BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TITLE: SUB-STATION AUTOMATION SYSTEM		SIGN			
		DATE	03/08/20	4-8-20	5/8/20
		GROUP	TBEM	W.O. No	411
CUSTOMER	Indian Oil Corporation Limited (IOCL)				
CONSULTANT	TATA Consulting Engineers Limited (TCE)				
PROJECT	LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery				

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 220kV/ 33kV Substation Automation System along with Control & Protection Panels, LMS, Energy Metering System, UPS System etc. at 220/33kV GIS at IOCL Panipat, complete with accessories as listed in this specification. Testing and commissioning of all SAS equipments/ numerical/ digital devices including Protective relays shall be done by the OEM Engineer.

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

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

The specification comprises of following sections:

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

In case of any conflict between various sections, **order of precedence** shall be in the same order as listed above, unless otherwise mentioned specifically.

Note: The terms used in this specification namely, "Employer/Purchaser/Owner" refers to IOCL/ HVPNL & "Contractor/ LSTK Contractor /Sub-contractor/Manufacturer" refers to successful bidder.

2.0 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: **Indian Oil Corporation Limited (IOCL)**

Name of consultant: **TATA Consulting Engineers Limited (TCE)**

Name of Project: **LSTK Job for ISBL work of 220kV Grid Power Import at IOCL, Panipat Refinery**

3.0 SPECIFIC TECHNICAL REQUIREMENTS

3.1 Refer Section–2 and Single Line Diagrams & Key Metering and Protection Single Line Diagram Enclosed with Section-4.
{ The Key Metering and *Protection Single Line Diagram is for tender purpose only }*

3.2 a) Complete Substation automation system based on IEC 61850 communication protocol including hardware and software along with associated equipments for the 220 and 33kV bays as shown in the SLD and as per Section-2.

b) The integration of IEC 61850 communication protocol-based monitoring equipments like Online dissolved Gas analyzer, Online Insulating Oil Dehydration System, Digital RTCC/ AVR, Optical temperature sensors provided on each of the Transformer Units, Online PD Monitoring System provided on each of the Transformer & GIS (GIS & Transformers being supplied under a separate contract) with the offered SAS is also included in the present scope of the bidder.

For the purpose of interfacing of offered SAS with Transformers/ GIS, any necessary co-ordination with the respective equipment suppliers for completion of the SAS shall be in bidder's scope. In this regard, bidder shall finalize the SAS I/O list in co-ordination with OEM and as per customer approval without any commercial implication to BHEL.

c) Transformer Units are being provided with Online Dissolved Gas analyzer, Online Insulating Oil Dehydration System, Online PD Monitoring System (both Transformer & GIS), Digital RTCC/ AVR, Optical temperature sensors. These equipments shall be IEC 61850-compliant & required to be integrated with the offered Substation Automation System (SAS). Above equipments, being supplied in separate packages, shall be connected to Managed Ethernet Switches compliant to IEC 61850 communication protocol through fiber optic cable. This Ethernet switches shall be supplied by the bidder under the present scope of work and shall be mounted in Marshalling Box (MB) of the Transformers & LCC Panels of GIS. To connect this Ethernet switch to Bay Ethernet switch (mounted in relay panel), all accessories (LIU, patch cords etc.) and Armoured Optical fiber cable from MB/ LCC to relay room shall be in the scope of Bidder under this tender. Necessary space provision for mounting these Ethernet Switches & LIUs in the Transformer MB/ GIS LCC shall be kept by the OEM of Transformer/ GIS.

Approx. distance between Transformer MB and Relay Room shall be 200m.
Approx. distance between GIS LCC and Relay Room shall be 50m.
Approx. distance between GIS Building Relay Room and PR Control Room shall be 500m.
Approx. distance between GIS Building Relay Room and PNCP Control Room shall be 5000m.

The Actual requirement of FO/Twisted pair cable for integration of Online dissolved Gas analyzer, Online Insulating Oil Dehydration System, Online PD Monitoring System, Digital RTCC/ AVR, Optical temperature sensors etc shall be finalised during detailed engineering.

d) The FO cable requirement mentioned in BOQ is tentative. All FO cable supply and splicing/ termination is in scope of bidder as per actual requirement.

e) The bidder's scope shall include all primary equipment interfaces with offered control & relay Panel /SAS/LMS etc. in the respective panel schematics during drawing submission at contract stage. For all CB/ Isolators/ Earth Switches of 220kV GIS & associated 33kV system, contact multiplier relays shall be included in the bidder's quoted price, for use in the offered Control & Protection systems/ LMS/ SCAP/ IMB Panels etc.

f) Wherever bidder offers any spare in lieu of the same being "Built-in feature" of any relay/ fitment or the same being "Not applicable" is subject to approval by IOCL. No price implication will be entertained by BHEL at contract stage if any separate item is insisted by IOCL to meet the contract requirement.

g) Line current differential protection relays offered shall be complete with necessary FODP/ LIU, Patch Cords etc and integration of supplied remote end Line current differential protection relays with remote end SAS shall also be in bidder's scope. For end-to-end connectivity of line current differential protection relays, bidder shall supply 48F armoured fibre optic cables from substation gantry upto relay panels at both ends, matching with OPGW Cable (OPGW & Joint Boxes being procured under a separate contract).

h) The Control & Protection Panels of individual bays shall be placed in the relay rooms located in GIS Building. Substation Level Equipments/ Panels shall be placed in the 220kV GIS Building Control Room, PR CPP Control Room, PNCP CPP Control Room.

i) For the 33kV New LIB/ 33kV Existing Switch Gear (Please refer project SLD & KSLD attached along with Technical Specification for clarity), Control & Protection Cubicle (LT Compartment) along with IEC-61850 compliant Numerical Overcurrent Relays and MODBUS compliant MFM are being supplied under a separate contract and it will be mounted on the respective Switch Gear Panels. Necessary space shall be considered in the Switch Gear Panel LT Compartments for mounting the cable differential relays to be supplied loose by the bidder under present contract scope. Necessary internal wiring of Cable Differential relays along with supply of necessary LIU/ Patch Cords etc. shall be in bidder's scope. For integration of the 33kV system LIB Panels & associated 33kV incoming feeders in existing switchgears in the offered SAS system, separate panels along with required number of BCUs and other accessories shall be supplied by the bidder in respective switchgear rooms (PR SS-63 & PNCP SS-9).

j) All the existing system details regarding interfacing with existing Generator Controllers/ ECS/ Islanding Scheme/line remote end details etc, as applicable as per Section-2, shall be collected from site. Necessary site visits (before submission of bid) for collecting inputs for successful interfacing with the existing system at IOCL Panipat PR & PNCP Complex is included in the bidder's scope for this tender. Also, necessary transducers, contact multiplier relays, switches etc. shall be supplied loose by the bidder and prices of these items shall be included in the total price quoted by the bidder. No claim whatsoever shall be entertained at contract stage in this regard.

k) The successful bidder shall have to extend all possible supports like timely submission/re-submission of drawings, visit to end customer IOCL/ HVPNL to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer (IOCL/ HVPNL) approval. Testing of metering equipments as per HVPNL guidelines, at third party lab, if any, shall be carried out by successful bidder without any commercial implications to BHEL/ IOCL. Arranging and coordinating with HVPNL engineers for witnessing routine/ acceptance/ type tests at manufacturer's works or at third party lab is in the scope of bidder, without any commercial implications to BHEL/ IOCL.

4.0 TECHNICAL PRE QUALIFYING REQUIREMENTS

The bidder shall be original equipment manufacturer (OEM) for Numerical Relays and Bay Control Units (BCU). The manufacturer whose Control, Relay & Protection System (Control & protection Intelligent Electronic Devices (IEDs)) and BCUs are offered should have designed, manufactured, tested and commissioned Control, Relay & Protection system along with Sub-station Automation System which must be in satisfactory operation in 220kV or above voltage level for at least 2 (two) years as 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.

5.0 TRAINING

The bidder shall impart training to Employer's Personnel as per requirements 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 a later stage.

However, the travel, lodging & boarding expenses of employers' personnel, if any shall be borne by Employer.

6.0 PRE-COMMISSIONING & COMMISSIONING

PRE-COMMISSIONING: As per requirements specified in Section-2.

COMMISSIONING :

Charging of the facilities at rated voltage. Further, wherever appearing in this specification, the words – 'commissioning checks', 'installation checks', 'site tests', 'Performance guarantee tests', are to be considered as 'pre commissioning checks'.

7.0 BILL OF QUANTITES

7.1 As per annexure-A, Section-1.

7.2 UNIT PRICE OF ALL THE CONTROL, PROTECTION, SAS AND METERING FITMENTS

The addition/ deletion to the scope shall be as per the break-up unit rates for all the control, protection, SAS and metering fitments furnished with the offer.

8.0 TYPE TEST

All equipment being supplied shall conform to type tests including additional type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections. The reports for all type tests and additional type tests as per technical specification shall be furnished by the bidder alongwith equipment / material drawings. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited base on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by the representatives(s) of IOCL.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

9.0 DRAWINGS / DOCUMENTS REQUIRED FOR ENGINEERING MANUFACTURING CLEARANCE

The minimum drawings/ documents, as follows shall be required for providing engineering manufacturing clearance of the equipment (SAS/ CRP/ LMS) and furthermore, it shall be used for delay analysis, if any, on account of the bidder. The schedule for submission and resubmission shall be in line with details provided in section-3.

1	Board Formation, BOM & Panel Schematic Drawings, Architecture drawings with Guaranteed Technical Particulars
2	Type Test Reports
3	Quality Assurance Plan & Inspection Test Schedule, FAT/ SAT Procedure

10.0 PACKING AND DISPATCH

The equipment shall be divided into suitable number of shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for selected mode of transportation i.e. sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage. The equipments shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars\ 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should also be suitable for outdoor storage areas with heavy rains/ high ambient temperature unless otherwise agreed and hence, packing shall be suitable for long duration storage (minimum 1 year).

11.0 DEVIATIONS:

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

12.0 MANUFACTURING QUALITY PLAN:

Bidder has to follow IOCL approved Manufacturing Quality Plan, SAT /FAT procedure at contract stage.

13.0 DRAWINGS and SCHEME

The documentation requirements detailed under Section-2 and 3 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.

14.0 DOCUMENTS REQUIRED WITH TECHNICAL OFFER

a) Clause-wise confirmation/ comments
b) Bill of Materials
c) Unpriced schedule of Unit Prices
d) Filled-up Guaranteed Technical Particulars
e) Catalogue and Technical Leaflets for the offered Equipments

BILL OF QUANTITIES				
Sl.No.	**Item Description as per Tender BOQ**	**Detailed Description**	**Unit**	**Qty.**
A)		**Main Items:**		
1	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 220KV, LINE BAY, PROTECTION PANEL	220kV Line Protection Panel	Set	**2**
2	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 220/34.5 KV, 50/65 MVA TRANSFORMER PROTECTION PANEL FOR PR O/G BAY (FOR BOTH HV & LV SIDE)	220/34.5 kV, 50/65 MVA Transformer Protection Panel for PR O/G Bay (for both HV & LV side)	Set	**2**
3	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 220/34.5 KV, 50/65 MVA TRANSFORMER PROTECTION PANEL FOR PNCP O/G BAY (FOR BOTH HV & LV SIDE)	220/34.5 kV, 50/65 MVA Transformer Protection Panel for PNCP O/G Bay (for both HV & LV side)	Set	**2**
4	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 220KV, SPARE BAY (FUTURE CABLE FEEDER) PROTECTION PANEL	220kV Spare Bay (Future Cable Feeder) Protection Panel	Set	**4**
5	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 220KV, BUS COUPLER PROTECTION PANEL (WITH FBT SCHEME)	220kV Bus Coupler Protection panel (with FBT scheme)	Set	**1**
6	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 220KV, BUSBAR PROTECTION RELAY PANELS (SINGLE)	220kV Bus Bar Protection Panel (Single Bus Bar Protection)	Set	**2**
7	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 220KV, ISLANDING PROTECTION RELAY PANELS	Grid Islanding Panel	Set	**1**
8	SUPPLY- SUBSTATION AUTOMATION SYSTEM : ARMOURED FIBRE OPTIC CABLE ALONG WITH HDPE PIPE	Armoured Fibre Optic Cable along with HDPE Pipe	kM	**40**
9	SUPPLY- SUBSTATION AUTOMATION SYSTEM : ARMOURED FIBRE OPTIC CABLE ALONG WITH HDPE PIPE FOR LINE DIFFERENTIAL RELAYS	Armoured Fibre Optic Cable along with HDPE Pipe for Line Differential Relays	kM	**1**
10	SUPPLY- SUBSTATION AUTOMATION SYSTEM : CENTRAL TRANSDUCER PANEL	Central Transducer Panel	Set	**1**
11	SUPPLY- SUBSTATION AUTOMATION SYSTEM : SCAP PANEL FOR PR CONTROL ROOM	SCAP Panel for PR Control Room	Set	**1**
12	SUPPLY- SUBSTATION AUTOMATION SYSTEM : SCAP PANEL FOR PNCP CONTROL ROOM	SCAP Panel for PNCP Control Room	Set	**1**
13	SUPPLY- SUBSTATION AUTOMATION SYSTEM : SYNCHRONISING TROLLEY	Synchronising Trolley for SCAP Panels	Set	**4**
14	SUPPLY- SUBSTATION AUTOMATION SYSTEM : ENERGY METERING PANEL	Energy Metering Panel *(With 2 Nos. Main Meters & 2 Nos. Check Meters)*	Set	**1**
15	SUPPLY- SUBSTATION AUTOMATION SYSTEM : COMMON METER READING INSTRUMENT (CMRI) ALONG WITH ALL COMMUNICATION HARDWARE SET	Common Meter Reading Instrument (CMRI) along with all Communication Hardware Set	Set	**4**
16	SUPPLY- SUBSTATION AUTOMATION SYSTEM : ENERGY METERING SYSTEM - NECESSARY NETWORK SWITCHES/ LIU/ PATCH CORD/ HMI/ SOFTWARE/TTB ETC, AS REQUIRED, FOR COMPLETION OF THE ENERGY METERING SYSTEM AS PER TS	Energy Metering System - Necessary Network Switches/ LIU/ Patch Cord/ HMI/ Software/TTB etc, as required, for completion of the Energy Metering System as per TS	Lot	**1**
17	SUPPLY- SUBSTATION AUTOMATION SYSTEM : LOAD MANAGEMENT SYSTEM (LMS) - LMS CENTRAL PROCESSING SYSTEM/ UNIT	Load Management System (LMS) - LMS Central Processing System/ Unit	Set	**1**
18	SUPPLY- SUBSTATION AUTOMATION SYSTEM : LOAD MANAGEMENT SYSTEM (LMS) - RTU FOR 220KV GIS SYSTEM & PR SS-28	Load Management System (LMS) - RTU for 220kV GIS System & PR SS-28	Set	**2**
19	SUPPLY- SUBSTATION AUTOMATION SYSTEM : LOAD MANAGEMENT SYSTEM (LMS) - RTU FOR PR CONTROL ROOM	Load Management System (LMS) - RTU for PR Control Room	Set	**2**
20	SUPPLY- SUBSTATION AUTOMATION SYSTEM : LOAD MANAGEMENT SYSTEM (LMS) - RTU FOR PNCP CONTROL ROOM	Load Management System (LMS) - RTU for PNCP Control Room	Set	**2**
21	SUPPLY- SUBSTATION AUTOMATION SYSTEM : LOAD MANAGEMENT SYSTEM (LMS) - NECESSARY NETWORK SWITCHES/ LIU/ PATCH CORD/ HMI/ SOFTWARE/TRANSDUCERS/ AUXILIARY RELAYS ETC, AS REQUIRED, FOR COMPLETION OF THE LMS SYSTEM AS PER TS	Load Management System (LMS) - Necessary Network Switches/ LIU/ Patch Cord/ HMI/ Software/Transducers/ Auxiliary Relays etc, as required, for completion of the LMS system as per TS	Lot	**1**
22	SUPPLY- SUBSTATION AUTOMATION SYSTEM : INTERFACING MB (IMB) PANEL FOR EXISTING PR ECS INTERFACING	Interfacing MB (IMB) Panel for Existing PR ECS Interfacing	Set	**1**

