accept	1 No.
xv)	Flag relays, auxiliary relay, CMR, timers etc. including transformer alarms and trip functions as required by the Scheme.	1 LOT
xvi)	DC Supervision Relay	1 Set
xvii)	Test Blocks for relays	1 Set
xviii)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 7 – 220 KV BUS COUPLER CONTROL AND RELAY PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Multifunction Panel Meter :	1 No.
iii)	Energy Meter (ABT Compliant Trivector meter, Accuracy: 0.2, SCADA Compatible)	1 No.
iv)	IEC-61850 Complaint Bay Control Unit : (having all functions such as control, supervisory, monitoring, Measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities / satisfactory operation of substation).	1 No.
v)	IEC-61850 Compliant Circuit Bay Protection (As per specification)	1 Set
vi)	Trip circuit supervision relays suitable for both open and closed position of circuit breakers.	6 Nos.
vii)	High speed trip relay (1 phase & 3 phase trip unit) with adequate number of contacts for the complete scheme.	1 Set
viii)	Emergency Trip Switch for Circuit Breaker (in emergency	1 No.

	conditions of bay IED outage)	
ix)	Voltage Selector Relay (If applicable)	1 Set
x)	IEC 61850 Compliant LBB [Separate as per specification]	1 Set
xi)	24/36 way facia annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell. (If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized. Combination of both can also be utilized by selecting the lower size annunciator scheme to meet the functionalities)	1 No.
xii)	Three phase 4 wire link type test terminal block of current rating 15 amp. For testing of trivector meters.	1 Set
xiii)	Dead Bus Closing switch, Synchronization selector switch [If it is not achieved through the soft logics / BCU]	1 Set
xiv)	Indicating LEDs for Breaker Position, Auto Trip & Healthiness	1 Set
xv)	Lamp for DC fail Indication	1 No.
xvi)	Push Button for DC fail accept	1 No.
xvii)	Flag relays,auxiliary relay, CMR etc. as required by the scheme	1 LOT
xviii)	DC Supervision Relay	1 Set
xix)	Test Blocks for relays	1 Set
xx)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 8 – 220 KV BUSBAR PROTECTION RELAY PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	IEC-61850 Compliant Master / Main (BB Protection As per specification)	1 Set
iii)	Bay Control Units / Modules	1Set
iv)	Bay Control Unit / Modules Future (only Cut Outs / slots fully wired in Panels)	1 Set
v)	Bus Zone In / Out Switches	1 Set
vi)	12 way annunciator	1 Set
vii)	DC selection switch	1 Set
viii)	Lamp for DC fail Indication	1 No.
ix)	Push Button for DC fail accept	1 No.
x)	Auxiliary relay, CMR, timers etc. as required by the Scheme.	1 LOT
xi)	DC Supervision Relay	1 Set
xii)	Test Blocks for relays	1 Set
xiii)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 9 – 132 KV FEEDER CONTROL PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Multifunction Panel Meter :	1 No.
iii)	Energy Meter (ABT Compliant Trivector meter, Accuracy: 0.2, SCADA Compatible)	1 No.
iv)	IEC-61850 Complaint Bay Control Unit : (having all functions such as control, supervisory, monitoring, Measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities / satisfactory operation of substation).	1 No.
v)	Trip circuit supervision relays suitable for both open and closed position of circuit breaker	6 Nos.
vi)	Emergency Trip Switch for Circuit Breaker (in emergency conditions of bay IED outage)	1 No.
vii)	24/36 way facia annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell. (If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized. Combination of both can also be utilized by selecting the lower size annunciator scheme to meet the functionalities)	1 No.
viii)	Three phase 4 wire link type test terminal block of current rating 15 amp. For testing of trivector meters.	1 Set
ix)	Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer ii) Normal [If it is not achieved through the Soft Logics]	1 No.
x)	Indicating LEDs for Breaker Position, Auto Trip & Healthiness	1 Set
xi)	Terminal Blocks	1 Set
xii)	Auxiliary relay, CMR etc. as required by the scheme	1 LOT
xiii)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 10 – 132 KV FEEDER RELAY PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	IEC-61850 Compliant Bay Protection Unit (Main Protection As per specification)	1 No.
iii)	Trip circuit supervision relays for continuous supervision (pre-close and after close supervision) of trip coil I & II	1 Set

	circuit breaker having 2 coils of trip coils (each trip coil is common to all 3 phases)	
iv)	High speed trip relay (3 Phase trip unit) with adequate number of contacts for the complete scheme.	2 Nos.
v)	Back Up Protection (as per specification)	1 Set
vi)	IEC61850 Compliant LBB [Separate as per specification]	1 Set
vii)	IEC61850 Compliant Circuit Breaker Protection [As per specification] [with Check synchronization Relay, Auto Re-close functions]	1 Set
viii)	Disturbance recorder (as per specification) [If not included in bay Protection Unit as above]	1 Set
ix)	Distance to Fault Locator (as per clause specification) [If not included in Bay Protection Unit as above]	1 Set
x)	Voltage Selector Relay	1 Set
xi)	Lamp for DC fail Indication	1 No.
xii)	Push Button for DC fail accept	1 No.
xiii)	Flag relays, auxiliary relay, CMR, timers etc. as required by the Scheme.	1 LOT
xiv)	DC Supervision Relay	1 Set
xv)	Test Blocks for Relay	1 Set
xvi)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 11 – 132 KV BUS COUPLER CONTROL AND RELAY PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Multifunction Panel Meter :	1 No.
iii)	Energy Meter (ABT Compliant Trivector meter, Accuracy: 0.2, SCADA Compatible)	1 No.
iv)	IEC-61850 Complaint Bay Control Unit : (having all functions such as control, supervisory, monitoring, Measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities / satisfactory operation of substation).	1 No.
v)	IEC-61850 Compliant Bay Protection Unit (Main Protection As per specification)	1 No.
vi)	Trip circuit supervision relays for continuous supervision (pre-close and after close supervision) of trip coil I & II circuit breaker having 2 coils of trip coils (each trip coil is common to all 3 phases)	1 Set
vii)	High speed trip relay (3 Phase trip unit) with adequate number of contacts for the complete scheme.	1 Set
viii)	Voltage Selector Relay (If required)	1 Set
ix)	Lamp for DC fail Indication	1 No.

x)	Push Button for DC fail accept	1 No.
xi)	Flag relays, auxiliary relay, CMR, timers etc. as required by the Scheme.	1 LOT
xii)	DC Supervision Relay	1 Set
xiii)	Test Blocks for Relay	1 Set
xvii)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 12 – 132 KV BUSBAR PROTECTION RELAY PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	IEC-61850 Compliant Master / Main (BB Protection As per specification)	1 No.
iii)	Bay Control Units (to be connected on fiber to main unit)	8 Nos.
iv)	Bay Control Unit Future (only Cutout with Wiring)	2 Nos.
v)	Bus Zone In / Out Switches	1 Set
vi)	12 way annunciator	1 Set
vii)	DC selection switch	1 Set
viii)	Lamp for DC fail Indication	1 No.
ix)	Push Button for DC fail accept	1 No.
x)	Auxiliary relay, CMR, timers etc. as required by the Scheme.	1 LOT
xi)	DC Supervision Relay	1 Set
xii)	Test Blocks for Relay	1 Set
xiii)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 13 – 33 KV FEEDER CONTROL AND RELAY PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Multifunctional Panel Meter :	1 No.
iii)	Energy Meter (ABT Compliant Trivector meter, Accuracy: 0.2, SCADA Compatible)	1 No.
iv)	IEC-61850 Complaint Bay Control Unit : (having all functions such as control, supervisory, monitoring, Measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities / satisfactory operation of substation).	1 No.
v)	IEC-61850 Compliant Bay Protection Unit (Main Protection as per specification, Non directional O/C & E/F)	1 No.
vi)	Trip circuit supervision relays for continuous supervision	1 Set

	(pre-close and after close supervision) of trip coil	
vii)	High speed trip relay (3 Phase trip unit) with adequate number of contacts for the complete scheme.	2 Nos.
viii)	Emergency Trip Switch for Circuit Breaker (in emergency conditions of bay IED outage)	1 No.
ix)	Three phase 4 wire link type test terminal block of current rating 15 amp. For testing of trivector meters.	1 Set
x)	Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer ii) Normal [If it is not achieved through the Soft Logics]	1 No.
xi)	Indicating LEDs for Breaker Position, Auto Trip & Healthiness	1 Set
xii)	Disturbance recorder (as per specification) [If not included in bay Protection Unit as above]	1 Set
xiii)	Voltage Selector Relay	1 Set
xiv)	Lamp for DC fail Indication	1 No.
xv)	Push Button for DC fail accept	1 No.
xvi)	Flag relays, auxiliary relay, CMR, timers etc. as required by the Scheme.	1 LOT
xvii)	DC Supervision Relay	1 Set
xviii)	Test Blocks for Relay	1 Set
xix)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 14 – 132/ 33 KV 40MVAR/ 10MVAR CAPACITOR BANK C&R PANELS

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Multifunctional Panel Meter :	1 No.
iii)	Energy Meter (ABT Compliant Trivector meter, Accuracy: 0.2, SCADA Compatible)	1 No.
iv)	IEC-61850 Complaint Bay Control Unit : (having all functions such as control, supervisory, monitoring, Measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities / satisfactory operation of substation).	1 No.
v)	IEC-61850 Compliant Bay Protection Unit (as per specification, Non directional O/C & E/F Protection)	1 No.
vi)	Trip circuit supervision relays for continuous supervision (pre-close and after close supervision) of trip coil	1 Set
vii)	High speed trip relay (3 Phase trip unit) with adequate number of contacts for the complete scheme.	2 Nos.
viii)	Emergency Trip Switch for Circuit Breaker (in emergency conditions of bay IED outage)	1 No.
ix)	Three phase 4 wire link type test terminal block of current rating 15 amp. For testing of trivector meters.	1 Set

x)	Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer ii) Normal [If it is not achieved through the Soft Logics]	1 No.
xi)	Indicating LEDs for Breaker Position, Auto Trip & Healthiness	1 Set
xii)	Disturbance recorder (as per specification) [If not included in bay Protection Unit as above]	1 Set
xiii)	Voltage Selector Relay	1 Set
xiv)	Lamp for DC fail Indication	1 No.
xv)	Push Button for DC fail accept	1 No.
xvi)	Flag relays, auxiliary relay, CMR, timers etc. as required by the Scheme.	1 LOT
xvii)	DC Supervision Relay	1 Set
xviii)	Test Blocks for Relay	1 Set
xix)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 15 – SUBSTATION AUTOMATION SYSTEM NETWORK PANEL

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No.
ii)	Managed Ethernet Switches 24 Ports (24 port 10/100/1000 TX + 4 Uplink 10/100/1000 FX) (Suitable with Substation DC Supply)	2 Set
iii)	LIU / Jack Panels (Rack Mountable)	1 LOT
iv)	SC Adapter & Pigtails	1 LOT
v)	1 mtr Fiber Patch Cord	1 LOT
vi)	Lamp for DC fail Indication	1 No.
vii)	Push Button for DC fail accept	1 No.
viii)	DC Supervision Relay	1 No.
ix)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 16 – SUBSTATION NETWORK PANEL

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No
ii)	Managed Ethernet Switches 24 Ports (as per requirement + 4 Spare) (24 port 10/100/1000 Base FX + 4 No 10/100/1000 Base FX) (Suitable with Substation DC Supply)	2 Set
iii)	LIU (Rack Mountable)	1 LOT
iv)	SC Adapter & Pigtails	1 LOT
v)	1 mtr Fiber Patch Cord	1 LOT

vi)	Lamp for DC fail Indication	1 No.
vii)	Push Button for DC fail accept	1 No.
viii)	DC Supervision Relay	1 Set
ix)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 17 – TIME SYNCHRONIZATION AND GATEWAY PANEL

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No
ii)	Time Synchronization Equipment (TSE)	1 No.
iii)	Master Display Unit (LED) 100 mm Size (to be synchronized from TSE)	1 No.
iv)	Gateway to RCC & SLDC (Fitting only)	1 Set
v)	Modems (Fitting Only)	1 Set
vi)	Lamp for DC fail Indication	1 No.
vii)	Push Button for DC fail accept	1 No.
viii)	DC Supervision Relay	1 Set
ix)	Other general equipments / features as per general specification of Simplex panels.	

Item No. 18 – SUBSTATION AUXILIARY MONITORING PANEL

Simplex panels as required equipped with the following and fully wired :

i)	Circuit identification label :	1 No
ii)	IEC-61850 Complaint Bay Control Unit (having all functions such as control, supervisory, monitoring, Measuring of all the LT Transformers, LT AC/DC Supplies, Fire Fighting, Air-Conditioning, Automatic Supply Changeovers DG Set, Ambient Temperatures, battery System, PLCC Panels Counters etc. for meeting the functionalities / satisfactory auxiliary operation of substation) [BCU shall be equipped with sufficient Analog, Digital input/output Cards alongwith communication ports / Photocols such as modules RTU etc. for interfacing transducers and further interface on Substation SCADA on IEC-61850 to transfer of events/ alarms and other measured parameters for monitoring]	1 No.
iii)	24/36 way facia annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell	1 No.
iv)	Auxiliary relay, CMR etc. as required by the scheme	1 LOT
v)	Other general equipments / features as per general	

specification of Simplex panels.

NOTE:

1. The panels are optimized in view of the space limitations in Control Room. It is assumed that, various functionalities/ items (except those required mandatorily external to BCU/ BPU or as per protection requirement in separate device) already integrated/ in-built in modern BCU/BPU shall be put to fullest use so as to reduce the panel requirements.
2. However the items and their quantities shown in this schedule are indicative in nature and for general guidance of the Bidders. Bidders shall quote all items / panels required for completion of the control and protection scheme for the substation and later on no extra price implication shall be considered for payment.

ANNEXURE -2

GENERAL ANNUNCIATION WINDOW / LED CONFIGURATION REQUIREMENTS

1. **420 KV LINE PANEL**

TRIP ALARMS

1. Distance protection operated.
2. Auto re-close lockout.
3. Pole discrepancy relay operated.
4. DOCR/DEFR operated.
5. Bus bar protection operated.
6. Local breaker back up protection operated.

NON – TRIP ALARMS

1. Trip circuit supervision alarm TC 1.
2. Trip circuit supervision alarm TC2.
3. VT fuse failure alarm.
4. **Carrier failure.**
5. SF6 gas pressure low.
6. **Air pressure low.**
7. DC fail to distance protection / control circuit.
8. Breaker lockout.
9. Auto re-close operated.
10. **Carrier receive.**
11. Spare. Two nos.

2. **220 KV LINE PANEL**

TRIP ALARMS

7. Distance protection operated.
8. Auto re-close lockout.
9. Pole discrepancy relay operated.
10. DOCR/DEFR operated.
11. Bus bar protection operated.
12. Local breaker back up protection operated.

NON – TRIP ALARMS

12. Trip circuit supervision alarm TC 1.
13. Trip circuit supervision alarm TC2.
14. VT fuse failure alarm.
15. **Carrier failure.**
16. SF6 gas pressure low.
17. **Air pressure low.**
18. DC fail to distance protection / control circuit.

19. Breaker lockout.
20. Auto re-close operated.
21. Carrier receive.
22. Spare. Two nos.

3. 132KV LINE PANELS

TRIP ALARMS

1. Distance protection operated.
2. DOCR / DEPR operated.
3. Local breaker back up protection operated.

NON TRIP ALARMS

1. Trip circuit supervision alarm TC1.
2. Trip circuit supervision alarm TC2.
3. VT fuse failure alarm.
4. Carrier failure.
5. SF6 gas pressure low.
6. Air pressure low.
7. DC fail distance protection / control circuit.
8. Breaker lockout.
9. Spare one no.

4. 33 KV FEEDER

TRIP ALARM

1. OCR operated
2. EFR operated

NON TRIP ALARMS

1. Trip circuit supervision alarm TC
2. SF6 gas pressure law.
3. Air pressure low.
4. Breaker lockout.
5. Spares 4 nos.
6. DC fail.

5. 220/ 132 KV TRANSFORMERS (220 KV SIDE)

TRIP ALARMS

1. Main Differential Prot. Operated.
2. Circulating Current Differential Prot. Operated.
3. Over current prot. Operated.
4. Earth Fault prot. Operated.

5. Restricted Earth Fault prot. Operated.
6. Neutral displacement prot. Operated.
7. Over flux prot. Trip.
8. LBB prot. Operated.
9. Buchholz Alarm.
10. Buchholz Trip.
11. Pressure Relief Device – I/II operated.
12. HV/LV Winding Temperature Trip.
13. Oil Temperature Trip.
14. OLTC Surge Relay Trip R-phase.
15. OLTC Surge Relay Trip Y-phase.
16. OLTC Surge Relay Trip B-phase.
17. OLTC Surge Relay Trip Common.
18. Bus Bar Protection Trip Relay Operated.

NON TRIP ALARMS

1. HV/LV Winding Temperature High.
2. Oil Temperature Trip.
3. Over flux prot. Alarm.
4. Transformer Oil Level Low.
5. OLTC Oil Level Low.
6. Group A/B protection DC Fail.
7. VT not selected.
8. Differential Prot. Unhealthy.
9. CB Trip Circuit -1 Faulty.
10. CB Trip Circuit-2 Faulty
11. **CB Low Air Pressure.**
12. CB Low SF 6 Gas Pressure.
13. **CB Low Air** / SF 6 Gas Pressure Lockout.
14. CB Pole Discrepancy Trip.
15. Control Board AC Supply Fail.

6. 220/ 132 KV TRANSFORMERS (132 KV SIDE)

TRIP ALARMS

1. Over current Prot. Operated.
2. Earth Fault Prot. Operated.

NON TRIP ALARMS

1. Protection DC Fail
2. VT not Selected.
3. CB Trip Circuit-1 Faulty.
4. CB Trip Circuit-2 Faulty.
5. **CB Low Air Pressure.**
6. CB Low SF 6 Gas Pressure.

7. CB **Low Air** / SF6 Gas Pressure Lockout.
8. CB Pole Discrepancy Trip.
9. Control Board AC Supply Fail.

7. 132 / 33 KV TRANSFORMERS

TRIP ALARMS

1. Differential Prot. Operated.
2. Over current prot. Operated.
3. Earth fault prot. Operated.
4. Over Flux prot. Trip.
5. Buchholz alarm.
6. Buchholz trip.
7. Pressure relief device operated.
8. HV / LV winding temp. trip.
9. Oil temp. trip.
10. OLTC surge relay trip.

NON TRIP ALARM

1. Over flux prot. Alarm.
2. HV/LV winding temp. high.
3. Oil Temp. High.
4. Oil Level Low.
5. OLTC oil level low.
6. Protection DC fail.
7. Differential protection unhealthy.
8. CB trip circuit – 1 / 2 faulty.
9. **CB low air pressure.**
10. CB low SF6 gas pressure.
11. CB **low air** / SF6 gas pressure lockout.
12. Control Board AC Supply Fail.

8. 420/220 KV BUS COUPLER

TRIP ALARMS

1. Pole discrepancy relay operated.
2. Bus bar protection operated.
3. OCR / EFR operated.
4. Local breaker back up protection operated.

NON TRIP ALARMS

1. Trip circuit supervision alarm TC-1
2. Trip circuit supervision alarm TC2.
3. VT fuse failure alarm.

4. Carrier failure.
5. SF6 gas pressure low.
6. Air pressure low.
7. DC fail to distance protection / control circuit.
8. Breaker lockout.
9. Spare six nos.

9. 132 KV BUS COUPLER

TRIP ALARM

1. Distance protection operated.
2. OCR / EFR operated.
3. Local breaker back up protection operated.

NON TRIP ALARM

1. Trip circuit supervision alarm TC 1.
2. Trip circuit supervision alarm TC 2.
3. VT fuse failure alarm.
4. Carrier failure.
5. SF 6 Gas pressure low.
6. Air pressure low.
7. DC fail to distance protection / control circuit.
8. Breaker lockout.
9. Spares one no.

10. 420/220 KV/132KV BUS BAR PROTECTION PANELS

TRIP ALARM

1. Local breaker back up protection operated.
2. Bus bar protection operated.

NON TRIP ALARM

1. CT Secondary open circuit.
2. Bus bar check operated.
3. Spares – 4 Nos.

11. 132/ 33 KV 40MVAR/ 10MVAR CAPACITOR BANK C&R PANELS

TRIP ALARM

1. OCR operated
2. EFR operated

NON TRIP ALARMS

1. Trip circuit supervision alarm TC
2. SF6 gas pressure low.
3. Air pressure low.
4. Breaker lockout.
5. Spares 4 nos.
6. DC fail.

SECTION-3

GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS (GTR)

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GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS (GTR)

1.0 GENERAL

This section stipulates the General Technical Requirements (GTR) under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under respective equipment sections and are not exclusive. However in case of conflict between the requirement specified in this section and requirements specified under respective equipment sections, the requirements specified under respective sections shall hold good.

Every effort will be made to supply all equipment as per the technical details furnished in the specification. However, due to the standard manufacturing practice of various equipment suppliers and depending on the selected vendor, there may be slight variations from indicated values at the contract stage. Such variations should not affect the quality and performance of the equipment.

It is not the intent to specify completely in technical specifications of equipments/ materials all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. The Purchaser will interpret the meaning of drawing and specification and shall have the power to reject any work or material which in his judgement is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply, irrespective of whether these are specifically brought out in this specification and/or commercial order or not.

2.0 COMPLETENESS OF EQUIPMENTS

2.1 Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories specified &/or normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost All similar standard components/ parts of similar standard equipment provided, shall be inter-changeable with one another.

2.2 The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid. In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening. The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

3.0 STANDARDS

3.1 Except as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments/ works shall be designed, engineered, manufactured, built, tested and commissioned shall be carried out in accordance with the Acts, Rules, Laws and Regulations in force in India.

3.2 In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.3 In the event of the Bidder offering equipment conforming to standards other than ISS/IES standards, which ensure equivalent or better performance than that specified in the standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of such standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's approval.

3.4 The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.

3.5 Should the Bidder wish to depart from the provisions of the specifications, either on accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the Purchaser.

3.6 REFERENCE OF STANDARDS

Reference	Abbreviation	Name and Address
IEC/ CISPR	International Electro technical Commission	Bureau Central de la Commission, Electro Technique International, 1 Rue de verembe Geneva, Switzerland
IS	Indian Standards,	Bureau of Indian Standard, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi-110 002, INDIA

BS	British Standards,	British Standards Institution, 101, Pentonville Road, N-19-ND UK
ISO	International Organization For Standardization,	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelstrup, DENMARK
NEMA	National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A

4.0 PROJECT DATA

i.	Location	UTTAR PRADESH
ii.	Altitude	not exceeding 1000 Meters
iii.	Climatic Conditions	
(a)	Design maximum ambient Air Temperature	50 ⁰ C
(b)	Minimum ambient air temperature in shade	0 ⁰ C
(c)	Relative Humidity	100%Max.
(d)	Wind Load	195 Kg./ Sq.m.
(e)	Seismic Level	0.3 g
(f)	Isoceraunic Level	50days/ year
(g)	Average annual rain fall	1200 mm
(h)	Hot and humid tropical Climate conducive to rust and fungus growth	

5.0 SYSTEM PARTICULARS

(i)	Rated System voltage	420 kV, 245kV, 145kV, 36kV
(ii)	System frequency	50 Hz, This may vary by $\pm$ 5%
(iii)	Number of phases	Three
(iv)	Neutral	Effectively Earthed
(v)	Auxiliary power supply:-	

Auxiliary electrical equipment shall be suitable for operation on the following supply system:

(a)	Power device (Like drive motors)	400V, 3Phase, 4Wire 50Hz Effectively earthed AC system.
(b)	Lighting fixtures, space heaters, fractional Horse Power motors and control devices.	250V, 2wire, 50Hz, AC supply with one point grounded.
(c)	DC alarm, Control and Protective Devices from sub station batteries as under	2wire ungrounded DC supplies
	(i)	400 kV S/S : 220V DC (ii)
		220/132kV S/S : 110V DC (iii)
		Communication : 48 V DC equipment

The above supply voltage is subject to variation as follows:

All devices must be suitable for a continuous operation over the entire range of voltage variations :

- (i) AC
 - Voltage may vary by $\pm 10\%$.
 - Frequency by $\pm 5\%$
 - Combined Voltage & frequency by $\pm 10\%$.
- (ii) DC
 - a) 220 V may vary between 187 & 242 V
 - b) 110 V may vary between 93 & 121 V
 - c) 48 V may vary between 41 & 53 V

6.0 SYSTEM PARAMETERS

The following system parameters shall prevail:

Sl. No.	Description of Parameters	400 kV System	220 kV System	132 kV System	33 kV System
1.	Nominal system voltage	4000kV	220kV	132kV	33kV
2.	Maximum operating voltage of the system(rms)	420kV	245kV	145kV	36kV
3.	Rated frequency	50Hz	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3	3
5.	Rated short time current	50 kA for 3 Sec.	40 kA for 3 sec	31.5 kA for 3 sec	25 kA for 3 sec
6.	Dry and wet one minute power frequency withstand voltage	680 kV	460 kV	275 kV	95 kV
7.	Dry and wet impulse withstand voltage positive and negative	1550 kVp	1050 kVp	650 kVp	250 kVp
8.	Corona extinction voltage	320 kV	156 kV	105 kV	-
9.	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, 320kV rms for 400kV system and 156kV rms for 220kV system & 92kV rms for 132kV system	1000 microvolt	1000 microvolt	500 microvolt	-
10.	Minimum total creepage	25mm/ kV (10500 mm)	25mm/ kV (6125 mm)	25mm /kV (3625 mm)	25mm/kV (1300 mm)
11.	Min. clearances				
	i. Phase to phase	4000mm (for Conductor-conductor) 4200mm (for rod - Conductor)	2100 mm	1300 mm	320 mm
	ii. Phase to earth	3500 mm	2100 mm	1300 mm	320 mm

	iii) Sectional clearances	6500 mm	5000 mm	4000 mm	3000 mm
12.	System neutral earthing	Effectively Earthed	Effectively Earthed	Effectively Earthed	Effectively Earthed

Major technical parameters of bushings/ hollow column/ support insulators are given below:

Sl. No	Parameters	400 kV System	220 kV System	132 kV System	33 kV System
(a)	Max. System voltage Um (kV)	420	245	145	36
(b)	Impulse withstand voltage (dry & wet) (kVp)	± 1425	± 1050	± 650	±170
(c)	Switching surge withstand voltage (dry & wet) (kVp)	1050	-	-	-
(d)	Power frequency withstand voltage (dry and wet) (kV rms)	650	460	275	75
(e)	Total creepage distance(min) (mm)	10500	6125	3625	900

Insulator shall also meet requirement of IEC- 815 for 420kV, 245kV, 145kV and 36kV systems, as applicable having alternate long and short sheds.

7.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT

All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site.

All equipment shall be able to withstand all external and internal mechanical thermal and electromechanical forces due to various factors like wind load temperature variation, ice & snow (wherever applicable) short circuit etc for the equipment.

The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.

All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.

To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

8.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

8.1 Each equipment shall be supplied with necessary terminals and connectors as required by the design for the particular installation. The terminal connector shall be suitable for the conductor used for particular installation, which are as under as per UPPTCL's practice:

8.2 Where copper to aluminum connections are required, bimetallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to part which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Bidder.

- 8.3** Low voltage connectors, grounding connectors and accessories for grounding all equipment are also included in the scope of work.
- 8.4** No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be used with aluminum body for Bimetallic clamps.
- 8.5** All casting shall be free from blow holes, surface blisters cracks and cavities. Sharp edges and corners shall be blurred and rounded off.
- 8.6** Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 8.7** The clamps/ connectors shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/ connector is designed with respect to specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on hardware.
- 8.8** All current carrying parts shall be designed and manufactured to have minimum contact resistant.
- 8.9** Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 420kV, 220kV and 132kV class clamps shall not be less than 320, 156 and 105kV (rms) respectively and R.I.V. level shall not be more than specified 1000, 1000 and 500 micro volts for 420kV, 220kV and 132kV system at the test voltage specified.

9.0 SUPPORT STRUCTURES

- 9.1** The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 400/220/132/33kV Substations.
- 9.2** All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc.
- 9.3** The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

10.0 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification. For the approval of purchaser. The decision of Purchaser shall be final. The scheme shall include.

Finishing colour of Indoor equipment.

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint with a suitable primer. It may be noted that normally all electrical equipments in switchyard are painted with shade 631 of IS-5. The indoor cubicles, GIS enclosures and other miscellaneous items, the colour scheme shall be approved by the Purchaser during detailed engineering.

11.0 MATERIAL/ WORKMANSHIP

11.1 General Requirement

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is understood that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits. Suitable guards shall be provided for the protection of personnel on all exposed rotating and/or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder shall apply oil and grease of the proper specification to suit the machinery, as is

necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Bidder shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Bidder has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, of so required.

11.2 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

12.0 SPACE HEATERS

The heaters shall be suitable for continuous operation at 240V AC supply. On-off switch and fuse shall be provided for the heater.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulator wire or other component in the compartments.

13.0 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where

the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

14.0 VENTILATION OPENING

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air/ dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

15.0 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, junction boxes and Marshalling Boxes, panels etc. to be installed shall be provided with degree of protection as detailed here under:

- a) Installed out door : IP-55
- b) Installed indoor in air conditioned area : IP-31
- c) Installed in covered area : IP -52
- d) Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41
- e) For LT Switchgear (AC & DC distribution Boards): IP-52

The degree of protection shall be in accordance with :13947 (Part-I)/ IEC-60947 (Part-I)/ IS 12063 / IEC-60529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

16.0 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instructions plates, rating plates CB, CT, VT, SA, Isolators and Relay & Protection panels equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

17.0 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment, covered under the scope of the specifications, into successful operation, shall be furnished by the Bidder unless specifically excluded under

the exclusions in these specifications and documents.

18.0 PACKAGING AND PROTECTION

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Bidder shall also submit packing details/associated drawing for any equipment/material, to facilitate the Purchaser to repack any equipment/material at a later date. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Bidder.

All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protectin device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

19.0 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

All external painting shall be as per shade No. 631 of IS: 5.

20.0 HOT DIP GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS: 2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/ sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. For items lower than 6mm thickness, requirement of coating shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

The galvanized surfaces shall have a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off,

etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

21.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotation and/of moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

22.0 TOOLS AND TACKLES

The Bidder shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately packed and brought on to site.