Sl.No.	Item Description as per Tender BOQ	Detailed Description	Unit	Qty.
23	SUPPLY- SUBSTATION AUTOMATION SYSTEM : INTERFACING MB (IMB) PANEL FOR EXISTING PNCP ECS INTERFACING	Interfacing MB (IMB) Panel for Existing PNCP ECS Interfacing	Set	**1**
24	SUPPLY- SUBSTATION AUTOMATION SYSTEM : SECONDARY INJECTION TEST KIT	Secondary Injection Test Kit	Set	**2**
25	SUPPLY- SUBSTATION AUTOMATION SYSTEM : MAIN-1 LINE PROTECTION RELAY AT REMOTE END (ALONG WITH NECESSARY PATCH CORDS & LIUs)	Main-1 Line Protection Relay at Remote End (along with necessary patch cords & LIUs)	No.	**2**
26	SUPPLY- SUBSTATION AUTOMATION SYSTEM : MAIN-2 LINE PROTECTION RELAY AT REMOTE END (ALONG WITH NECESSARY PATCH CORDS & LIUs)	Main-2 Line Protection Relay at Remote End (along with necessary patch cords & LIUs)	No.	**2**
27	SUPPLY- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM (2 X 25 KVA MINIMUM) IN PARALLEL REDUNDANT CONFIGURATION ALONG WITH ACDB & NI-CD BATTERIES (FOR GIS BUILDING)	UPS System (2 x 25 kVA minimum) in parallel redundant configuration along with ACDB & Ni-Cd Batteries (for GIS Building)	Set	**1**
28	SUPPLY- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM (2 X 3 KVA MINIMUM) IN PARALLEL REDUNDANT CONFIGURATION ALONG WITH ACDB & NI-CD BATTERIES (FOR PR CONTROL ROOM)	UPS System (2 x 3 kVA minimum) in parallel redundant configuration along with ACDB & Ni-Cd Batteries (for PR Control Room)	Set	**1**
29	SUPPLY- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM (2 X 3 KVA MINIMUM) IN PARALLEL REDUNDANT CONFIGURATION ALONG WITH ACDB & NI-CD BATTERIES (FOR PNCP CONTROL ROOM)	UPS System (2 x 3 kVA minimum) in parallel redundant configuration along with ACDB & Ni-Cd Batteries (for PNCP Control Room)	Set	**1**
30	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 33KV CABLE DIFFERENTIAL PROTECTION RELAY (87CD1) (ALONG WITH NECESSARY PATCH CORDS & LIUS)	33kV Cable Differential Protection Relay (87CD1) (along with necessary patch cords & LIUs)	No.	**4**
31	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 33KV CABLE DIFFERENTIAL PROTECTION RELAY (87CD2) (ALONG WITH NECESSARY PATCH CORDS & LIUS)	33kV Cable Differential Protection Relay (87CD2) (along with necessary patch cords & LIUs)	No.	**2**
32	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 220KV, BAY CONTROL UNIT	Substation Automation System (SAS): Bay Control Unit (BCU) for 220kV Bays *(With Redundant RTU Cards & Redundant Power Supply Units)*	Set	**13**
33	SUPPLY- SUBSTATION AUTOMATION SYSTEM : BAY CONTROL UNIT (BCU) FOR SAS INTEGRATION OF 33KV LIBS & 33KV EXISTING SWITCHGEAR I/C BAYS (ASSOCIATED WITH 220KV GIS SYSTEM) AT PR SS-63	Substation Automation System (SAS): Bay Control Unit (BCU) for SAS integration of 33kV LIBs & 33kV Existing Switchgear I/C Bays (associated with 220kV GIS system) at PR SS-63 *(along with required number of DI/ DO/ AI/ CT/PT Input Cards in BCUs, Standalone Panels, Ethernet Switches, Patch Cords, LIUs etc. as required)*	Set	**1**
34	SUPPLY- SUBSTATION AUTOMATION SYSTEM : BAY CONTROL UNIT (BCU) FOR SAS INTEGRATION OF 33KV LIBS & 33KV EXISTING SWITCHGEAR I/C BAYS (ASSOCIATED WITH 220KV GIS SYSTEM) AT PNCP SS-9	Substation Automation System (SAS): Bay Control Unit (BCU) for SAS integration of 33kV LIBs & 33kV Existing Switchgear I/C Bays (associated with 220kV GIS system) at PNCP SS-9 *(along with required number of DI/ DO/ AI/ CT/PT Input Cards in BCUs, Standalone Panels, Ethernet Switches, Patch Cords, LIUs etc. as required)*	Set	**1**
35	SUPPLY- SUBSTATION AUTOMATION SYSTEM : BAY CONTROL UNIT (BCU) FOR SUB-STATION AUXILIARY SYSTEM	Substation Automation System (SAS): Bay Control Unit (BCU) for Sub-Station Auxiliary System *(With minimum 320 Nos. DI, 60 Nos. DO, 64 Nos. AI and necessary CT/PT input cards)*	Set	**1**
36	SUPPLY- SUBSTATION AUTOMATION SYSTEM : ETHERNET SWITCH	Substation Automation System (SAS): Ethernet Switches as required for implementing redundant LANs at Station Level and Inter-Bay Level *(Including required switches at Transformer MB & GIS LCC, PR/ PNCP Control Rooms also)*	Lot	**1**
37	SUPPLY- SUBSTATION AUTOMATION SYSTEM : OWS/ EWS/ STATION HMI/ DR PC/ HISTORIAN PC IN 220KV GIS BUILDING CONTROL ROOM/ ENGINEERING ROOM, PR CPP CONTROL ROOM & PNCP CPP CONTROL ROOM	Substation Automation System (SAS): OWS/ EWS/ Station HMI/ DR PC/ Historian PC in 220kV GIS Building Control Room/ Engineering Room, PR CPP Control Room & PNCP CPP Control Room	No.	**10**

Sl.No.	Item Description as per Tender BOQ	Detailed Description	Unit	Qty.
38	SUPPLY- SUBSTATION AUTOMATION SYSTEM : GATEWAY PANEL (COMPLETE WITH PANEL, GATEWAY DEVICES-2 NOS IN REDUNDANT CONFIGURATION FOR RCC AND RSCC, ROUTERS, HOOTER - 2 NOS FOR SUB-STATION URGENT AND NON-URGENT ALARMS)	Substation Automation System (SAS): Gateway Panel (Complete with panel, Gateway devices-2 Nos in redundant configuration for RCC and RSCC, Routers, Hooter - 2 Nos for sub-station urgent and non-urgent alarms)	Set	**1**
39	SUPPLY- SUBSTATION AUTOMATION SYSTEM : SAS NETWORKING PANEL AT PR CONTROL ROOM	Substation Automation System (SAS): SAS Networking Panel at PR Control Room	Set	**1**
40	SUPPLY- SUBSTATION AUTOMATION SYSTEM : SAS NETWORKING PANEL AT PNCP CONTROL ROOM	Substation Automation System (SAS): SAS Networking Panel at PNCP Control Room	Set	**1**
41	SUPPLY- SUBSTATION AUTOMATION SYSTEM : REDUNDANT COMMUNICATION EQUIPMENT	Substation Automation System (SAS): Redundant Communication Equipment *(Complete with MODEMs - 4 Nos., Power Supply Units, Lightning Arrestors for MODEM, Communication Ports and Media Interface Device and all Accessories for redundant gateway interface for LDC) at Panipat End*	Set	**1**
42	SUPPLY- SUBSTATION AUTOMATION SYSTEM : TIME SYNCHRONISING EQUIPMENT	Substation Automation System (SAS): Time Synchronisation Equipments *(GPS with all accessories, Antenna, Cables, Software, Lightning Arrestors for GPS, Separate time display unit display size of approx. 100 mm height. etc)*	Set	**1**
43	SUPPLY- SUBSTATION AUTOMATION SYSTEM : A3/A4 SIZE COLOUR LASER JET PRINTER WITH MFD	Substation Automation System (SAS): A3/A4 size Colour Laser Jet Printer with MFD *(A3 & A4 size Print, Scan, Fax and Photocopy)*	Set	**3**
44	SUPPLY- SUBSTATION AUTOMATION SYSTEM : PRINTER (LASER) A4	Substation Automation System (SAS): A4 size Colour Laser Jet Printer	Set	**1**
45	SUPPLY- SUBSTATION AUTOMATION SYSTEM : PRINTER (DOT MATRIX)	Substation Automation System (SAS): Dot Matrix Printer	Set	**3**
46	SUPPLY- SUBSTATION AUTOMATION SYSTEM : 60" VIDEO WALL SCREEN	Substation Automation System (SAS): 60" Video Wall Screen	Set	**2**
47	SUPPLY- SUBSTATION AUTOMATION SYSTEM : ROUTER	Substation Automation System (SAS): Router	No.	**1**
48	SUPPLY- SUBSTATION AUTOMATION SYSTEM : NECESSARY ELEGANT AND ERGONOMIC FURNITURE	Substation Automation System (SAS): Necessary elegant and ergonomic furniture *(Required in 220kV GIS Building Control Room/ Engineering Room, PR CPP Control Room & PNCP CPP Control Room for the offered equipments)*	Set	**3**
49	SUPPLY- SUBSTATION AUTOMATION SYSTEM : ALL LAN CABLES/ COMMUNICATION CABLES/ FO PATCH CORDS AND CABLE CONNECTORS ALONGWITH ASSOCIATED CABLE DUCTS AND ALL ACCESSORIES, REQUIRED NO. OF FO PATCH PANELS, MEDIA CONVERTERS, LIU ETC. FOR COMPLETENESS OF THE OFFERED CONTROL & PROTECTION SYSTEM/ SAS/ METERING SYSTEM/ DFR SYSTEM ETC.	Substation Automation System (SAS): All LAN Cables/ Communication Cables/ FO Patch Cords and Cable Connectors alongwith associated cable ducts and all accessories, Required No. of FO patch panels, media converters, LIU etc. for completeness of the offered Control & Protection System/ SAS/ Metering System/ DFR System etc.	Lot	**1**

Sl.No.	Item Description as per Tender BOQ	Detailed Description	Unit	Qty.
50	SUPPLY- SUBSTATION AUTOMATION SYSTEM : CONFIGURATION TOOLS FOR SAS AND RELAY PANELS AS PER ANNEXURE-A, SECTION-1 OF TS	Substation Automation System (SAS): Configuration tools for SAS and Relay panels: i) SAS HMI software for Client access. ii) Laptop computer with all necessary software - 8 set. iii) Software for configuration of all devices in relay panels - 1 set iv) Software for configuration of all SAS devices - 1 set. v) Necessary communication cables for programming the offered relays - 1 set. vi) All kinds of communication and protocol converters - 5 Nos. of each type. vii) Any other necessary tools for offered SAS & relay panels.	Lot	**1**
B)		**Mandatory Spares:**		
51	SPARES- SUBSTATION AUTOMATION SYSTEM : MAIN-1 LINE PROTECTION RELAY	Main-1 Line Protection Relay	No.	**1**
52	SPARES- SUBSTATION AUTOMATION SYSTEM : MAIN-2 LINE PROTECTION RELAY	Main-2 Line Protection Relay	No.	**1**
53	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSFORMER DIFFERENTIAL PROTECTION RELAY	Transformer Differential Protection Relay	No.	**1**
54	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSFORMER BAY, REF PROTECTION RELAY	Transformer REF Protection Relay	No.	**1**
55	SPARES- SUBSTATION AUTOMATION SYSTEM : 220KV, CABLE DIFFERENTIAL PROTECTION RELAY	220kV Cable Differential Protection Relay	No.	**1**
56	SPARES- SUBSTATION AUTOMATION SYSTEM : LBB PROTECTION RELAY	LBB Protection Relay	No.	**1**
57	SPARES- SUBSTATION AUTOMATION SYSTEM : BUSBAR DIFFERENTIAL PROTECTION RELAY - CENTRAL UNIT	Busbar Differential Protection Relay - Central Unit	No.	**1**
58	SPARES- SUBSTATION AUTOMATION SYSTEM : BUSBAR DIFFERENTIAL PROTECTION RELAY - BAY UNIT	Busbar Differential Protection Relay - Bay Unit	No.	**1**
59	SPARES- SUBSTATION AUTOMATION SYSTEM : ISLANDING PROTECTION RELAY	Grid Islanding Protection Relay	No.	**1**
60	SPARES- SUBSTATION AUTOMATION SYSTEM : FAST BUS TRANSFER RELAY	Fast Bus Transfer Relay	No.	**1**
61	SPARES- SUBSTATION AUTOMATION SYSTEM : O/C / E/F PROTECTION RELAY	O/C and E/F Protection Relay	No.	**1**
62	SPARES- SUBSTATION AUTOMATION SYSTEM : BAY CONTROL UNIT	Bay Control Unit *(with Maximum Configuration used in the offered system)*	No.	**1**
63	SPARES- SUBSTATION AUTOMATION SYSTEM : LIGHT INTERFACE UNIT (LIU)	LIU *(with Maximum No. of ports used in the offered system)*	No.	**1**
64	SPARES- SUBSTATION AUTOMATION SYSTEM : MODEM	Mandatory Spares: MODEM	No.	**1**
65	SPARES- SUBSTATION AUTOMATION SYSTEM : OFFERED NUMERICAL PROTECTION RELAYS (NOT COVERED IN SL. NO. 51 TO 62 ABOVE), IF ANY	Mandatory Spares: Offered Numerical Protection Relays (not covered in Sl. No. 51 to 62 above), if any *(1 Set = 1 No. of each type & make)*	Set	**1**
66	SPARES- SUBSTATION AUTOMATION SYSTEM : CONTROL FUSE/ MCB	Control Fuse/ MCB *(1 Set = 1 No. of each type & rating)*	Set	**10**
67	SPARES- SUBSTATION AUTOMATION SYSTEM : CONTROL SWITCHES & SELECTOR SWITCHES	Control Switches & Selector Switches *(1 Set = 1 No. of each type & make)*	Set	**1**
68	SPARES- SUBSTATION AUTOMATION SYSTEM : AUXILIARY RELAY	Auxiliary Relays *(1 Set = 1 No. of each type & make)*	Set	**2**

Sl.No.	Item Description as per Tender BOQ	Detailed Description	Unit	Qty.
69	SPARES- SUBSTATION AUTOMATION SYSTEM : SAS/ HMI/ DATA CONCENTRATOR: ALL CARDS SUCH AS INPUT & OUTPUT CARDS, POWER SUPPLY CARDS, PROCESSOR CARDS ETC.	SAS/ HMI/ Data Concentrator: All Cards Such as input & output cards, power supply cards, processor cards etc. *(1 Set = 1 No. of each type)*	Set	**1**
70	SPARES- SUBSTATION AUTOMATION SYSTEM : SAS/ HMI/ DATA CONCENTRATOR: ETHERNET SWITCH	SAS/ HMI/ Data Concentrator: Ethernet Switch *(1 Set = 1 No. of each type)*	Set	**1**
71	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSDUCER PANELS & LMS: INTERPOSING RELAYS, IF APPLICABLE	Transducer Panels & LMS: Interposing Relays, If Applicable *(1 Set = 1 No. of each type)*	Set	**5**
72	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSDUCER PANELS & LMS: ALL TYPE OF ELECTRONIC CARDS/ PROCESSOR/ IO ASSEMBLY/ POWER SUPPLY CARDS/ CONTROL CARDS	Transducer Panels & LMS: All Type of Electronic Cards/ Processor/ IO Assembly/ Power Supply Cards/ Control Cards *(1 Set = 1 No. of each type)*	Set	**1**
73	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSDUCER PANELS & LMS: TRANSDUCERS	Transducer Panels & LMS: Transducers *(1 Set = 20% of total quantity of each rating, type & make)*	Set	**1**
74	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSDUCER PANELS & LMS: FUNCTION GENERATOR CUM COUNTER, IF APPLICABLE	Transducer Panels & LMS: Function Generator Cum Counter, If Applicable *(1 Set = 1 No.)*	Set	**1**
75	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSDUCER PANELS & LMS: 4-20 MA SIGNAL INJECTION SET, IF APPLICABLE	Transducer Panels & LMS: 4-20 mA Signal Injection Set, If Applicable *(1 Set = 1 No.)*	Set	**1**
76	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSDUCER PANELS & LMS: ISOLATION TRANSFORMER, IF APPLICABLE	Transducer Panels & LMS: Isolation Transformer, If Applicable *(1 Set = 1 No.)*	Set	**1**
77	SPARES- SUBSTATION AUTOMATION SYSTEM : TRANSDUCER PANELS & LMS: NETWORK SWITCH	Transducer Panels & LMS: Network Switch *(1 Set = 1 No. of each type)*	Set	**1**
78	SPARES- SUBSTATION AUTOMATION SYSTEM : SCAP/ COMMUNICATION SYSTEM/ ENERGY METERING SYSTEM: ALL TYPE OF ELECTRONIC CARDS/ PROCESSOR/ IO ASSEMBLY	SCAP/ Communication System/ Energy Metering System: All Type of Electronic Cards/ Processor/ IO Assembly *(1 Set = 1 No. of each type)*	Set	**1**
79	SPARES- SUBSTATION AUTOMATION SYSTEM : SCAP/ COMMUNICATION SYSTEM/ ENERGY METERING SYSTEM: TRANSDUCERS	SCAP/ Communication System/ Energy Metering System: Transducers *(1 Set = 1 No. of each type, make & rating)*	Set	**2**
80	SPARES- SUBSTATION AUTOMATION SYSTEM : SCAP/ COMMUNICATION SYSTEM/ ENERGY METERING SYSTEM: NETWORK SWITCH	SCAP/ Communication System/ Energy Metering System: Network Switch *(1 Set = 1 No. of each type)*	Set	**1**
81	SPARES- SUBSTATION AUTOMATION SYSTEM : SCAP/ COMMUNICATION SYSTEM/ ENERGY METERING SYSTEM: DISCREPANCY SWITCH	SCAP/ Communication System/ Energy Metering System: Discrepancy Switch *(1 Set = 1 No. of each type)*	Set	**2**
82	SPARES- SUBSTATION AUTOMATION SYSTEM : SCAP/ COMMUNICATION SYSTEM/ ENERGY METERING SYSTEM: SELECTOR SWITCH/ TNC SWITCH	SCAP/ Communication System/ Energy Metering System: Selector Switch/ TNC Switch *(1 Set = 1 No. of each type & rating)*	Set	**1**
83	SPARES- SUBSTATION AUTOMATION SYSTEM : SCAP/ COMMUNICATION SYSTEM/ ENERGY METERING SYSTEM: SPECIAL TARIFF METERS (ABT, TOD)	SCAP/ Communication System/ Energy Metering System: Special Tariff Meters (ABT, TOD) *(1 Set = 1 No. of each type)*	Set	**1**
84	SPARES- SUBSTATION AUTOMATION SYSTEM : SCAP/ COMMUNICATION SYSTEM/ ENERGY METERING SYSTEM: CMRI/ MRI SYSTEM	SCAP/ Communication System/ Energy Metering System: CMRI/ MRI System *(1 Set = 1 No. of each type)*	Set	**1**

Sl.No.	Item Description as per Tender BOQ	Detailed Description	Unit	Qty.
85	SPARES- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM: POWER THYRISTORS / TRANSISTORS / IGBT /IGCT	UPS System: Power Thyristors / Transistors / IGBT /IGCT *(1 Set = 1 No. of each rating & type)*	Set	**1**
86	SPARES- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM: CONTROL CARDS	UPS System: Control cards *(1 Set = 1 No. of each type)*	Set	**1**
87	SPARES- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM: POWER SUPPLY CARDS	UPS System: Power supply cards *(1 Set = 1 No. of each rating & type)*	Set	**1**
88	SPARES- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM: POWER FUSES	UPS System: Power fuses *(1 Set = 20% of each rating)*	Set	**1**
89	SPARES- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM: CONTROL FUSES / MCB	UPS System: Control fuses / MCB *(1 Set = 1 No. of each rating & type)*	Set	**10**
90	SPARES- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM: INDICATING LAMPS	UPS System: Indicating lamps *(1 Set = 10% of total quantity)*	Set	**1**
91	SPARES- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM: INDICATING LAMPS COVERS	UPS System: Indicating lamps covers *(1 Set = 1 No. of each colour)*	Set	**2**
92	SPARES- SUBSTATION AUTOMATION SYSTEM : UPS SYSTEM: BLOCKER DIODE	UPS System: Blocker Diode *(1 Set = 1 No. of each rating & type)*	Set	**2**
93	SPARES- SUBSTATION AUTOMATION SYSTEM : CONTACT MULTIPLICATION RELAY	Contact Multiplication Relay	No.	**2**
		Services:		
94	SERVICES- SUBSTATION AUTOMATION SYSTEM : SUPERVISION (BAY-WISE) OF SITE TESTING AND COMMISSIONING OF THE COMPLETE CONTROL & PROTECTION SYSTEM AND SAS AS PER TS	Supervision (Bay-Wise) of Site Testing and Commissioning of the Complete Control & Protection System and offered SAS including the following: a) Testing & Commissioning of Numerical Protection Relays including Relay Parameterisation, Setting and Configuration. b) Testing & Commissioning of Busbar Protection, Metering System & SAS including termination of Network/ Optical Cables (Complete with supply of all end connectors, tees etc. as required). c) For armoured Network/ Optical Cables which are in the bidder's scope, laying of cables shall be in BHEL's scope; However, laying of all patch cords and supervision of Armoured Optical Cable laying is included in bidder's scope. d) Splicing & termination of FO cables (armoured & patch-cord) & offered communication cables. e) Arranging all necessary tools & tackles and equipment including Automatic Relay Test Kit for testing of the complete offered system (Control & Protection System/ SAS) shall be bidder's responsibility. f) Site Acceptance Tests (SAT), Availability Tests. g) Integration of IEC 61850-based monitoring equipments (mounted on Transformers Units/ GIS) & 33kV Bay relays/ MFM with the offered SAS as per section-1. h) Demonstration of Relay Test Kit/ Instruments supplied. i) Integration of remote end 220kV line differential relays with the existing remote end SAS as per section-1.	Lot	**11**

Sl.No.	Item Description as per Tender BOQ	Detailed Description	Unit	Qty.
95	SERVICES- SUBSTATION AUTOMATION SYSTEM : SUPERVISION OF SITE TESTING AND COMMISSIONING OF ENERGY METERING SYSTEM/ LMS/ SCAP PANELS/ CENTRAL TRANSDUCER PANELS/ UPS SYSTEM AS PER ANNEXURE-A, SECTION-1 OF TS	Supervision of Site Testing and Commissioning of the offered Energy Metering System/ LMS/ SCAP Panels/ Central Transducer Panels/ UPS System etc, including the following: a) Testing & Commissioning of all numerical/ digital devices/ cards including termination of Network/ Optical Cables (Complete with supply of all end connectors, tees etc. as required). b) For armoured Network/ Optical Cables which are in the bidder's scope, laying of cables shall be in BHEL's scope; However, laying of all patch cords and supervision of Armoured Optical Cable laying is included in bidder's scope. c) Splicing & termination of FO cables (armoured & patch-cord) & offered communication cables. d) Arranging all necessary tools & tackles and equipment for testing of the complete offered Energy Metering System/ Communication System/ LMS/ SCAP/ Transducer Panels etc. shall be bidder's responsibility. e) Site Acceptance Tests (SAT), Availability Tests.	Lot	**1**
96	SERVICES- SUBSTATION AUTOMATION SYSTEM : TRAINING AS PER TS	Training as per Section-2 of TS	Lot	**1**
97	SERVICES- SUBSTATION AUTOMATION SYSTEM : ENGINEERING SERVICES AS PER TS	Complete Engineering of the offered System including the following: a) Diagram showing routing of FO Cables alongwith patch cords/ LAN Cables and preparation of FO Cable/patch cord/LAN Cable BOQ. b) Relay setting in OEM format along with with supporting calculation and application Checks. c) Incorporation of complete primary equipment and auxiliary system (as per specification) interfaces in the CRP schemes prepared by the bidder.	Lot	**1**

Note:

1. Complete Sub-station Automation System (SAS)/ LMS/ SCAP/ CRP/ Energy Metering System/ Central Transducer Panels/ UPS System etc. is inluded in bidder's scope under this tender (Tentative list of supplies as per this BOQ). If any other item as per the specification is required to be supplied for completion of the system over and above the items indicated above, the same shall be indicated clearly in the offer. Otherwise, the same shall be deemed to be included in the offer.