23.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

- 23.1** All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039/ IS-8623, IEC-60439, as applicable, and the clauses given below.
- 23.2** Control cabinets, junction boxes, marshalling boxes and terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box, the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.
- 23.3** Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes/ Control cabinets to prevent ingress of rain water.
- 23.4** Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 23.5** All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/cracked during 10(ten) years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion

and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters, the screen shall be fine wire mesh made of brass.

23.6 All boxes/ cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required.

23.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

23.8 For illumination, a 20 Watts fluorescent tube or 15 watts CFL/LED bulb shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

23.9 All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

23.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

23.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ wiring by pasting the same on the inside of the door.

23.12 a) The following routine tests alongwith the routine tests as per IS: 5039 shall also be conducted.

Check for wiring
Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall be type tested for IP-55 as per IS: 13947. After IP-55 test, 2.5 kVrms for 1 (one) minute, insulation resistance and functional test should be conducted.

23.13 Auxiliary Switches

All the auxiliary switches shall be fully type tested as per relevant IS.

The following type test reports on auxiliary switches shall be submitted:

(a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.

- (b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.
- (c) Heat run test on contacts.
- (d) IR/HV test etc.

24.0 TERMINAL BLOCKS AND WIRING

- 24.1** Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.
- 24.2** Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be of moulded piece, complete with insulated/barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type of Elmex type CATM4, phoenix cage clamp type or equivalent. The insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.
- 24.3** Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 24.4** The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 24.5** The conducting part in contact with cable shall preferably be tinned or silver plated, however Nickel plated copper or zinc plated steel shall also be acceptable.
- 24.6** The terminal blocks shall be of extensible design.
- 24.7** The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 24.8** The terminal blocks shall be fully enclosed with removable covers of transparent, non-deterioration type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 24.9** Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- | | | |
|----|---------------------------------|---|
| a) | All circuits except CT circuits | Minimum of 2 nos. of 2.5 sq. mm copper flexible |
| b) | All CT circuits | Minimum of 4 nos. of 2.5 sq.mm copper flexible |
- 24.10** The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

- 24.11** At least 20% spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminal rows.
- 24.12** There shall be minimum clearance of 250 mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 24.13** The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.
- 24.14** All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Bidder shall also provide necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

25.0 LAMPS AND SOCKETS

25.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

25.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

25.3 Hand Lamp

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON- OFF Switch for connection of hand lamps.

25.4 Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker/ switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS-9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

26.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

26.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.

The bidder may also offer composite silicon rubber insulator, conforming to IEC-61462.

26.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

26.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

26.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

26.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

26.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

26.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

26.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS: 2544 & IS : 5621.

27.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

27.1 Enclosures

- a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

27.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system.

27.3 Starting Requirements

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified, shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

27.4 Running Requirements

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729.

Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

27.5 TESTING AND COMMISSIONING

The Bidder shall conduct following tests alongwith list of instruments and calibration certificates to the Purchaser. If any additional test is required the same shall be conducted without any extra cost to the Purchaser.

- (a) Insulation resistance.
- (b) Phase sequence and proper direction of rotation.
- (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

28.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

28.1 Circuit Breakers (Applicable for 400kV, 220kV & 132 kV)

- 28.1.(i) The manufacturer(s) whose SF6 Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage and **40kA/ 50kA fault level or above class** which are in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.1.(ii)(a) The manufacturer(s) whose SF6 Circuit Breaker are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.1.(i) given above.

And

- 28.1.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.1.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.2 Isolators (Applicable for 400kV, 220kV & 132kV)

- 28.2.(i) The manufacturer whose isolator are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the isolator for the specified system voltage and and **40kA/ 50kA fault level or above class** and should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.2.(ii)(a) The manufacturer(s) whose Isolator are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a

parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.2.(i) given above.

And

- 28.2.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.2.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.3 Instrument Transformers (Applicable for 400kV, 220kV & 132kV)

- 28.3.(i) The manufacturer whose instrument transformers are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the same for the specified system voltage for CT & VT and 40kA/ 50kA fault level or above class. These equipment should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.3.(ii)(a) The manufacturer(s) whose Instrument Transformer are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.3.(i) given above.

And

- 28.3.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.3.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.4 Surge Arresters (Applicable for 400kV, 220kV & 132kV)

- (a) The manufacturer whose Surge Arresters are offered should have designed, manufactured and tested as per IEC/IS or equivalent standard and supplied the Surge Arrester for the specified energy capability with rated system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

Or

- (b) The manufacturer(s) whose Surge Arrestors are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no (a) given above.

And

Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to

guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder.

28.5 220 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 220kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.6 132 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 132kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.7 33 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 33kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.8 1.1 kV Grade Power & Control Cables

28.8.1 Applicable for PVC Control Cable

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 kms of 1.1 kV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the date of bid opening.

28.8.2 Applicable for PVC Power Cable

The manufacturer, whose PVC Power Cables are offered, should have designed, manufactured, tested and supplied in a single contract atleast 100 kms of 1.1 kV or higher grade PVC insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size as on the date of bid opening.

28.8.3 Applicable for XLPE Power Cables

The Manufacturer, whose XLPE Power cables are offered, should have designed, manufactured,

tested and supplied in a single contract atleast 25 kms of 1.1 kV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the date of bid opening.

28.9 LT Switchgear

28.9.1 The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designe manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos. MCC panels comprising of MCCBs (ie Moulded Case Circuit Breakers) modules of the type offered which should be in successful operation as on date of bid opening.

28.9.2 The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design. At least one hundred circuit breakers of the make and type being offered shall be operating satisfactory as on date of bid opening.

28.10 Battery and Battery Charger

28.10.1 Requirements for Battery Manufacturers

The manufacturer whose Batteries are offered should have designed, manufactured and supplied DC Batteries of the type specified and being offered, having a capacity of at least 600 AH and these shall be operating satisfactorily for two years in power sector and/or industrial installations as on date of bid opening.

28.10.2 Requirements for Battery Charger Manufacturers

The manufacturer, whose Battery Chargers are offered, should have designed, manufactured and supplied Battery Chargers generally of the type offered, with static automatic voltage regulators and having a continuous output of at least ten (10) kW and these should be in successful as on the date of bid opening.

28.11 LT Transformers

The manufacturer, whose transformers are offered should have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformers of at least 33 kV class of 800 kVA or higher. The transformer should have been in successful operation for at least 2 years as on the date of bid opening.

28.12 Fire Fighting System

The bidder or his sub-vendor should have designed, supplied, tested, erected and commissioned at least one number fire protection system of the each type described in (i), (ii), (iii) and (iv) below in installations such as power plants, substations, refineries, fertilizer plants or other industrial or commercial installations. Such systems must have been designed to the recommendations of Tariff Advisory Committee of India or any other international reputed

authority like (FOC, London or NFPA, USA etc.) executed during last ten (10) years and should have been in successful operation for at least 2 (two) years as on the date of bid opening.

- i) Nitrogen Injection Fire Prevention cum Extinguishing System
- ii) Portable Fire Extinguishers
- iii) GI Buckets – 9.0 liters capacity and Steel stand for Buckets
- iv) Fire Detection and Alarm System

In case bidder himself do not meet the requirement of design, he can engage a consultant(s) who must have designed the above system, which must be in successful operation for at least two years as on the date of bid opening.

28.13 Control and Relay Panels (400 kV, 220 kV, 132 kV & 33 kV)

The manufacturer whose Control, Relay & Protection System (Control & protection Intelligent Electronic Devices (IEDs)), and Sub-station Automation System (If applicable) are offered should have designed, manufactured, tested, installed and commissioned Control, Relay & Protection system along with Sub-station Automation System which must be in satisfactory operation on specified voltage level or above for atleast 2 (two) years on the date of bid opening.

AND

The Manufacturer or their joint venture or subsidiary company must have established repair, testing and integration (for at least 4 bays) facilities for Control, Relay & Protection System and Sub-station Automation System in India.

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400 kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132 kV above.

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 400kV, 220kV, 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised

and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.

- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132 kV and above) shall be carried out alongwith supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/UPPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

India Electricity Rules

Indian Electricity Act

Indian Electricity (Supply) Act

Indian Factories Act

IS-5,	-	Colors for Ready Mixed Paints and Enamels.
IS-335,	-	New Insulating Oils.
IS-617,	-	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	-	Methods of Test for Petroleum and its Products.
IS-2071 (P1 to P3)	-	Methods of High Voltage Testing.
IS-12063	-	Classification of degrees of protection provided by enclosures of electrical equipment.
IS-2165 P1:1997 P2:1983	-	Insulation Coordination.
IS-3043	-	Code of Practice for Earthing
IS-6103	-	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids
IS-6104	-	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	-	Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids.
IS-6792	-	Method for determination of electric strength of insulating oils.
IS-5578	-	Guide for marking of insulated conductors.
IS-11353	-	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	-	Methods for Radio Interference Test on High voltage Insulators.
IS-9224 (Part 1,2&4)	-	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	-	High Voltage Test Techniques
IEC 60068	-	Environmental Test

IEC-60117	-	Graphical Symbols
IEC-60156,	-	Method for the Determination of the Electrical Strength of Insulation Oils.
IEC-60270,	-	Partial Discharge Measurements.
IEC-60376	-	Specification and Acceptance of New Sulphur Hexafluoride
IEC-60437	-	Radio Interference Test on High Voltage Insulators.
IEC-60507	-	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.
IEC-62271-1	-	Common Specification for High Voltage Switchgear & Controlgear Standards.
IEC-60815	-	Guide for the Selection of Insulators in respect of Polluted Conditions.
IEC-60865 (P1 & P2)	-	Short Circuit Current - Calculation of effects.
ANSI-C.1/NFPA.70	-	National Electrical Code
ANSI-C37.90A	-	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21,	-	Specification for Electromagnetic Noise and
C63.3	-	Field Strength Instrumentation 10 KHz to 1 GHz
C36.4ANSI-C68.1	-	Techniques for Dielectric Tests
ANSI-C76.1/IEEE21	-	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.
ANSI-SI-4	-	Specification for Sound Level Meters
ANSI-Y32-2/C337.2	-	Drawing Symbols
ANSI-Z55.11	-	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	-	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	-	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	-	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	-	Quality Assurance Program Requirements
CSA-Z299.2-1979h	-	Quality Control Program Requirements
CSA-Z299.3-1979h	-	Quality Verification Program Requirements

CSA-Z299.4-1979h - Inspection Program Requirements

TRANSFORMERS AND REACTORS

IS:10028 (Part 2 & 3)	-	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	-	Power Transformers
IS-3347 (part 1 to Part 8)	-	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres.
IS-3639	-	Fittings and Accessories for Power Transformers
IS-6600	-	Guide for Loading of Oil immersed Transformers.
IEC-60076 (Part 1 to 5)	-	Power Transformers
IEC-60214	-	On-Load Tap-Changers.
IEC-60289	-	Reactors.
IEC- 60354	-	Loading Guide for Oil - Immersed power transformers
IEC-60076-10	-	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	-	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	-	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	-	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	-	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	-	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise
ANSI-CG,1EEE-4	-	Standard Techniques for High Voltage Testing

CIRCUIT BREAKERS

IEC-62271-100	-	High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers
IEC-62271-101	-	High-voltage switchgear and controlgear - Part 101:

Synthetic testing

- | | | |
|---------------|---|---|
| IEC-62155 | - | Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V |
| IEC-62271-110 | - | High-voltage switchgear and controlgear - Part 110: Inductive load switching |
| IEC-62271-109 | - | High-voltage switchgear and controlgear - Part 110: Inductive load switching |

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING

CAPACITOR VOLTAGE TRANSFORMERS

- | | | |
|---------------------|---|--|
| IS-2705- (P1 to P4) | - | Current Transformers. |
| IS:3156- (P1 to P4) | - | Voltage Transformers. |
| IS-4379 | - | Identification of the Contents of Industrial Gas Cylinders |
| IEC-60044-1 | - | Current transformers. |
| IEC-60044-2 | - | Inductive Voltage Transformers. |
| IEC-60044-4 | - | Instrument Transformes : Measurement of Partial Discharges |
| IEC-60044-5 | - | Instrument transformers - Part 5: Capacitor voltage transformers |
| IEC-60358 | - | Coupling capacitors and capacitor dividers. |
| IEC-60481 | - | Coupling Devices for power Line Carrier Systems. |
| ANSI-C5713 | - | Requirements for Instrument transformers |
| ANSIC92.2 | - | Power Line Coupling voltage Transformers |
| ANSI-C93.1 | - | Requirements for Power Line Carrier Coupling Capacitors |
| BUSHING | | |
| IS-2099 | - | Bushings for Alternating Voltages above 1000V |
| IEC-60137 | - | Insulated Bushings for Alternating Voltages above 1000V |

SURGE ARRESTERS

- | | | |
|-----------------|---|---|
| IS-3070 (PART2) | - | Lightning arresters for alternating current systems |
|-----------------|---|---|

		: Metal oxide lightning arrestors without gaps.
IEC-60099-4	-	Metal oxide surge arrestors without gaps
IEC-60099-5	-	Selection and application recommendation
ANSI-C62.1	-	IEEE Standards for S A for AC Power Circuits
NEMA-LA 1	-	Surge Arresters

CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248, IS-3231, 3231 (P-3)	-	Electrical relays for power system protection
IS:5039	-	Distributed pillars for Voltages not Exceeding 1000 Volts.
IEC-60068.2.2	-	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	-	Degree of Protection provided by enclosures.
IEC-60947-4-1	-	Low voltage switchgear and control gear.
IEC-61095	-	Electromechanical Contactors for household and similar purposes.
IEC-60439 (P1 & 2)	-	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	-	Switchgear Assemblies, including metal enclosed bus.
ANSI-C37.50	-	Test Procedures for Low Voltage Alternating Current Power Circuit Breakers
ANSI-C39	-	Electric Measuring instrument
ANSI-C83	-	Components for Electric Equipment
IS: 8623: (Part I to 3)	-	Specification for Switchgear & Control Assemblies.
NEMA-AB	-	Moulded Case Circuit and Systems
NEMA-CS	-	Industrial Controls and Systems
NEMA-PB-1	-	Panel Boards
NEMA-SG-5	-	Low voltage Power Circuit breakers
NEMA-SG-3	-	Power Switchgear Assemblies
NEMA-SG-6	-	Power switching Equipment
NEMA-5E-3	-	Motor Control Centers
1248 (P1 to P9)	-	Direct acting indicating analogue electrical

measuring instruments & their accessories.

Disconnecting Switches

IEC-62271-102	-	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches
IEC-60129	-	Alternating Current Disconnectors (Isolators) and Earthing switches
IEC-1129	-	Alternating Current Earthing Switches Induced Current switching
IEC-60265 (Part 1 & 2)	-	High Voltage switches
ANSI-C37.32	-	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	-	Test Code for high voltage air switches
NEMA-SG6	-	Power switching equipment

PLCC and Line Traps

IS-8792	-	Line traps for AC power system.
IS-8793	-	Methods of tests for line traps.
IS-8997	-	Coupling devices for PLC systems.
IS-8998	-	Methods of test for coupling devices for PLC systems.
IEC-60353	-	Line traps for A.C. power systems.
IEC-60481	-	Coupling Devices for power line carrier systems.
IEC-60495	-	Single sideboard power line carrier terminals
IEC-60683	-	Planning of (single Side-Band) power line carrier systems.
CIGRE	-	Teleprotection report by Committee 34 & 35.
CIGRE	-	Guide on power line carrier 1979.
CCIR	-	International Radio Consultative Committee
CCITT	-	International Telegraph & Telephone Consultative Committee

EIA - Electric Industries Association

Protection and Control Equipment

IEC-60051 : (P1 to P9)	-	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to 23)	-	Electrical relays.
IEC-60297 (P1 to P4)	-	Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-60359	-	Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	-	Symbols for Alternating-Current Electricity meters.
IEC-60447	-	Man machine interface (MMI) - Actuating principles.
IEC-60521	-	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	-	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	-	Screw threads
ANSI-B18	-	Bolts and Nuts
ANSI-C37.1	-	Relays, Station Controls etc.
ANSI-C37.2	-	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	-	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	-	Requirements for electrical analog indicating Instruments

MOTORS

IS-325	-	Three phase induction motors.
IS-4691	-	Degree of protection provided by enclosure for rotating electrical machinery.
IEC-60034 (P1 to P19:)	-	Rotating electrical machines

IEC-Document 2 - Three phase induction motors
(Central Office) NEMA-MGI Motors and Generators

Electronic Equipment and Components

MIL-21B, MIL-833 & MIL-2750

- IEC-60068 (P1 to P5) - Environmental testing
- IEC-60326 (P1 to P2) - Printed boards
Material and workmanship standards
- IS-1363 (P1 to P3) - Hexagon headbolts, screws and nuts of product grade C.
- IS-1364 (P1 to P5) - Hexagon head bolts, screws and nuts of products grades A and B.
- IS-3138 - Hexagonal Bolts and Nuts (M42 to M150)
- ISO-898 - Fasteners: Bolts, screws and studs
- ASTM - Specification and tests for materials

Clamps & Connectors

- IS-5561 - Electric power connectors.
- NEMA-CC1 - Electric Power connectors for sub station
- NEMA-CC 3 - Connectors for Use between aluminium or aluminum-Copper Overhead Conductors

Bus Hardware and Insulators

- IS: 2121 - Fittings for Aluminum and steel cored Al conductors for overhead power lines.
- IS-731 - Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V.
- IS-2486 (P1 to P4) - Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V.
- IEC-60120 - Dimensions of Ball and Socket Couplings of string insulator units.
- IEC-60137 - Insulated bushings for alternating voltages above 1000 V.
- IEC-60168 - Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.

IEC-62155	-	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60233	-	Tests on Hollow Insulators for use in electrical equipment.
IEC-60273	-	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-61462	-	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	-	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pintype.
IEC-60372 (1984)	-	Locking devices for ball and socket couplings of string insulator units : dimensions and tests.
IEC-60383 (P1 and P2)	-	Insulators for overhead lines with a nominal voltage above 1000 V.
IEC-60433	-	Characteristics of string insulator units of the long rod type.
IEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29	-	Wet process procelain insulators
ANSI-C29.1	-	Test methods for electrical power insulators
ANSI-C92.2	-	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	-	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	-	Iron and steel hardware
CISPR-7B	-	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	-	Zinc Coating (Hot-Dip) on iron and steel hardware

Strain and Rigid Bus-Conductor

IS-2678	-	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube.
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IS-5082	-	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes.
ASTM-B 230-82	-	Aluminum 1350 H19 Wire for electrical purposes
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	-	Aluminum - Alloy extruded bar, rod, wire, shape
ASTM-B 236-83	-	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

Batteries and Batteries Charger

Battery

IS:1651	-	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	-	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	-	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	-	Synthetic Separators for Lead-Acid Batteries
IS:266	-	Specification for Sulphuric Acid
IS:1069	-	Specification for Water for Storage Batteries
IS:3116	-	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	-	Indicating Instruments
IS:10918	-	Vented type nickel Cadmium Batteries
IEC:60896-21&22	-	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	-	Vented type nickel Cadmium Batteries
IEC:60622	-	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	-	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	-	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	-	Recommended practices for sizing of Lead Acid

Batteries

IEEE-1115	-	Sizing of Ni-Cd Batteries
IEEE-1187	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	-	Guide for selection of VRLA Batteries

Battery Charger

IS:3895	-	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	-	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.
IS:6619	-	Safety Code for Semiconductor Rectifier Equipment
IS:2026	-	Power Transformers
IS:2959	-	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	-	Indicating Instruments
IS:2208	-	HRC Fuses
IS:13947 (Part-3)	-	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	-	Degree of protection provided by enclosures for low voltage switchgear and controlgear.
IS:6005	-	Code of practice for phosphating of Iron and Steel
IS:3231	-	Electrical relays for power system protection
IS:3842	-	Electrical relay for AC Systems
IS:5	-	Colours for ready mix paint
IEEE-484	-	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE-485	-	Sizing large lead storage batteries for generating stations and substations

Wires and Cables

ASTMD-2863	-	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	-	PVC insulated cables for working voltages upto and including 1100 Volts.
IS-1255	-	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	-	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V.
	-	Part (2) for working voltage from 3.3 kV upto and including 11kV.
IS:1753	-	Aluminium conductor for insulated cables
IS:2982	-	Copper Conductor in insulated cables.
IS-3961 (P1 to P5)	-	Recommended current ratings for cables.
IS-3975	-	Mild steel wires, formed wires and tapes for armouring of cables.
IS-5831	-	PVC insulating and sheath of electric cables.
IS-6380	-	Elastometric insulating and sheath of electric cables.
IS-7098	-	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts.
IS-7098	-	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV.
IS-8130	-	Conductors for insulated electrical cables and flexible cords.
IS-1753	-	Aluminum Conductors for insulated cables.
IS-10418	-	Specification for drums for electric cables.
IEC-60096 (part 0 to p4)	-	Radio Frequency cables.
IEC-60183	-	Guide to the Selection of High Voltage Cables.
IEC-60189 (P1 to P7)	-	Low frequency cables and wires with PVC insulation and PVC sheath.
IEC-60227 (P1 to P7)	-	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.
IEC-60228	-	Conductors of insulated cables
IEC-60230	-	Impulse tests on cables and their accessories.

IEC-60287 (P1 to P3)	-	Calculation of the continuous current rating of cables (100% load factor).
IEC-60304	-	Standard colours for insulation for low-frequency cables and wires.
IEC-60331	-	Fire resisting characteristics of Electric cables.
IEC-60332 (P1 to P3)	-	Tests on electric cables under fire conditions.
IEC-60502	-	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	-	Tests on gases evolved during combustion of electric cables.

Air Conditioning and Ventilation

IS-659	-	Safety code for air conditioning
IS-660	-	Safety code for Mechanical Refrigeration
ARI:520	-	Standard for Positive Displacement Refrigeration Compressor and Condensing Units
IS:4503	-	Shell and tube type heat exchanger
ASHRAE-24	-	Method of testing for rating of liquid coolers
ANSI-B-31.5	-	Refrigeration Piping
IS:2062	-	Steel for general structural purposes
IS:655	-	Specification for Metal Air Dust
IS:277	-	Specification for Galvanised Steel Sheets
IS-737	-	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	-	Hot rolled cast steel sheet & strip
IS-3588	-	Specification for Electrical Axial Flow Fans
IS-2312	-	Propeller Type AC Ventilation Fans
BS-848	-	Methods of Performance Test for Fans
BS-6540 Part-I	-	Air Filters used in Air Conditioning and General Ventilation
BS-3928	-	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	-	Method of cold DOP & hot DOP test
MIL-STD-282	-	DOP smoke penetration method
ASHRAE-52	-	Air cleaning device used in general ventilation for

		removing particle matter
IS:3069	-	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials.
IS:4671	-	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	-	Bonded Mineral Wool
IS:3346	-	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	-	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	-	Centrifugal Fans
BS:848 Fans	-	Method of Performance Test for Centrifugal Fans
IS:325	-	Induction motors, three-phase
IS:4722	-	Rotating electrical machines
IS:1231	-	Three phase foot mounted Induction motors, dimensions of
IS:2233	-	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Vertical shaft motors for pumps, dimensions of
IS:7816	-	Guide for testing insulation resistance of rotating machines
IS:4029	-	Guide for testing three phase induction motors
IS:4729	-	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	-	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	-	Guide for testing single-phase a.c. motors
IS:2148	-	Flame proof enclosure for electrical apparatus
BS:4999 (Part-51)	-	Noise levels

Galvanizing

IS-209	-	Zinc Ingot
IS-2629	-	Recommended Practice for Hot-Dip galvanizing

on iron and steel.

- | | | |
|---------------|---|--|
| IS-2633 | - | Methods for testing uniformity of coating of zinc coated articles. |
| ASTM-A-123 | - | Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips. |
| ASTM-A-121-77 | - | Zinc-coated (Galvanized) steel barbed wire |

Painting

- | | | |
|-----------|---|--|
| IS-6005 | - | Code of practice for phosphating of iron and steel. |
| ANSI-Z551 | - | Gray finishes for industrial apparatus and equipment |
| SSPEC | - | Steel structure painting council |

Fire Protection System

Fire protection manual issued by tariff advisory committee (TAC) of India

HORIZONTAL CENTRIFUGAL PUMPS

- | | | |
|---------|---|--|
| IS:1520 | - | Horizontal centrifugal pumps for clear, cold and fresh water |
| IS:9137 | - | Code for acceptance test for centrifugal & axial pumps |
| IS:5120 | - | Technical requirement - Rotodynamic special purpose pumps |
| API-610 | - | Centrifugal pumps for general services |
| | - | Hydraulic Institutes Standards |
| BS:599 | - | Methods of testing pumps |
| PTC-8.2 | - | Power Test Codes - Centrifugal pumps |

DIESEL ENGINES

- | | | |
|----------|---|--|
| IS:10000 | - | Methods of tests for internal combustion engines |
| IS:10002 | - | Specification for performance requirements for |

		constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	-	The performance of reciprocating compression ignition (Diesel) engines, utilising liquid fuel only, for general purposes
ISO:3046	-	Reciprocating internal combustion engines performance
IS:554	-	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	-	Internal combustion engine PTC-17
	-	Codes of Diesel Engine Manufacturer's Association, USA

PIPING VALVES & SPECIALITIES

IS:636	-	Non percolating flexible fire fighting delivery hose
IS:638	-	Sheet rubber jointing and rubber inserting jointing
IS:778	-	Gun metal gate, globe and check valves for general purpose
IS:780	-	Sluice valves for water works purposes (50 to 300 mm)
IS:901	-	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	-	Suction hose couplings for fire fighting purposes
IS:903	-	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	-	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	-	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	-	SP for weldable structural steel
IS:2379	-	Colour Code for the identification of pipelines
IS:2643	-	Dimensions of pipe threads for fastening purposes
IS:2685	-	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	-	Sluice valves for water-works purposes (350 to 1200 mm size)

IS:3582	-	Basket strainers for fire fighting purposes (cylindrical type)
IS:3589	-	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	-	Foot valves for water works purposes
IS:4927	-	Unlined flax canvas hose for fire fighting
IS:5290	-	Landing valves (internal hydrant)
IS:5312	-	Swing check type reflex (non-return) valves
(Part-I)		
IS:5306	-	Code of practice for fire extinguishing installations and equipment on premises
Part-I	-	Hydrant systems, hose reels and foam inlets
Part-II	-	Sprinkler systems
BS:5150	-	Specification for cast iron gate valves

MOTORS & ANNUNCIATION PANELS

IS:325	-	Three phase induction motors
IS:900	-	Code of practice for installation and maintenance of induction motors
IS:996	-	Single phase small AC and universal electric motors
IS:1231	-	Dimensions of three phase foot mounted induction motors
IS:2148	-	Flame proof enclosure of electrical apparatus
IS:2223	-	Dimensions of flange mounted AC induction motors
IS:2253	-	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Dimensions of vertical shaft motors for pumps
IS:3202	-	Code of practice for climate proofing of electrical equipment
IS:4029	-	Guide for testing three phase induction motors
IS:4691	-	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	-	Rotating electrical machines

IS:4729	-	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	-	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	-	Designation of methods of cooling for rotating electrical machines
IS:6381	-	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	-	Guide for testing insulation for rotating machine
IS:4064	-	Air break switches
IEC DOCUMENT 2 (Control Office) 432	-	Three Phase Induction Motor
VDE 0530 Part I/66	-	Three Phase Induction Motor
IS:9224 (Part-II)	-	HRC Fuses
IS:6875	-	Push Button and Control Switches
IS:694	-	PVC Insulated cables
IS:1248	-	Indicating instruments
IS:375	-	Auxiliary wiring & busbar markings
IS:2147	-	Degree of protection
IS:5	-	Colour Relay and timers
IS:2959	-	Contactors

PG Test Procedures

NFPA-13	-	Standard for the installation of sprinkler system
NFPA-15	-	Standard for water spray fixed system for the fire protection
NFPA-12A	-	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	-	Standard on Automatic Fire Detectors
Fire Protection Manual by TAC (Latest Edition)		
NFPA-12	-	Standard on Carbon dioxide extinguisher systems
IS:3034	-	Fire of industrial building:
Electrical generating and distributing stations code of practice		

IS:2878	-	CO2 (Carbon dioxide) Type Extinguisher
IS:2171	-	DC (Dry Chemical Powder) type
IS:940	-	Pressurised Water Type

D.G. SET

IS:10002	-	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	-	Method of tests for internal combustion engines
IS:4722	-	Rotating electrical machines-specification
IS:12063	-	Degree of protection provided by enclosures
IS:12065	-	Permissible limit of noise levels for rotating electrical machines.
	-	Indian Explosive Act 1932

Steel Structures

IS-228 (1992)	-	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3:)	-	Code of practice for use of structural steel in overhead transmission line towers.
IS-806	-	Code of practice for use of steel tubes in general building construction
IS-808	-	Dimensions for hot rolled steel beam, column channel and angle sections.
IS-814	-	Covered electrodes for manual arc welding of carbon of carbon manganese steel.
IS-816	-	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	-	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding.
IS-875 (P1 to P4)	-	Code of practice for design loads (other than earthquake) for buildings and structures.
IS-1161	-	Steel tubes for structural purposes.
IS-1182	-	Recommended practice for radiographic examination of fusion welded butt joints in steel

		plates.
IS-1363 (P1 to P3)	-	Hexagonal head bolts, screws & nuts of products grade C.
IS-1364	-	Hexagon headbolts, screws and nuts of product grades A and B.
IS-1367 (P1 to P18)	-	Technical supply condition for threaded steel fasteners.
IS-1599	-	Methods for bend test.
IS-1608	-	Method for tensile testing of steel products.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-1978	-	Line Pipe.
IS-2062	-	Steel for general structural purposes.
IS-2595	-	Code of practice for Radiographic testing.
IS-3063	-	Single coil rectangular section spring washers for bolts, nuts and screws.
IS-3664	-	Code of practice for ultrasonic pulse echo testing by contact and immersion methods.
IS-7205	-	Safety code for erection of structural steel work.
IS-9595	-	Recommendations for metal arc welding of carbon and carbon manganese steels.
ANSI-B18.2.1	-	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-G8.14	-	Round head bolts
ASTM-A6	-	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	-	Specifications of structural steel
ASTM-A47	-	Specification for malleable iron castings
ASTM-A143	-	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement
ASTM-A242	-	Specification for high strength low alloy structural steel
ASTM-A283	-	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	-	Specification for Galvanized steel transmission

		tower bolts and nuts
ASTM-441	-	Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572	-	Specification for High strength low alloy columbium-Vanadium steel of structural quality
AWS D1-0	-	Code for welding in building construction welding inspection
AWS D1-1	-	Structural welding code
AISC	-	American institute of steel construction
NEMA-CG1	-	Manufactured graphite electrodes

Piping and Pressure Vessels

IS-1239 (Part 1 and 2) steel	-	Mild steel tubes, tubulars and other wrought fittings
IS-3589	-	Seamless Electrically welded steel pipes for water, gas and sewage.
IS-6392	-	Steel pipe flanges
ASME	-	Boiler and pressure vessel code
ASTM-A120	-	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	-	Specification for pipe, steel, black, and hotdipped, zinc coated welded and seamless
ASTM-A106	-	Seamless carbon steel pipe for high temperature service
ASTM-A284	-	Low and intermediate tensile strength carbonsilicon steel plates for machine parts and general construction.
ASTM-A234	-	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	-	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	-	Forgings, carbon steel for piping components
ASTM-A307	-	Carbon steel externally threaded standard fasteners
ASTM-A193	-	Alloy steel and stainless steel bolting materials for

		high temperature service
ASTM-A345	-	Flat rolled electrical steel for magnetic applications
ASTM-A197	-	Cupola malleable iron
ANSI-B2.1	-	Pipe threads (Except dry seal)
ANSI-B16.1	-	Cast iron pipe flanges and flanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	-	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	-	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	-	Factory-made wrought steel butt welding fittings
ANSI-B16.11	-	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	-	Ferrous pipe plug, bushings and locknuts with pipe threads
ANSI-B16.25	-	Butt welding ends
ANSI-B18.1.1	-	Fire hose couplings screw thread.
ANSI-B18.2.1	-	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-B18.21.1	-	Lock washers
ANSI-B18.21.2	-	Plain washers
ANSI-B31.1	-	Power piping
ANSI-B36.10	-	Welded and seamless wrought steel pipe
ANSI-B36.9	-	Stainless steel pipe

Other Civil Works Standards

IS-269	-	33 grade ordinary portland cement.
IS-2721	-	Galvanized steel chain link fence fabric
IS-278	-	Galvanized steel barbed wire for fencing.
IS-383	-	Coarse and fine aggregates from natural sources for concrete.
IS-432 (P1 and P2)	-	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.
IS-456	-	Code of practice for plain and reinforced concrete.