2. Proper sizing of UPS & Battery to be done by bidder in line with ratings of offered equipments, which shall be approved by IOCL.

3. 220 kV Numerical Busbar Protection Schemes shall be equipped completely for all the bays shown in SLD and additional 3 Nos. future bays as per specification.

4. Separate BCU for Bus VT and Bus Isolators/ Earth Switches shall be supplied for each Bus.

5. During contract stage, the above quantities are subject to change by ±20% of overall contract value. Some of the items may not be ordered at all.

6. Any revision in relay setting during commissioning/ As-Built Relay Setting document preparation shall also be in bidder's scope.

SECTION-2

EQUIPMENT SPECIFICATION

SECTION-2

CHAPTER-5

Technical Specifications for ELECTRICAL SYSTEM STUDY, ELECTRICAL CONTROL & PROTECTION PHILOSOPHY

* IN CASE OF ANY CONTRADICTIONS BETWEEN THIS SECTION & THE "AMENDMENTS BY IOCL" ATTACHED AT THE END OF SECTION-2, THE AMENDMENTS SHALL PREVAIL.

** ANY CIVIL WORK / CABLE LAYING WORK FOR CU/AL CONTROL CABLES, AUXILIARY POWER CABLES, HT CABLES / SYSTEM STUDY IS NOT INCLUDED IN THE PRESENT SCOPE OF BIDDER.

CODES AND STANDARDS

1. The design, material, construction, manufacture, inspection, testing and performance of the offered item shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest relevant IS standards as given below or equivalent IEC or British Standards. Nothing in this specification shall be construed to relieve the bidder of his responsibility.

IS: 694	PVC-insulated cables for working voltages up to including 1100V
IS: 722(1986) (Part I)	Specification for AC electricity meters.
IS: 1248(1993) (Part-I)	Specification for direct acting analogue electrical measuring instruments and their accessories
IS: 1248(1983) (Part - II to V)	Specification for direct acting indicating analogue electrical measuring instruments and their accessories.
IS: 2071	Methods of High Voltage Testing
IS: 13118(1991)	High voltage alternating current circuit breakers
IS: 2705(1992) (Part I to IV)	Specification for current transformers
IS: 3156(1992) (Part - I to IV)	Specification for voltage transformers
IS: 3231(1986) (Part- 0 to III)	Specification for electrical relays for power system protection
IS: 3618	Phosphate treatment of iron and steel for protection against corrosion
IS: 5082(1981)	Wrought Aluminium and Al alloy bars, rods, tubes and Sections for electrical purposes
IS: 5578(1984)	Guide for marking of insulated conductors.
IS: 6005	Code of practice for phophating of iron & steel
IS: 6875 (1973) (Part –I to II)	Specification for control switches for voltages up to and including 1000V AC and 1200V dc
IS: 9046(1978)	Specification for AC contactors of voltages above 1000V up to and including 11000V.
IS: 9920(1982) Part I to III	Switches and switch isolators for voltages above 1000V.
IS: 9921(1987) (Part I to V)	AC disconnectors (isolators) and earthing switches for voltages above 1000V
IS: 11353(1985)	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS: 12661(1988) (Part I)	High voltage motor starters.
IS: 12729 (1988)	General requirements for switchgear & control gear for voltages exceeding 1000V.
IS: 13703(1993) (Part - I)	Low voltage fuses for voltages not exceeding 1000V AC or 1500V DC
IS: 13118	General requirement for circuit breakers for voltages up to 1000V

Standard no.	Title
IS-3231 IEC-255 Part 1 to 3 BS – 142	Electrical relays for power system protection.
IS – 722 BS – 37 IEC-337 & 337-1	Control switches (LV Switching devices for control and auxiliary circuits.)
IS – 2705	Current transformers
IS – 3156	Voltage transformers
IS – 4237	General requirements for switches and control gear for voltages not exceeding 1 kV
IS – 375	Marking and arrangements for switch gear, bus bars, main connections and auxiliary wiring
BS – 152	Relay coding, auxiliary wiring and panel and wiring
IS – 8686	Static protective relays
IS – 2147	Degree of protection for cubicles
IEC-297 Part 1-3	Dimensions of mechanical structures of the 482.6mm (19)" series.
IS – 6875	Control switches (LV Switching devices for control and auxiliary circuits)
IS – 5	Colour for ready mixed paints and channels.
IS – 1554 Part-I, 1988	PVC insulated cables up to and including 1000 volts.
IS – 3842 Part- II to IV	Application guide for protection
IS – 9224 Part- II	HRC Cartridge fuse links.
IS – 6005	Code of practice for phosphating iron and steel
IS-5578	Guide for making of insulated conductors.
IS – 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS – 9482- 1980	Characteristics values of input and outputs of single side band PLCC terminals.
IS- 9528 Part-1 and 2	Planning of (single side band) power line carrier systems.
IS – 10706 – 1983	Methods of tests for single side band PLC terminals.
IS-8997- 1978	Coupling device for PLC systems (note This is to be referred for the PLCC terminal connections.
IEC-686-1	Transducers
IS – 2206	Fuses
IS – 9000	Dry heat test
IEC – 801-4	Electrical heat transient bursts.

Characteristic, Performance, Accuracy, Burden, Mechanical endurance test		
1.	IEC-60255-6	Thermal requirements Mechanical requirements Limiting dynamic value Accuracy requirements Rated Burden
2.	IEC-60255-11	Interruption to and alternating component in DC aux. Energizing quantity
3.	IEC-60255-3, IEC-60255-12, IEC-60255-13	Relay characteristic & Performance test
4.	IEC-60255-23	Contact Performance test
Electromagnetic Compatibility type test		
1.	IEC-60255-22-1, Class-III,	1MHz burst immunity test
2.	IEC-60255-22-2, Class-III IEC-61000-4-2, Class-III	Electrostatic discharge test Direct application Indirect application
3.	IEC-60255-22-4, Class-A	Fast transient / burst immunity test
4.	IEC-, 60255-22-5	Surge immunity test
5.	IEC-60255-22-7, Class-A	Power frequency immunity test
6.	IEC-61000-4-8, Class-V	Power frequency magnetic field test
7.	IEC- 60255-22-3	Radiated electromagnetic field immunity
9.	IEEE/ANSI/C37.90.2	Radiated electromagnetic field disturbance
10.	IEC- 60255-22-3	Immunity to conducted disturbances induced by radio frequency fields test
11.	IEC- 60255-25	Electromagnetic emission tests - Conducted emission test - Radiated emission test
Insulation tests		
1.	IEC- 60255-5	Dielectric test Impulse voltage test Insulation resistance
Environmental tests		
1.	IEC-60068-2-1	Cold test Storage test
2.	IEC-60068-2-2	Dry heat test
3.	IEC-60068-2-3	Damp heat test, steady state
4.	IEC-60068-2-30	Damp heat test, cyclic
5.	IEC-60068-2-48	Storage temperature test
CE compliance		
1.	IEC- 60255-26	Electromagnetic compatibility requirements

Mechanical tests		
1.	IEC- 60255-21-1	Vibration
2.	IEC- 60255-21-2	Shock and bump
3.	IEC- 60255-21-3	Seismic
Degree of protection test		
1.	IEC 60529	Degree of Protection Provided by enclosure test
Safety test		
1.	IEC 61010-1	Single fault condition assessment Earth bonding impedance test Mechanical resistance to shock and impact - Rigidity test - Impact hammer test Protection against electrical shock Protection against the spread of fire

- Indian Electricity Act and Indian Electricity Rules.
- Fire Insurance Authority Regulations.
- Wherever Indian standards are not available, relevant IEC standard shall be applicable.
- The switchboard shall also conform to the provisions of the latest revision of the 'Indian electricity rules' and other statutory regulations currently in force.

1.2 In case of imported equipment, standards of the country of the origin shall be if these are equivalent are or stringent than the applicable Indian Standards.

1.3 In case of any contradiction between various referred standards/specifications/data sheets and statutory regulations, the following order of priority shall be given:

- Statutory regulations
- BOM
- Detailed Job Specifications
- Standard Specifications

SPECIFICATION FOR [redacted] CONTROL & PROTECTION SCHEMES

1.0 SCOPE

1.1 The overall scope of work shall be as per following specifications.

1.1.1 This specification covers the design, engineering, manufacture, inspection & testing at manufacturer's work before dispatch, packing, forwarding, delivery , [redacted] cabling, connections, testing & commissioning at site as per overall project requirements of Control & Protection scheme for complete ISBL scope, The major components included in ISBL scope for control and protection schemes are given below but not limited to-

a- 220 KV overhead double circuit lines
b- 220 KV GIS system
c- 220/33 KV power transformer
d- Power evacuation 33 KV cables and associated downstream switchgears
e- Auxiliary systems
f- Testing instruments as listed in clause 2.0

the relay panel for all above systems shall be complete with respect to all required relays and associated auxiliaries.

1.1.2 Design, fabrication, supply, [redacted] factory and site testing including commissioning of Synchronising control alarm (SCAP) system to meet the requirements of various control and protection schemes for protection of

a- 220 KV overhead double circuit lines
b- 220 KV GIS system
c- 4 no of 220/33 KV power transformer
d- 4 nos of spare bays
e- Power evacuation 33 KV cables and associated downstream switchgears
f- Auxiliary systems.

1.1.2.1 Design and fabrication of Control & Protection Panels for mounting the relay and relay assemblies along with all necessary accessories like switches, measuring & recording instruments & indicating lamps etc. and wiring up of the same to provide self contained and ready to use protection as per this specification.

1.1.3 Bidder shall design the complete protection philosophy in line with HVPNL grid codes, CEA requirements, **Requirement of OEM of different components** & as per applicable standards.

1.1.4 Complete testing at manufacturer's works of the relays and protection schemes after mounting and fully wiring up in the Control & Protection Panels and other required testing at site. F.O.R. destination supply of completely assembled Control & Protection Panels.

1.1.5 [redacted], Testing and commissioning of these panels at site including all associated cabling

1.1.6 It is not the intent to specify completely all the details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and

workmanship as mentioned in ~~clause 4.0~~ SECTION-3 and shall be capable of performing continuous commercial operation up to the supplier's guarantee.

In a manner acceptable to the purchaser, who will interpret the meaning of drawings and specifications, and shall have the power to reject any work of material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective trouble free operation for the control & protection schematics of 220 KV Overhead lines, all feeders of 220kV GIS, 220/33kV Power transformers and their concerned 33 KV downstream switchgear panel with the bidder's scope including any equipment not mentioned in the specifications but required for complete and successful commissioning of the equipment mentioned above. All such components shall be supplied without any limitation whether it is a part of specification /purchase order or not.

1.1.7 System Study: (NOT IN BIDDER'S SCOPE)

1.1.7.1 Bidder to carry out details system study of complete system in integration of existing system for
a- **Load flow studies in normal and contingency cases. Various operating cases will be provided during detailed engineering. Load flow parameters shall also be checked for existing generation buses in every operating and contingency cases.**
b- Short circuit studies for new electrical system and existing generation buses.
c- Complete relay coordination for new Electrical system offered in tender.
d- Transient stability study in normal and contingency cases
e- Grid Islanding setting derivation with respect to system stability in various grid disturbances.
f- Load shedding requirements in various contingencies for both fast load shedding system and under-frequency based load shedding system.

1.1.7.2 The system study shall be carried out through following reputed consultancy agency or equivalent only.

a) TCE
b) ABB
c) PEARL
d) TRACTEBEL
e) BECHTEL
f) NTPC
g) EIL

1.1.7.3 For any other firm, the required credentials, work experience documents shall be submitted to Engineer In-charge for approval.

1.1.7.4 Bidder shall submit detail system study report to IOCL for review and approval. The comments of IOCL shall be resolved by LSTK contractor and revised report to be submitted for approval. All different base conditions, operating cases and assumptions to be approved by IOCL shall be final. The finalisation of operating cases, contingency cases, shall be finalised by Engineer Incharge during detailed engineering as applicable for the project without any extra cost implication.

1.1.7.5 The detail calculation of relay setting shall take care recommendation of OEMs of major equipments Major Equipment OEM to be submitted to IOCL for approval.

1.1.7.6 Collection of data which is required for system study from various sources like HVPNL, OEM's, Owner's system is sole responsibility of LSTK contractor.

1.1.8: The system study done on the latest version of ETAP platform. The back-up files and modelling files to be submitted to IOCL post completion of studies.

1.1.9 Two no.'s remotely installed (in existing user control room of PR and PNCP power plant). Synchronising, control and annunciation panel (SCAP) shall be provided in project along with its complete engineering, interconnection details, supply, erection and commissioning.

1.1.10 **Central Transducer Panel**- Central transducer panels to be provided for all required inputs for SCADA, ECS (existing), SCAP system & load management package. It shall be provided in project along with its complete engineering, interconnection details, supply, erection and commissioning including supply of transducers, wiring (hard wired, Optical Fiber, D/A & A/D conversion) as per detailed engineering.