IS-516	-	Method of test for strength of concrete.
IS-800	-	Code of practice for general construction in steel.
IS-806	-	Steel tubes for structural purposes.
IS-1172	-	Basic requirements for water supply, drainage and sanitation.
IS-1199	-	Methods of sampling and analysis of concrete.
IS-1566	-	Hard-drawn steel wire fabric for concrete reinforcement.
IS-1742	-	Code of Practice for Building drainage.
IS-1785	-	Plain hard-drawn steel wire for prestressed concrete.
IS-1786	-	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	-	Methods of sampling Foundry sands.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-2062	-	Steel for general structural purposes.
IS-2064	-	Selection, installation and maintenance of sanitary appliances-code of practices.
IS-2065	-	Code of practice for water supply in buildings.
IS-2090	-	High tension steel bars used in prestressed concrete.
IS-2140	-	Standard Galvanized steel wire for fencing.
IS-2470 (P1 & P2)	-	Code of practice for installation of septic tanks.
IS-2514	-	Concrete vibrating tables.
IS-2645	-	Integral cement waterproofing compounds.
IS-3025 (Part 1 to Part 48)	-	Methods of sampling and test (Physical and chemical) for water and waste water.
IS-4091	-	Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part 1 to P5)	-	Code of practice for ancillary structures in sewerage system.
IS-4990	-	Plywood for concrete shuttering work.
IS-5600	-	Sewage and drainage pumps.

National Buiding Code of India 1970

USBR E12	-	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	-	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	-	test for moisture-density relation of soils using 10-lb (4.5 kg) rame land 18-in. (457 mm) Drop.
ASTM-D1586	-	Penetration Test and Split-Barrel
(1967)	-	Sampling of Soils
ASTM-D2049-69	-	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	-	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression.
BS-5075	-	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures.
CPWD	-	Latest CPWD specifications

ACSR MOOSE CONDUCTOR

IS:6745	Methods for Determination of BS:443-1969 Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973	Test on High Voltage Insulators NEMA:107-1964 CISPR
IS:209	Zinc Ingot BS:3436-1961
IS:398	Aluminum Conductors for IEC:209-1966
Part - V	Overhead Transmission Purposes
BS:215(Part-II)	Aluminium Conductors galvanized IEC:209-1966 steel reinforced extra high
BS:215(Part-II)	voltage (400 kV and above)
IS:1778	Reels and Drums forBS:1559-1949 Bare Conductors
IS:1521	Method for Tensile Testing ISO/R89-1959of steel wire

IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel.
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles.
IS:4826	Hot dip galvanised coatings on round steel wires ASTM-A-472-729

GALVANISED STEEL EARTHWIRE

IS:1521	Method for Tensile Testing ISO/R:89-1959 of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel.
IS:2633 Coated	Methods for testing Uniformity of Coating of Zinc Articles.
IS:4826	Hot dip Galvanised Coatings ASTM:A 475-72a on Round Steel Wires BS:443-1969
IS:6745	Method for Determination BS:443-1969 of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209	Zinc ingot BS:3463-1961
IS:398 (Pt. I to P5:1992)	Aluminum Conductors for BS:215 (Part-II) overhead transmission purposes.

Lighting Fixtures and Accessories

IS:1913	General and safety requirements for electric lighting fittings.
IS:3528	Water proof electric lighting fittings.
IS:4012	Dust proof electric lighting fittings.
IS:4013	Dust tight proof electric lighting fittings.
IS:10322	Industrial lighting fittings with metal reflectors.
IS:10322	Industrial lighting fittings with plastic reflectors.
IS:2206 mines	Well glass lighting fittings for use under ground in

	(non-flameproof type).
IS:10322	Specification for flood light.
IS:10322	Specification for decorative lighting outfits.
IS:10322	Luminaries for street lighting
IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps.
IS:1258	Specification for Bayonet lamp fluorescent lamp.
IS:3323	Bi-pin lamp holder tubular fluorescent lamps.
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings.
IS:2215	Starters for fluorescent lamps.
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. Purposes

Conduits, Accessories and Junction Boxes

IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical wiring
IS:4649	Adaptors for flexible steel conduits.
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel.

Lighting Panels

IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house
hold	and similar installations.
IS:5	Ready mix paints

IS:2551	Danger notice plates
IS:2705	Current transformers
IS:9224 (7)IS:5082 and	HRC Cartridge fuse links for voltage above 650V(Part-2) Wrought aluminium and Al. alloys, bars, rods, tubes sections for electrical purposes.
(8)IS:8623 Gear	Factory built Assemblies of Switchgear and Control for voltages upto and including 1000V AC and 1200V DC.
(9)IS:1248	Direct Acting electrical indicating instruments

Electrical Installation

IS:1293 3	pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work.
IS:732 (system	Code of practice for electrical wiring installation voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing.
IS:3646	Code of practice of interior illumination part II & III.
IS:1944	Code of practice for lighting of public through fares.
IS:5571 hazardous	Guide for selection of electrical equipment for areas.
IS:800	Code of practice for use of structural steel in general building construction.
IS:2633 coated	Methods of Testing uniformity of coating on zinc articles.
IS:6005	Code of practice for phosphating iron and steel.
	INDIAN ELECTRICITY ACT
	INDIAN ELECTRICITY RULES

LT SWITCHGEAR

IS:8623 (Part-I) gear	Specification for low voltage switchgear and control assemblies
IS:13947 (Part-I) gear,	Specification for low voltage switchgear and control Part 1 General Rules
IS:13947 (part-2) gear,	Specification for low voltage switchgear and control Part 2 circuit breakers.
IS:13947 (part-3) gear.	Specification for low voltage switchgear and control Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4) gear.	Specification for low voltage switchgear and control Part 4 Contactors and motors starters.
IS:13947 (part-5) gear.	Specification for low voltage switchgear and control Part 5 Control-circuit devices and switching elements
IS:13947 (part-6) gear.	Specification for low voltage switchgear and control Part 6 Multiple function switching devices.
IS:13947 (part-7) gear.	Specification for low voltage switchgear and control Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1) or	Low voltage fuses for voltage not exceeding 1000V AC 1500V DC Part 1 General Requirements
IS:13703 (part 2) or	Low voltage fuses for voltage not exceeding 1000V AC 1500V DC Part 2 Fuses for use of authorized persons

IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

SECTION -4
TECHNICAL DATA REQUIREMENTS

Control and Relay panels

- 1 Name & country of Manufacture of panels
- 2 Manufacturer's type & and designation
- 3 Type of construction (Simplex / Duplex)
- 4 Thickness of sheet steel
 - (i) Front
 - (ii) Back
 - (iii) Sides
- 5 Degree of Protection
- 6 Name of the manufacturer of relays
- 7 DC Voltage of the relays
- 8 Make and model of static (0.2 accuracy class type) energy meters
- 9 Confirm whether offered C&R panel manufacturer and protective relays have tested commissioned and they are in successful operation for at least two years in 400kV System

TRANSMISSION LINE PROTECTION

Numerical Distance protection Scheme

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Switched or Non switched type (is it with separate measurement for single / three phase faults)
- 4 Setting range of offset feature
- 5 Whether relay is having self monitoring feature

SECTION -4
TECHNICAL DATA REQUIREMENTS

- 6 Whether relay is compatible for PLCC equipment and can be used for permissive/ under reach/over reach/ Blocking scheme
- 7 Suitable for single & three phase trip
- 8 Type of shaped characteristic
- 9 No. of tripping contacts with making capacity of 30 amps for 0.2 seconds
- 10 In case 16 contacts as per above clause are not available with the distance relay offered, type of tripping relay being offered
- 11 Maximum operating time for at 50% of the reach setting of 2 ohms and 10/20 ohms (with CVT) including all trip relays, if any (Bidder is required to enclose isochronic curve with CVT on Line)
 - a) at SIR = 4
 - b) at SIR=15 (3 Phase faults)
 - c) at SIR =15 (other faults)
- 12 IDMT earth fault relay meeting Normal Inverse characteristics as per IEC 60253 is being offered as built in feature for 400/220 kV Lines
- 13 If no type of IDMT relay being offered
- 14 Built in feature offered with the relay (Yes/No)
 - a) Disturbance Recorder
 - b) Fault Locator
 - c) Over voltage (one stage only)
 - d) Auto reclose relay along with dead line charging and check synchronising

STATIC Distance Protection Scheme

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Switched or Non switched type (is it with separate measurement for single / three phase faults)
- 4 Setting range of offset feature
- 5 Whether relay is having self monitoring feature

SECTION -4
TECHNICAL DATA REQUIREMENTS

- 6 Whether relay is compatible for PLCC equipment and can be used for permissive/ under reach/over reach/ Blocking scheme
- 7 Suitable for single & three phase trip
- 8 Type of shaped characteristic
- 9 No. of tripping contacts with making capacity of 30 amps for 0.2 seconds
- 10 In case 16 contacts as per above clause are not available with the distance relay offered, type of tripping relay being offered
- 11 Maximum operating time for at 50% of the reach setting of 2 ohms and 10/20 ohms (with CVT) including all trip relays, if any (Bidder is required to enclose isochronic curve with CVT on Line)
 - a) at SIR = 4
 - b) at SIR=15 (3 Phase faults)
 - c) at SIR =15 (other faults)
- 12 IDMT earth fault relay meeting Normal Inverse characteristics as per IEC 60253 is being offered as built in feature for 400/220 kV Lines
- 13 If no type of IDMT relay being offered
- 14 Built in feature offered with the relay (Yes/No)
 - a) Disturbance Recorder
 - b) Fault Locator
 - c) Over voltage (one stage only)
 - d) Auto reclose relay along with check synchronising relay (for 132 kV Lines)

Directional O/C and E/F Relay

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Three over current and one E/F element(s) are whether independent or composite units
- 4 Type of relay Electromechanical/ static/ Numerical

SECTION -4
TECHNICAL DATA REQUIREMENTS

- 5 Whether characteristics will confirm to IEC255-3
- 6 Directional sensitivity
- 7 Overcurrent unit setting range
 - a) Inverse time
 - b) High set inst. Unit
- 8 Earth fault unit setting range
 - a) Inverse time
 - b) High set inst. Unit
- 9 VT fuse failure relay/ feature included for Alarm

Line Over voltage Protection relay

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Type of Relay (Electromechanical/ Static Numerical)
- 4 Operating indicator provided
- 5 Operating time
- 6 Resetting time
- 7 Whether monitors all three phases ?
- 8 Built in feature of Main 1/Main 2 distance relay is offered. If so which stage is offered as built in

Distance to fault locator

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Built in feature of Main 1/Main 2 distance relay is offered

SECTION -4
TECHNICAL DATA REQUIREMENTS

- 4 Maximum registering time
- 5 Whether direct display unit provided
- 6 Whether both phase to phase fault & phase to earth fault measuring units included
- 7 Whether " On - Line" type
- 8 Accuracy for typical conditions defined under technical specifications

Disturbance Recorder

a. Acquisition unit

- 1 Name & country of Manufacture
- 2 Manufacturer's type & designation
- 3 No. of Analogue Channels
- 4 No. of Digital recording Channels
- 5 Built in feature of Main 1 / Main 2 distance relay offered
- 6 Pre Fault memory (milli seconds)
- 7 Post Fault memory (seconds)
- 8 Total storage memory in seconds
- 9 Sampling Frequency
- 10 Resolution of event channels (msec)
- 11 Time display present?
- 12 Data output in COMTRADE is available

b. Evaluation Unit

- 1 Name & country of Manufacture
- 2 Manufacturer's type & designation

SECTION -4
TECHNICAL DATA REQUIREMENTS

- 3 No. of acquisition unit that can be connected to one evaluation unit
- 4 Technical parameters of evaluation unit
 - a. Processor & Speed
 - b. RAM & Hard Disk Capacity
 - c. Additional facilities
 - d. Details of Printer
- 5 Details of Power supply arrangement for acquisition unit (including printer)

Auto Reclose Relay

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Electromechanical / Static / Numerical
- 4 Auto Reclose relay along with dead line charging and check synchronising relay offered as part of distance relay
- 5 Suitable for single & three phase ?
- 6 Single phase dead time setting ranges
- 7 Three phase dead time range earth faults
- 8 Reclaim time setting range

Auto Reclose Relay (FOR NEW SUBSTATION ONLY)

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Electromechanical / Static / Numerical
- 4 Auto Reclose relay along with dead line charging and check synchronising relay offered as part of distance relay
- 5 Suitable for single & three phase ?

SECTION -4
TECHNICAL DATA REQUIREMENTS

- 6 Single phase dead time setting ranges
- 7 Three phase dead time range earth faults
- 8 Reclaim time setting range

TRANSFORMER PROTECTION

Differential relay

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Second harmonic restraint feature provided ?
- 4 Whether three instantaneous units provided
- 5 Operating current setting range
- 6 Bias setting range
- 7 Operating time at 5x setting current
- 8 Resetting time
- 9 How ratio / phase angle corrections are being done (inter posing transformer / internal feature in the relay)

Restricted Earth Fault Relay

- 1 Name and country of Manufacturer
- 2 Manufacturer type and designation
- 3 Operating time at 2 x setting

Overfluxing relays

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation

SECTION -4
TECHNICAL DATA REQUIREMENTS

- 3 Whether inverse time operating characteristics provided ?
- 4 Maximum operating time
- 5 Accuracy operating time
- 6 Resetting time

Directional O/C and E/F Relay

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Whether characteristics will confirm to IEC255-3
- 4 Directional sensitivity
- 5 Overcurrent unit setting range
 - a) Inverse time
 - b) High set inst. Unit
- 6 Earth fault unit setting range
 - a) Inverse time
 - b) High set inst. Unit

REACTOR PROTECTION

Differential relay

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Second harmonic restraint feature provided ?
- 4 Whether three instantaneous units provided
- 5 Operating current setting range

SECTION -4
TECHNICAL DATA REQUIREMENTS

- 6 Bias setting range
- 7 Operating time at 5x setting current
- 8 Resetting time
- 9 How ratio / phase angle corrections are being done (inter posing transformer / internal feature in the relay)

Restricted Earth Fault Relay

- 1 Name and country of Manufacturer
- 2 Manufacturer type and designation
- 3 Operating time at 2 x setting

Back up Impedance Protection Relay

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Whether characteristics will confirm to IEC255-3
- 4 Directional sensitivity
- 5 Overcurrent unit setting range
 - a) Inverse time
 - b) High set inst. Unit
- 6 Earth fault unit setting range
 - a) Inverse time
 - b) High set inst. Unit

SECTION -4
TECHNICAL DATA REQUIREMENTS

GENERAL PROTECTION / MONITORING EQUIPMENT

Trip circuit supervision relay

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Whether preclosing and post closing supervision provided ?
- 4 Time delay

High Speed Trip Relays

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Contacts ratings
 - a) Make & carry continuously
 - b) Make & carry for 0.5 sec
 - c) Break
 - i. Resistive load
 - ii. Inductive load (With $L/R = 40$ msec)
- 4 Operating time at rated voltage (maximum)
- 5 Resetting time
- 6 Whether supervisory relays included

SECTION -4
TECHNICAL DATA REQUIREMENTS

Local Breaker Back - up protection

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Operating time
- 4 Resetting time
- 5 Setting range
 - (I) Current
 - (ii) Time

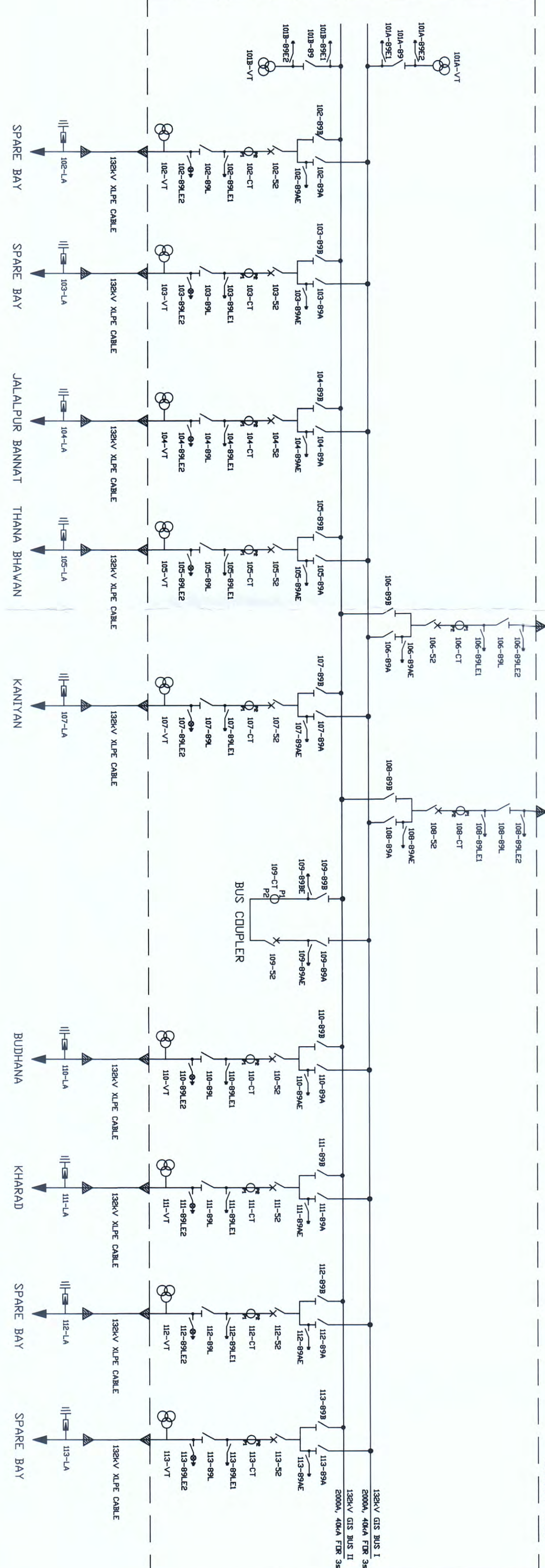
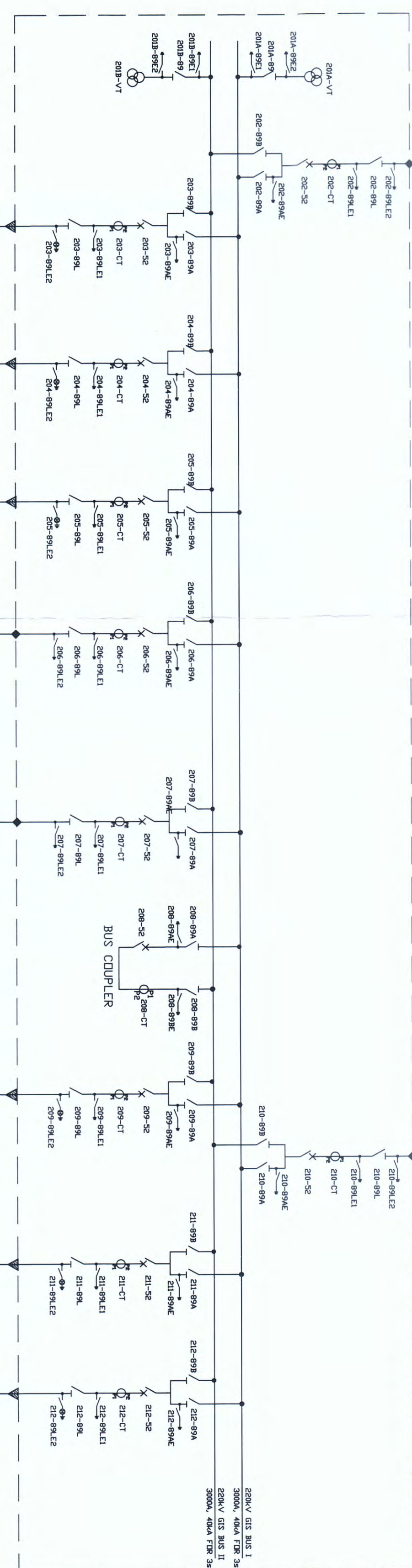
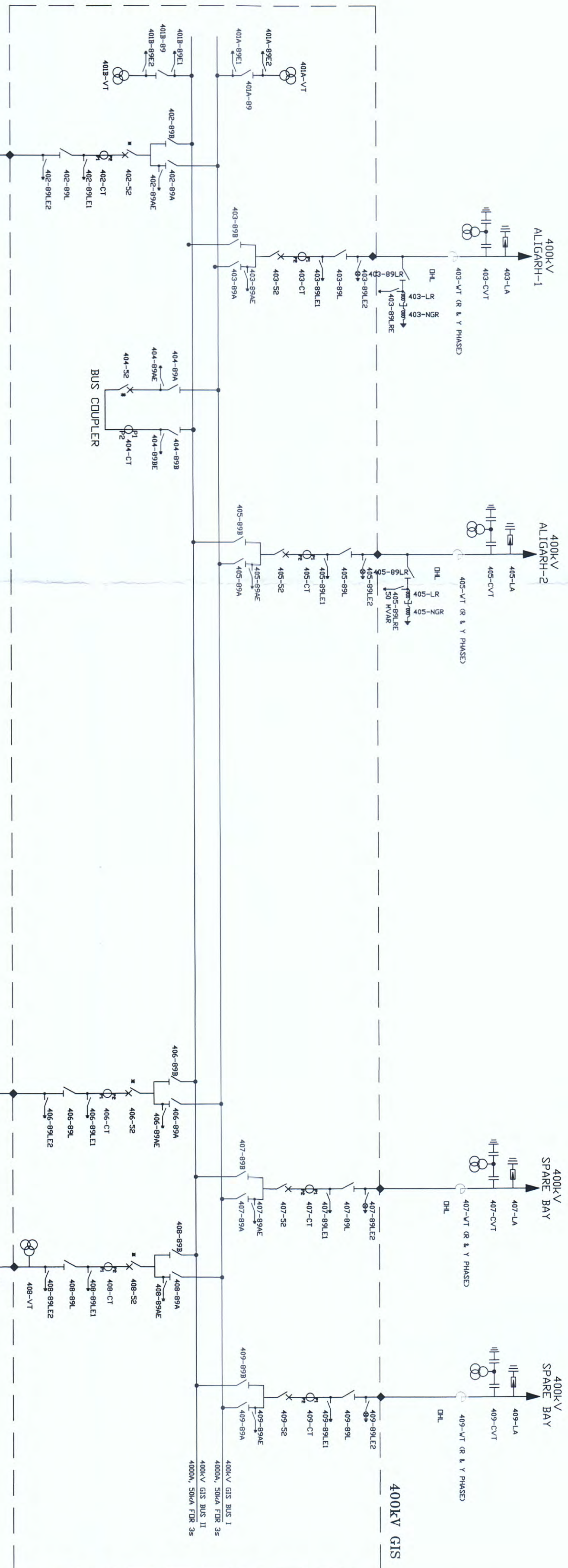
Bus bar Protection (APPLICABLE FOR NEW STATION ONLY)

- 1 Name & country of Manufacture
- 2 Manufacturer type & designation
- 3 Type of relay
- 4 Principle of operation
- 5 Operating time
- 6 Resetting time
- 7 Setting ranges
 - (I) Current
 - (ii) Time
- 8 Whether it will cause tripping for the differential current below the load current of heavily loaded feeder (Bidder shall submit application check for the same)

SECTION –V (ATTACHMENTS)

- A)** SLD , Key SLD 400/220/132 kV GIS SHAMLI SUBSTATION
- B)** LAYOUT OF SHAMLI SUBSTATION
- G)** CORRIGENDUM BY UPPTCL (ANNEXURE-B)

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)



A. 400 KV OUTDOOR EQUIPMENT:-

S.N	DESCRIPTION	SYMBOLS	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		402	402	402	02
2.	400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		403	403	403	02
3.	400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		404	404	404	02
4.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		405	405	405	02
5.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		406	406	406	02
6.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		407	407	407	02
7.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		408	408	408	02
8.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		409	409	409	02
9.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		410	410	410	02
10.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		411	411	411	02
11.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		412	412	412	02
12.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		413	413	413	02
13.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		414	414	414	02
14.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		415	415	415	02
15.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		416	416	416	02
16.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV		417			

A. 220 KV OUTDOOR EQUIPMENT:-

S.N.	DESCRIPTION	SYMBOLS (LEGEND)	BAY NO/LOCATION	UNIT	QTY
1.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
2.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
3.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
4.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
5.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
6.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
7.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
8.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
9.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
10.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
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12.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
13.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
14.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
15.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
16.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
17.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				
18.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 41				

A. 132 KV OUTDOOR EQUIPMENT:-

S.N.	DESCRIPTION	SYMBOLS (LEGEND)	BAY NO/LOCATION	UNIT
1.	120KV, 220KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV	—	99	LA
2.	120KV, 220KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV	—	99	LA
3.	120KV, 220KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV	—	99	LA

B. 400 KV INDOOR GIS:-

S.N.	DESCRIPTION	SYMBOLS (LEGEND)	BAY NO/LOCATION	UNIT	QTY
1.	300KV, 400KV, 500KV, 600KV, 700KV, 800KV, 900KV, 1000KV, 1100KV, 1200KV, 1300KV, 1400KV, 1500KV, 1600KV, 1700KV, 1800KV, 1900KV, 2000KV, 2100KV, 2200KV, 2300KV, 2400KV, 2500KV, 2600KV, 2700KV, 2800KV, 2900KV, 3000KV, 3100KV, 3200KV, 3300KV, 3400KV, 3500KV, 3600KV, 3700KV, 3800KV, 3900KV, 4000KV, 4100KV, 4200KV, 4300KV, 4400KV, 4500KV, 4600KV, 4700KV, 4800KV, 4900KV, 5000KV, 5100KV, 5200KV, 5300KV, 5400KV, 5500KV, 5600KV, 5700KV, 5800KV, 5900KV, 6000KV, 6100KV, 6200KV, 6300KV, 6400KV, 6500KV, 6600KV, 6700KV, 6800KV, 6900KV, 7000KV, 7100KV, 7200KV, 7300KV, 7400KV, 7500KV, 7600KV, 7700KV, 7800KV, 7900KV, 8000KV, 8100KV, 8200KV, 8300KV, 8400KV, 8500KV, 8600KV, 8700KV, 8800KV, 8900KV, 9000KV, 9100KV, 9200KV, 9300KV, 9400KV, 9500KV, 9600KV, 9700KV, 9800KV, 9900KV, 10000KV				

B. 220 KV INDOOR GIS:-

AS PER	4. 125MW/HR BUS REACTOR CT PARAMETERS REVISED BHPL BHOPAL INPUT.	
4		

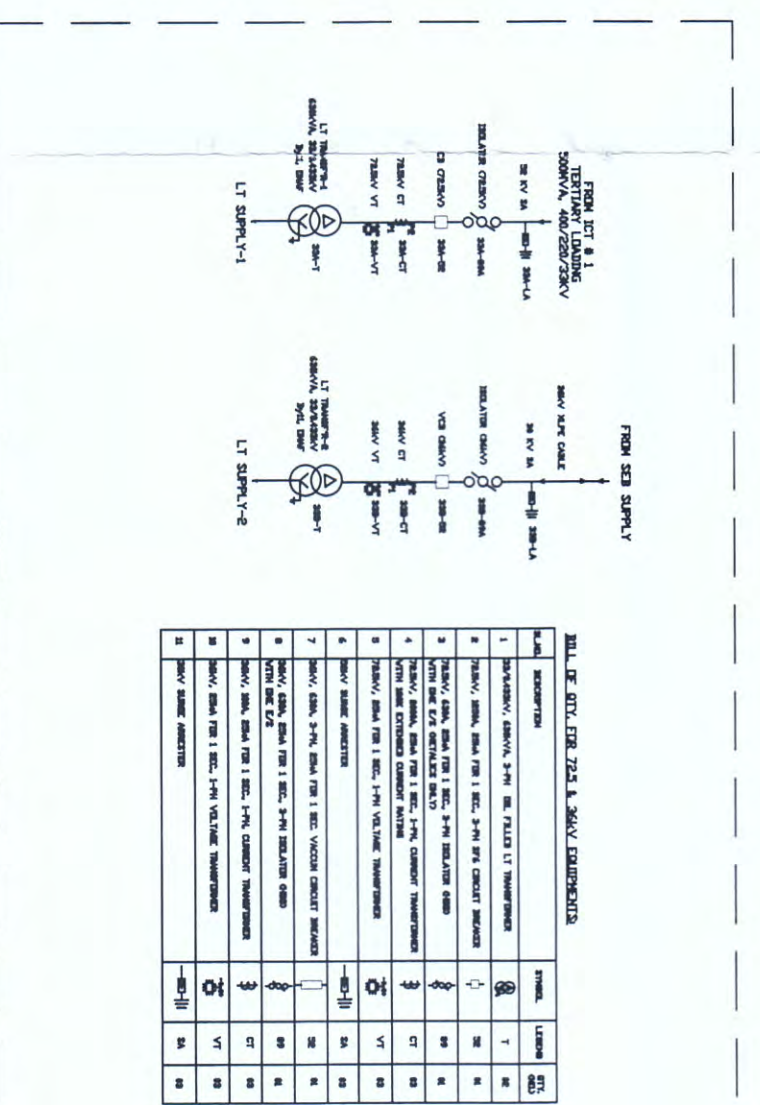
NOTES :
1. PRESENT
FUTURE/ SPARE
SF6/AIR BUSHING
OHL - OVERHEAD LINE
SF6/XLPE CABLE TERMINATION
* - CB WITH CONTROLLED SWITCHING DEVICE IN ICT & BUS REACTOR BAYS.
- CB RATED 400KA IN BUS COUPLER BAYS.

S.N.	SYSTEM PARAMETERS	400KV
1.	NOMINAL VOLTAGE	400KV
2.	HIGHEST SYSTEM VOLTAGE	425KV
3.	BATTS FREQUENCY	50HZ
4.	RAVED SHORT TIME CURRENT	50KA for 3SEC.
5.	POWER FREQUENCY WATTAGE VOLTAGE	3000A (rated)
6.	LINEING IMPULSIVE WITHSTAND VOLTAGE	1100KV (4V peak)
7.	SWITCHING IMPULSIVE WITHSTAND VOLTAGE	1050KV (4V peak)
8.	SWITCHING	1000KV (4V peak)
9.	SWITCHING	Effective switching

220 KV SYSTEM PARAMETERS:-		
S.N.	SYSTEM PARAMETERS	220KV
1.	NOMINAL VOLTAGE	220KV
2.	HIGHEST SYSTEM VOLTAGE	245KV
3.	BASE FREQUENCY	50Hz
4.	BASED SHORT TIME CURRENT	40KA for 3Sec.
5.	POWER FREQUENCY WITHSTAND VOLTAGE	460KV (max)
6.	TERMINAL BREAKER WITHSTAND VOLTAGE	1000 KV peak
7.	SWITCHING BREAKER WITHSTAND VOLTAGE	NA
8.	CRATING	
9.	DESIGNING	Design/ date/ no
		effective/ revised

132 KV SYSTEM PARAMETERS:-

S.N.	SYSTEM PARAMETERS	VALUE
1.	NOMINAL VOLTAGE	132KV
2.	PHASE FREQUENCY	50Hz
3.	PHASE CURRENT	750A
4.	PHASE INDUCTIVE REACTANCE	0.000125 pu
5.	PHASE CAPACITIVE REACTANCE	0.000125 pu
6.	PHASE RESISTANCE	0.000125 pu
7.	PHASE CAPACITANCE	0.000125 pu
8.	PHASE INDUCTANCE	0.000125 pu



Approved by: *[Signature]*
Checked by: *[Signature]*
Drawn by: *[Signature]*
Reviewed by: *[Signature]*
Approved by: *[Signature]*
Checked by: *[Signature]*
Drawn by: *[Signature]*
Reviewed by: *[Signature]*

LOI No. 1311/ESD-8/126/II/400KV SHAMLI Dated: 14.11.2018

REFERENCE DRG:- TENDER SINGLE LINE DIAGRAM 400/220/132KV GIS S/S

PROJECT: 400/220/132KV GIS SUBSTATION AT SHAMLI (U.P.)

CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LIMITED

DESIGNER: BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA

SCALE: N.T.S.

WEIGHT (KG): N.A.

ITEM NO: N.A.

NO. OF SHEETS: 02

DATE: 25.10.19

VAR: N.A.

APPD. SKS

CHD. MSP

DRG. NO. TB-0-406-510-001

REV. 02

100-015-906-510-001

DRG. NO.

6

5

4

3

2

1

400kV GIS CT DETAILS						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV	Maximum Ret (Ohms)	Purpose
1	3000-2000-1000/1 A	-	3000-2000-1000	20-30-60	15-10-5	PS
2	3000-2000-1000/1 A	-	3000-2000-1000	20-30-60	15-10-5	PS
3	3000-2000-1000-500/1 A	20	-	-	-	0.2s, ISF ≤ 5
4	3000-2000-1000-500/1 A	-	6000-4000-2000-1000	20-30-60-120	15-10-5-2.5	PS
5	3000-2000-1000-500/1 A	-	6000-4000-2000-1000	20-30-60-120	15-10-5-2.5	PS

400kV GIS VT DETAILS				
Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(400 kV/√3) / (110V/√3)	3P	50	Protection
2	(400 kV/√3) / (110V/√3)	3P	50	Protection
3	(400 kV/√3) / (110V/√3)	0.2	50	Metering

400kV, 8800pF (+10%, -5%) OUTDOOR CVT DETAILS				
Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(400 kV/√3) / (110V/√3)	3P	50	Protection
2	(400 kV/√3) / (110V/√3)	3P	50	Protection
3	(400 kV/√3) / (110V/√3)	0.2	50	Metering

220kV GIS CT DETAILS						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV	Maximum Ret (Ohms)	Purpose
1	2000-1600-1000-500/1 A	-	2000-1600-1000-500	30-37.5-60-120	10-8.5-2.5	PS
2	2000-1600-1000-500/1 A	-	2000-1600-1000-500	30-37.5-60-120	10-8.5-2.5	PS
3	2000-1600-1000-500/1 A	20	-	-	-	0.2s, ISF ≤ 5
4	2000-1600-1000-500/1 A	-	2000-1600-1000-500	30-37.5-60-120	10-8.5-2.5	PS
5	2000-1600-1000-500/1 A	-	2000-1600-1000-500	30-37.5-60-120	10-8.5-2.5	PS

220kV GIS VT DETAILS				
Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(220 kV/√3) / (110V/√3)	3P	50	Protection
2	(220 kV/√3) / (110V/√3)	3P	50	Protection
3	(220 kV/√3) / (110V/√3)	0.2	50	Metering

220kV, 4400pF (+10%, -5%) OUTDOOR CVT DETAILS				
Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(220 kV/√3) / (110V/√3)	3P	50	Protection
2	(220 kV/√3) / (110V/√3)	3P	50	Protection
3	(220 kV/√3) / (110V/√3)	0.2	50	Metering

132kV GIS VT DETAILS				
Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(132 kV/√3) / (110V/√3)	3P	50	Protection
2	(132 kV/√3) / (110V/√3)	3P	50	Protection
3	(132 kV/√3) / (110V/√3)	0.2	50	Metering

500 MVA, 400/220/132kV ICT BUSHING CT DETAILS						
400kV SIDE BUSHING CT						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV	Maximum Ret (Ohms)	Purpose
1	1600/1 A	-	1600	25	4	PS
2	1000/1 A	30	-	-	-	0.2, ISF ≤ 5
220kV SIDE BUSHING CT						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV	Maximum Ret (Ohms)	Purpose
1	1600/1 A	-	1600	25	4	PS
2	1600/1 A	30	-	-	-	0.2, ISF ≤ 5
NEUTRAL SIDE BUSHING CT						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV	Maximum Ret (Ohms)	Purpose
1	1600/1 A	-	1600	25	4	PS

125MVAR, 400kV SHUNT REACTOR BUSHING CT DETAILS						
400kV SHUNT REACTOR (LINE SIDE)						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
1	200/1 A	-	200	100	1	PS
2	200/1 A	-	200	100	1	PS
3	200/1 A	15	-	-	-	PS
400kV SHUNT REACTOR (NEUTRAL SIDE)						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
1	200/1 A	-	200	100	1	PS
2	200/1 A	-	200	100	1	PS
3	500/1 A	10	-	-	-	0.2, ISF ≤ 5
4	172.2/2.2-0.18-1.6 A	10	-	-	-	5

200 MVA, 220/132/11 kV ICT BUSHING CT DETAILS						
220kV SIDE BUSHING CT						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
1	1000/1 A	-	1000	40	5	PS
132kV SIDE BUSHING CT						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
1	1000/1 A	-	1000	40	5	PS
NEUTRAL SIDE BUSHING CT						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
1	1000/1 A	-	1000	40	5	PS
11kV TERTIARY BUSHING CT						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/4	Maximum Ret (Ohms)	Purpose
1	2500/1 A	-	600	30	5	PS
2	2500/1 A	-	300	40	5	PS
3	2500/1 A	30	-	-	5	1

132kV GIS CT DETAILS (BUS COUPLER BAY)						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV	Maximum Ret (Ohms)	Purpose
1	1600-800-400/1 A	-	1600-800-400	25-50-100	8-4-2	PS
2	1600-800-400/1 A	-	1600-800-400	25-50-100	8-4-2	PS
3	1600-800-400/1 A	20	-	-	-	0.2s, ISF ≤ 5
4	1600-800-400/1 A	-	1600-800-400	25-50-100	8-4-2	PS
5	1600-800-400/1 A	-	1600-800-400	25-50-100	8-4-2	PS

132kV GIS CT DETAILS (LINE & TRF BAY)						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV	Maximum Ret (Ohms)	Purpose
1	1000-500-250/1 A	-	1000-500-250	25-50-100	5-2.5-1.25	PS
2	1000-500-250/1 A	-	1000-500-250	25-50-100	5-2.5-1.25	PS
3	1000-500-250/1 A	20	-	-	-	0.2s, ISF ≤ 5
4	1000-500-250/1 A	-	1000-500-250	25-50-100	5-2.5-1.25	PS
5	1000-500-250/1 A	-	1000-500-250	25-50-100	5-2.5-1.25	PS

50MVAR, 400kV SHUNT REACTOR BUSHING CT DETAILS

400kV SHUNT REACTOR (LINE SIDE)						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
1	200/1 A	-	200	100	1	PS
2	200/1 A	-	200	100	1	PS
3	200/1 A	15	-	-	-	SP20
4	500/1 A	10	-	-	-	0.2, ISF ≤ 5

400kV SHUNT REACTOR (NEUTRAL SIDE)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
1	2000-1000-500/1 A	-	1000-500-250	30-15-8	10-5-2.5	PS
2	2000-1000-500/1 A	-	1000-500-250	30-15-8	10-5-2.5	PS
3	200/1 A	-	200	100	1	PS
4	60/2.3-1-9-1.5	10	-	-	-	5

50MVAR, 400kV SHUNT REACTOR NGR BUSHING CT DETAILS

400kV NGR (LINE SIDE)						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
1	200/1 A	-	200	100	1	PS
400kV NGR (NEUTRAL SIDE)						
Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KVP (Volts)	Max Ie (mA) at KPV/2	Maximum Ret (Ohms)	Purpose
3	200/1 A	-	200	100	1	PS

Approved for Revision - 2 only

Office of The Superintending Engineer
Electricity 765/400KV Substation Design Circle-II
UP Power Transmission Corporation Limited
11th Floor, Shakti Bhawan Extn. Lucknow

APPROVED

AE EE SE

LOI No. 1311/ESD-8/126/III/400kV SHAMLI Dated: 14.11.2018

REFERENCE DRG.: TENDER SINGLE LINE DIAGRAM 400/220/132kV GIS S/S

PROJECT:
400/220/132kV GIS SUBSTATION AT SHAMLI (U.P.)CUSTOMER:
UTTAR PRADESH TRANSMISSION CORPORATION LIMITED

	BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA			NAME	SIGN.	DATE	NO.OF VAR.
	DRN.	PK	<i>Rev</i>	<i>Soy</i>	25.10.2018		
	CHD.	MPS/SKS		<i>Vijay</i>			N.A.
	APPD.	AG					

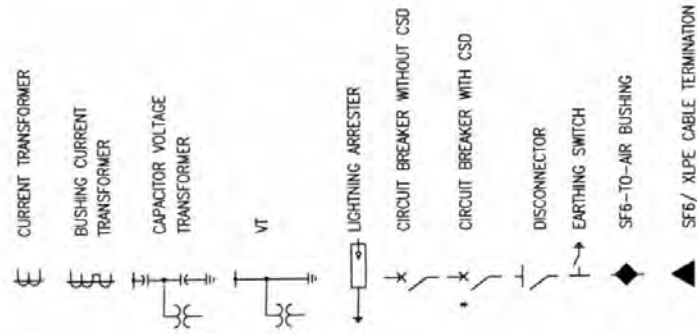
DEPT. TBG CODE	UNTOL. DIMS. GR. 9/M/F	SCALE N.T.S	WEIGHT (KG) N.A.	REF. TO ASSY. DRG. N.A.	ITEM NO. N.A.	NO. OF ITEMS N.A.
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TITLE		CARD CODE		REV.	
SINGLE LINE DIAGRAM 400/220/132kV GIS SUB STATION		TB-0-406-510-001		02	
SHT. No 02		NO. OF SHT. --		SIZE-A0	

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE		
1. EARTHING SWITCHES IN 400KV BUS VT, 125MVAR BUS REACTOR, 500MVA ICT O/G FEEDER ADDED AS PER CONTRACT.			2. EARTHING SWITCHES IN 500MVA ICT I/C, 220KV BUS VT, 500MVA ICT O/G FEEDER ADDED AS PER CONTRACT.			3. EARTHING SWITCHES IN 200MVA ICT I/C, 132KV BUS VT, ADDED AS PER CONTRACT.			4. 50MVAR LINE REACTOR CT PARAMETERS REVISED AS PER BHEL BHOPAL INPUT.		
5. HIGH SPEED SWITCHES IN 400KV BUS VT, 125MVAR BUS REACTOR, 500MVA ICT O/G FEEDER REMOVED AS PER CONTRACT.			6. HIGH SPEED SWITCHES IN 500MVA ICT I/C, 220KV BUS VT, 500MVA ICT O/G FEEDER REMOVED AS PER CONTRACT.			7. HIGH SPEED SWITCHES IN 200MVA ICT I/C, 132KV BUS VT, REMOVED AS PER CONTRACT.			8. 125MVAR BUS REACTOR CT PARAMETERS REVISED AS PER BHEL BHOPAL INPUT.		

LEGEND

DEVICE NO.	FUNCTION
21M1	DIST. PROTECTION RELAY MAIN-I
21M2	DIST. PROTECTION RELAY MAIN-II (N-BUILT IN LINE DIFFERENTIAL PROTECTION RELAY)
79	AUTO-RECLOSE FUNCTION
25	CHECK SYNCHRONISING FUNCTION
DPL	DISTURBANCE/FAULT LOCATOR FUNCTION
98	CVT FUSE FAIL RELAY
59	TWO STAGE OVER VOLTAGE FUNCTION
67/67N	DIRECTIONAL IDMT PHASE 0/C / E/F PROTECTION WITH HIGH SET FUNCTION
68	POWER SWING BLOCKING FUNCTION
46 BC	BROKEN CONDUCTOR PROTECTION
85	CARRIER-AIDED INER-TRIPPING FUNCTION
5ER	SEQUENCE OF EVENT RECORDER
68/78	OUT OF STEP PROTECTION
27	UNDER VOLTAGE PROTECTION
DR	DISTURBANCE RECORDER
51/51N	NON DIRECTIONAL IDMT PHASE 0/C / E/F PROTECTION WITH HIGH SET FUNCTION
63 AX/TX	BUCHHOLZ RELAY, ALARM/TRIP
PRD TX	PRESSURE RELIEF DEVICE, TRIP
490 AX/TX	OIL TEMPERATURE HIGH, ALARM/TRIP
49W AX/TX	WINDING TEMPERATURE HIGH, ALARM/TRIP
OLAX	OIL LEVEL LOW, ALARM
63 OLTX	OLTC OIL SURGE, TRIP
87T1/T2/87R	TRANSFORMER/REACTOR DIFFERENTIAL PROTECTION
64	TRANSFORMER/REACTOR RESTRICTED EARTH FAULT PROTECTION
99	OVER FLUXING PROTECTION
50/50N	NON DIRECTIONAL INSTANTANEOUS PHASE 0/C / E/F PROTECTION WITH HIGH SET FUNCTION
87B1/82	BUSBAR DIFFERENTIAL PROTECTION MAIN-1/2
50 LBB	LOCAL BREAKER BACKUP PROTECTION
BCU	BAY CONTROL UNIT
EM M/C	ENERGY METER MAIN/CHECK
87LD1	LINE DIFFERENTIAL PROTECTION RELAY (WITH DIST. PROTECTION FUNCTION)



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COMPUTER DRG. PATH NAME :

INVENTORY NO. SIGN & DATE

GENERAL NOTE (APPLICABLE FOR COMPLETE SUBSTATION):

- 1) ALL PROTECTION FEATURES SHOWN IN THIS DRAWING SHALL BE PROVIDED IN THE OFFERED SYSTEM; HOWEVER, CLUBBING OF PROTECTION FUNCTIONS IN NUMERICAL RELAYS SHALL BE DECIDED AFTER FINALISATION OF RELAY/BCU SUPPLIER.
- 2) REFERENCE DRAWING: SINGLE LINE DIAGRAM FOR 400/220/132KV SHAMLI GIS, DWG NO. TB-0-406-510-001, REV. 02
- 3) THE MAKE OF LINE DIFFERENTIAL PROTECTION RELAY AT REMOTE END SUBSTATIONS FOR DIFFERENT OUTGOING LINES SHALL BE MATCHED WITH SHAMLI END BY UPPTCL. BHEL SCOPE OF SUPPLY IS LIMITED TO SHAMLI END ONLY. ANY LINE DIFFERENTIAL PROTECTION RELAY AT REMOTE END IS NOT ENGAGED IN BHEL SCOPE.
- 4) SOLBB PROTECTION SHALL BE BUILT-IN FUNCTION OF BUSBAR PROTECTION RELAY.
- 5) AUTO-RECLOSE FUNCTION SHALL BE BUILT-IN FUNCTION OF LINE DISTANCE PROTECTION RELAY FOR ALL 400KV & 220KV LINES.
AUTO-RECLOSE FUNCTION HAS NOT BEEN ENGAGED FOR ANY 132KV LINES.
- 6) THE BCU'S AND RELAYS SHALL BE HOUSED IN CONTROL & RELAY PANELS (I.E., COMBINED BCU & RELAY PANELS) OF INDIVIDUAL BAYS.

LEGEND SHEET

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Office of The Superintending Engineer
Electricity 765/400KV Substation Design Circle-II
UP Power Transmission Corporation Limited
11th Floor, Shakti Bhawan Extn, Lucknow

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PROJECT: 400/220/132 kV GIS SUBSTATION AT SHAMLI(U.P.)

CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LTD (UPPTCL)

				BHARAT HEAVY ELECTRICALS LTD TRANSMISSION BUSINESS GROUP NOIDA		SCALE: NTS
						SHEET 01 OF 12
		DATE 06/03/19		NAME VSG		
		DESIGN BY 06/03/19		VSG		
		CHECKED BY 06/03/19		SS		
		APPROVED BY 06/03/19		SS		
						
				TITLE KEY METERING & PROTECTION SINGLE LINE DIAGRAM		
		SIZE: A3		PROJECT NO.: 406		
		ANNEX:		DRAWING NO.: TB-3-406-510-101		REV: 0

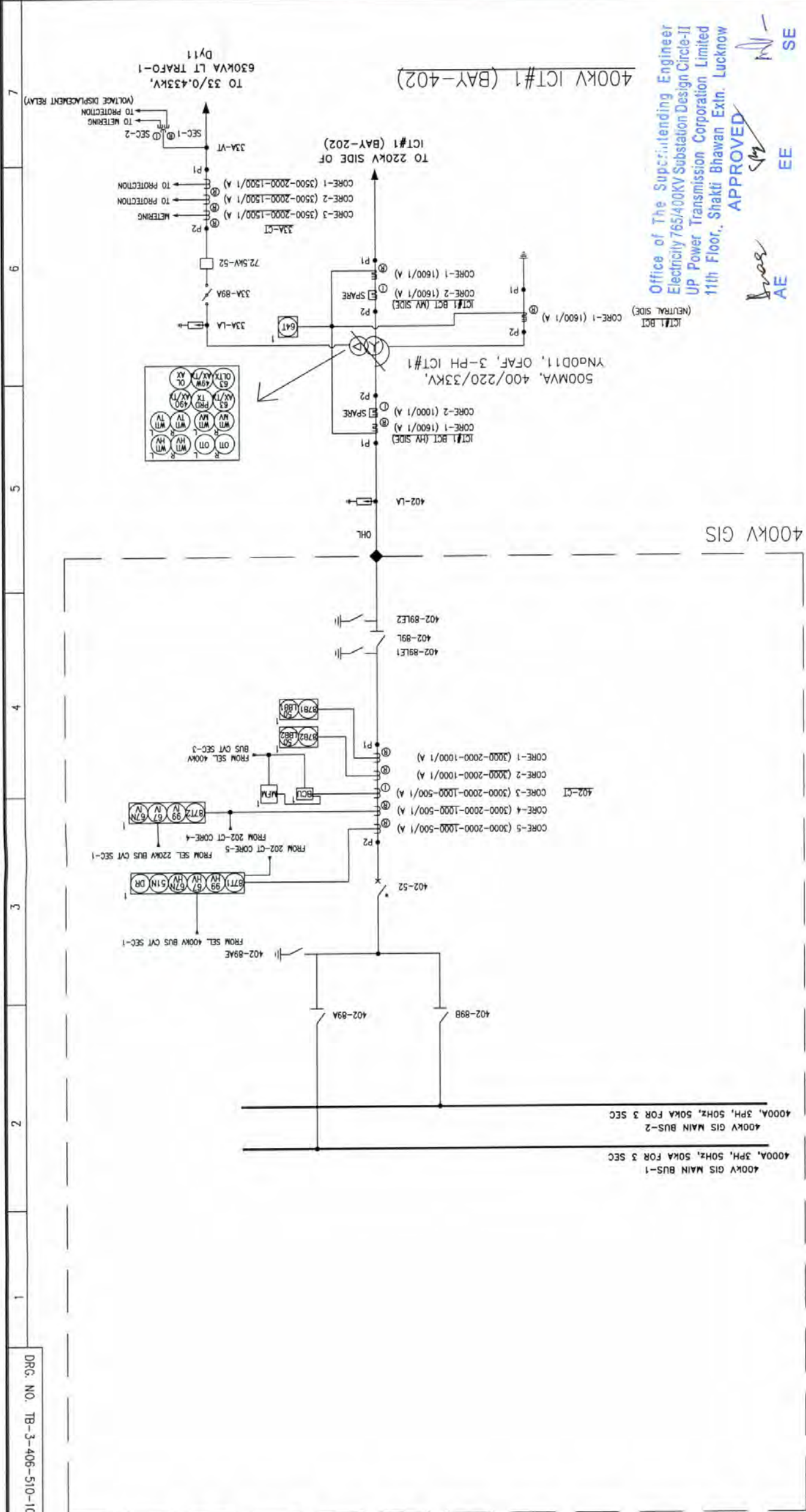
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COMPUTER DRC. PATH NAME :

INVENTORY NO. SIGN & DATE

DWG. NO. TB-3-406-510-101

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)



NOTE:
1) THIS DIAGRAM APPLICABLE FOR 400KV ICT#2 (BAY-406) ALSO.

PROJECT: 400/220/132 kV GIS SUBSTATION AT SHAMLI (U.P.)

CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LTD (UPPTCL)



BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP
NOIDA

SCALE: NTS
SHEET 04
OF 12

TITLE

KEY METERING & PROTECTION SINGLE LINE DIAGRAM

DATE	NAME
06/03/19	VSG
06/03/19	VSG
06/03/19	SS
06/03/19	SS

Signature

NOTE

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PROJECT NO. 406
DRAWING NO. TB-3-406-510-101

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UP Power Transmission Corporation Limited
11th Floor, Shakti Bhawan Extn. Lucknow

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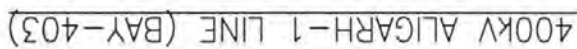
COMPUTER DRG. PATH NAME :

INVENTORY NO.

NOTE:

- 2) AUTO-RECLOSE FUNCTION SHALL BE BUILT-IN FUNCTION OF LINE DISTANCE PROTECTION RELAY FOR ALL 400KV & 220KV LINES.

5) THIS DIAGRAM APPLICABLE FOR 400KV ALGABH-2 LINE (BAY-405), 400KV SPARE LINE (BAY-407 & 409) ALSO.



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PROJECT: 400/220/132 kV GIS SUBSTATION AT SHAMLI (U.P.)

CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LTD (UPPTCL)

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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-3-406-510-101

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INVENTORY NO. SIGN & DATE

REV.	DATE	ALTERED	CHECKED	APPROVED	NOTE

Signature

SIZE: A3
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DRAWING NO: TB-3-406-510-101

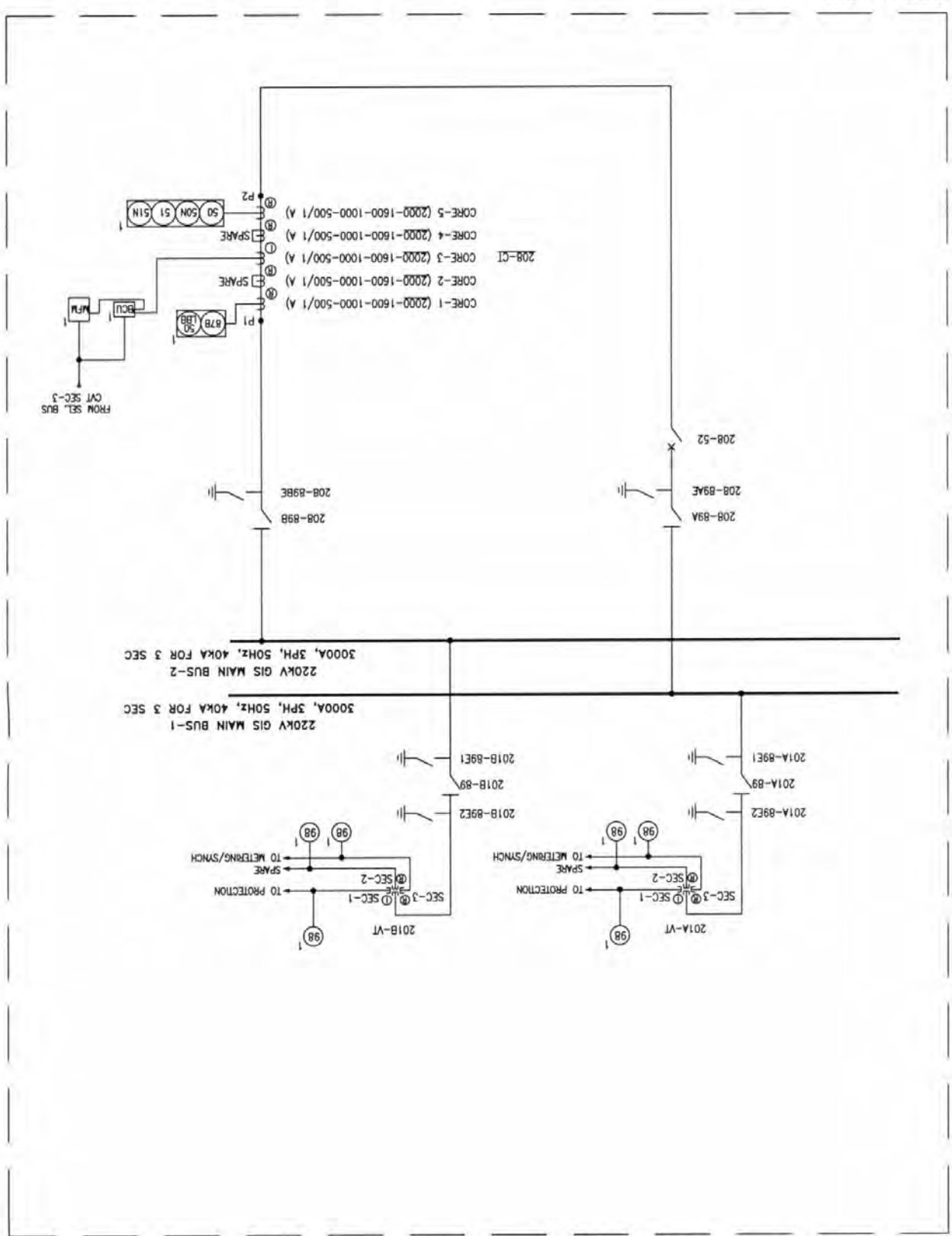
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TITLE
KEY METERING & PROTECTION SINGLE LINE DIAGRAM

SCALE: NTS
SHEET 06 OF 12
BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP
NOIDA

CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LTD (UPPTCL)

PROJECT: 400/220/132 kV GIS SUBSTATION AT SHAMLI (U.P.)