1.1.10 Grid islanding facility: The RELAY panel shall have exclusive relays & protection elements with redundancy to ensure implementation of Grid islanding on following criteria (minimum) –

a. Frequency based
b. Rate of change of frequency &/or combination of both frequency and rate of change of frequency
c. Directional Power (active and reactive)
d. Voltage level with directional current (VOC)
e. Vector jump / vector surge protection
f. Voltage based protection

1.1.11 – Energy Metering Facility – Special ABT meter of 0.2S class shall be provided as per specification and requirement of HVPNL. Both main and check meters with CMRI facility to be provided. One proper energy meter room to be provided near GIS switchgear in sub-station very near to the CT & PT system. The guidelines of HVPNL is attached as annex- S-3/C-5/1.

1.1.12 All site work including supply of all associated materials like instrument transformers (CT, PT), control cables, power cables all kind of OFC cables, communication cables, its installation shall be in bidders scope. This also includes supply of instrument transformers, protection relays, control accessories, switches, analog/digital meters, control cables, OFC cables, installation and commissioning at concerned 33 KV side switchgears also.

1.1.13 Reliability recommendations as detailed in [illegible] Chapter-14 related with protection and control system shall be included in the design of protection and control system.

2.0 SUPPLY OF TESTING EQUIPMENTS AS PER PROJECT REQUIREMENTS:

Following are the list of Brand new Testing Kits to be supplied by [illegible] bidder. These testing kits shall be handed over to IOCL and shall be property of IOCL which shall be required for day-to-day maintenance and troubleshooting requirements post commissioning of the system.

S. No	Description	Quantity
1	Primary Current Injection Kit, Portable, Input: 0-230V AC, Output: 2500A continuous, Make: Megger, FLUKE, equivalent	0
2	Secondary Injection test Kit, 3 phase, Adjustable (voltage, current, frequency, phase angle, AC/DC output) Make: FREJA 300 equivalent	2
3	VLF AC Test kit with attachments for PD assessments and analysis system, Portable, 0-40KV AC, Make: Megger or equivalent	0
4	Battery Ground Fault Locator, make: Megger	0
5	Phase sequence tester, Make: Megger or equivalent	0
6	Power Quality Analyser, 3 Phase, make: Fluke	0
7	Transformer Oil Moisture Analyser, Make: Megger or equivalent	0
8	Cable route tracer, Make: Megger or equivalent	0
9	Transformer Oil BDV test Kit. Make:	0

The supplied testing kits shall be with guarantee/warrantee certificates & product catalogues and type test certificates. The purchaser reserves the right to accept the testing kits as per requirement and may suggest a particular make & model no. also.

2.5: Necessary operating tools and safety equipments to be supplied as listed below (minimum):

S. No	Description	Quantity
1	Insulated hand gloves for HV systems	~~10 pair~~ 0
2	Contact type Live line Detectors upto 220 KV voltage level	[illegible] 0
3	Non- Contact type Live line Detectors upto 220 KV voltage level	[illegible] 0
4	Arc Flash suit	[illegible] 0
5	Face shield	[illegible] 0
6	Discharge rod suitable for EHV system	[illegible] 0
7	Safety Goggles	[illegible] 0

The supplied equipments shall be with guarantee/warrantee certificates & product catalogues and type test certificates. The purchaser reserves the right to accept the equipments as per requirement and may suggest a particular make & model no. also.

3. STANDARDS:

3.1. Unless otherwise specified elsewhere, in this specification, the rating, performance and testing of Control & Protection Panels and accessories shall conform to the latest revisions, available at the time of placement of order of all relevant standards listed in the starting of the annexure.

However the supplier shall submit the copies of the relevant standards applicable to the required Control & Protection Panels.

3.2. The equipment shall complied with the latest revision of Indian Electricity Act and Indian Electricity Rules, HVPNL guidelines and any other applicable statutory provisions, rules and regulations applicable in the locations where these panels are to be installed.

3.3 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

3.4 The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified above.

3.5 In addition to meeting the specific requirement called for in the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards and shall form an integral part of Specification.

3.6 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.

3.7 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

3.8 When the specific requirements stipulated in the specification exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.9 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standard referred shall also be accepted.

3.10 In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Employer's approval.

3.11 The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be confirmed.

4. PRINCIPAL TECHNICAL PARAMETERS:

The Control & Protection Panels covered in these specifications shall have the technical requirements listed in Annexure- S-3/C-5/2

5. GENERAL TECHNICAL REQUIREMENTS:

5.1. SCOPE OF WORK.

5.1.1. Design and fabrication of complete panels with provision for mounting all the associated equipment. The list of major mountings shall be given by bidder in Annexure- S-3/C-5/2.

5.1.2. Supply and mounting of all equipment as specified in Annexure- S-3/C-5/2 and in this specification together with such auxiliary equipment and materials as required. The bidder shall indicate make, type and designation of all equipments and shall submit for approval by owner during detailed engineering.

5.1.3. Complete internal wiring of equipment and terminal blocks and wiring between adjacent panels. Design and manufacturing of relays and relay assemblies to meet the requirement of various protection schemes, as specified hereunder for the panels as per project requirements.

5.1.4. Electrical detailing as outlined in this specification.

5.1.5. Preparation and furnishing of all the required drawings including schematic, internal external cable connection drawings and wiring schedules. All wires shall be ferruled at both ends (cross & straight) even on shorting links also and shall be clearly shown in the schematic drawings.

5.1.6. Testing of panels and associated equipments and furnishing of test certificates including testing instruments & testing engineer.

5.1.7. Preparation/furnishing of erection, commissioning instructions, operation and maintenance manuals for all protections with all operational features/optional features.

5.1.8. Testing and commissioning of all the supplied equipment at site.

5.1.9. The supplier of RELAY panels shall be manufacturer of relays and all the main relays on the RELAY panels shall be of his make only. However, one of the distance protection schemes on each 220 kV feeder RELAY panel can be of different make in view of the fact that both the distance protection scheme (Main-I & Main-II) should have different measuring techniques.

5.1.10 The successful bidder have to submit Five sets of all types of drawings, schematics and electrical internal circuits, indicating measuring points and measuring values, external cable connection drawings, wiring schedules, erection instructions, operation and maintenance manuals to Engineer-In-Charge. One set each shall be supplied along with each panel.

5.1.11 The offered equipment shall be brand new with state of the art technology and proven field track record. No prototype equipment shall be offered.

5.1.12 Bidder shall give a notice of at least one year to the end user of equipment before phasing out of product/ spares to enable the end user for the placement of order for spares & services.

5.2. SIZE AND GENERAL DIMENSIONS REQUIREMENTS FOR RELAY PANEL:

5.2.1. **Control & Protection Panels**: The panels shall be 'Simplex' type with **swing frame front door**. The overall panel dimensions shall be as per project requirements.

5.2.2. The Control & Protection Panels shall be modular rack mounting type consisting of standard width racks, in accordance with the IEC – 297. The relays shall be as described under clause nos. 5.11. The relays shall be suitable to form composite relay assemblies in racks to form complete protection schemes with minimum external wiring involved. Ancillary components like switches, lamps etc whenever needed, for protection schemes shall be installed on plates suitable for mounting in racks. The Control & Protection Panel shall have full transparent (Perspex) front door with lockable handle, in addition to main front swing frame door.

5.2.3. GENERAL REQUIREMNT FOR CONTROL & PROTECTION PANEL

5.2.3.1. The slots for inter panel wiring shall be spaced at 300mm from top of the side panel and their size shall be **80mm (H) x 300mm (W)** or suitable for entry of wires as per requirement

5.2.3.2. Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof to meet the requirement to IP-42 of relevant IS.

5.2.3.3. The panels shall be free standing, floor mounting type and shall comprise rigid, welded structural frame enclosed completely with specially selected, smooth finished cold rolled sheet steel of thickness not less than 3mm for load bearing members (front panel, base frame, door frame)and 2.0mm for non load bearing members (side panel, cubicle roof, door). There shall be sufficient reinforcement to provide level surfaces, resistance to vibration, and rigidity during transportation and installation. No deviation to this clause is permitted.

5.2.3.4. All doors and removable covers shall be gasketed all round with neoprene gaskets, ventilating louvers, with screens and filters.

5.2.3.5. Design, material selection and workmanship shall be such as to result in neat appearance inside and outside with no weld, rivets or bolt heads apparent from outside and with all exterior surface true and smooth.

5.2.3.6. All CT, PT signal cabling, control cabling, AC/DC power supply cabling, OFC based cabling and any other kind of the cable shall be supplied by LSTK contractor including its termination complete in all with all materials like lugs, ferrules, glands etc. Cable entries to the panels shall be from the **two numbers** of screwed type removable bottom plates .

5.2.3.7. Bay wise Bay Control Unit* i.e. BCU, Breaker control switch, Energy meter, Analog & Digital Meters, Numerical protective relays as required and as per IOCL approved drawings along with required Auxiliary / Multiplication /Tripping / Supervision Relays & Push Buttons shall be accommodated in Control & Protection Panels for 220KV Bays.

5.2.3.8. The size and/or number of relay panels shall be such that to accommodate, Energy meter, Numerical protective relays as per project requirements along with required Auxiliary / Multiplication / Tripping / Supervision Relays shall be accommodated in one Control & Protection Panel per bay.

5.3 LABEL

5.3.1. All front mounted equipment as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved. The labels shall be mounted directly below the respective equipment. Label with large and bold letters engraved with panel designation shall be provided at the top of each panel on front and rear side.

5.3.2. All the front mounted equipment shall also be provided tag numbers corresponding to the ones shown in the panel internal wiring to facilitate easy tracing of wiring. These labels shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.

5.3.3. Labels shall be made of Aluminum anodized plate P.V. Castings. Labels shall have white letters on black background. All relays shall be given standard abbreviation numbers with name of device, corresponding to the ones shown in the panel internal wiring.

5.3.4. 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-BOFF' etc.

5.4. CONTROL SWITCHES

5.4.1. Control switch shall be rotary type provided with escutcheon plates clearly marked to show operating position and suitable for flush mounting with only the switch front plate and operating handle projecting out. The connections shall be from the rear. The contact assembly at the back of the switch shall be enclosed in dust tight removable covers. The access to the contacts shall be from the back by the removal of the cover. Contact assembly shall be smooth enough for operations.

5.4.2. Breaker control switch of "3 position spring return to neutral" type shall be provided. 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 position to 'After Close' and 'After Trip' positions respectively. The handle or base for breaker control switch shall have **RED COLOUR**

5.4.3. The number of contacts in the control switches shall be decided by the tenderer in view of various requirements of this specification. Two pairs of contacts one normally open and one normally closed shall be kept spare. The total number of contacts proposed to be provided shall be stated in the tender.

5.4.4. Safety against inadvertent operation due to light touch in the control switches shall be ensured.

5.4.5. The Control switches of SCAP panel shall have flasher Facility to indicate mismatch in Switch position and actual breaker status.

5.4.6. Contacts of the switch shall be spring assisted and contact faces shall be silver plated. Spring shall not be used as current carrying parts. The contacts of all switches shall preferably open and close with snap action to minimize arcing. The contact rating of the switches shall be as follows or as per applicable standard references:

	Description Contact rating	**240V**	**220VDC**
A	Make and carry continuously	25A	25A
B	Make and carry for 0.5 sec	30A	30A
C	1) Resistive load 2) Inductive load with L/R = 40msec	7A 7A	7A 5A

5.5 Panel Internal Wiring

All wiring shall be carried out with 1100V grade single core multi strand flexible copper conductor wires with PVC insulation and shall be Flame Retardant Low Smoke (FRLS) *type,* vermin and rodent proof. The current carrying capacity of wire shall be adequate for the duty assigned to it considering short circuit condition and shall have sufficient flexibility to facilitate proper termination at any location. Color coded wires (red, yellow, blue, black) shall be used for CT, VT and CVT secondary connections.

The copper conductor used for internal wiring be as follows:

a) All circuits except instrument transformer circuit of 1.5 Sq mm per lead

b) CT circuit - one 2.5 Sq mm per lead.

c) VT circuits one 2.5 Sq mm per lead.

d) Energy metering - 2.5 Sq mm per lead for both PT & CT circuits.

5.5.2. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common circuits shall be provided near the top of the panels running throughout the entire length of the panels.

5.5.3. The wire numbers shown in the wiring diagram shall be in accordance with IS375/BS152/BS156. All wires directly connected to trip circuit breaker or devices shall be distinguished by addition of a red colored or lettered ferrule.

5.5.4. Panel wiring shall be securely supported, neatly installed by lacing and tying, readily accessible and connected to equipment terminals and terminal blocks. Flame retardant, plastic wiring channels/troughs with strap on plastic covers shall be used for this purpose. Sufficient space in channel for modification of wiring shall be kept.

5.5.5. Accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker or positive and negative wires, these wires shall not be terminated on adjacent terminal blocks.

5.5.6. The unused space on the front or rear of the panels shall be kept clear of wiring to facilitate addition of devices without rewiring associated portion of the panels.

5.5.7. Wire termination shall be made with solder less crimping type of tinned copper lugs which firmly grip the conductor. Insulation 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.

5.5.8. The bidder shall be responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment. Terminations on T.B. shall be grouped function wise on one region of T.B.(may not be full T.B) to take outlet connections in one cable for the function.

5.6. Interior Lighting

5.6.1. The switchboard shall be illuminated by 11 W, LED with fixture including reflector, front cover, etc. The voltage rating shall be 230 Volts, 1 Phase 50 Hz, AC supply. This light shall be operated by door operated switch.

5.6.2. The panel shall be provided with 240V, 50Hz. 15 A, multi pin universal socket with switch. The socket with switch shall be mounted inside the panel at convenient location.