220kV GIS

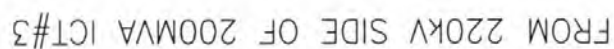
220kV BUS COUPLER & BUS VT

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COMPUTER DRG. PATH NAME :

INVENTORY NO. SIGN & DATE

NOTE



132KV ICT#3 200MVA (BAY-106)

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UP Power Transmission Corporation Limited
14th Floor, Shakti Bhawan Extn. Lucknow

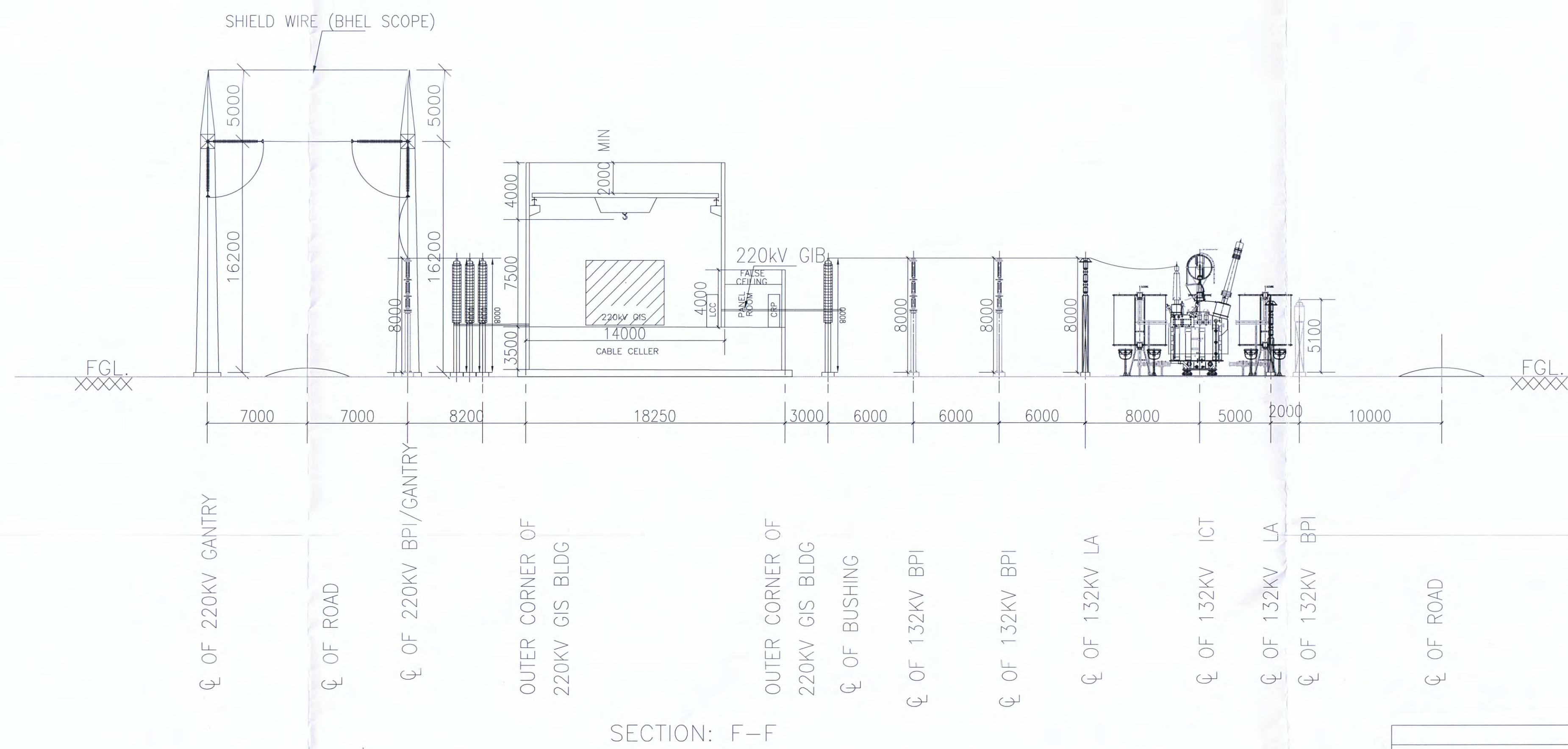
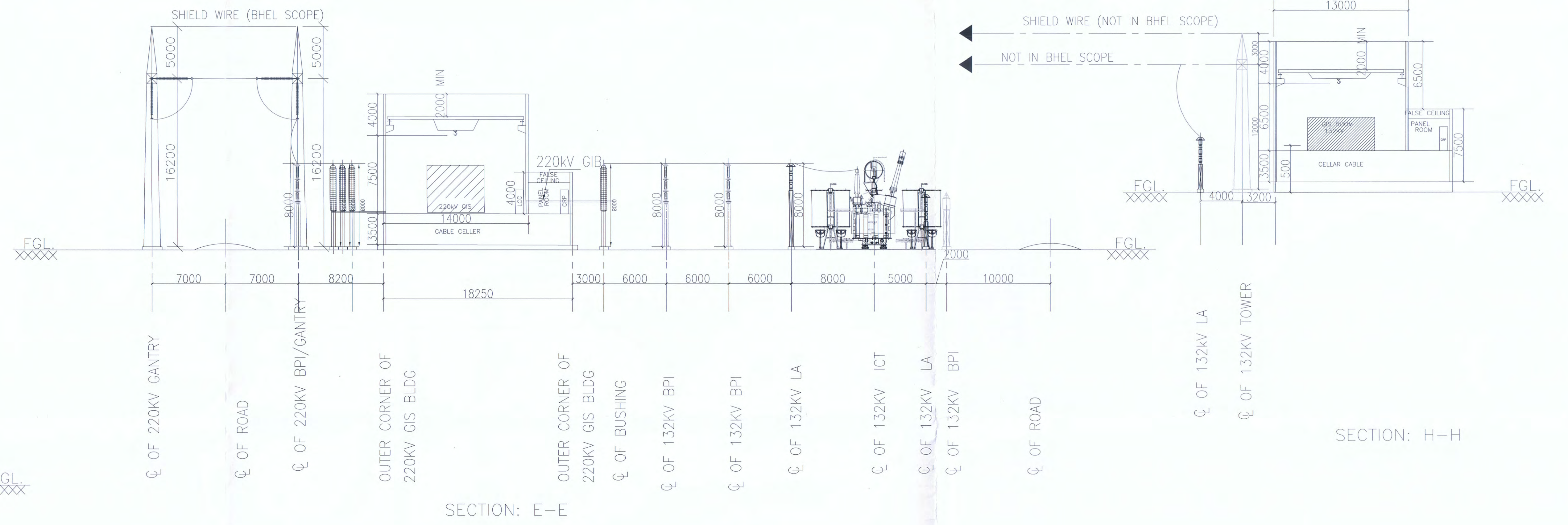
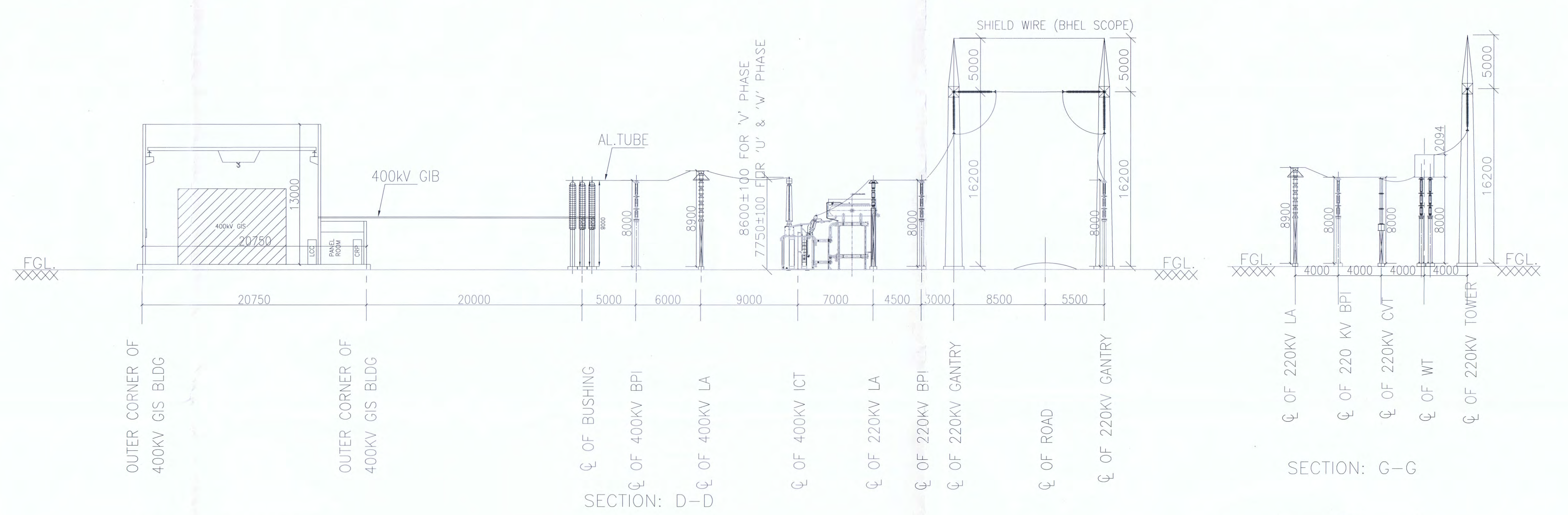
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PROJECT: 400/220/132 kV GIS SUBSTATION AT SHAMLI (U.P.)

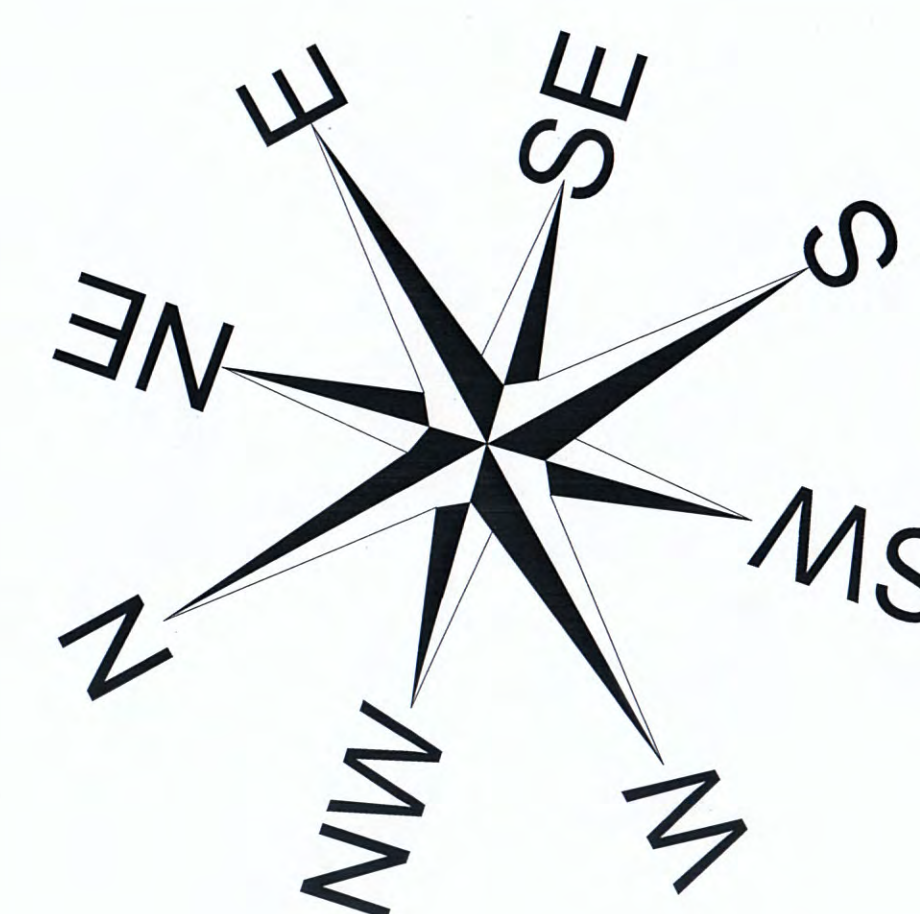
CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LTD (UPPTCL)

				BHARAT HEAVY ELECTRICALS LTD TRANSMISSION BUSINESS GROUP NOIDA		SCALE: NTS SHEET 11 OF 12
		DATE 06/03/19		NAME VSG		TITLE KEY METERING & PROTECTION SINGLE LINE DIAGRAM
		DESIGN BY		VSG		
		CHECKED BY		SS		
		APPROVED BY		SS		
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Electricity 765/400KV Substation Design Circle-II
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		TENDER SINGLE LINE DIAGRAM 400/220/132kV GIS S/S			
REF. DRG. NO.		TITLE			
LOI NO. : 1311/FSD-8/126//II/400KV SHAMLI dated 14.11.2018					
अनुबंध/प्रतिबंध का नाम NAME OF CUSTOMER / PROJECT		UTTAR PRADESH POWER TRANSMISSION CORPORATION LIMITED			
ADDITIONAL INFORMATION W.O.No.		400/220/132 kV SUBSTATION AT SHAMLI. (U.P.)			
STATUS OF DRAWING: CONTRACT					
DISTRIBUTION OF PRINTS					
		भारत हेवी इलेक्ट्रिकल्स लिमिटेड शरात भारती इलेक्ट्रिकल्स प्रा. लिमिटेड SARAT HEAVY ELECTRICALS LTD. TRANSMISSION PROJECTS DIVISION		क्रमांक SHEET NO. पृष्ठ सं./ SHEET NO. अंश पुराने/ NEWT SHEET	
REV.	DATE	ALTERED CHECKED APPROVED	क्रमांक SHEET NO. पृष्ठ सं./ SHEET NO.	अनुपात / SCALE	शरीट नं० CARD CODE
ZONE			शीट नं./TITLE		
400/220/132KV ELECTRICAL LAYOUT-SHAMLI				प्रकृति/प्र. /NATURAL NO. TH-0-406-050-002 पृष्ठ सं./SHEET NO. 02 अंश पुराने/NEWT SHEET -	



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1. TENDER SPECIFICATION REF: ESD-8/126
2. TOPOLOGICAL SURVEY PLAN OF PROPOSED 400/220/132kV GIS SUBSTATION Drg no. HK/PS/TGS/561
3. APPROVED ESLD DOC NO: TB-0-406-510-001 Rev 00 dated 25.10.2018.

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. DEPTH OF INDIVIDUAL TRANSFORMER (1000MM, 2000MM) SOAK PIT WILL BE 600MM BELOW THE FCL.
3. TOP OF SOAK PIT SHALL BE PROVIDED WITH 150 FLAT GRATING SUPPORTED BY 150MM/60MM SIZES ON THE ABOVE CARTING 40 MM METAL SPREADING FOR 1000MM THICK SHALL BE PROVIDED
4. DETAILED DESIGN OF SOAK PIT AND COMMON CATCH OR COLLECTING PIT SHALL BE SHOWN IN SEPARATE CIVIL DRAWING.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY APPROVALS. THE SAME SHALL BE INCORPORATED SUBSEQUENT TO THE DESIGN.
6. SPACE FOR 4 NO FUTURE BAYS (NOT IN BHEL SCOPE OF SUPPLY) IS SHOWN IN 400MM/225MM/32MM G/S BUILDING.
7. ALL EQUIPMENT DIMENSIONS ARE TENTATIVE & FINAL DIMENSIONS SHALL BE AS PER MANUFACTURER DRAWING.
8. TYPE OF CONDUCTOR SHALL BE AS APPROVED CONDUCTOR USING CALCULATION, SHORT CIRCUIT CALCULATIONS & STRUCTURE LOADING DIAGRAM.
9. DETAILING DRAWING SHALL BE REVIEWED FOR TEMPERATURE RISE, SHORT CIRCUIT, MECHANICAL STRESS, VIBRATION, ETC.
10. SIZE & LOCATION OF CABLE BEND IS NOT INDICATED. SHALL BE AS PER APPROVED CABLE, TRENCH/CABLE LAYOUT DRAWING.

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Office of The Superintending Engineer
Electricity 765400KV Substation Design Circle-II
UP Power Transmission Corporation Limited
11th Floor, Shakti Bhawan Extn. Lucknow

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		TENDER 'SINGLE LINE DIAGRAM' 400/220V/132KV GIS S/S																	
REF. DRG. NO.		TITLE																	
LOI NO. : 1311/ESD-8/126/IN/4/600K SHAMLI dated 14.11.2018																			
ADDITIONAL INFORMATION W.D.N. STATUS OF DRAWING CONTRACT DISTRIBUTION OF PRINTS		उत्तर प्रदेश पावर ट्रांसमिशन कॉर्पोरेशन लिमिटेड NAME OF CUSTOMER / PROJECT  400/220/132KV GIS SUBSTATION AT SHAMLI. (U.P.)																	
 भारत भारी इलेक्ट्रिकल्स लिमिटेड भारतीय भारी बिजली निगम BHARAT HEAVY ELECTRICALS LTD TRANSMISSION PROJECTS DIVISION		<table border="1"> <thead> <tr> <th>क्रमांक / NO</th><th>विवरण / NAME</th><th>स्थान / STN</th><th>दिनांक / DATE</th></tr> </thead> <tbody> <tr> <td>01</td><td>S/S</td><td>-SHOND-</td><td>10.01.19</td></tr> <tr> <td>02</td><td>WSP</td><td>-SHOND-</td><td>10.01.19</td></tr> <tr> <td>03</td><td>S/S</td><td>-SHOND-</td><td>10.01.19</td></tr> </tbody> </table>		क्रमांक / NO	विवरण / NAME	स्थान / STN	दिनांक / DATE	01	S/S	-SHOND-	10.01.19	02	WSP	-SHOND-	10.01.19	03	S/S	-SHOND-	10.01.19
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ANNUXURE-B

SI. No.	REFERENCE DOC.	EXISTING CLAUSE	CLARIFICATION/ CONFIRMATION REQUIRED	UPPTCL REPLY
1	SECTION I / INVITATION FOR PREQUALIFICATION / Cl. 4.1.1 (d) (Technical Experience).	The type tests should have been conducted within last 10(ten) years from the date of opening of Bids. Necessary documentary evidence in support of the same should be enclosed along with the offer.	We would like to inform you that, as per Section-I, Qualification of bidder, Cl. 4.1.1 (d) (Technical Experience), it is mentioned, the GIS modules should have been type tested earlier in any internationally recognized Test House and the type tests should have been conducted within last 10(ten) years from the date of opening of Bids. Necessary documentary evidence in support of the same should be enclosed along with the offer.	Please go through as per clause "Qualification of bidder, Cl. 4.1.1 (d) (Technical Experience)" and for other offered equipments must have been fully type tested during the last Five (5) years. In case as per requirement the repetition of Type tests shall be carried out by the bidders without any extra cost to the purchaser. Please accept the clause as such.
	SPECIAL CONDITIONS OF SPECIFICATIONS / Cl 6.7.4 / & GTR /CL.2.2 &	TYPE TEST FOR INDIGENOUS OR FULLY IMPORTED EQUIPMENTS: The offered equipments must have been fully type tested as per relevant ISS and/or any other specified international standards, during the last 5 years period to be reckoned from the date of opening of tender.	However, under special conditions of specifications, GTR and Cl. No. 38.1.2 of GIS specifications, it is indicated the offered equipments must have been fully type tested during the last Five (5) years. The clauses are contradictory, we understand that for the offered GIS and other equipments, the type tests should have been conducted within last 10(ten) years from the date of opening of Bids as mentioned under per Section-I, Qualification of bidder, Cl. 4.1.1 (d) (Technical Experience). Please confirm.	
	TECHNICAL SPECS FOR GIS/ Cl. No. 38.1.2	The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening. The type test reports of GIS offered and the individual switchgear and control gear equipment of the GIS offered shall not be earlier than 5(five) years as on the date of opening of bids.	Further, we would like to inform you that, Type tests are carried out once to establish the design of the Equipments. Unless there is some design changes, there is no requirement of repetition of Type tests. Valid type test reports not older than 10 years from the date of bid submission shall be submitted along with the bid. Request you to please accept the same.	
	SECTION V/ INVITATION FOR PREQUALIFICATION/ Cl. No. 43.6.	Target Availability: The contractor has to ensure 98% availability of substation during the maintenance period as per clause no. 3.5 of UPERC regulation 2006-2101 dated 6-10-2006 failing which the penalty shall be levied as per provisions of UPERC regulation.	We would like to inform you that, UPPTCL being a Utility Customer, Target availability of the Substation is dependent on many factors which are not in the control of the Substation Contractor / Bidder. Hence request you exclude this clause from Scope of the bidder.	This clause is not applicable as there is no operation and maintenance of the substation in the scope of bidder.
	Cl. No. 5/Section-1 /Pg 26 of 1201	Completion Period: The completion period for 400kV substation shall be 24 (twenty four) months from the date of issue of LOI or from handing over of the land whichever is later.	We would like to inform you if the date of handing over of the site is delayed by customer, then the Contractor shall be entitled to claim cost in case of delay in handing over of the Site. Please confirm.	The completion period for 400kV GIS Substation Shamli shall be 24 (twenty four) months from the date of issue of LOI or from handing over of the land whichever is later." Please accept the completion period without any change.
2	Cl. No. 9/ Section-V/ Special Conditions of Specifications/ Pg. 101 of 1201.	PAYMENT: (a) 80% payment of supplied equipment after completion of the foundation of equipment. (b) 10% payment after erection of equipment. (c) Balance 10% amount to be released after satisfactory commissioning of entire 400kV substation, 100% completion of all electrical and civil works and adjustment of liquidated damaged if any and issuance of taking over certificate.	We understand that 80% payment shall be paid after equipment supply and completion of its respective foundation. Other items such as earthing material, lighting material, cabling material, testing equipments, conductors, busbar material, oil filtration plant, Firefighting material, PLCC and FOTE equipments etc. which is not linked with civil foundations shall be paid by UPPTCL within 30 days from receipt of such material at site. Please confirm our understanding.	Please accept the "Payment Clause" without any change.
3	Cl.3.1/ SPECIAL CONDITIONS OF SPECIFICATIONS and	The Contract for construction of above 400kV GIS Substation on the basis of single work contract on single source responsibility, on turnkey basis shall be awarded.	We would like to inform you that, tender specifications (Clause no. 3.1), mention nature of contract, as single work contract on single source responsibility, on turnkey basis shall be awarded.	The titles of equipment and material, supplied by Bidder or Sub-Bidder to UPPTCL, shall pass on to UPPTCL on completion of the substation.
	Cl.31.2/ SPECIAL CONDITIONS OF SPECIFICATIONS	The titles of equipment and material, supplied by Bidder or Sub-Bidder to UPPTCL, shall pass on to UPPTCL on ex-works dispatch basis.	However, Cl. No 31.2, mention transfer of title shall be passed on to UPPTCL on ex-works dispatch basis. We would like to clarify that, this shall be applicable only in case of divisible contract, i.e. wherein UPPTCL shall be issuing separate contract for supply portion and service portion. Accordingly, understand that in line with clause no 3.1 as this contract is a Single work	

Queries for 400/220/132kV GIS Substation , Shamli

4	SECTION V /Instruction to Bidders/Nature of Prices, Cl. 5.1 and Cl. No. 7/ Special Conditions of Specifications. Cl. No. 40.8/ SPECIAL INSTRUCTIONS TO TENDERERS /Tech Specs for Auto Transformers.	The prices of all the items including ex-works prices, packing and forwarding, freight, insurance, erection, testing, & commissioning etc. shall remain "Firm" in all respects throughout the currency of the contract. The Prices of all the items and services quoted in the Price Schedules shall be shall remain "Fixed and Firm" in all respects during the currency of the contract. The IEEMA price variation formula applicable for transformer and OLTC component as per prevailing/current IEEMA Circular. The Tenderers are requested to follow the IEEMA formula in respect of the transformer offered by them.	We would like to draw your attention to Clause No.7 of Conditions of specifications and Cl. No. 5.1 of Instruction to bidder, wherein it is mentioned that prices shall remain Firm throughout the currency of contract. However, Clause No.40.8 of SPECIAL INSTRUCTIONS TO TENDERERS, of technical specification for Transformer, wherein it is mentioned that IEEMA price variation formula applicable for transformer and OLTC component as per prevailing/current IEEMA Circular. Please note that Power Transformers and Reactors are cost intensive equipment dependent on the global rates of raw materials like CRGO, Copper, Oil, Insulation, etc. as well as the exchange rates. Considering above and long Validity requirement of (6 months) & Completion period of (18 Months) for this tender, it is difficult to predict estimation of the cost escalation during tender validity/Contract execution period. We therefor request UPPTCL to allow bid on variable price basis for Power Transformers and Reactors as per IEEMA PV Formula without any ceiling for the complete Contractual Period with the base date of 1 month prior to the date of bid submission.	Prices shall remain Firm throughout the currency of contract. No Price Variation shall be allowed on Power Transformers, and Reactors and other equipments. The completion period shall be 24(twenty four) months.
5	NIT/ SHORT TERM E-TENDER NOTICE AGAINST SPECN. NO. ESD-8/117 THROUGH E-TENDERING	No tender document including tender fee and other commercial papers are required to be submitted in hard copy or through messenger.	In line with NIT against specn. NO. ESD-8/117, we understand that, No tender document including tender fee and other commercial papers are required to be submitted in hard copy. Please confirm.	No tender document including tender fee and other commercial papers are required to be submitted in hard copy at the time of bid submission on etender portal. However, some important document such as EMD BG etc. shall be submitted as per tender specification.
6	Clause No. 5.2/ Sl. No. 33/ Factory Test/ Tech Specs/ 500 MVA, 400/220/33KV, Auto Transformers.	Factory Test: (B)Dynamic Short circuit withstand test (For 400 kV class transformer below 500 MVA rating). – Type*	We would like to inform you that, as dynamic short circuit test is a special Type test as per IEC, the bidder/ manufacturer should have successfully carried out dynamic short circuit test on 315 MVA, 400/220/33 KV Auto Transformer within ten (10) years from the date of bid opening and shall enclose the relevant Test report/ certificate along with the bid. Please confirm our understanding. Further we would like to inform you that, in per previous UPPTCL tender against Tender no. ESD-765KV/10 for 400/220/132KV GIS substation at Rasara, Ballia, the requirement of Dynamic Short circuit test was waived off by UPPTCL. Accordingly, we request you to waive off the requirement of Dynamic Short circuit test for 400/220/132KV GIS Shamli package also.	The clause for "Dynamic Short Circuit test:"shall be as per our Tender Specification. No Dynamic Short Circuit test is required to be conducted by bidder if the bidder/ manufacturer has successfully carried out dynamic short circuit test on 315 MVA, 400/220/33 KV Auto Transformer within ten (10) years from the date of bid opening.
7	Clause No. 3.5.1.2/ Tech Specs/ 500 MVA, 400 /220 /33KV, Auto Transformers	52 kV and above Bushing : Hermetically sealed Oil filled condenser type/ RIP bushing with porcelain or composite insulator.	We understand that, for 52 kV and above bushing shall be Oil filled condenser type only. Please furnish your acceptance for the same.	Both type of Oil filled condenser type/ RIP bushing with porcelain or composite insulator are acceptable.
8	Cl. No. Cl 1.2 i) & ii)/ Tech Specs/ 500 MVA, 400/220/33KV, Auto Transformers.	The auto transformer shall in general have constant ohmic impedance between HV and IV on all taps. However, in case of parallel operation with the existing transformer, i) The impedance, vector group, OLTC connection & range etc. of the transformer is to be matched with that of the existing transformer. The rating plate details of the existing transformer shall be furnished by the Owner. ii) Necessary provision is to be kept in the transformer control scheme for parallel operation with the existing Master/Follower/Independent /Off type, OLTC control scheme.	We understand that existing site is new & there is no existing transformer. Hence clause not applicable for this project. Please confirm our understanding, else Please clarify whether parallel operation with existing Transformer is envisaged in this tender or not. If yes then please provide following details: 1. The impedance, vector group, OLTC connection & range etc. of the transformer is to be matched with that of the existing transformer along with the rating plate details of the existing transformer. Clarification is requested from UPPTCL.	This a new Substation and there is no existing transformer, however necessary provision is to be kept in the transformer control scheme for parallel operation with the other transformers.
9	Clause No. 3.1.3.4/ Tech Specs/ 500 MVA, 400 /220 /33KV, Auto Transformers.	'Bidder can supply one set of trolleys in place of wheel assembly rollers for movement of transformer for plinth mounted transformer.	We would like to inform you that, we will provide flange roller for transformer instead of trolleys. Please confirm.	As per specification/ latest standard..
10	Clause No. 3.8.1.8/ Tech Specs/ 500 MVA, 400 /220 /33KV, Auto Transformers	'The cooler and its accessories shall preferably be hot dip galvanised or corrosion resistant paint (as per clause 3.1.1.8) should be applied to it.	We would like to inform you that, We will paint cooler and its accessories with corrosion resistant paint. Request you to accept the same.	As per specification/ latest standard..
11	Clause No. 3.10.2/ Tech Specs/ 500 MVA, 400 /220 /33KV, Auto Transformers	'Cabinets and Panels shall be tank mounted, provided with suitable lifting arrangement and have sloping roof.	We would like to inform you that , 'Cabinets and Panels can be either mounted or floor mounted , provided with suitable lifting arrangement and have sloping roof. Request you to accept the same.	Both types are acceptable.
12	Clause No. 4.5/ Tech Specs/ 500 MVA, 400 /220 /33KV, Auto Transformers	Optical sensors: For 500 MVA , 400 kV class transformer only) Adequate no of optical temp sensors of at least 16 numbers with the unit which is to be type tested and at least 8 numbers with each other units fitted.	Request M/s UPPTCL to clarify no. of probes required will be 16 or 8.	Sixteen(16) numbers.

Queries for 400/220/132kV GIS Substation , Shamli

13	Cl. 5.1.8.1/ Tech Specs/ 500 MVA, 400 /220 /33KV, Auto Transformers	The makes of all major bought out items shall be subject to Employer's approval	We request UPPTCL to provide list of make approved for major bought component as required in specification. This will help bidder to take same reference from Tendering to Contract execution.	UPPTCL has provided list of make approved for major bought component as required in specification, however for other items which are not mentioned shall be of standard make as per latest IS/ IEC standard during bidding process, however their final approval shall be required after award of contract.
			Else Bidder Shall provide transformer with its own sub-vendors for all major bought components during bidding process that shall also be valid till execution. Requesting UPPTCL acceptance to the same.	Own sub-vendors for all major boughtout items during bidding process, however their final approval shall be required after award of contract.
14	General Comment for 500 MVA 400/220/33 KV ICT ;160 MVA 220/132/33 KV ICT and 125 MVAR 420 KV Reactor.		We would like to inform you that, Section Project & Technical specification has not specified the requirement of Numerical / Digital RTCC for 500 MVA & 200 MVA transformer. Please recheck the requirement considering Substation Automation & SCADA Operation.	Numerical digital RTCC required with RTCC Panel
15	Cl. No. 3.4 (VII) / Tech Specs for GIS /Pg 243 of 1201.	Lightning arresters(LA)	We understand that, Surge arresters shall be of outdoor AIS type as per Bill of material for all voltage levels. We have not considered surge arresters inside GIS. Please confirm our understading.	Surge arresters shall be of outdoor AIS type
16	Supply Schedule – Q1, S. No. - B.1.1 &2.1	Length of GIS Bus duct for Transformer Bay Module– 50 Meter	We understand that bus duct length quantity 50 meter & 25 meter mentioned in price schedule is the quantity of Three phase bus duct from Transformer/ Reactor bay GIS module up to and including SF6/Air Bushing. Hence, if we have to consider single phase bus duct in our design these quantities would be multiplied with three (3). Please confirm our understanding.	Confirmed, the quantity is for Three phase bus duct. Actual quantity will be decided during drawing/engineering.
		Length of GIS Bus duct for Reactor Bay Module– 25 Meter		
17	Supply Schedule – Q1, S. No. - 3.1	Length of GIS Bus duct for Line Feeder Bay Module – 195 Meter	We understand that bus duct length quantity 195 meter given in price schedule is the quantity of Three phase bus duct from line bay GIS module up to SF6/Air Bushing for 6 Nos. Line bays. Hence, if we have to consider single phase bus duct in our design these quantity would be multiplied with three (3). Please confirm our understanding.	Confirmed, the quantity is for Three phase bus duct. Actual quantity will be decided during drawing/engineering.
18	Supply Schedule – Q1, S. No. - C.1.1 &2.1	Length of GIS Bus duct for LV Transformer bay module– 50 Meter	We understand that bus duct length quantity 50 meter & 60 mtrs mentioned in price schedule is the quantity of three phase bus duct from Transformer bay GIS module up to and including SF6/Air Bushing. Hence, if we have to consider single phase bus duct in our design these quantity would be multiplied with three (3) . Please confirm our understanding.	Confirmed, the quantity is for Three phase bus duct. Actual quantity will be decided during drawing/engineering.
		Length of GIS Bus duct for 200 MVA Transformer bay module– 60 Meter		
19	Cl. No. 3.4 pg 7 to 17 of 80	For 132kV :	Request you to please confirm, offered 132kV GIS shall be rated for 40kA rms with peak withstand current of 100kAp.	Confirmed.
		I) 12, II) 19), iii) 5), IV) 3), V) 13). Rated short time withstand current (1sec)		
		I)13, II) 19, III) 6), IV) 4), V) 14) Rated peak withstand current		
20	Cl. No. 3.4 pg 8 of 80	For 400kV : Pre-insertion resistor requirement	We would like to inform you that, as per data sheet, the values of PIR are indicated.	PIR for 400kV Circuit Breakers are for 400 KV Shamli- Aligarh DC lines.
			However, BOM or in 400kV SLD, the requirement is not explicitly given. Please clarify your requirement of PIR and quantity of PIR (with feeder names) for 400kV Circuit Breakers is to be considered if any	
21	Cl. No. 3.4 II) pg 9 of 80	ii) Line charging current - 50A rms	We would like to inform you that, for 400kV, 220kV and 132kV GIS, the line charging, cable charging and inductive breaking current shall be as per IEC. Please confirm.	As per specification/ latest IEC standard.
		iii) Cable charging current - 120Arms		
		iv) Small inductive breaking current - 10A rms		
22	Cl. No. 3.4 II) 23) pg 9 of 80	Breaking capacity of aux. contacts less than 20ms	We would like to inform you that, Breaking capacity shall be 2 Amps. Please confirm.	As per specification/ latest IEC standard.
23	Cl. No. 3.4 V) pg 12 of 80	One minute power frequency withstand voltage	We would like to inform you that, One minute power frequency withstand voltage between secondary terminal & earth of CT shall be 3 kV rms. Please confirm.	As per specification/ latest IEC standard.
		between sec Terminal & earth - 5 kV rms		
24	Cl. No. 3.4 V) pg 12 of 80	9. Current ratio : For feeder, Transformer and BC	We would like to inform you that, CT ratios provided in this clause is not matching with the Table-1A to 1C.	As per BOQ.
			Please clarify which CT parameters are to be considered.	
25	Cl. No. 5.3 pg 19 of 80	These compartments shall be such that maintenance on one feeder may be performed without de-energising the adjacent feeders.	We would like to inform you that, Routine maintenance like gas refilling, replacement of gas density switch, drive mechanism can be carried out without disturbing/ shutting down the adjacent feeders. Please confirm	As per Enclosed Gas SLD "Annexure A gas segregation scheme Gas SLD" Bidder/ manufacturers have to conform to follow gas SLD as provided.

Queries for 400/220/132kV GIS Substation , Shamli

26	Cl.No. 5.5 & 5.6 "GENERAL DESIGN AND SAFETY REQUIREMENT" of Technical Specification _GIS Page 247	The design of 220 kV GIS shall be such that in case a circuit breaker module of a feeder is removed for maintenance, both busbars shall remain in service. Further the design of 132kV GIS shall be such that in case a circuit breaker module of a feeder is removed for maintenance, the busbar shall remain in service. For achieving the above requirements, adequate Mechanical support and number of intermediate gas tight compartments as required, shall be provided to ensure equipment and operating personnel's safety.	5.5 Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. They shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. Due to safety requirement for working on this pressurized equipment, whenever the pressure of the adjacent gas compartment is reduced, it should be ensured by the bidder that adjacent compartment would remain in service with reduced pressure. The gas tight barriers shall be clearly marked on the outside of the enclosures. Please confirm. 5.6 The bus enclosure should be sectionalized in a manner that maintenance work on any bus disconnecter (when bus and bus disconnecter are enclosed in a single enclosure) can be carried out by isolating and evacuating the small effected section and not the entire bus. The design of the 400 kV GIS shall be such that in case one circuit breaker module is removed for maintenance, there is no disruption in the power flow in any of the two circuits in the diameter. The design of 220 kV GIS shall be such that in case a circuit breaker module of a feeder is removed for maintenance, both busbars shall remain in service. Further the design of 132kV GIS shall be such that that in case a circuit breaker module of a feeder is removed for maintenance, the bus bar shall remain in service. For achieving the above requirements, adequate Mechanical support and number of intermediate gas tight compartments as required, shall be provided to ensure equipment and operating personnel's safety. Please confirm.	5.5 Please adhere to the clause as such. 5.6 Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. The gas tight barriers shall be clearly marked on the outside of the enclosures. The design of 420 kV, 245 kV and 145 kV GIS shall be such that in case an interrupter of a circuit breaker module of a feeder is removed for maintenance, both busbars shall remain in service. For achieving the above requirements, adequate Mechanical support and number of intermediate gas tight compartments as required, shall be provided to ensure equipment and operating personnel's safety. Continuous Bus bar without gas sectionalisation, even if passive bus bar, will not be accepted. Bidders has to confirm and offer the GIS exactly in line with the enclosed drawings indicating gas tight compartments are enclosed at Annexure-A. A signed and stamped copy has to be submitted, as a token of acceptance, along with the bid.
27	Cl. No. 5.7 pg 19 of 80	The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300 ms at rated short time withstand current.	We would like to inform you that, The offered GIS enclosures can withstand internal flash over without burn though as per IEC 62271-203.	As per specification/ latest IEC standard.
28	Cl. No. 14.1.2 pg 28 of 80	The circuit breakers shall be designed for high speed single and three phase reclosing with an operating sequence and timing as specified.	We would like to inform you that, Offered 132kV CB is three phase encapsulated with one operating mechanism for all 3 poles. Only three phase reclosing is possible with this arrangement. Please confirm.	Auto-Reclosing on 132 kV is not required.
29	Cl. No. 14.3 pg 29 of 80	Interrupting the steady and transient magnetizing current corresponding to 400/220/33 kV class transformers of 500MVA ratings on both 400 kV & 220 kV side and 220/132/11 kV class transformers of 200MVA ratings on both 220 kV & 132 kV side.	We would like to inform you that, Interruption of steady and transient magnetizing current of CB shall be as per latest IEC standards. Please confirm.	As per latest IEC.
30	Cl. No. 14.6.4 pg 30 of 80	The gap between the open contacts shall be such that it can withstand at least the rated phase to ground voltage for eight hours at zero pressure above atmospheric level of SF6 gas due to its leakage	We would like to inform you that, 08 hours at atmosphere pressure is not specified by any IEC standards. Plesse clarify.	This shall be as per specification/ as per IEC standard for GIS.
31	Cl. No. 17.1 pg 34 of 80	Disconnectors shall be of the single-pole, group operated type, installed	We would like to inform you that, In 132kV GIS, disconnectors shall be 3 pole, group operated type.	Confirmed.
32	Cl. No. 20.1.1 D) a) b) pg 38 of 80	The current transformers incorporated into the GIS will be used for protective relaying..... Each current transformer shall be equipped with a marshalling box with terminals...	We would like to inform you that, CT secondary shall be outside the HV enclosure. Inbuilt terminal box shall be provided for each current transformer. Marshalling box is not applicable to GIS.	Confirmed with the condition that the design is type tested and as per relevant IEC standard.
33	C. No. 10.1.2 pg 40 of 80	e) The accuracy of 0.2 on secondary III should be maintained throughout the entire burden range upto 100 VA on all the three windings without any adjustments during operation.	We would like to inform you that, The burden of VTs shall be as per Table-IIC of specification. Please confirm.	Table IC may be referred.
34	Cl. No. 29.1 pg 51 of 80	GIS bus ducts of each circuit shall be arranged in preferably horizontal formation and the clearance (outer to outer) between nearest bus ducts of two adjacent circuits shall be minimum one (1) meter. The minimum outer to outer horizontal clearance between each GIS bus duct shall be 0.75 meter for 400 kV voltage level and 0.5 meter for 220 kV & 132 kV voltage level.	We would like to inform you that, Clearances between GIB shall be as per manufacturer standard. Please confirm.	As per Clause 29.1/IEC/ISS
35	Cl. No. 31.2 pg 53 of 80	The LCCs shall be provided with the following features: a) A mimic diagram showing the single line diagram.....	We would like to inform you that, As per clause 5.31.3 pg 23, as BCU is provided in LCC, separate mimic/LED display with control, measuring instruments may not be required in LCC. Please confirm.	BCU can also be used as LCC
36	Cl. No. 38.3.4 pg 63 of 80	38.3.4 The bidder shall provide one set of high voltage test equipment suitable for testing of 400kV, 220kV and 132kV GIS and include in the offer.	We would like to inform you that, HV test kit shall be brought to site on returnable basis during testing. Please confirm.	High Voltage Testing Kits required at site shall be provided by the successful bidder on returnable basis.

Queries for 400/220/132kV GIS Substation , Shamli

37	Annex: A-1, 2.0 pg 67 of 80	PORTABLE UHF PARTIAL DISCHARGE MONITOR FOR GIS	We would like to inform you that, the technical specifications for GIS mention requirement of portable Partial Discharge Monitoring System for GIS, however the same is not mentioned in price schedule (Schedule Q1) for Testing & Maintenance Equipment for GIS. Please confirm whether bidder the same is required to be quoted by bidder.	It is mentioned at F.2 "Testing & Maintenance Equipment for GIS"
38	Annex: A-1, 2.0 pg 67 of 80	PORTABLE UHF PARTIAL DISCHARGE MONITOR FOR GIS: 12V DC supply for DMS external coupler with amplifier. Couplers & accessories Operation with DMS active couplers Removable Laptop PC with DMS software installed.	Further to above, if Partial Discharge Monitoring System for GIS is to be considered by bidder, we would like to inform you that, Annex: A-I/ Technical Specifications, requirement of DMS model Partial Discharge Monitoring System is indicated. We understand that, in line with previous UPPTCL tenders , bidder can consider (Dobel make or equivalent make offline type Partial Discharge Monitoring System for GIS.	It is mentioned at F.2 "Testing & Maintenance Equipment for GIS"
39	Sl. no. B. 2/ Price Schedule for GIS	Bus Reactor bay module :420kV, 2000A, 50kA, 3 phase SF6 gas insulated 63MVAR Bus Reactor bay module each comprising of SF6 gas insulated circuit breaker (3150A), current transformer, voltage transformer, two bus-bar disconnectors (2000A) with common grounding switch,	We would like to inform you that, As per SLD and scope of works, there is no Voltage Transformer (VT) for Bus Reactor bay. However the requirement of Voltage Transformer (VT) is mentioned in bill of material. Please clarify your requirement.	VT is required
40	Sl. No. B) C) D) 4.0/ Price Schedule for GIS	400/220/132kV Busbars: Local control cubicle	We would like to inform you that, Busbar VT with disconnecter controls can be integrated in Bus coupler LCC itself, separate LCC for Metering VT is not required. Please confirm.	Confirmed.
41	Sl. No. A 5.1, A5.2 / Mandatory Spares for GIS/ / Price Schedule for GIS	400kV Voltage Transformer - 3 Nos. 220kV Voltage Transformer - 3 Nos.	We would like to inform you that, for 400kV and 220kV we offer single phase encapsulated Voltage Transformer (VTs). Hence 3 Nos. Single phase Voltage Transformer shall be considered in spare. Please confirm.	Confirmed.
42	Sl. No. A.1.1.17/ Mandatory Spares for GIS/ / Price Schedule for GIS	400kV GIS: Bushing for di-electric test on cable.	We would like to inform you that, the same is Not applicable for 400kV as there is no cable termination.	Confirmed.
43	Sl. No. A 2.1 / Mandatory Spares for GIS/ / Price Schedule for GIS	400kV Circuit Breaker: a) Complete Circuit Breaker pole of each type & rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism - 3 set	We would like to inform you that, we shall provide 1 No. Circuit Breaker pole with operating mechanism against this item as we have same design of both current ratings. Please confirm	Confirmed
44	Sl. No. A 2.2 a) / Mandatory Spares for GIS/ / Price Schedule for GIS	220kV Circuit Breaker: Complete Circuit Breaker pole of each type & rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism - 3 sets	We would like to inform you that, we shall provide 1 No. Circuit breaker pole with operating mechanism against this item as we have same design of both current ratings. Please confirm	Confirmed
45	Sl. No. A 2.3 a) / Mandatory Spares for GIS/ / Price Schedule for GIS	132kV Circuit Breaker: Complete Circuit Breaker pole of each type & rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism - 3 sets	We would like to inform you that, We shall provide 1 No. Circuit Breaker pole with operating mechanism against this item as we have same design of both current ratings. Please confirm	Confirmed
46	Sl. No. A5.3 / Mandatory Spares for GIS/ / Price Schedule for GIS	132kV Voltage Transformer - 3 Nos	We would like to inform you that, as offered 132 kV GIS is three phase encapsulated design, we offer 3 phase Voltage Transformer – 1 No. as spare. Please confirm.	As per specification.
47	220kV SLD	Outgoing side Voltage Transformer (VT) in line bays	We would like to inform you that, as per BOM Voltage Transformer (VT) is not specified in line bay. However as per scope of works Voltage Transformer (VT) with isolator is specified in outgoing side of line bays. Further as per SLD, Voltage Transformer (VT) without isolator for line bays is indicated. As above clauses are contradictory, Please clarify a) whether Voltage Transformer (VT) is required for line bay or not . b) if required Voltage Transformer (VT) with disconnector or without disconnector to be considered inside GIS or not.	As indicated at C 7.0 "245 kV GIS Equipment" 245 KV CVTs shall be outdoor type.
48	132kV SLD	Outgoing side Voltage Transformer (VT) in line bays	We would like to inform you that, as per SLD VT is not shown in line bay. Further as per scope of works , VT with isolator is specified in outgoing side of line bays and as per BOM, VT without isolator for line bays. Please clarify a) whether VT is required for line bay or not b) if required VTs with disconnector or without disconnector to be considered inside GIS or not.	145 KV VTs shall be inside GIS.
49	Cl. No. 3.1.1 pg 4 of 14	132kV GIS : (a) (ii), D(iii) Three, inductive potential transformers, complete with isolator switch (b) (ii), C(ii), D) ii), Three 5 core-multi ratio, single phase current transformers.	We would like to inform you that, as we offer three phase encapsulated design for 132kV GIS, one, three phase inductive potential transformer shall be considered. Accordingly, as above, current transformers. shall be one 5 core-multi ratio three phase CTs. Please confirm.	Three phase inductive potential transformer shall be considered. Current transformers shall be one 5 core-multi ratio three phase CTs

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50	Cl. No. 38.1.3 of Technical specification GIS, page no. 62 of 80	38.1.3 The Purchaser may decide to get some or all for the following "special type tests" conducted. The type test charges for these tests shall be quoted along with other type tested as per IEC: 62271-203. i) Radio interference voltage (RIV) level test. ii) Internal arc test iii) Thermal stability tests iv) Operation tests at limit temperature v) Gas tightness test	We would like to inform you that, Type tests are carried out once to establish the design of the Equipments. Unless there is some design changes, there is no requirement of repetition of Type tests. Valid type test reports not older than 10 years from the date of bid submission shall be submitted along with the bid. In line with previous UPPTCL S/S package, request you to please accept the same.	In case as per requirement the repetition of Type tests shall be carried out by the bidders without any extra cost to the purchaser. Please accept the clause as such.
51	Cl. No. 1.2 pg 4 of 80	Following associated items shall also be included in the scope of supply:- d) 4 Nos. bottles (40 kg each) of SF6 gas in non-returnable vessels. E) Gas leakage detectors. F) Measuring instrument for air content and moisture content in SF6 gas.	Please confirm whether SF6 spare gas and tools are to be considered as per specification requirement or as per price schedule requirement.	As per bill of Quantity.
52	Tech Spec: GIS	Controlled switching device not mentioned	We have not envisaged controlled switching device/ point on wave controller for 400kV Circuit breaker as the requirement is not specified in price schedule nor mentioned in breaker specification. Please confirm.	The CSD is required for both 400/220/33 KV transformers and reactors.
53	Cl no 4.1.5 / Substation automation system	Switched Ethernet Communication Infrastructure: One switch shall be provided to connect all IEDs for 400kV, 220kV, 132kV & 33kV bays.	We wish to inform that, it is not possible practically to connect all IEDs to one Ethernet switch of different voltage level. Kindly confirm the requirement.	Separate Ethernet switches to be provided for different voltage levels as per tender SAS architecture.
54	Price schedule item no. G.4.a	Common equipment (Voltage & Frequency recorder, Digital voltage and frequency meter)	Please clarify the item to be quoted under Common equipment (Voltage & Frequency recorder, Digital voltage and frequency meter). We understand that meters and recorders and meters are part of CRP panel of respective voltage level. Please confirm our understanding.	Configuration and design of CRP are in bidder scope. However all necessary control, protection and data communication facility as per latest standards shall be provided.
55	Cl no 12.5 / Sub-Station Automation System with Relay and Protection Panels	Back-up control mimics and associated switchgear with two years proven field experience for HV applications. The distributed back-up control mimic shall be installed along with the bay controller IED which can be used in case of maintenance or emergency or if bay control IED fails. Local bay control via the back-up control mimic.	We have not considered any back-up control mimic for offered 400kV, 220kV and 132kV CRP since it is a GIS substation with local control cubicle available as a backup in case of failure of bay controller (BCU). Please confirm our understanding.	Confirmed
56	Cl no 14.7 / Sub-Station Automation System with Relay and Protection Panels	Synchronizing equipment	We have not considered any synchronization trolley, synchronization socket for 400kV, 220kV and 132kV system since synchronization check feature is part of BCU. Please confirm. In case standalone panel to be provided with trolley then please include the same as a separate item in price schedule.	Confirmed
57	Cl no 23.1.2 and cl. No. 23.2 / Sub-Station Automation System with Relay and Protection Panels	Cl. No. 23.1.2 In case of 400KV and 220KV XLPE cables Distance protection will be used as Main-I whereas the current differential protection will be used as Main-II protection. In case of 132KV XLPE cables current differential protection will be used as Main protection. Cl no. 23.2.2 i) Main – I : Numerical, Communicable Distance protection scheme. ii) Main – II : Numerical, Communicable Line Current Differential with backup Distance protection scheme.	As per specification cl. No. 23.1.2, distance protection to be provided for 400kV, 200kV and 132kV lines but in case of cable connection, line differential protection to be provided whereas in cl. No. 23.2, Main-1 Distance and Main-2 Line differential protection specified for 400kV and 220kV lines. Please clarify the actual protection requirement. We have considered distance protection on lines.	Line Protection: On all the lines distance protection should be provided on main-I & main- II . Makes of both the protection shall be different.
58	Cl no. 23.2 / Sub-Station Automation System with Relay and Protection Panels	i) Main – I : Numerical, Communicable Distance protection scheme. ii) Main – II : Numerical, Communicable Line Current Differential with backup Distance protection scheme.	In case Main-2 line differential protection is to be considered for 400kV and 220kV lines then we understand that bidder's scope is limited to loose supply of remote end line differential relay which shall be installed in existing panel at remote end. Please confirm our understanding.	Line Protection: On all the lines distance protection should be provided on main-I & main- II . Makes of both the protection shall be different
59	Cl no. 23.5.8 / Sub-Station Automation System with Relay and Protection Panels	Control and relay panel for 72.5kV and 33kV system	Please include the Control and relay panel for 72.5kV equipment and 33kV equipment as a separate line item in price schedule. Also, include the same in SAS item of price schedule.	Protection for 72.5kV shall be included in transformer protection panel. Only fuse protection to be provided for 33kV system
60	Cl no. 23.6. h / Sub-Station Automation System with Relay and Protection Panels	Under frequency relay scheme	We have not envisaged Under frequency relay scheme in present scope as the same is not mentioned in price schedule. Please confirm.	Confirmed
61	Cl no. 24 / Sub-Station Automation System with Relay and Protection Panels	TEE protection	We have not envisaged TEED protection in present scope as the same is not applicable for double bus scheme. Please confirm.	Confirmed

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62	Cl. No. 25 / Sub-Station Automation System with Relay and Protection Panels	Rotational Under frequency relay scheme	We have not envisaged Rotational Under frequency relay scheme with PLC based load shedding scheme in present scope as the same is not mentioned in price schedule. Please confirm.	Confirmed
63	Annexure-I, Item no. B / Sub-Station Automation System with Relay and Protection Panels	Energy Meter (ABT Compliant Trivector meter, 1 No. Of Accuracy: 0.2, SCADA Compatible)	As per energy meter specification one no. Main and one no. Check meter to be provided for each circuit whereas the relay and control panel configuration indicates only 1 no. ABT type meter for each circuit. Please clarify the actual requirement.	One no. Main and one no. Check ABT meter (one set) of control panel mounted type for 400kV lines to be provided. Electronic energy meters are to be provided on control panels of each bay 200kV and 132kV line & Transformer.
	Cl no. 3.2 / Energy Meter-CMRI		Also, we understand that ABT meter is to be mounted in respective bay CRP. Standalone metering panel is not envisaged. Please confirm.	
		One static type composite meter along		
		with one check meter shall be installed for each circuit,...		
64	Price schedule item no. G. 6.	Energy meter and CMRI	As per price schedule 4 nos. Main and 4 nos. Check meters are to be provided. Please inform the feeders for which these metres are to be provided. We have not considered any dedicated CT and VT for these meters. Please confirm.	One no. Main and one no. Check ABT meter (one set) of control panel mounted type for 400kV lines to be provided. Electronic energy meters are to be provided on control panels of each bay 200kV and 132kV line & Transformer.
65	General	Busbar protection- Future bays	We have considered Busbar protection with peripheral units for bays under present scope of works at all voltage level. Future bays peripheral unit not envisaged in present scope. Please confirm our understanding.	In present scope of supply.
66	Price schedule item no. G.5.b	Testing & Maintenance equipment	Please clarify the item to be quoted under 'Testing & Maintenance equipment' .	Please quote as per "Price Schedule".
67	General	400kV Line Length	Please confirm ii) Line distance between 400kV Shamli-400kV Aligarh DC Lines	Length of 400kV Shamli-400kV Aligarh DC Lines (235 KM).
		220kV Line Length		Length of 220 KV Lines i) Shamli(220)--to- Shamli(400) 23 KM ii) Nanauta(220)--to-- Shmali(400) 36 KM
		132 kV Line Length		Length of 132 KV Lines i) Jalalpur (Bannat)--to- Shamli(400) 10 KM ii) Thanabhawan--to- Shamli(400) 22 KM iii) Budhana--to- Shamli(400) 21 KM iv) Kharad--to- Shamli(400) 15.5 KM
68	Fault Level/ Cl. No. 3.1.1 B (a) / 400 KV GIS	Fault Level for 400kV.	As per Section – 1, Cl. No. 3.1.1 B (a), 400kV GIS (a), Fault level mentioned 50/63 kA. Please confirm the final fault level and duration of time for 400kV.	Fault level 50 KA for 3 sec for 400 KV, as mentioned in "Price Schedule"
69	Fault Level/ Cl. No. 3.1.1 B (a) / 220 KV GIS	Fault Level for 220kV.	As per Section – 1, Cl. No. 3.1.1, 220kV GIS (a), Fault level mentioned 40/50kA. Please confirm the final fault level and duration of time for 220kV.	Fault level 40 KA for 3 sec for 220 KV, as mentioned in "Price Schedule"
70	Section – 1, Scope of works, Cl. No. 3.1.1, 400kV GIS (c & d) , & 220 KV GIS & 132 KV GIS Supply schedule Q1, S. No. B. C & D. & Cl. No. 3.4.7 of Technical specification GIS,	400kV GIS Transformer, Line & Reactor Bay Module= 2000 A Circuit Breaker. 220kV GIS Transformer, Line Bay Module= 2000 A Circuit Breaker 132kV GIS Transformer, Line Bay Module= 1600 A Circuit Breaker & 400 KV SF6 gas insulated circuit breaker (3150A), 220 KV SF6 gas insulated circuit breaker (2500A), and 132 KV SF6 gas insulated circuit breaker (1600A). ii) Feeder and Transformer Bay – 2000Amps (400 KV & 220 KV) ii) Feeder and Transformer Bay – 800Amps (132 KV)	We have observed a discrepancy in Circuit Breaker current rating for all voltage level (400 KV, 220 KV & 132 KV) of different sections of Section Scope of works , Bill of Material and Technical Specifications for GIS. As per Scope of works, Cl. No. 3.1.1, 400 KV Circuit Breaker rating is mentioned as 2000 A for Transformer, Reactor and Line bays. 2000A Circuit breakers for 220 KV Line and Transformer bays and 1600 A Circuit Breakers for 132 KV Line and Transformer bays. Whereas as per Bill of material, 400 KV Circuit Breaker rating is mentioned as 3150 A for Transformer, Reactor and Line bays. 2500 A Circuit Breaker rating for 220 KV Line and Transformer bays and 1250 A circuit breaker rating for 132 KV line and Transformer bays. As per technical specification for GIS, Cl. No. 3.4.7, feeder and Transformer bays Circuit breaker rating is mentioned as 2000Amps for 400 KV & 220 KV and 800 A for 132 KV voltage level. We request kindly clarify the Circuit breaker rating to be considered by the bidder for Line, transformer and reactor bays for all voltage level (400 KV, 220 KV & 132 KV).	The ratings shall be as per "Price Schedule".
71	Section – 1, Scope of works & Supply schedule Q1, S. No. B.2 & Cl. No. 3.4.7 of Technical specification GIS, page no. 6 of 80	Bus reactor bay module	We would like to inform you that, under section – 1, Scope of works, Bus reactor module description is not mentioned. However, the same is indicated in SLD and Bill of Material. We request kindly furnish the same.	The same shall be considered in scope.
72	Section – 1, Scope of works, Cl. No. 3.1.1 (H) & Supply Schedule – Q1, S. No. – M	NIFPES System & Fire prevention and extinguishing system	As per Section – 1, Scope of works, NIFPES is mentioned however as per Supply Schedule – Q1 only or Fire prevention and extinguishing system is mentioned. We understand NIFPS system is excluded from bidder's scope of work as same is not appearing in Schedule Q (Price Schedule). And only Fire prevention and extinguishing system (HVW system) is to be provided by bidder. Please confirm our understanding.	Both NIFPES & HVW Spray, fire prevention and extinguishing Systems are required for both 500MVA & 200MVA Transformers
73	Section – 1, Scope of works, Cl. No. 3.2.(iii), GIS cum control room building	The minimum height of crane hook shall be 9.0 meter or as per actual requirement whichever is higher.	We understand that 9 meter minimum crane hook height is tentative and is not applicable for all voltage levels i.e. 400kV, 220kV and 132kV GIS Hall.	The Minimum height of crane hook shall be as per specification. However, the actual requirement shall be decided during detailed engineering after award of contract keeping in view the actual

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	Control room building,		Bidder will decide the Minimum crane hook height as per OEM recommendation and O&M requirement. Please confirm.	engineering after award of contract keeping in view the actual height of GIS Modules for all three voltage (400kV, 220kV, 132kV) levels offered by bidder.
74	Section – 1, Scope of works, Cl. No. 3.2.(iii), GIS cum control room bldg.	Handle at least two times the maximum weight of the heaviest package of GIS but shall not less than 10 tones for 400kV.	We understand bidder can select the crane capacity as per OEM recommendation or Handle at least two times the maximum weight of the heaviest package of GIS for 400kV which ever is higher. Please confirm.	This shall be as per specification. However the same shall be at least two times the maximum weight of the heaviest package of GIS module offered by the bidder. The approval of Purchaser shall be required during detailed engineering after award of contract.
75	Section – 1, Scope of works, Cl. No. 3.2.(iii), GIS cum control room bldg.	Handle at least two times the maximum weight of the heaviest package of GIS but shall not less than 6 tones for 220kV.	We understand bidder can select the crane capacity as per OEM recommendation or Handle at least two times the maximum weight of the heaviest package of GIS for 220kV which ever is higher. Please confirm.	This shall be as per specification. However the same shall be at least two times the maximum weight of the heaviest package of GIS module offered by the bidder. The approval of Purchaser shall be required during detailed engineering after award of contract.
76	General	EOT Crane	Please furnish the type of EOT Crane, either single girder or double girder for 400kV, 220kV & 132kV GIS hall.	Double girder type.
77	Cl. 3 / 2. 220 KV GIS (d) 220 KV Cable Termination Kits/ Section 1/ Invitation for pre qualification	Cable termination kit shall be of dry type for connection with GIS and overhead conductor	We request you to accept Oil type 220 KV & 132 KV out door termination kits for connection with GIS and overhead conductor. We would like to inform you that this is in line with the type of 220 KV & 132 KV termination kits already supplied for ongoing UPPTCL jobs at Kanpur road and Neembu park package. Request you to please accept the same.	As IS/ IEC standard/ UPPTCL standard
78	Section-I 12of 1270 (H)	Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES).	We understand that NIFPES is required for both transformer and reactor. Please confirm.	The NIFPES is required for both transformer and reactor.
79	Section-I 14 of 1270 (AD)	A tentative layout of the switchyard is enclosed with this specification. Bidder may adopt similar arrangement or optimize the same further without affecting any of the functional requirements specified.	We have not found any tentative layout of switchyard. Kindly provide the same.	A tentative layout of the switchyard is enclosed herewith for reference. However the Bidder may adopt similar arrangement or optimize the same further without affecting any of the functional requirements specified.
80	Section-I 14 of 1270 (AJ)	SF6 Gas Filling & Evacuation Plant, Portable Partial Discharge Monitoring equipment (as per Specification) along with ten nos. Gas masks etc	We have not found any line item for portable partial discharge monitoring equipment in Supply schedule. Kindly add this item in price schedule.	Item V ,1.9 "Tools and Plants"
81	Section-I 16 of 1270 3.2-iii	Dimensions of the GIS rooms shall be decided by the bidder during detailed engineering depending upon the requirement. The Bidder will keep the provision for extension of the GIS rooms to meet the future requirement for extension of bays. Provision for service bay shall also be made. A corridor having minimum width of 1500 mm shall be provided all around GIS rooms to facilitate maintenance of equipments.	Kindly confirm the number of future bays for which space to be kept in GIS Hall.	To meet the future requirement, provision for extension of 04 nos. bays each for 400 KV, 220 KV and 132 KV class shall be made inside the GIS room. Accordingly arrangement for panels inside Relay and Protection panel room shall also be made.
82	Section-I 17 of 1270 -	Electric Overhead Travelling Crane (EOT) The minimum height of crane hook shall be 9.0 meter or as per actual requirement whichever is higher.	The Minimum height of crane hook shall depend on GIS height and will be different (not 9 mtr) for all three voltage (400kV, 220kV, 132kV) level. Please confirm.	The Minimum height of crane hook shall be as per specification. However, the actual requirement shall be decided during detailed engineering after award of contract keeping in view the actual height of GIS Modules for all three voltage (400kV, 220kV, 132kV) levels offered by bidder.
83	Price Schedule Supply-Q1 2	2.1(a) 245kV, 1-Core, 1200sq.mm, XLPE copper cable along with termination kit etc. for 220kV GIS as per design and rating (however the quantity shall be worked out by the bidder) 2.2(a)145kV, 1-Core, 630sq.mm, XLPE copper cable along with termination kit etc. for 132kV GIS as per design and rating (however the quantity shall be worked out by the bidder) 2.3(a) 36kV, 1-Core, two run, 630sq.mm, XLPE copper cable with termination kit as per design and rating (however the quantity shall be worked out by the bidder)	A) Kindly break the items as following for 245kV, 145kV and 33kV Cable. i) Cable(mtr) ii) Termination kit(nos.) iii) Accessories(Link boxes etc) B) We understand that qty of cable in price schedule in only tentative and actual qty of cable shall be worked by bidder as per layout and payment shall be done on the basis of unit rate quoted in price schedule. Please confirm.	A) These shall be worked out by the bidder. B) The quantity of cable indicated in price schedule has been decided as per standard estimation. However, if the actual requirement of quantity worked out by the bidder increased/ decreased as per site conditions after detailed engineering, the provision for quantity variation shall be made as per our tender specification only.
84	Price Schedule Supply-Q1 P	3. GS Shield Wire 3.1: 10.98 mm GI Shield Wire: 1200mtr	We understand that shield wire/earth wire is already covered in s.no. P-3.1 of Price schedule, therefore we are not considering shield wire in erection hardware. Please confirm.	Confirmed
85	Price Schedule Supply-Q1 S	Erection Hardware Insulator strings, Disc Insulators, Hardware conductor, bus-bar materials, cable trays, Bay MB, clamps, spacers, connectors including equipment connectors, junction box, earthwire, earthing material risers, buried cable trenches./pipe equipment & lighting, all accessories etc. for the following:		
86	Price Schedule Supply-Q1 H	PLCC Equipment 2.0 PLCC Cabinet(Digital) 2.8: Digital Protection Coupler	Kindly provide specification for digital PLCC and digital protection coupler.	As per latest standard IS/ IEC of digital PLCC cabinet and Protection Coupler