5.7 Earthing

5.7.1. Each panel shall be provided with earth bus tinned copper, having minimum cross section area of 25 x 6 sq mm flat securely fixed along with inside base of panels. It shall be provided with M4 holes and Nuts & Bolts at a distance of 100mm. Since several panels are to be 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.

Provision shall be made to extend the earth bus bars to future adjoining panels. Provision shall be on the earth bus of the end panels for connecting owner's earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply, of the contractor.

5.7.2. All metallic cases of relays, instruments and other mounted equipment shall be connected to earth bus by copper wires of size not less than 2.5 sq. mm. The colour of the earthing wire shall be green.

5.7.3. 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.

5.7.4. VT, CVT and CT secondary neutral or common lead shall be earthed at one place only. Such earthing shall be made through links, so that earthing may be removed from one group without disturbing continuity of earthing systems for other group.

5.7.5. A separate earthing point shall be provided in the panel for cable screens of static equipment, insulation between two earths prior to connections of the two earths to the Purchaser's earthing grid, shall withstand a test voltage of 500V for 1 minute (or higher insulation resistance of not less than 1 meg-ohms at 500V) connection between the screen terminals and the screen earth – point shall be jumper wires. Connection of this earth point to the station earth shall be carried out by Purchaser.

5.8 Terminal blocks

5.8.1. Terminal blocks shall be 800V grade, 45 amps rated, one piece molded, complete with insulated barriers, stud type, melamine housing brass terminals, washers, brass nuts and brass lock nuts and identification strips.

Markings on the terminals strips shall correspond to wire number on the wiring diagrams. Not more than 2 wires shall be connected to any terminals.

5.8.2. Terminal blocks for CT, CVT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary wiring should be such that it can connect additional circuit in series.

5.8.3. At least 20% spare terminals shall be provided in each panel and these spare. Terminals shall be uniformly distributed on all terminal blocks, near each group of connections for function wise circuits.

5.8.4. All spare contacts and terminals of the panel mounted equipment and devices shall be wired up to terminal blocks with ferrule numbers starting with U.

5.8.5. Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of purchaser's cables on each side.

5.8.5.1. All DC and auxiliary AC circuits -- minimum one of 2.5mm2 copper

5.8.5.2. All CT & PT circuits -- minimum two of 4 mm2 copper

5.8.6. Cable gland plate fitted on the bottom of panel shall be connected to earthing of panel/station through a flexible braided copper conductor rigidly.

5.8.7. There shall be minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate. Also the clearance between two rows of terminal blocks edge shall be minimum of 150mm.

5.8.8. Molding materials shall be self extinguishing or resistant to flame propagation, substantially non hydroscopic and shall not carbonized when tested for tracking. The insulation between any terminal and frame work between adjacent terminals shall with stand test of 2kV rms. For one minute. The molding shall be mechanically robust to withstand handling while making terminations.

5.8.9. Easily removable Protective transparent plastic covers for placing over the live parts of the terminal blocks shall be provided invariably.

5.9 Painting

5.9.1. All sheet steel work shall be phosphated in accordance with the following procedures and in accordance with IS; 6005 'Code of Practice for phosphating iron and steel'.

5.9.2. Oil, grease, dirt and swart shall be thoroughly removed by emulsion cleaning.

5.9.3. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

5.9.4. After phosphating, through rinsing shall be carried out with clean water followed by final rinsing with dilute bi-chromate solution and oven drying.

5.9.5. The phosphate coating shall be sealed by the application of two coats of ready mixed, stowing type zinc chromate primer. The first coat may be 'Flash dried' while the second coat shall be stowed.

5.9.6. After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stowing. The second finishing coat shall be applied after completion of tests. The panel shall have colour confirming to shade 631 of IS-5 for outside. Inside of the panel will be egg shell white.

5.9.7. Each coat of primer and finishing paint shall be of a slightly aesthetically pleasing appearance free from dirt and uneven surface.

5.9.8. Finished painted appearance of panel shall present an aesthetically pleasing appearance free from dirt and uneven surface.

5.9.9. The bottom plate shall be painted with anti corrosive paint.

5.9.10. A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panel.

5.9.11. The paint thickness shall be 60- 100 microns for powder coating.

5.10 Mounting

5.10.1. All equipment on front of panel shall be mounted flush.

5.10.2. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment. Equipment mounted inside the panel shall be so located that terminals of adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible.

5.10.3. Cut-outs and wiring for free issue items. If any, shall be according to corresponding equipment manufacturer's drawings, cut-out, if any provided for future mounting of equipment shall be properly blanked off at a height not less than 750mm from the bottom of the panel. The centre line of relays, meters and recorders shall be at a height not less than 450mm from the bottom of the panel.

5.10.5. The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise, the top edges of all meters, relays and recorders etc. shall be matched.

5.10.6. No equipment shall be mounted on the doors without prior approval of the purchaser.

5.10.7. Panels shall be matched with other panels in the control room in respect of dimensions, colour, appearance and arrangement of equipment on the front.

5.10.8. At the existing stations, centre lines of switches, push buttons and other equipment shall be in line with existing panels.

5.10.1 Measuring and recording instruments

1. Microprocessor type

Separate digital type of meters to be provided in each of the bays in Relay Panel for 220kV for comprehensive measurement of electrical parameters.

2. Conventional type

Separate analogue meters shall be provided, wherever applicable. All analogue instruments shall be of square pattern, 96 x 96 mm, flush mounted type. Instruments shall be provided wherever specified in the data sheet. The accuracy class for all instruments shall be 1.0 as per IS: 1248.

3. Ammeters, voltmeters

Analogue meters shall be of moving iron type. The range shall be as indicated on the drawings. Ammeters for motor feeders shall have a non linear compressed scale at the end to indicate motor starting current. Red pointer shall be provided which can be adjustable at site for indicating full load current of the motor. The class of accuracy for ammeter and voltmeter shall be 1.5.

4. Auxiliary equipment

Auxiliary relays and contactors

Auxiliary relays (Alstom make VAA,VAJC, VAJH series only or advanced version) and contactors shall generally be used for interlocking and multiplying contacts. Auxiliary contacts shall be capable of carrying the maximum estimated current. In any case, their rating must not be less than 5 A for 240V AC at a power factor between 0.3 and 1.0 and 2 A for 220 V DC (inductive load)

Tripping relays (Separate Relay)

All tripping relays shall be of lockout type with hand reset contacts (Alstom make VAJH series only or advanced version), and shall be suitable to operate on the specified DC voltage. These relays shall have self coil cutoff contacts, and shall be provided with hand reset operation indicators (flags). Tripping relays will be acceptable in non drawout cases. The number of contacts shall be as shown on the approved schematic drawings.

Latching Type Contactors/Relays: Latching type contractor/relays to be provided for multiplication of critical signals.

5.11. RELAYS :

All the relays used for protection purpose shall be numerical relays only with latest state of art technology as per latest applicable standards of IS/IEC.

5.11.1. The general requirements for the protective relays are described here under however all relays shall in general comply with the technical specifications mentioned in annexures elsewhere.

5.11.2. All relays shall conform to the type test requirements of IS: 3231/IEC- 60255/IEC-61000 or other applicable standards. Relays shall be suitable for flush mounting on the front with connections from the rear.

5.11.3. All protective relays shall be with proper on line testing facilities without isolation from TB where inputs viz CT/ PT and DC are wired. All main relays shall be provided with test plug to test the relay on line & required test handle may be invariably indicated

Necessary test plugs/ test handles shall be supplied loose and shall be included in contractor's scope of supply.

5.11.4. All AC operated relays shall be suitable for operation at 50 Hz. AC voltage operated relays shall be suitable for 110V VT secondary and current operated relays for 1or 5 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.

5.11.5. All relays shall have the facility of communication on IEC-61850 communication platform with dedicated dual ports.

5.11.6 All relays must have software based programming facilities using PSLs/ block logics. All logics can be developed and modified at site with the help of laptop /HMIs. The relay must have all the logic blocks for like AND gate, OR gate, On delay items, Off delay times, pulse timers, latching blocks etc.

5.11.7 The relays offered must have the selection facility of all kinds of IEC and IEEE characteristic curves for DMT/IDMT based relay co-ordination scheme.

5.11.8 The [redacted] contractor must select the relays with the digital inputs and digital outputs considering 20% spares after build up of complete protection schemes. Also each should have minimum 6 DIs and 4 Dos with a minimum of 2 power DOs.

5.11.9 The [redacted] contractor shall provide the following items for interfacing with the relays.

a) Latest version relay software CDs – 2 Nos. minimum for each type of software and necessary communication cables for programming the relay. The software should have all basic and advanced features required for relay setting and data analysis.
b) All kinds of communications and protocol converters minimum 5 Nos. of each type shall be provided.

5.11.5. 1 REQUIREMENT OF AUXILIARY RELAYS FOR MULTIPLICATION

5.11.5.1. Latched type electrically reset auxiliary relay having sufficient nos. of contacts for completing the scheme and spare for use in future shall be used for contact multiplication with Flag / LED Indication.

5.11.5.2. These contacts will be used for status indications, switchgear interlocks, DR & SER etc.

5.11.5.3. These contacts multiplication relays shall be completely wired up to the terminal blocks of the control panel.

5.11.6. 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 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 relays coils and contacts, including spare contacts.

5.11.7. All protective relays, auxiliary relays and timers except the lockout relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relay and timers shall be provided with externally hand reset positive action operation indicators with inscription. 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, sudden pressure devices, fire protection etc.

5.11.8. Timers shall be of the solid state & shall be of continuous rating. Time delay in terms of milli seconds obtained by the external capacitor resistor combination is not acceptable. The variable pot type timer is not acceptable.

5.11.9. No control relay which shall trip the power circuit breaker when the relay is de-energized shall be employed in the circuits.

5.11.10. Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

5.11.11. All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

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

5.11.13. Any alternative/ additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the IOCL.

5.11.14. The bidder shall include in his bid a list of installations where the relays quoted have been in satisfactory operation.

5.11.15. All relays and their drawings shall have phase indications as R-Red, Y-Yellow and B-Blue.

5.11.16. Wherever numerical relays are used, the scope shall include the following:

a) The relay shall have suitable communication facility for connectivity to SCADA system offered in tender. The complete integration and mapping of data in SCADA from relay is sole responsibility of bidder. The relay shall be capable of supporting IEC 61850 protocol (with fibre optical port) and shall be compatible with existing SAS (may be of other make).

b) Necessary software and hardware to up/down load the data to/from the relay from/to personal computer installed in the substation. Including, the supply of two no. of laptops is also covered under this clause.

c) Laptops (Minimum: 2 Nos.) shall be of brand new latest version of windows operating system of following specifications:

i. Controller – Intel Core-i7 2.8 GHz or higher
ii. Make - HP/DELL/IBM
iii. RAM - 4 GB
iv. Harddisk-1 TB SATA or higher
v. Gigabit Ethernet Network Ports - 2 nos.
vi. USB Ports - 4 Nos.
vii. Serial Communication Ports: 2 Nos
viii. Keyboard & Optical Mouse with Pad

d) Necessary licensed copy of software and hardware to up/ down load the data to/from the relay from/to the personal computer installed in the substation shall be provided. Relay shall be looped by Fiber Optic/ twisted wire Cables up to PC.

e) The software shall be suitable for operations like switching, retrieval of information or changing of setting groups, retrieve oscillographic fault data from the relay memory and to store fault record data as oscilloraphic records in standard COMTRADE format. The software shall be suitable to provide oscilloraphic data into several different graphical representations that can be used to analyze the fault or event captured by the relay. It shall also be possible to calculate additional values from the captured signals and display analog curve with time base phasor diagram locus diagrams, harmonic graphs etc. Automatic upload of DR files should be possible.

f) The relay shall be supplied with all the original customized licensed software, IO Cards, required cable for local or remote communication mentioned in the catalogue including all optional items.

5.11.17. All not used terminal shall also be provided with screws washers, lugs etc. as for used terminal.

5.11.18. All the bidders have to demonstrate main protection relays and other relays as may be demanded by the IOCL, free of cost within 15 days after issue of intimation from IOCL for verifying its functions, features, accuracies etc. the testing shall be performed by fully 3 phase automatic testing set. The relays which don't meet requirements, don't function as per GTP will not be accepted.

5.11.19. The type test offered for relay shall be supplied with full options of protection and control functions mentioned in the catalogue.

5.11.20 The protection scheme as detailed below are minimum protections. While detail design, coordination, selection of protection shall be as per HVPNL, applicable standards & OEM requirement shall be in bidder's scope.

5.11.21 Complete Relay setting calculation of all proposed protection with its justification shall be submitted by bidder during detail designing stage for approval of IOCL. OEM endorsement is also required for protection setting specific to equipments.

~~5.11.22 Bidder shall carry out independent system study consisting of short circuit, transient faults etc. Bidder to include Existing Generation system also (of both PR & PNCP) for carrying out Short circuit , load flow and transient stability studies to ensure adequacy, protection checking and voltage regulations of existing system also.~~

5.11.22 REQUIREMENT OF DIRECT CARRIER INTERTRIP FOR LINES:

Instantaneous tripping of the remote end breaker shall be achieved through the direct carrier inter-trip tele-link/ OFC link in case any of the following operations/occurrences & others if any mentioned during detailed engineering.