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87	Price Schedule Supply-Q1 M-(1.1)	Fire prevention & extinguishing system HVW spray system, Hydrant system and complete U/G & O/G piping and accessories etc. out side the pump house for 2x500 MVA, 2x200 MVA Auto Transformers and 63 MVAR Bus Reactor.	As per specification "Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES)" is required for transformer, however as per price schedule HVW spray system is required. Kindly confirm whether NIFPES is required or not. If yes, kindly add line item for this in price schedule.	"Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES)" is an integral part of transformer specification and must be supplied with the transformer. However as per specification HVW spray system is also required
88	Price Schedule Supply-Q1 V	Tools and Plants	We have not found specification of following tools & plant asked in price schedule. Kindly provide specification of these items.	Most of specifications of "Tools and Plants" are herewith enclosed. The specifications of items which are not provided by us shall be of standard make as per latest IS/ IEC standard.
89	Price Schedule Supply-Q1 N	Illumination System with LED/CFL/Metal Halide Lamp as per technical specification(All the lights & fittings shall preferably be of LED type)	We understand that all fixture shall be LED type, However, we have not found any details/type of LED fixture required. Kindly provide the specification fo LED fixtures.	The Technical Specifications of LED shall be of standard make as per latest IS/ IEC standard.
90	Technical Specification SAS 689 of 1270 9	Large Video Display System:	Please confirm whether any LVS is required or not.	Visual Display Unit shall be as per clause 4.1.1.1 Visual Display Units/ TFT's (Thin Film Technology) of "Substation Automation System".
91	General		As Substation automation system(BCU based) is required, therefore we understand that any convetional backup control panel is not required. Please confirm.	Substation Automation System(SAS based) is required.
92	General	Funding	Please confirm the source of Funding for the project.	Source of Funding shall be through REC/ PFC scheme to be submitted by consignees of field unit.
93	Special Conditions of Specifications. page-101 of 1270 Clause 11.0	The substation has to be erected, tested and commissioned with in 18(eighteen) months from the date of letter of intent or from the date of handing over of land whichever is later.	Please confirm that the Project land shall be handed over to the successful bidder within one month from the date of LOI. If the handing over of the land is delayed by UPPTCL beyond one month from the date of LOI, the completion time shall be extended suitably covering such delayed period. Also the price variation for the delayed period shall be paid by UPPTCL based on IEEMA indices.	As specified in tender specification, "The completion period for 400kV substation shall be 18(eighteen) months from the date of issue of LOI or from handing over of the land whichever is later." Since this is a firm price based contract, as such no price variation for the delayed period shall be allowed by UPPTCL based on IEEMA indices.
94	Special Conditions of Specifications page-98 of 1270 Clause 7.0	The Prices of all the items and services quoted in the Price Schedules shall be shall remain "Fixed and Firm" in all respects during the currency of the contract. The prices of spare parts shall remain 'Firm' and valid for a period of three years from the date of taking over of the substation by UPPTCL.	Keeping the frequent changing of price trend for various raw materials in view, it is suggested that "VARIABLE" prices may be considered in place of "FIRM" prices. Also we request M/s UPPTCL to consider providing at least 10% interest free advance for supply as well as for Civil & ETC Work so that smooth execution of work is ensured.	This is a firm price based contract, hence variable prices may not be considered for any item by UPPTCL. Interest free advance for supply items as well as for Civil & ETC Work shall not be considered as per our tender specification.
95	Special Conditions of Specifications page-95 of 1270 Clause 3.4	QUANTITY VARIATION The quantities of individual items/works under any or all the above contracts may vary to any extent, however the total value of such variations shall not exceed the 10% of the aggregate contract value.	As per clause no. 3.4, no limit has been stipulated for negative quantity variation. M/s UPPTCL is requested to set a limit up to 10% for negative quantity variation also.	No change.
96	Form-A. page-216 of 1270 Clause 28	Payment shall be due and payable by the Purchaser in accordance with the provisions of clause 25..... provided that the Purchaser shall not be bound to make any payment represents at least 8 percent of the total Contract value of the plant.	M/s UPPTCL is requested to remove this clause as this will adversely affect the cash inflow of contractor.	No change.
97	Instructions to Bidders page-79 of 1270 Clause 1.1	The land for substation bays shall be made available to the Bidder on 'as is where is' basis. Further levelling and development of land shall be in the Bidder's scope.	We request UPPTCL to provide levelled land developed upto FGL, with security fencing , free of any encumbrance/encroachment and not on 'as is where is' basis for subject project.	Please accept the clause as such.
98	Form-A. page-206 of 1270 Clause 3	Further, if required by the Purchaser, the Contractor shall deposit with the Purchaser as security for the due and faithful performance of the Contract such sums not being less than one per cent of the total value of the Contract as may be fixed by the Purchaser either in case or in any other form approved by the Purchaser. The security deposit shall be refunded to the to the Contractor on the satisfactory completion of tests and the taking over of the plant by the Purchaser.	Since,Performance BG has to be submitted to UPPTCL. Kindly Confirm whether Security deposit has to be additionally provided to UPPTCL at contract stage.	Please accept the clause as such.
99	GIS Specification 1.1 3.4 (I) (1)	All parts of the switchgear should be single phase (segregated) enclosed for 400 kV & 220 kV GIS and single phase/ three phases encapsulated for 132 kV GIS 220 kV System : Single Phase Segregated	For 245 kV Volatge level GIS, manufacturer's request to accept both "Three phase enclosed" design and "Single Phase enclosed" design of GIS in line with all earlier 245 kV GIS tenders in UPPTCL. The three phase enclosed design is also accpeted by all major state and central utility customers including PGCIL. Request for your acceptance.	As per UPPTCL earlier GIS tenders.
100	GIS Specification 3.4 II (18) (ii) & (iii)	Line charging current Cable charging current	The Line charging and cable charging current shall be as per the IEC	As per specification/ latest IEC standard.
101	GIS Specification 5.7	5.7 The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300 ms at rated short time withstand current.	The burn through time shall be as per IEC 62271-203	As per specification/ latest IEC standard.

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102	GIS Specification 12.1	A bursting pressure test shall be carried out at 5 times the design pressure as a type test on each type of enclosure.	The GIS manufacturer has to submit the valid type test report to proof the strength of enclosure but conduction/repetition of type test is not required. Please confirm	In case as per requirement the repetition of Type tests shall be carried out by the bidders without any extra cost to the purchaser. Please accept the clause as such.
103	GIS Specification 14.6.4	The gap between the open contacts shall be such that it can withstand atleast the rated phase to ground voltage for eight hours at zero pressure above atmospheric level of SF6 gas due to its leakage.	The caluse is not applicable for GIS as per IEC.	The caluse shall be as per specification/ as per IEC standard for GIS.
104	GIS Specification 17.1	Disconnectors shall be of the single-pole, group operated type,	The disconnector for 245 kV GIS and 145 kV GIS shall be Three phase group operated type. Please confirm	As per specification
105	GIS Specification 29.1	(2) GIS bus ducts of each circuit shall be arranged in preferably horizontal formation and the clearance (outer to outer) between nearest bus ducts of two adjacent circuits shall be minimum one (1) meter. (4)The minimum outer to outer horizontal clearance between each GIS bus duct shall be 0.75 meter for 400 kV voltage level and 0.5 meter for 220 kV & 132 kV voltage level.	The clarence between the bus duct will be as per the GIS manufacturer standard practice. Request for your acceptance.	As per specification.
106	GIS Specification 38.1.2 4.1.1 (d)	38.1.2 In case that the equipment of the type and design offered has already been type tested, the bidder shall furnish type test reports which are certified by internationally authorized/accredited laboratory along with the offer. The typetest reports of GIS offered and the individual switchgear and control gear equipment of the GIS offered shall not be earlier than 5(five) years as on the date of opening of bids. The type tests should have been conducted within last 10(ten) years from the date of opening of Bids.	We understand that the GIS type test reports shall be within 10 years from the date of opening as per the Qualification requirement. Please confirm. For 420 kV, 245 kV and 132 kV GIS, the type test reports conducted by Parent company/group Company/Collaborator/ Subsidiary company, within last ten (10) years, on similar design equipments will be accepted. Please confirm.	As per specification.
107	GIS Specification 38.1.2 38.1.3	38.1.2 The Purchaser reserves the right to demand repetition of some or all the type tests in the presence of the Purchaser's representative without any extra cost. 38.1.3 The Purchaser may decide to get some or all for the following "special type tests" conducted. The type test charges for these tests shall be quoted along with other type tested as per IEC: 62271-203.	We understand that GIS manufacturer has to submit all the valid type test report for the 420 kV GIS, 245 kV GIS and 145 kV GIS but the repetition/conduction of any type test or special test is not envisaged. Please confirm.	In case as per requirement the repetition of Type tests shall be carried out by the bidders without any extra cost to the purchaser. Please accept the clause as such.
108	GIS Specification 38.3.4	38.3.4 The bidder shall provide one set of high voltage test equipment suitable for testing of 400kV, 220kV and 132kV GIS and include in the offer	We understand that the HV test kit has to supplied at site on returnable basis. i.e after completion of the HV test the GIS manufacturer will take the HV test kit back. Request for your confirmation.	High Voltage Testing Kits required at site shall be provided by the successful bidder on returnable basis.
109	Project Scope 3.1.1 (B) 400 kV GIS	Bus Reactor Bay module	The Bus reactor Bay module requiremnet is mentioned in the BOQ but the details of the Bus reactor bay are not mentioned in the scope.	The same shall be considered in scope.
110	Project Scope 3.1.1 (B) 400 kV GIS	Surge arrestor and Voltage transformer	We understand that GIS type surge arrestor and voltage transformer are not to be provided in any bays in the GIS. Please confirm.	Only 145 KV voltage transformers are to be provided in bay module. All surge arresters, 420 KV & 245 KV Capacitor Voltage Transformers are outdoor equipments.
111	Project Scope 3.1.1 (B) 220 kV GIS	Surge arrestor and Voltage transformer	We understand that GIS type surge arrestor are not required in any bays in the GIS and GIS type voltage transformer are only in the 06 nos transmission line feeder bay of GIS. Please confirm.	Only 145 KV voltage transformers are to be provided in bay module. All surge arresters, 420 KV & 245 KV Capacitor Voltage Transformers are outdoor equipments.
112	Project Scope 3.1.1 (B) 145 kV GIS	Surge arrestor and Voltage transformer	We understand that GIS type surge arrestor are not required in any bays in the GIS and GIS type voltage transformer are only in the 05 nos transmission line feeder bay of GIS. Please confirm.	Only 145 KV voltage transformers are to be provided in bay module. All surge arresters, 420 KV & 245 KV Capacitor Voltage Transformers are outdoor equipments.
113	BOQ Technical Specification_GIS B.4 3.4-I.7	Bus Bars: 420kV, 50kA, single phase (isolated) units SF6 gas insulated, metal enclosed 4000A bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnector, safety grounding switch, Local Control Cubicle, SF6 gas monitoring system etc. as per technical specification. Rated continuous current rating at design ambient temperature i.e. 50 0C i) Busbar and Bus coupler Bay -3000A	As per BOQ(BPS) current rating for 420 kV Busbar is 4000 A whereas as per Technical Spec current rating for 420 kV Busbar is 3000 A. Please confirm whether Busbar rating as 3000 A shall be considered.	Current rating for 420 kV Busbar is 4000 A, as per BOQ "Price Schedule"

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114	Invitation for Prequalification & BOQ Section-I, 3.1.1 (B)		As per scope of works under specification Clause No. 3.1.1 B 400 kV GIS (a) 2000 A Circuit Breakers are required for Transformer Bays, Feeder Bays and Reactors Bay. However in BOQ(BPS) circuit breakers of 3150 A is mentioned under Transformer Bays, Feeder Bays and reactors Bay. Please confirm which one shall be followed.	As per BOQ "Price Schedule"
115	Invitation for Prequalification & BOQ Section-I, 3.1.1 (B)		As per scope of works under specification Clause No. 3.1.1 B 220 kV GIS (a) 2000 A Circuit Breakers are required for Transformer Bays and Feeder Bays. However in BOQ(BPS) circuit breakers of 2500 A is mentioned under Transformer Bays and Feeder Bays. Please confirm which one shall be followed.	As per BOQ "Price Schedule"
116	BOQ & GTR (Clause no.6)		Short time current rating mentioned in BOQ(BPS) and in General Technical Requirement under Technical Specification are not matching with each other. We are considering following rated short time current i. For 420 kV 50 kA for 1 Sec. ii. For 245 kV 40 kA for 1 Sec. iii. For 145 kV 40 kA for 1 Sec. iv. For 72.5 kV 25 kA for 1 Sec. v. For 36 kV 25 kA for 1 Sec. Please confirm.	As per BOQ "Price Schedule"
117	Invitation for Prequalification & Tender SLD Section-I, 3.1.1 (B) 400kV GIS (a)		As per scope of works under specification Clause No. 3.1.1 B 400 kV GIS (a) one number Earth Switch considered for 420 kV Bus Potential Transformer connection. However in SLD two numbers Earth Switches shown. We are considering one number Earth Switch for 420 kV Bus PT. Please confirm.	shall be as per clause.
118				
119	Invitation for Prequalification & Tender SLD Section-I, 3.1.1 (B) 220kV GIS (a)		As per scope of works under specification Clause No. 3.1.1 B 220 kV GIS (a) one number Earth Switch considered for 245 kV Bus PT connection. However in SLD two numbers Earth Switches shown. We are considering one number Earth Switch for 245 kV Bus PT. Kindly confirm.	shall be as per clause.
120	Invitation for Prequalification & BOQ Section-I, 3.1.1 (B) 220kV GIS (a)		As per scope of works under specification Clause No. 3.1.1 B 220 kV GIS (d) three numbers inductive PT along with isolator are coming under GIS feeder module however as per BOQ(BPS) 18 Nos outdoor CVT are considered for feeder bays. As per our understanding inductive PT are not required inside GIS module. Kindly confirm.	inductive PT are not required inside GIS module.
121	Invitation for Prequalification & BOQ Section-I, 3.1.1 (B)		As per BOQ(BPS) and Scope of work current rating for 145 kV Busbar , Feeder and Transformer Bays are 2000 A, 1600 A and 1600 A respectively. However as per Technical Specification for GIS the same ratings are 1200 A, 800 A and 800 A respectively. Please confirm which one to follow.	As per BOQ
122	BOQ		For 145kV GIS, CT Ratio and Disconnecter rating shall be followed as per BOQ(BPS). Please confirm.	As per BOQ
123	Technical Specification_GIS & BOQ		As per Technical Specification for GIS current ratio for 220 kV CT for Feeders Bay, Transformer Bays and Buscoupler Bays are 1600-800-500-300/1A. However as per BOQ(BPS) the same is 2000-1600-1000-500 / 1 A. Kindly confirm which one to follow.	As per BOQ
124	TS GIS-3.4 -III - 8 BOQ -1-I-C-3.0		As per Technical Specification for GIS current ratio for 220 kV Disconnecter for Feeders Bay are 1600 A. However as per BOQ(BPS) the same is 2000 A. Kindly confirm which one to follow.	As per BOQ
125	BOQ -1-I-E		As per our understanding 72.5 kV equipments mentioned in BOQ(BPS) to be connected with Tertiary winding of one no. 500 MVA Transformer to supply one number Aux transformer. Aux Transformer to be placed adjacent to the transformer so that it can be connected directly through conductor. Hence no 72.5 kV cable envisaged under present scope of work.	The price shall be included in BOQ , S "Erection Hardware" at sl.no. 4 "Erection Hardware for the 72.5 kV and 36 kV"
126	BOQ -1-I-N		In the BOQ(BPS) it is mentioned that LED lightings are preferable. As per our understanding LED lighting is mandatory. Please confirm.	As per BOQ.
127	Tender SLD		Outdoor 145 kV PT is shown in SLD however the same is not included in BOQ(BPS). Kindly confirm the requirement.	145 kV PT is a part of GIS module.
128	BOQ -1-I-O-2		Quantities of HT Power Cables are given. We understand that price of any extra quantity required to complete the scope to be borne by the customer. Kindly confirm.	In the scope of Bidder
129	TS LS-7-v		Please confirm whether Outdoor / SWYD Lighting Fixtures can be mounted on Substation Tower-Gantry.	As per specification.
130	TS LS-1.2-i		We understand 400 kV 220 kV and 132 kV Swyd area means the equiped area under present scope. Kindly confirm.	400 kV 220 kV and 132 kV Swyd area are as per detailed design and engineering by the Bidder'
131	Section-V-ITB 2.2.1 Bid Part-I	Bidder is required to deposit earnest money Rs. 6,00,00,000.00(Rs. Six crore only) as stated above.	Please provide the EMD validity period.	12 months
132	Section-V-SCC 1.2 e) O&M period	Commissioning, putting into successful operation and handing over of complete substation after successful operation and maintenance.	Please specify O&M period.	There is no O&M period. However the substation shall be handed over after commissioning and successful operation and maintenance.

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133	Section-V-SCC 9.1.1 supply payment	In case of supply- Payment shall be made as detailed below:- (a) 80% payment of supplied equipment after completion of the foundation of equipment. (b) 10% payment after erection of equipment. (c) Balance 10% amount to be released after satisfactory commissioning of entire substation, 100% completion of all electrical and civil works, adjustment of liquidated damaged if any and issuance of taking over certificate	We understand that balance 10% shall be released after completion and successful commissioning of entire Substation . Please confirm our understading.	OK, shall be as per Payment Clause of the specification.
134	I & ii	90 % of running bill once in a month and balance 10 % on issuance of TOC	We understand that balance 10% shall be released after completion and successful commissioning of entire Substation . Please confirm our understading.	OK, shall be as per Payment Clause of the specification.
135	Section-V-SCC 28.1 Performance Security Guarantee	The Gurantee period for Transformers and GIS shall be 60 months from date of taking over of facilities and 12 months from taking over for all balance items. The date of taking over will date of commissioning of substation suitable for commercial use .	we understand that TOC shall be issued after successful commissioning of the Substation and O&M is not linked with TOC. Please confirm our understanding.	OK, shall be as per Clause of the specification.
136	Section-V-SCC 28.2 Deposit for Performance Guarantee	BG is to be valid for maintenance period with 6 months claim period thereafter and needs to be extended every year for 4 years	We understand tha only BG towards GIS modules and Transformers wil be extended as Guarantee period is 60 months From TOC. Please confirm,	OK, shall be as per Clause of the specification.
137	Section-V-SCC 29.2 Responsibility of Bidder for completeness of contract	The Purchaser shall have the right to require the Bidder to make any changes in the general arrangement which may be necessary in the opinion of the Engineer to make the equipment to conform to the provisions and the intent of the contract specification without additional cost to the Purchaser.	Request you to limit the date of this change before design approval of the equipment.	Any necessary changes in the general arrangement shall immediatetly be carried out for design approval.
138	Section-V-SCC 41 Replacement of defective parts / equipment / works & rectification of defects	In case any defect is discovered at site after taking over of the Substation by the Purchaser in the materials supplied or works done by Bidder, the Bidder at his own cost shall rectify the defect/ replace the equipment or material promptly as soon as informed by the Purchaser.	We understand that this provision shall only be limited to DLP / guarantee period. Please confirm.	Rectification of the defect/ replacement of the equipment or material shall be as per our tender specification.
139	Section-V-SCC i where spare is procured	damaged equipment to be replaced by spare and damaged equipments will be got replenished by the contractor on their own cost and the same shall be kept as spare after replenishment.	We understand that the damaged equipment shall be repaired and replenished. Please confirm.	Please accept clause as such.
140	Section-V-SCC ii where spare is not procured	replacement may be provided by UPPCL and same shall be installed by the contractors and the damaged equipments shall be got replenished from the manufacturer by the contractor	We understand that the damaged equipment shall be repaired and replenished. Please confirm.	Please accept clause as such.
141	Section-V-SCC a) Damage of equipment after Guarantee Period			
142	Section-V-SCC i	If it is established that the equipment got damaged due to contractor's negligence, the equipment shall be made available at site by UPPTCL and the entire cost of the equipment including its installation shall be recovered from the contractor.	We understand that after the completion of Guarantee period contractor is not responsible for any damage and their shall not be any commercial implication to contractor. Please confirm our understanding.	Please accept clause as such.
143	Section-V-SCC ii	If it is established that the equipment got damaged due to abnormal system conditions, and the contractor can not be held responsible for the damage, the damaged equipment will be replaced by spare if available, and the damaged equipment shall be made available to UPPTCL. In case the damaged equipment has not been procured as spare, the same shall be made available to contractor at site by UPPTCL within a reasonable time. The damaged equipment shall be replaced by the contractor and the damaged equipment shall be made available to UPPTCL.	We understand that after the completion of Guarantee period contractor is not responsible for any damage and their shall not be any commercial implication to contractor. Please confirm our understanding.	Please accept clause as such.
144	Section-V - FORM-A-GCC 4 Contract Drawings	Within a reasonable period of the notification by the Engineer to the Bidder of his approval of such drawings, three sets in ink on tracing cloth or ferrogalic prints mounted on cloth, of the drawings as approved shall be supplied to him by the Bidder....	Please clarify whether this provision is applicable even in this project.	As per UPPTCL practice or latest provision.
145	Section-V - FORM-A-GCC 7-A Training of Engineer	Contractor to sign separate contract agreement for traning of purchaser's engineer.	Please clarify whether training of purchaser's engineers will be covered to separate contract and beyond the scope of current contract.	Please accept clause as such.

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146	Section-V - FORM-A-GCC 20 Bidder's representative and workmen	The Purchaser shall provide suitable living accommodation on the site for the use of Bidder's representative unless the Bidder exempts him from this liability.	please confirm this provision is applicable for contractor staffs of the project, and provide the extent of furnishing for the same.	Please accept clause as such.
147	Section-V - FORM-A-GCC 21 liability for accidents and damage	Provided that the Bidder shall not be liable for any loss of profit or loss of Contract or any other claim made against the Purchaser not already provided for in the Contract, not for any injury or damage caused by or arising from the acts of the Purchaser or of any other person or due to circumstances over which the Bidder has no control, nor shall his total liability for loss, damage, or injury in this clause exceed the total value of Contract.	We understand contractor is not liable for any kind of direct and indirect consequential damages. Please confirm	Please accept clause as such.
148	Section-V - FORM-A-GCC 36 Maintenance	For a period of 12 (twelve) calendar months commencing from the date on which the plant is taken over or is deemed to have been taken over under clause 35 (called "the maintenance period") the Bidder shall remain liable to replace any defective parts that may develop in plant.....	Please confirm whether maintenance period is same as Defect Liability period for the subject package.	Please accept clause as such.
149	General	Construction power supply	Please confirm the distance from the nearest distribution company for construction power.	Please send your representative to enquire and getting for electricity connection for construction power.
150	Section -1, CL:3, 3.1.1, (AH)	Invitation for pre-qualification, Scope of work.	33kV incomer cable size, source of incomer supply and distance to be provided for 630 KVA, 33/0.433 kV Auxiliary transformer.	33 KV incomer cable size shall be as per "Technical Specification for Cable". The distance to 630 KVA transformer is to be done by the bidder during detailed engineering.
151	CL:3, principal parameters	SF6 GAS insulated Metal enclosed switchgear.	Please note that fault currents are indicated in the technical parameters sheet as 63KA/50KA/40KA for 400kV and 50/40kA for 220kV system. Please clarify how much fault current shall be followed by bidder for 400kV & 220kV.	It is indicated in "Price Schedule"
152		CONSORTIUM AGREEMENT	Request you to provide us asap the CONSORTIUM AGREEMENT format which is missing in the tender specification	We do not have the CONSORTIUM AGREEMENT format at this stage. Please follow the contents keeping in view the Clause "4.1.4 CONSORTIUM FIRMS" of tender specification.
153	GIS Specification 3.4 II (10) 420 kV GIS	Pre-insertion resistor requirement	The specification mentions the requirement of PIR but the BOQ and the SLD does not mention PI for the 420 kV GIS.Please confirm the requirement of PIR in the 420 kV GIS bays.	PIR for 400kV Circuit Breakers are:- Shamli to Aligarh DC lines
154	GIS Specification 5.7	5.7 The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300 ms at rated short time withstand current.	The burn through time shall be as per IEC 62271-203	As per specification/ latest IEC standard.
155	GIS Specification 14.6.4	The gap between the open contacts shall be such that it can withstand atleast the rated phase to ground voltage for eight hours at zero pressure above atmospheric level of SF6 gas due to its leakage.	The caluse is not applicable for GIS as per IEC.	The caluse shall be as per specification/ as per IEC standard for GIS.
156	GIS Specification 17.1	Disconnectors shall be of the single-pole, group operated type,	The disconnector for 245 kV GIS and 145 kV GIS shall be Three phase group operated type. Please confirm	As per specification
157	GIS Specification 38.1.2 4.1.1 (d)	38.1.2 In case that the equipment of the type and design offered has already been type tested, the bidder shall furnish type test reports which are certified by internationally authorized/accredited laboratory along with the offer. The typetest reports of GIS offered and the individual switchgear and control gear equipment of the GIS offered shall not be earlier than 5(five) years as on the date of opening of bids. The type tests should have been conducted within last 10(ten) years from the date of opening of Bids.	We understand that the GIS type test reports shall be within 10 years from the date of opening as per the Qualification requirement. Please confirm. For 420 kV, 245 kV and 132 kV GIS GIS we understand that the type test reports conducted by Parent company/group Company/Collaborator/ Subsidiary company, within last ten (10) years, on similar design equipments will be accepted. Please confirm.	As per specification.
158	GIS Specification 38.3.4	38.3.4 The bidder shall provide one set of high voltage test equipment suitable for testing of 400kV, 220kV and 132kV GIS and include in the offer	We understand that the HV test kit has to supplied at site on returable basis. i.e after completion of the HV test the GIS manufacturer will take the HV test kit back. Request for your confirmation.	High Voltage Testing Kits required at site shall be provided by the successful bidder on returnable basis.
159	Project Scope 3.1.1 (B) 400 kV GIS	Bus Rector Bay module	The Bus rector Bay module requiremnet is mentioned in the BOQ but the details of the Bus rector bay are not mentionedin the scope.	The same shall be considered in scope.
160	Invitation for prequalification Clause no.4.1.1 (b)		As per the referred clause GIS modules should be offered from manufacturer who have designed and supplied minimum 6 nos 400kV GIS modules and also having well equipped repair and maintenance facility in India. We understand that the GIS equipment should be offered from manufacturer who have designed and supplied minimum 6 nos 400kV GIS modules in India along with having well equipped repair and maintenance facility in India. Please confirm. Also, Kindly provide the list of documents to be enclosed in the bid for proving the repair and maintenance facility for GIS equipments.	Please enclose the documents available with you in the bid for proving the repair and maintenance facility for GIS equipments.

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161	Invitation for prequalification Clause no.4.1.1 (b)&€		GIS manufacturer who has established their factory in india and whose parent company is meeting the pre qualifying conditions of GIS manufacturer as mentioned in clause 4.1.1(b)& (e) of Invitation for prequalification can also supply the GIS modules. Please confirm.	Please follow the clause "Invitation for prequalification" Clause no.4.1.1 (b)&€ accordingly.
162	General		Kindly confirm if any manufacturer's authorization letter is required to be submitted along with the bid. If required kindly provide the format for the same.	If you have any documentary evidence proving the authorization, the same may be submitted alongwith the Bid.
163	CL no: 2 ITB, submission of Bids		The cl no: 2.1 of ITB states that " Bidder shall submit one hard copy of the bid. But whereas cl no : 2.2 states that "No tender document including tender fee, EMD BG and other commercial papers are required to be submitted in hard copy". As Both the clauses are contradictory, request you to confirm whether hard copy submission of Bid is required or not. If required kindly mention the deadline for the Hardcopy submission.	No tender document including tender fee and other commercial papers are required to be submitted in hard copy at the time of bid submission on etender portal. However, some important document such as EMD BG etc. shall be submitted as per tender specification.
164	Special conditions of specifications Clause no.43.5 (b)		As per the referred clause it is told that after the gaurantee period if the equipment gets damaged ,the entire cost of the equipment including installation shall be recovered from the contractor.However the contractor cannot be responsible for the damage for any equipment after guarantee period without any limitation. Even none of the manufacturers can give life time guarantee for their equipments. We request to keep the max cap of 5 years as the latent defect liability period from the date of post warranty of the respective equipments.	The gaurantee period of the equipments shall be as per our specification. Please accept the clause as such.
165	Special conditions of specifications Clause no.8		As per the referred clause we understand that the contract shall be treated as works contract. At present, the rate of GST applicable for works contract is 18%. However if there is any increase or decrease in the GST rate after the submission of bid or during the execution of contract then the same shall be reimbursed/ adjusted to the contractor by UPPTCL. Kindly confirm.	The reimbursement/ adjustment on account of any increase or decrease in the GST rate after the submission of bid or during the execution of contract, shall be decided after getting approval from higher authority.
166	Special conditions of specifications Clause no.8.9		As per the referred clause, it is mentioned as "In the event of a change in the law post signing of the contract, including the introduction of GST, UPPTCL and the supplier agree to re-negotiate the Contract Price such that the net impact of the GST gets factored in the price." As GST is already introudced and implemented, we presume that the above clause is not applicable for this package. Please confirm.	The applicability of clause for this package shall be decided after getting approval from higher authority.
167	Special conditions of specifications Clause no.32		As per the referred clause, successful bidder needs to impart training to purchaser's engineers in design,manuafcture,testing,operation and maintenance of GIS and automation system and all types of major equipment. Request you to kindly specify the duration for which the training is to be given and also the no. of UPPTCL representatives attending the training at manufacturers works as well as at site. We understand that all necessary Airfare, Boarding & Lodging and Visa expenses (if any) will be in UPPTCL's account only.	Please accept the Clause 32.0 "TRAINING OF ENGINEERS" as such.
168	Special conditions of specifications Clause no.6.7.4		We understand that for all the equipments the type test should have been conducted within last 10 years from the date of bid opening. Please confirm	Please go through as per clause "Qualification of bidder, Cl. 4.1.1 (d) (Technical Experience)"and for other offered equipments must have been fully type tested during the last Five (5) years.
169	Special conditions of specifications Clause no.9		As per payment terms for supply 9.1.1, - 80% payment of supplied equipment after completion of the foundation of equipment. Kindly confirm how the payment will be done for the equipments such as cables,hardwares,control relay panels ,ACDB,battery and chargers which are independent of foundation works.	Please accept the "Payment Clause"without any change.
170	Sction-I Invitation for prequalification Clause no.4.1.1 (b)		As per the referred clause GIS manufacturer has to give Bank Guarantee for the performance of offered GIS module for a period of 2 years after the date of commissioning. We understand that the said Bank Guarantee should be given by GIS manufacturer to UPPTCL directly. Please confirm. Kindly provide the BG format for above referred performance bank gurantee.	Please accept the "Section-I Invitation for prequalification Clause no.4.1.1 (b)" without any change. We do not have any "BG format for above referred performance bank guarantee" at this stage.
171	General		We understand that operation and maintenance of the substation is not in the scope of the bidder. Please confirm.	The operation and maintenance of the substation is not in the scope of the bidder.
172	Section-I Invitation for prequalification Technical specification-GIS Clause no.4.1.d Clause no.38.1.2		As per the referred clause, it is mentioned that, type tests should have been conducted within last 10(ten) years from the date of bid opening. Necessary documentary evidence in support of the same should be enclosed along with the offer. However, in the GIS specification, Cl. 38.1.2, type test reports of GIS offered and the individual switchgear and control gear equipment of the GIS offered shall not be earlier than 5(five) years as on the date of bid opening. We understand the the type test validity for GIS is 10 years only. Please confirm.	Please accept the clause Clause no.4.1.d Clause no.38.1.2 as such.
173	Submission of Type Test reports		We understand that Type test reports to be submitted only for GIS and Transformers. Kindly confirm.	Type test reports for all equipments and material are to be submitted alongwith the offer.

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174	BOCW Cess		We understand the BOCW cess is applicable on Erection and civil works only. Please confirm.	For evaluation the bid prices shall be compared inclusive of GST and other taxes/duties. No separate tax/cess is applicable on Supply, Erection and civil works.
175	Schedule-Q1, Sl. No.B. 1.1, 2.1 and 3.1, Length of GI Bus Duct (3-Ph)		The line item description for Gas insulated bus duct is indicated as 3-phase. However, in Section-1, CL. 3.1.1 (B)-(c) & (d), 1-phase Gas insulated busduct is mentioned. Please check and clarify. If Bidder still need to quote for 3-phase quantity, we request UPPTCL to change the unit as circuit-meter in order to avoid ambiguities.	The length of GIB duct shall be as per "Schedule-Q1, Sl. No.B. 1.1, 2.1 and 3.1, Length of GI Bus Duct (3-Ph)" Actual quantity will be decided during drawing/engineering.
176	Section-1, Clause-3.1.1 (B), Sl. No. (a), 400kV Busbar		As per the referred clause under scope of works, 1set of maintenance grounding switch is indicated for the grounding of Busbar. But as per SLD, 2 sets of maintenance grounding switches are shown; one for busbar and one for Bus PT. Please check and clarify the actual requirement.	shall be as per clause.
177	Schedule-Q1, Sl. No.G .6.a), Energy Meters and CMRI		Kindly specify for which bays the Energy meters (as specified in the referred line item of price schedule) shall be provided.	400 KV side bays
178	Schedule-Q1, Sl. No.G .6.a), Energy Meters and CMRI		We presume from the BPS line item description that 1Set of Trivector meter =1# Main meter + 1# check meter. Please confirm.	Confirmed
179	Schedule-Q1, Sl. No. H.a.2.9, FOTE		a) Please confirm the transmission capability of the SDH equipment (STM-1 or STM-4 or STM-16) b) Please furnish the make & model number of the remote end FOTE equipment	a) As per FOTE specification b) shall be provided after award of contract
180	Schedule-Q1, PLCC equipment		It is presumed that the supply and laying of power and control cables for the remote end PLCC is not in the scope of this package. Kindly confirm.	Commissioning and testing is in the scope of bidder.
181	Schedule-Q1, Sl. No. O, 2.1, 2.2 and 2.3, XLPE Cables		In the referred line item description for 220kV, 132kV & 33kV XLPE cables it is mentioned that 'the quantity shall be worked out by Bidder'. We understand that during execution, the required length of cable shall be supplied by Bidder based on the layout requirement and the increase in quantity shall be operated based on the unit rates quoted in the bid. Please confirm.	The quantity shall be worked out by the bidder. The quantity of cable indicated in price schedule has been decided as per standard estimation. However, if the actual requirement of quantity worked out by the bidder increased/ decreased as per site conditions after detailed engineering, the provision for quantity variation shall be made as per our tender specification only.
182	General technical Requirements of specification (GTR), Clause 2.2		As per the referred clause of GTR the validity for type test reports is indicated as 5years prior to the date of bid opening. However, as per Section-1, Cl. 4.1.1, the type test report validity for GIS is mentioned as 10 years from the date of opening of Bids. As the requirements are contradicting we request UPPTCL to accept 10years type test validity for GIS, Power transformers, EHV cables & outdoor equipments such CVT and LA. Please confirm acceptance.	Please go through as per clause "Qualification of bidder, Cl. 4.1.1 (d) (Technical Experience)" and for other offered equipments must have been fully type tested during the last Five (5) years.
183	Technical specification_GIS, Clause-3.4, Sl. No. 12, Rated short time withstand current		As per the referred clause of technical specification for GIS, multiple choices are mentioned for rated short time current of GIS equipment as follows: 400kV- 63kA/50/40kA for 1sec 220kV - 50/40kA for 1sec 132kV-40/31.5kA for 1sec In this regard please clarify the exact requirement of Short time current rating to be adopted for GIS equipment.	The rated short time current of GIS equipment shall be as per "Price Schedule".
184	Technical specification_GIS, Clause-3.4, Sl. No. 12, Rated short time withstand current		As per the referred clause of technical specification for GIS, the time duration for rated short time withstand current for GIS shall be 1second. However, as per GTR, Clause 3.4, the duration for system fault current is indicated as 3seconds. As the above clauses are contradicting, please clarify the exact requirement.	As per requirement, the duration for system fault current is 3 seconds.
185	Technical Specifications_GIS, Clause no. V. (9) Current Transformers, page no. 12/ 80		We understand that the CT ratio & tapings according to the Price Schedule shall be followed as it is different from the technical specification for GIS. Please confirm.	Confirmed
186	Technical Specification_GIS- Clause 29.1		The clearances required between busducts (between adjacent circuits and between phases of the same circuit) as indicated in the referred clause is not possible to maintain as it is design specific. As the design varies from manufacturer to manufacturer, we request UPPTCL to accept the same as per manufacturer's standards.	As per specification.
187	Technical Specification_GIS- Clause 30.0		We do not envisage any direct termination of GIB on to the transformer/reactor bushings (i.e. SF6-to-Oil termination) in this package. Please confirm.	As per specification.

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188	Technical Specification_Auto transformer- Clause no. 5.2, Sl. No. 33		Kindly clarify whether repetition of Dynamic short circuit test can be waived off, if Bidder possess valid test reports of already Dynamic short circuit tested similar rating transformer.	In case as per requirement the repetition of Type tests shall be carried out by the bidders without any extra cost to the purchaser. Please accept the clause as such.
189	Technical Specification_Auto transformer- Clause no. 5.2, Sl. No. 33		Please clarify whether Dynamic short circuit test report of already short-circuit tested 315MVA transformer can be acceptable to establish the Dynamic short circuit capability of 500MVA transformer. Otherwise, the Dynamic short circuit capability of 500MVA transformer shall be justified using calculations (or) as per IEC60076-5 by check against the manufacturer's design rules for short circuit strength. Please confirm acceptance.	Please accept the clause "Technical Specification_Auto transformer- Clause no. 5.2, Sl. No. 33" without any change.
190	Technical Specification_Switchgear- Clause 15. IV. 72.5kV and 36 kV Isolator		As per the referred clause of technical specification, the current rating of the 72.5kV & 36kV isolators is 400 A. However, as per the price schedule the current rating is 630 A. Please clarify the actual requirement as both these clauses are contradicting.	As per the price schedule the current rating is 630 A.
191	Technical specification for 630kVA, 33/0.415kV class power transformer, clause 5.3, Transformer losses		In referred clause of technical specification, loss capitalization for iron loss and copper loss is indicated separately. However, as per recent amendments by Bureau of Indian Standards / Bureau of Energy Efficiency & notified in Gazette, all manufacturers are instructed to manufacture distribution class transformers in line with IS 1180 only. As per the gazette notification, total loss figures of distribution transformers are indicated for loading conditions only (50% and 100%). Separate iron & copper losses are not indicated. Further, loss figures are pre-defined in gazette amendment for various ratings, corresponding to appropriate star ratings. Hence, we request UPPTCL to inform the star rating required in the technical bid & eliminate loss capitalisation for distribution transformers, since all manufacturers would comply to same loss figures.	Please accept the clause "Technical specification for 630kVA, 33/0.415kV class power transformer, clause 5.3, Transformer losses" without any change.
192	Technical Specification_ Anti-fog disc insulators		Please confirm whether Long rod polymer insulators are acceptable to UPPTCL in place of Porcelain Disc insulators.	Only Porcelain Type Disc insulators are acceptable.
193	Technical Specification_Energy Meters_CMRI- Clause 3.2. Technical parameters		As per the referred clause, we presume that the Energy meters need not be interfaced with SAS. The metering data can be downloaded through an MRI and can be viewed directly in a PC loaded with Base computer software. Please confirm.	Confirmed as per referred clause.
194	Technical Specification_Lighting System- Clause 4.1, Indoor Lighting		As per the referred clause, we presume that the indoor lighting shall be through conventional CFL/FTL lamps. As conventional fittings are obsolete now-a-days, we request UPPTCL to please check and amend suitably to LED fixtures.	The Technical Specifications of LED shall be of standard make as per latest IS/ IEC standard.
195	Technical Specification_Lighting System- Clause 4.2. Outdoor Lighting		As per the referred clause, we presume that the outdoor lighting shall be through conventional HPSV lamps. As conentional fittings are obsolete now-a-days, we request UPPTCL to please check and amend suitably to LED fixtures.	The Technical Specifications of LED shall be of standard make as per latest IS/ IEC standard.
196	Technical Specification_ LT Switchgear, Page 40 of 41, Annexure-1, LT panels AC Distribution arrangement		In the referred schematic, the segregation between normal and emergency distribution is not clear. In this regard, request UPPTCL to furnish an LT distribution SLD showing the type & rating of feeders similar to UPPTCL RASARA package.	Furnished LT distribution SLD
197	Technical specification for Handling, Erection, Testing & Commissioning, Clause No. 11.03 (iii), Cable laying		We propose to lay cables on support angles (without trays) for outdoor & on ladder type trays for indoor. We presume the same is acceptable to UPPTCL. Please confirm.	As per tender specification.
198	Technical Specification_Substation Automation system with relay and protection panels, Clause 23.8, Reactor protection		We propose the following protection scheme for 400kV Bus reactor: Main-1 with Differential & inbuilt REF Main-2 with Back-up impedance We presume the same is acceptable to UPPTCL. Please confirm.	As per tender specification.
199	Technical Specification_Sub-station Automation System with relay and Protection Panel, clause no. 25.0)Relay Test kit. Page no.148 / 175		The mentioned item in the Price Schedule is Relay Test kit. Kindly specify if Numerical test kit is required or a normal kit is required.	As per specification/ latest IS/IEC standard
200	SECTION I- Clase 3.2. iii) GIS cum Control Room Building		As per the referred clause, we understand that the GIS building dimensions are tentative. Nevertheless, kindly confirm if the bidder can optimize the building size by reducing the dimensions according to the chosen GIS Modules.	The optimization by reducing the dimension of GIS building size shall be carried out by the bidder during detailed engineering after award of contract.
201	SECTION I- Clase 3.2. iii) GIS cum Control Room Building		As per the referred clause, we understand that only the number of bays represented in the SLD shall be accomodated in the GIS building and the dimesions shall be accordingly considered. Please confirm.	To meet the future requirement, provision for extension of 04 nos. bays each for 400 KV, 220 KV and 132 KV class shall be made inside the GIS room. Accordingly arrangement for panels inside Relay and Protection panel room shall also be made.

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202	Section - I, Scope of works, Clause No. 3.2. iii) EOT Crane		As per the referred Clause, For 400kV & 220 GIS Station, Minimum of 10 Ton & 6Ton respectively for EOT Crane is mentioned. We understand that this shall be as per the GIS Manufacturer's requirement and any decrease/ increase of the capacity shall be acceptable to the UPPTCL. Kindly confirm our understanding.	This shall be as per specification. However the same shall be at least two times the maximum weight of the heaviest package of GIS module offered by the bidder. The approval of Purchaser shall be required during detailed engineering after award of contract.
203	Section IV-A- XLPE Cables.		Kindly furnish the size and specification for Bonding Cables used for sheath bonding of 220kV & 132kV EHV cables.	The size and specification for Bonding Cables used for sheath bonding of 220kV & 132kV EHV cables shall be as per latest IS/ IEC standard.
204	PIR & CSD requirements for Circuit breakers		We do not envisage any Pre-insertion resistors or Control Switching devices for Line bay circuit breakers. Please confirm.	Pre-insertion resistors are required for 400 KV line bays. The CSD is required for both 400/220 KV transformers and reactors.
205	Surge Arresters		As per the given SLD and technical specification, we presume that all the surge arresters are outdoor air insulated type and hence we do not envisage supply of any indoor GIS type surge arresters. Please confirm.	Confirmed
206	Online DGA		We presume that online DGA is not envisaged for all the transformers & reactors in the present scope of work. Please confirm.	As per tender specification.
207	Transmission line side Hardware		We understand that the transmission line side hardware & string insulators are excluded from the scope of this package. Please confirm.	The transmission line side hardware & string insulators are not in scope.
208	SF6/Air Bushing		Please provide a separate line item for SF6/Air Bushing as required for outdoor termination of GIS bays.	The requirement shall be estimated by the bidder itself.
209	Location of CRP & SAS		We presume the following: a) Location of Control & relay panels shall be in the Local Control Room which is part of respective GIS building b) SAS, FOTE & PLCC panels only shall be located in the control building. Please confirm whether Bidder's understanding is in order.	During detailed engineering.
210	Tools and Tackles		Please furnish a separate schedule with the list of special tools & tackles required for the project.	List of tools & tackles required if any shall be furnished by the bidder in respective schedule of tender specification
211	Technical Specification_GIS- Clause 3.4 II (10) 420 kV GIS		The referred clause of specification mentions the requirement of PIR for 420kV GIS but the BoQ and the SLD does not mention PIR for the 420 kV GIS. Please confirm the requirement of PIR in the 420 kV GIS bays.	Pre-insertion resistors are required for 400 KV line bays.
212	Technical Specification_GIS- Clause 3.4 II (18) (ii) & (iii)		We understand that the Line charging and cable charging current shall be as per the IEC. Please confirm.	As per specification/ latest IEC standard.
213	Technical Specification_GIS- Clause 5.7		The referred clause states that "The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300 ms at rated short time withstand current." We understand that the burn through time shall be as per IEC 62271-203. Please confirm.	As per specification/ latest IEC standard.
214	Technical Specification_GIS- Clause 14.6.4		The referred clause states that "The gap between the open contacts shall be such that it can withstand atleast the rated phase to ground voltage for eight hours at zero pressure above atmospheric level of SF6 gas due to its leakage". Please check the applicability of this clause as it is not relevant for GIS.	The clause shall be as per specification/ as per IEC standard for GIS.
215	Technical Specification_GIS- Clause 17.1		The disconnecter for 245 kV GIS and 145 kV GIS shall be Three phase group operated type. Please confirm	As per specification
216	Technical Specification_GIS- Clause 38.1.2, 4.1.1 (d)		We understand that the GIS type test reports shall be within 10 years from the date of opening as per the Qualification requirement. Please confirm. For 420 kV, 245 kV and 132 kV GIS we understand that the type test reports conducted by Parent company/group Company/Collaborator/ Subsidiary company, within last ten (10) years, on similar design equipments will be accepted. Please confirm.	As per specification. Type test reports of the parent company shall only be accepted.
217	Technical Specification_GIS- Clause 38.1.2		We understand that GIS manufacturer has to submit all the valid type test report for the 420 kV GIS, 245 kV GIS and 145 kV GIS but the repetition/conduction of any type test or special test is not envisaged. Please confirm.	In case as per requirement the repetition of Type tests shall be carried out by the bidders without any extra cost to the purchaser. Please accept the clause as such.
218	Technical Specification_GIS- Clause 38.3.4		We understand that the HV test kit has to be supplied at site on returnable basis. i.e after completion of the HV test the GIS manufacturer will take the HV test kit back. Request for your confirmation.	High Voltage Testing Kits required at site shall be provided by the successful bidder on returnable basis.
219	Tender specification, Section IV 'Sl.no : 2 & 4		The listed drawings in the referred annexure are not enclosed with tender document(Except SLD, SAS Architecture & layout plan of control room building). Please furnish the same, in order to estimate the quantities.	Enclosed

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220	Bill of quantity of Civil works, Annexure-A & Schedule-Q1, Q2 'Sl.no : Q (1,1.1,1.2,1.3)		As per referred clause, Structural steel required for the tower & Equipment support structure shall be paid in MT basis. We trust that, the total weight is inclusive of all 400kV,220kV,132kV ,LM, towers ,Girders, Tertiary Equipments,delta, neutral buses , neutral CT,132kV SA and NGR's & Non-standard Structures etc.and also inclusive of Foundation bolts, nuts and bolts and Stub(if required). Please confirm.	in MT
221	TECHNICAL SPECIFICATION CLAUSE NO. A, i		As per the reffred clause, NIFPS sytem need to be provided for transformers/reactors but as per price schedule Sr.No.- M/ 1.1 HVW spray system has been given for transformer/reactors . Kindly clarify. If we need to proced as per price schedule, kindly provide the specification for the same.	Both NIFPES & HVW Spray, fire prevention and extinguishing Systems are required for both 500MVA & 200MVA Transformers
222	TECHNICAL SPECIFICATION CLAUSE NO.7 - FDA		It is given in the specification that GIS hall shall be covered by smoke detectors. As per TAC/NFPA Height of the building Beyond 10M heights beam detectors have to fix. So we preasume that GIS hall with beam detectors. Please confirm	As per specification / TAC/NFPA
223	TECHNICAL SPECIFICATION CLAUSE NO.4 - Carbon Dioxide Type Fire Extinguishers		11 KG Carbon Dioxide Type Portable Fire Extinguishers not available in the market. Please confirm	As per specification.
224		Section-I/ Invitation for Prequalification/SI.No.4/ Qualification Of the Bidder/SI.no. 4.1 /400kV GIS SUBSTATION/4.1.1(f) "c) The Bidder must have supplied, erected and commissioned not less than 01(one) no. 400 kV GIS substation in India in last seven years, having at least cumulatively 05(five) nos. circuit breaker bays of 400 kV or above and 40KA short circuit level or higher and the same should have been in successful operation in tropical climate for at least 02(two) years as on the date of bid opening." f) Those bidders who are meeting prequalifying conditions on the basis of the qualification of their parent company can also be considered provided: i) The parent company (Principal) meets the qualifying requirements stipulated under clause 4.1.1a & 4.1.1c to 4.1.1e above.	We are an Indian GIS Manufacturer, a 100% Owned Subsidiary of our Parent Company and have an Ongoing Technology Licensing Agreement with our Parent Company, who have established Full Fledged Manufacturing & Testing Facilities in India for the Design, Engineering, Manufacturing, Testing and After Sales Services of GIS Equipment of Up to 400KV Voltage Level in India, Hyderabad. In view of the above, we intend to participate under clause f) of Bidding Route provided. In this regard, with respect to the stipulations under clause f).i) we wish to bring the following points for your kind review and confirmation: We understand that our Parent company can meet clause c) with their global supply records [i.e Supply and Service Record in Tropical Climate instead of Supply record in India in the Last 7 Years] OR Alternatively, our Parent Company can meet Clause c) with Minimum One (1) Installation in India is considered in the last 10 Years, same period for which the Type Tests are validated or considered in the Tender Specifications. We request your kind review and consideration.	Review and consideration are subject to the submission of documentary evidence
225		Section-I/ Invitation for Prequalification/SI.No.4/ Qualification Of the Bidder/SI.no. 4.1 /400kV GIS SUBSTATION/4.1.1(f) b) The GIS modules should be offered from manufacturer who have designed and supplied minimum 06(six) nos. 400kV GIS modules and also having a well-equipped repair and maintenance facility in India. The bidder shall also guarantee supply of spares up to a minimum of 10(ten) years from the date of commissioning. Necessary documentary evidence shall be submitted in this regard. The manufacturer of GIS module shall submit a Bank Guarantee for Performance of the offered GIS module for a period of 02(two) years after the date of commissioning. f) Those bidders who are meeting prequalifying conditions on the basis of the qualification of their parent company can also be considered provided: i) The parent company (Principal) meets the qualifying requirements stipulated under clause 4.1.1a & 4.1.1c to 4.1.1e above. ii) The bidder furnishes a legally enforceable undertaking (Jointly with the Parent company) to guarantee quality, timely supply, performance and Warranty obligations as specified for the equipment(s)	We are 100% Owned Subsidiary of our Parent Company and having an Ongoing Technology Licensing Agreement and further bidder is furnishing a legally enforceable undertaking with their Parent company as per clause "f"(ii), hence we understand that clause "b" also can be met by parent company.	Review and consideration are subject to the submission of documentary evidence

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226	Special Conditions of Specifications for Construction of 400kV GIS Substation with Substation Automation System on Turnkey Basis. 6.7.4	D). TYPE TEST FOR INDIGENOUS OR FULLY IMPORTED EQUIPMENTS: The offered equipments must have been fully type tested as per relevant ISS and/or any other specified international standards, during the last 5 years period to be reckoned from the date of opening of tender. Photo copy of such type test reports/ certificates must be submitted along with the proposal. the test certificates of proto type manufactured and tested by foreign collaborators of the tenderers at their works shall not be acceptable for indigenously manufactured equipment.	We presume that the Type Test reports and certificates shall be submitted after award of contract during sub vendor approval and need not to be submitted during the bidding stage due to the space constraints in the portal. Please Confirm.	Copy of the Type Test reports /Certificates of equipments must be submitted along with the proposal.
227	Special Conditions of Specifications for Construction of 400kV GIS Substation with Substation Automation System on Turnkey Basis. 7	The prices of spare parts shall remain 'Firm' and valid for a period of three years from the date of taking over of the substation by UPPTCL.	We request customer to enter in to separate aggrement with the Supplier for spare parts to be supplied after taking over of the installation or Enter into a separate aggrement with the EPC Contractor for supplying spares after taking over of the installation delinking from the main contract. Kindly Confirm	Please accept the clause as such.
228	Special Conditions of Specifications for Construction of 400kV GIS Substation with Substation Automation System on Turnkey Basis. 27.0 -	SECURITY DEPOSIT BANK GUARANTEE Security, for the due & faithful Performance of the Contract Amounting to 1% of the Total value of Contract in the Form of Bank Draft or Bank Guarantee issued by any schedule Bank in India on a prescribed Proforma appended here to , shall be deposited within Thirty days (30) of the receipt of LOI by the Contractor. The Bank Guarantee shall be furnished on a Non judicial Stamp Paper calculated @ Rs. 5.00 per thousand of value of BG and maximum Rs. 10000.00 as per latest Provision of Indian Stamp Act.	Please note that the validity of the Security Deposit is not mentioned in the tender documents. Please Confirm the validity.	The Security Deposit should be valid for a period of 18(eighteen) months with a claim period of 06(six) months thereafter.
229	FORM 'A' General Conditions for the Supply of Plant and the Execution of Works in Connection with the Schemes in the UPPTCL Special Conditions of Specifications for Construction of 400kV GIS Substation with Substation Automation System on Turnkey Basis. 25 (1) (a) 9.1.1.	Eighty per cent of the f.o.r. Contract value of the plant in rupees on receipt by the Purchaser of the Bidder's invoice giving the number and date of railway receipt covering the dispatch of the plant from Indian Port and of the advice note giving case number and contents, together with a certificate by the Bidder to the effect that the plant detailed in the said advice note has actually been dispatched under the said railway receipt and that the Contract value of the said plant so dispatched is not less than the amount entered in the invoice. TERMS OF PAYMENT In case of supply- Payment shall be made as detailed below:- (a) 80% payment of supplied equipment after completion of the foundation of equipment. (b) 10% payment after erection of equipment. (c) Balance 10% amount to be released after satisfactory commissioning of entire substation, 100% completion of all electrical and civil works, adjustment of liquidated damaged if any and issuance of taking over certificate.	Please note that the referred clause mention that "80% after receipt by the Purchaser of the Bidder's invoice giving the number and date of railway receipt covering the dispatch of the plant from Indian Port" whereas the Terms of Payment denotes that "80% payment of supplied equipment after completion of the foundation of equipment". We request you to kindly Confirm the correct payment term for the Project. Further all the goods for the Project will be transported through road upto site, in view of this we request you to issue suitable ammendment i.e RR/LR to claim our bill after delivering the materials. Kindly Confirm	No ammendment in payment term, please accept the clause as such.
230	FORM 'A' General Conditions for the Supply of Plant and the Execution of Works in Connection with the Schemes in the UPPTCL 43.6	Target Availability The contractor has to ensure 98% availability of substation during the maintenance period as per clause no. 3.5 of UPERC regulation 2006-2101 dated 6-10-2006 failing which the penalty shall be levied as per provisions of UPERC regulation.	Please note that EPC Contractors are not involved in maintenance of the Substations. Since M/s. UPPTCL will takeover the substation after successful commissioning and the operation and maintenance of the substation comes under M/s. UPPTCL. Hence we presume this clause is not applicable. Kindly Confirm.	This clause is not applicable as there is no operation and maintenance of the substation in the scope of bidder.

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235	General SECTION V INSTRUCTIONS TO APPLICANTS Pg. No. 2 2.0	The original EMD B.G. shall be submitted within 01(one) week from the opening date of Part-I or before opening of Part-II (Price Part), failing which Part-II (Price Part) of such bidders shall not be opened. No tender document including tender fee and other commercial papers are required to be submitted in hard copy or through messenger. SUBMISSION OF BID The Bidder shall submit his Bid only on e-tendering site of U.P. Govt. The bidder shall also submit one hard copy of the bid in the office of Superintending Engineer, Electricity 765/400KV Substation Design Circle-II, U.P. Power Transmission Corporation Limited, 11th Floor, Shakti Bhawan Extension, 14-Ashok Marg, Lucknow-226001, U.P.	We request you to confirm only EMD B.G. shall be submitted in hard copy and no need of submitting any other documents in hard copy to M/s. UPPTCL. Please Confirm.	Confirmed.
236	SECTION III PREQUALIFICATION DATA Technical Specification of Transformers 3.1	CONTRACT TYPE AND CONDITIONS The contract will be a fixed price lump sum turnkey contract. UPPTCL Conditions of Contract will generally be used as basis of contract. The IEEMA price variation formula applicable for transformer and OLTC component as per prevailing/current IEEMA Circular. The Tenderers are requested to follow the IEEMA formula in respect of the transformer offered by them.	Please confirm price variation will be applicable for Transformers	Fixed price, no price variation will be applicable.
237	General -	Construction of Contract	Please confirm whether the Contract will be issued as a single contract or separate contracts.	EPC, work contract.
238	BOQ- PLCC- FOTE H-a-2.8	Digital Tele- Protection Coupler (4 Commands)	Please provide Technical specs for Digital Tele-Protection Coupler	As per latest standard IS/ IEC of digital PLCC cabinet and Protection Coupler
239	EOT Crane Technical Specification_ (EOT) Crane		-Type of Crane (Single Girder/Double Girder) -Space of the crane -Height of Lift of the crane -Travel Length -Speed if any -Bay length for each crane	-Type of Crane (Double Girder) During detailed engineering after award of contract
240	Price schedule	Digital PLCC or Analog PLCC	We understand that Digital type PLCC is to be offered for 400kV and 220kV lines as per quantity mentioned in price schedule. Analog type PLCC is not envisaged. Please confirm.	400kV – Digital 220kV - Analog