5.11.22.1. Hand tripping of the line breakers.

5.11.22.2. Hand tripping of the TBC (Transfer bus coupler) breaker if the line is controlled by the TBC breaker.

5.11.22.3. Operation of the local breaker back up protection.

5.11.22.4. Operation of the transfer bus, bus-bar protection relay, if the line is on the transfer bus.

5.11.22.5. Over voltage protection operation.

5.11.22.6. Bus bar protection operation.

Sufficient number of contacts shall be provided on the concerned switches relays, etc. to enable transmission of the carrier impulse by two independent carrier channels simultaneously.

5.12 TIME SYNCHRONISATION EQUIPMENT:

There shall be separate GPS based Time Synchronisation Equipment installed with SCADA system purchased with this project.

All the numerical relays /digital meters installed in 220 KV sub-station shall receive and update GPS based time & date with this Time synchronisation equipment installed in SCADA panel.

All the communication cables, control cables required for time updation shall be in bidder's scope.

5.13 Energy Meter:

The Energy Meter shall be 3-Phase, 4 Wire type with accuracy class 0.5 for all internal purpose. For Main tariff metering purpose, special ABT meters with TOD facility of accuracy 0.2S shall be provided (for both lines in main and check meter concept). The detail specification guidelines of HVPNL is attached as annexure--S-3/C-5/1 for compliance. It shall be as per separately attached technical specifications and it shall be compatible to the new SCADA/Das System that will be provided as part of tender. Suitable independent CMRI system shall be provided for each ABT meter system (total 4 ABT meters with independent CMRI system will be required)

Energy meters shall be HVPNL approved make and it shall be as per discretion of IOCL & shall be finalized during detailed engineering.

6. TESTS

6.1 Type test

The successful bidder shall submit the complete type test reports as stated hereunder for the offered item during detailed engineering stage. These tests must have been conducted in the laboratory approved by central govt/national/international standards as per IEC 60255, IEC 60068, IEC 61000, IEC 60529, and IEC 61010-1 & IEC 61850.

The reports for the type tests mentioned in clause 6.1.2 shall be submitted by the bidder for the Protective Relays. However, the type test report not mentioned in clause 6.1.2, but relevant to the offered protective relay as on date shall be attached with a copy of English version of that standard.

6.1.1. The purchaser reserves the right to demand repetition of some or all the type test in the presence of the purchaser's representative without any cost implication on IOCL/BHEL.

6.1.2: List of type tests/Special Tests:

a. Performance tests:
i. Accuracy requirements
ii. Limits of operating range of auxiliary energizing inputs and auxiliary Voltage dependence.
iii. Limits of frequency range and frequency dependence
iv. Rated burden
v. Mechanical Endurance test
vi. Characteristic and Functional test
b. Thermal requirements:
i. Maximum allowable temperature
ii. Limits of short time thermal withstand value of input energizing quantities.
iii. Limiting dynamic value
c. Insulation Tests:
i. Dielectric Tests
ii. Impulse Voltage withstand Test
iii. Insulation resistance measurement d.
Influencing Quantities
i Permissible ripples
ii. 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 (Conducted and Radiated) Test.
viii. Surge Immunity Test
f. Contact performance Test
i. Contact making/Breaking capacity test
ii. Continuous capacity test g.
g. Environmental tests:
i. Dry Cold Test
ii. Dry Heat test
iii. Storage temperature test iv.
Damp heat Cyclic test
h. Mechanical Tests:
i. Vibration response & Vibration endurance test
ii. Bump test
iii. Shock response test
iv. Seismic test
i. Enclosure Test:
i. Degree of Protection test – IP51
j. Safety Test:
i. Single fault condition assessment
ii. Earth bonding impedance test
iii. Mechanical resistance to shock and impact
iv. Protection against electrical shock
v. Protection against the spread of fire
k. IEC 61850 Compatibility tests

6.2 Acceptance and routine tests

6.2.1. All acceptance and routine test as stipulated in the relevant standards shall be carried out by the supplier in presence of TPI and/ or Purchaser's representative. All expense and testing arrangement will be in Bidder scope.

6.2.2. Immediately after finalization of the program of type/ acceptance/ routine/ testing the supplier shall give two weeks advance intimation to the purchaser to enable him to depute his representative for witnessing the tests.

7. INSPECTION DURING MANUFACTURING

7.1. The inspection may be carried out by the purchaser representative at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications and shall not prevent subsequent rejection if the equipment is found to be defective.

7.2. The supplier shall keep the purchaser informed well in advance, about the manufacturing program so that the arrangement can be made for inspection.

7.3. The purchaser reserves the right to insist for witnessing the acceptance routine testing of bought out items.

8. QUALITY ASSURANCE PLAN

8.1. The bidder shall invariably furnish along with his offer the quality `assurance plan adopted by him/his sub-supplies in the process of manufacturing all major equipment/component.

8.2. Precaution taken for ensuring usage of quality raw materials and subcomponents shall be stated in the quality assurance plan.

8.3. The bidder should specifically express their consent to accept additions, revisions to their quality assurance plan to meet the purchaser's requirements if needed. The final quality assurance plan to be adopted, with mutual consent, shall be decided after discussion with successful bidder.

9. DOCUMENTATION

9.1 All drawings shall conform to international standards organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS: 11065. All drawings shall be in ink and suitable for microfilming. If drawings are computerized than it shall be nicely printed copy. All dimensions and data shall be in S.I.Units. All drawings shall be of A-3 size. (297mmX420 mm) Final Drawing Technical literature and commissioning manuals shall be printed and not Xerox copy.

9.2 The successful Supplier shall submit four sets of G.A. and schematic drawings for Purchaser's approval within four weeks from the date of placement of order or as decided in document approval process. The Purchaser shall communicate his comments/approval on the drawings to the Supplier within four weeks of the date of receipt of above drawings. The Supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of Purchaser's comments.

9.6 Approval of drawings by Purchaser shall not relieve the Supplier of his responsibility and liability for ensuring correctness & correct interpretation of the latest revision of applicable standards, rules & codes of practices. The equipment shall conform in all respects to high standards of engineering, design,

workmanship and latest revisions of relevant standards at the time of ordering.

10. PACKING AND TRANSPORT

10.1. All equipment/material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The contractor shall be responsible for any damage to the equipment during transit due to improper and inadequate packing. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. 'FRAGILE' 'HANDLE WITH CARE', 'USE NO HOOK' etc. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.

10.2. Wherever necessary proper arrangement for attaching slings for lifting shall be provided and all packages clearly marked with gross weight, signs showing 'UP' and 'DOWN' sides of boxes, contents of each package, order no. and date, name of the plant/SS/ of which the material in the package forms part of and any handling and unpacking instructions considered necessary. Any material found short inside the intact packing cases shall be supplied by the manufacturer/supplier without any extra cost.

10.3. Bidder shall ascertain, prior to shipment, from concerned authorities, the transport limitations like weight and maximum allowable package size for transportation. Fragile material such as relay cases, Instruments and other glass material shall be carefully covered with shock absorbing protective materials, such as thermocol, silica gel or equivalent moisture absorbent material in small cotton bags shall be placed inside the packing wherever necessary.

10.4. Each consignment shall be accompanied by a detailed packing list containing the following information.

a) Purchase order reference.
b) Name of consignee
c) Details of consignment
d) Destination
e) Total weight of consignment
f) Handling and unpacking instructions.
g) Bill of materials indicating contents of each package
h) Sign showing upper/lower side of the crate.

11. TRAINING

11.1. The successful bidder shall be required to provide facility for training, at no extra cost to the purchaser's four engineers for 7 days (i.e. 4x7=28 man days) to be nominated by the purchaser at his works. Bidder has to furnish the training module at the time of detailed engineering. The training shall cover familiarization with procedures of installation, testing, commissioning, operation, maintenance and trouble shooting on the Substation Automation and protection relays and equipment.

11.2. In case of training, the to and fro travel expenses, lodging and boarding charges as well as allowances for out of pocket expenses in respect of the trainees, shall be borne by the Purchaser. However, the supplier shall provide suitable facilities for lodging and boarding as well as to and fro transport to place of training from the hotel/guest house.

11.3. The program of the training shall be mutually discussed and finalized by the purchaser with suppliers.

12. SUPERVISORY ERECTION & COMMISSIONING

12.1. The bidder shall depute their Engineer to the various sites for carrying out the testing and commissioning of RELAY panel and other protection & control schemes. The bidder shall provide an adequate number of skilled/unskilled workers as well as all ordinary tools and equipment and any special tools/equipments required for equipment commissioning at his expenses.

12.2 All kinds of site testing, configuration, settings, and commissioning of protection relays shall be done under the supervision of OEM of relays. [redacted] contractor shall ensure all due co-ordinations and arrangements including testing kits as required complete with all associated costs. All arrangements including lodging, boarding, travelling shall be in the scope of [redacted] contractor.

13. SCHEDULES

13.1. The bidder shall fill in the following schedules which form part of the tender specification. The bidder shall fill the schedules and submit the same during detailed engineering stage.
Annexure- S-3/C-5/2: Guaranteed Technical particulars
Annexure- S-3/C-5/5: List of equipment for Control & Protection Panels.

13.2. For any deviation from the specification which is not specifically brought out shall be supported by authentic documents, standards and clarifications, otherwise the offer may be liable for rejection. Any deviation from the specification shall be high lighted giving reasons and unit prices.

14. GUARANTEE FOR MAINTENANCE SPARES AND SERVICES

The bidder shall guarantee for supplying maintenance spares and services as well as repairing of relays for a period of the life expectancy of 10 years.

15. D C DISTRIBUTION AND DC SUPERVISION

15.1. 220V DC distribution for the Control & Protection Panels shall be such that separate sub – circuits with suitable HRC Fuse is provided for each of the following:

a) Main I / Main II
b) Isolators/Earth switch control / interlock
c) BCU
d) Breaker and isolator auxiliary contact multiplication
e) Circuit breaker closing
f) Circuit breaker tripping
g) Bus-bar protection
h) LBB protection
i) Main – I carrier scheme/Main II carrier scheme.
j) Synchronizing circuit.
k) Remote end trip isolating link for channel I and II.

15.2. DC supervision shall be provided to supervise continuously the DC supply. The scheme shall be suitable to work on 220 V DC supply from the station provided by IOC at single point, and shall have position for alarm.

15.3. Auxiliary relays used for the DC supervision scheme shall have adequate number of elements (minimum 5 nos.) with suitable self reset type operation indicators wherever applicable.

15.4. There shall be two DC source. Distribution of circuit should be as per working M1 and M2 protection, independently. The scheme to be designed to operate two group of relays on separate battery and if required all relays i.e. two groups can be connected on either of DC source by using source -1, intermediate source – II i.e. three position by auto change over relays.

16.0 SPECIFICATIONS FOR CRITICAL SCHEMES:

All the breaker operations shall be possible through both Synchronizing Control & Annunciation Panel (Here onwards referred as SCAP) & SCADA. A dedicated selector switch shall be provided at SCAP for

selecting the SCAP or SCADA operation. Also a LOCAL/REMOTE switch shall be provided on the switchgear

1. 220kV GIS: The operation of the 220kV GIS breakers shall be possible from all SCADA/SCAP panel both. All the necessary control cabling etc for the same shall be included in the scope of the bidder. The SLD shall be provided on the control panel from where switching shall be done as per the ~~with~~ overlaid Aluminium strip & control switches for breakers to be provided accordingly. The other details of the panel shall be as per the control panel specifications given below.

2. 33kV Downstream Breaker: The operation of the 33kV breakers including synchronization shall be possible from SCADA/SCAP both. Provision of SCAP is also included in the scope of tender, as per specifications given elsewhere. The SCAP shall be in continuation with the generator control panel situated in CPP control room. ~~The necessary civil work for modification of existing room to include this SCAP shall also be in scope of the contractor only.~~

3. RTF chapter applicable for protection, distribution concept and auto changeover scheme is attached as ~~Section-5~~ Chapter-14.

4. The tentative control philosophy is given below. The detail scheme shall be developed by successful bidder during detail engineering and to be approved by IOCL.

A. <u>Scheme for Incomer /Bus-coupler/Transformer-</u>

1. Incomer Breaker

1. Closing Operation- For closing operation through SCAP and/ or SCADA system . A selector switch for dead bus, synch or auto synchronizer mode will be provided and accordingly the subsequent action will be enabled.

a) Dead Bus Charging: Corresponding Bus will be dead, Selector Switch will be in Dead selection – Manual close command will be given through a TNC switch at SCAP, which shall give close command after checking dead bus condition/necessary interlocks pertaining to dead bus condition

b) Synch. Mode: Corresponding Bus will be Charged, Selector Switch will be in Synch selection- Manual close command will be given through a TNC switch at SCAP, which shall give close command after checking Synch condition through a check synch. Relay along-with necessary interlocks pertaining to synch. condition

c) Auto Mode Corresponding Bus will be Charged, Selector Switch will be in Auto selection- Auto close command will be generated through a Auto synchronizer relay installed at SCAP, which shall give close command along-with checking Synch condition through a check synch. Relay & necessary interlocks pertaining to synch. Condition

In case the selection at SCAP is made for SCADA operation, all the above operations should be possible through SCADA HMI and selection will be made through soft keys. Necessary engineering and hardware provision shall be made in scope of supply to achieve the same.

2. Opening Operation- The opening operation shall be through TNC switch at SCAP/ SCADA/LCC/Panel TNC.

3. The breaker operation in service shall be through SCAP & SCADA only and in test position it shall be through LCC/ panel TNC switch.

2. **Transformer Incomer Breaker Operation**

A. All the breaker operations shall be through SCAP/ SCADA only.

B. Closing Operation- For closing operation through SCAP a selector switch for dead bus & synch will be provided and accordingly the subsequent action will be enabled.

C. Dead Bus Charging: Corresponding Bus will be dead, Selector Switch will be in Dead selection – Manual close command will be given through a TNC switch at SCAP, which shall give close command after checking dead bus condition/necessary interlocks pertaining to dead bus condition

D. Synch. Mode: Corresponding Bus will be Charged, Selector Switch will be in Synch selection- Manual close command will be given through a TNC switch at SCAP, which shall give close command after checking Synch condition through a check synch. Relay along-with necessary interlocks pertaining to synch. condition

E. Opening Operation- The opening operation shall be through TNC switch at SCAP/ SCADA/LCC/Panel TNC.

In case the selection at SCAP is made for SCADA operation, all the above operations should be possible through SCADA HMI and selection will be made through soft keys.

3. Bus coupler Breaker Operation

1. Closing Operation- For closing operation through SCAP a selector switch for dead bus & synch will be provided and accordingly the subsequent action will be enabled.

a) Dead Bus Charging: Any of the connected Bus will be dead, Selector Switch will be in Dead selection –Manual close command will be given through a TNC switch at SCAP, which shall give close command after checking dead bus condition/necessary interlocks pertaining to dead bus condition

b) Synch. Mode: Both the connected Bus will be Charged, Selector Switch will be in Synch selection- Manual close command will be given through a TNC switch at SCAP, which shall give close command after checking Synch condition through a check synch. Relay along-with necessary interlocks pertaining to synch. condition

2. Opening Operation- The opening operation shall be through TNC switch at SCAP/ SCADA/ LCC/Panel TNC.

B. <u>Bus Transfer Scheme</u>

This scheme shall be given in 220kV GIS switchgear with necessary interlocks for synchronization as described above. The schemes shall be modified as per recommendations of system study for maintaining operational configurations to minimize fault current levels. For

inclusion, any additional requirements shall be in the scope of bidder without any financial implications to IOCL/BHEL.

Below guidelines are for reference purpose. The applicable guidelines and standards of HVPNL and CEA shall be followed for detailed designing.

1. Incomer Closing

d) Independent Mode/Dead Bus:
1. B/C Off **OR** B/C not in service **OR** other I/C Off **OR** Other I/C not in service.
2. A-I-M Switch in Independent Mode
3. Respective Bus Voltage Dead (U<40%, all 3 phases & Bus PT MCB Healthy)

e) Manual Mode
1. Synch. Check OK
2. B/C & Other I/C On **AND** in Service
3. A-I-M Switch in Manual Mode
4. TSS selected in B/C **OR** Other I/C

2. Incomer Tripping

a) Auto Mode
1. Own Line U/V (U, 40% in all 3 phases with elapsed time delay &
2. Line PT MCB OK)
3. Other Bus Voltage healthy (U>80%)
4. B/C in Service
5. B/C Closing Circuit Healthy
6. A-I-M switch selected in Auto.

b) Manual Mode
1. A-I-M switch in Manual Mode
2. TSS selected in respective Incomer
3. Both Incomers & B/C are on **AND** in Service with elapsed time after Paralleling.

3. Bus Coupler Closing

a) Independent Mode/ Dead Bus
1. A-I-M Switch in independent mode
2. Either of I/C is OFF
3. Respective Bus dead (U<40% in all 3 phases & Bus PT MCB healthy)

b) Auto Mode
1. A-I-M Switch in Auto Mode
2. One I/C Off **AND** in Service
3. Respective Bus PT Voltage dead (U<40% in all 3 phases & Bus PT MCB healthy)
4. Time Out of Bus Coupler has not been activated (5sec after dead bus).

c) Manual Mode
1. A-I-M Switch in Manual Mode
2. TSS selected in either of I/C.

3. Both I/Cs on **AND** in service
4. Synch. Check OK.

4. Bus Coupler Tripping

Manual Mode

1. A-I-M Switch in Manual Mode
2. TSS selected in B/C
3. Both I/Cs **AND** B/C are on **AND** in service **AND** elapsed time after paralleling.

5. Common Conditions For Close Permissive For Incomer & Bus-Coupler

1. Self 86 not operated
2. 86 of both either Incomer is not operated (for B/C)
3. 86 of B/C is not operated (for I/C)
4. Antipumping not operated
5. Spring is charged
6. Breaker is in service position
7. Line voltage is healthy (In case of incomer)
8. Trip circuit is healthy.
9. Breaker is OFF.
10. There should be at least one future interlock in the closing ckt. a.

C. Other General & Reliability points:

1. The auxiliary supply to the numeric relay should be tapped from before the main DC switch of that panel and should be routed through dedicated fuse TB.
2. All relay and auxiliary relay contacts should be wired up to the TBs.

6. Tentative 220 KV protection philosophy shall be as under, although final philosophy shall be prepared during detailed engineering stage as per HVPNL guidelines and CEA requirements.

220kV GIS Double bus bar configuration

Panel Type	Main-I protection	Main-II protection	B/U protection	Voltage protection	DC supervision	BCU
Feeder/Incomer	Distance & Line Diff. Protn, With DR (Protocol – 61850)	Distance & Line Diff. Protn, With DR(Protocol – 61850)	1.Dir O/C & E/F, With DR (Protocol – 61850)	Yes	Yes	Yes
			2. Reverse power			
			3.df/dt			
			4.dV/dt			

			5. Vector shift 6.O/V, U/V, O/f, U/f *			
Transformer 220/33kV**	Diff Protn-I & REF Protn (High impedance) With DR (Protocol – 61850)	Diff Protn-II & SBEF With DR (Protocol – 61850)	a.Dir O/C & E/F, With DR (Protocol – 61850). b. Overfluxing. c. Incipient Faults. d. Transformer switching relay.	Yes	Yes	Yes
Bus Coupler	-	-	Non-Dir O/C, E/F With DR (Protocol – 61850).	Yes	Yes	Yes
Bus Voltage (02nos.)	-	-	-	Yes With DR (Protocol –61850)	Yes	Yes
LBB/CBF	In all the feeders using the B/U relays. Separate relays with separate DC source of supply shall be provided.					
Bus Differential	Distributed Bus Zone Protection for all Bays With DR in Bay as well as Central Unit (Protocol – 61850) with main zone and check zone facilities for each bus with due overlapping to avoid any blind zones including bus-coupler.					
*The protections 2,3,4,5 & 6 listed are to be provided through separate islanding relay with DR (Protocol-61850)						
**Auxiliary protection also shall form a part of transformer protection which includes Oil temperature indicator, Winding temperature, PRV, Buchholz relay, MOG & any other protection suitable and necessary for safe operation of transformer. The same protections required shall be provided separately for OLTC also.						
***BCU unit may become a part of SCAP for control requirements.						

33 KV Power Evacuation Part				
Panel Type	**Protection**	**B/U protection**	**Voltage protection**	**DC supervision**
Feeder/Incomer	Cable diff. Protn, With DR (Protocol – 61850)	1.Non-Dir O/C & E/F, With DR (Protocol – 61850) 2.O/V, U/V.	Yes	Yes
LBB/CBF	In all the feeders using the B/U relays. Separate relays with separate DC source of supply shall be provided.			

17. SCAP PANEL REQUIREMENTS:

1) Two no's remotely installed (in existing user control room) Synchronising, control and annunciation panel (SCAP) shall be provided in project along with its complete engineering, interconnection details, supply, erection and commissioning.

2) The SCAP shall be separate for PR & PNC with features mentioned below.

3) The panels shall be installed and suitable wiring shall be made for incorporation of the same at PR CPP nearby generator control panel & PNC CPP Control Room for corresponding feeders.

4) The individual SCAP panel for PR & PNC shall be designed as per project requirement.

5) SCAP shall have synchronising facility for grid incomers, bus coupler, all 220 KV OG feeders & all 33 KV connecting feeders with existing system. It shall have all standard interlock including dead bus / manual check sync interlocks.

6) SCAP Panel at PR shall have facility of synchronisation for following feeders:

   a) 220 KV Line Incomers: 2 Nos
   b) 220 KV/33KV Power Transformers/O/G feeders: 8 Nos
   c) 33KV side Generation Bus Incomer feeders: 6 Nos
   d) 220 KV Bus Coupler Panel: 1 No.
   e) 33kV LIB Feeders : 2 Nos.

7) SCAP Panel at PNC shall have facility of synchronisation for following feeders:

   a) 33KV side Transformer feeders: 4 Nos
   b) 33kV LIB Feeders : 2 Nos.

8) All suitable selector switch, breaker control switches, flasher or breaker position check scheme/ indication facility/ annunciation facility for major alarm and trips shall be included for complete GIS system, Grid transformer, 33 KV connecting system.

9) Metering facility shall be provided by use of digital meters for voltage, current, power measurement related with new GIS and 33 KV power evacuation systems.

10) The SCAP system shall display complete system SLD with all components in standard form for operator understanding & usability.

11) The SCAP system details, scheme and arrangement shall be submitted to IOCL Panipat for approval prior to manufacturing.

12) There shall be provision of 220KV and 33 KV isolator control from SCAP as applicable for PR and PNCP side.

13) Group Control of Generators from SCAP during synchronization:

During synchronization of 220Kv/ 33kV GIS feeders, it shall be necessary to control the power sources of Panipat Refinery & naphtha cracker together, in view of which the following shall be required as a part of SCAP

a) The commands for Voltage raise, Voltage lower, Frequency raise, Frequency lower shall be simultaneously sent to all connected generators at once. ~~Necessary cabling for the same shall be in scope of bidder only.~~
b) A separate lockable type of switch for enabling and disabling of group operation of generators to be provide on SCAP.
c) This scheme shall be provided in both SCADA & SCAP through hard and soft control.

14) Auxiliary relays for speed raise/low command, voltage raise/low command & CB close command shall be provided as per requirement.

15) There shall be selector switches present on SCAP
   a) Separate switch for Synchronisation in Auto/Manual/Dead
   b) Separate switch for Synchroniser On/Off
   c) Separate switch for Synchronisation from SCAP/SCADA

16) There shall be alarms/trip annunciation facility as per requirement to be finalised during detailed engineering.

17) There shall be portable type synchronising trolley provision for synchronising the feeders at both SCAP panels.

18) Following shall be the technical details of the synchronising trolley:

   a) Male/Female contact plugs for Aux supply, BUS & feeder CT/PT inputs, final output.
   b) The contact plugs shall be push fit type in nature with sufficient current capacity.

c) There shall be selection switch on trolley for Dead Bus/Synchronise/Without synchronise option.
d) There shall be two separate analog meters for Voltage& frequency showing BUS and feeder both values.
e) There shall be two LED lamps to show matching/not-matching condition of synchronism with changing darkness of LEDs.
f) There shall have a third LED to show full synchronism condition.
g) There shall have synchronizer relay on the trolley with the features of
    a. Checking voltage difference conditions.
    b. Checking phase angle differences.
    c. Checking rate of change of phase angle.

h) One trolley shall be provided in each control room (PR & PNC) and One spare trolley shall also be provided.
i) In case of auto-synchronising through SCADA, interlock shall be provided from hardwired check sync. relays.

19) Any other relay/component, if required for operation of SCAP as per IOCL requirement shall be in the bidder scope.

20) The complete details and schemes of SCAP shall be submitted to IOCL for approval during detail engineering prior to manufacturing.

A. Component List : The below given list is minimum requirement but not limited to and shall be designed as per project requirements:

a. Synchronizing trolley with double voltmeters, double frequency meters, check sync relays, synchroscope, associated control switches, dark lamp and bright lamp check sync facility.
b. Auto Synchronizer relay for auto synchronization
c. Guard relay.
d. All synchronization breaker control switches shall be semaphore type (discrepancy control switch).
e. The synchronising selector switch shall be lockable for each feeder.
f. Separate annunciators for non-trip & trip alarms to be provided.
g. Digital meters for each bay and feeders:
    1) Digital frequency meter,
    2) Digital voltage meter for three phases,
    3) Digital ammeter for three phases
    4) Active Power (MW)
    5) Reactive Power (MVAR)
    6) Power factor (pf)

h. Push buttons: As per scheme requirements.

B. Construction Specification:

1. The panel will be free standing Unit with mosaic accessories load bearing sides having 3mm thickness and non load bearing sides having 2mm thickness.

2. Cubicle bottom will be closed and will have cable slots with detachable plates

3. Door at the back will have flush type lock arrangement. Doors at front & back side shall be hinged type.

4. Panel will have IP42 protection class

5. 15mm thick anti-vibration pad will be provided between panel and base frame

6. AC aux. supply will be 230V AC and DC aux. supply will be 220V DC

7. CT secondary will be 1A & PT Secondary 110V.

8. There shall be provision to connect removable plugs of synchronising trolley on each feeder of SCAP. These plugs shall receive aux power supply i.e. 220V DC, CT /PT inputs of both BUS, individual feeder and final output for breaker closing etc.

9. Control wiring shall be done using PVC FRLS flexible multi-strand Copper wire as per the specs mentioned below:

    - CT/PT circuits shall be wired using 2.5sq mm wires.

    - CT & PT wires shall be color coded as per the phase being used (Red/Yellow/Blue/Black).

    - All other control wiring shall be done using Grey color 1.5sq mm wire.

    - All wires shall be suitably lugged at Terminal blocks.

    - All terminal blocks shall be of polyamide type. CT terminal block shall be of disconnecting type.

    - All wires shall be ferruled (cross & spot) for identification.

    - All wires shall be routed through PVC troughs with detachable covers.

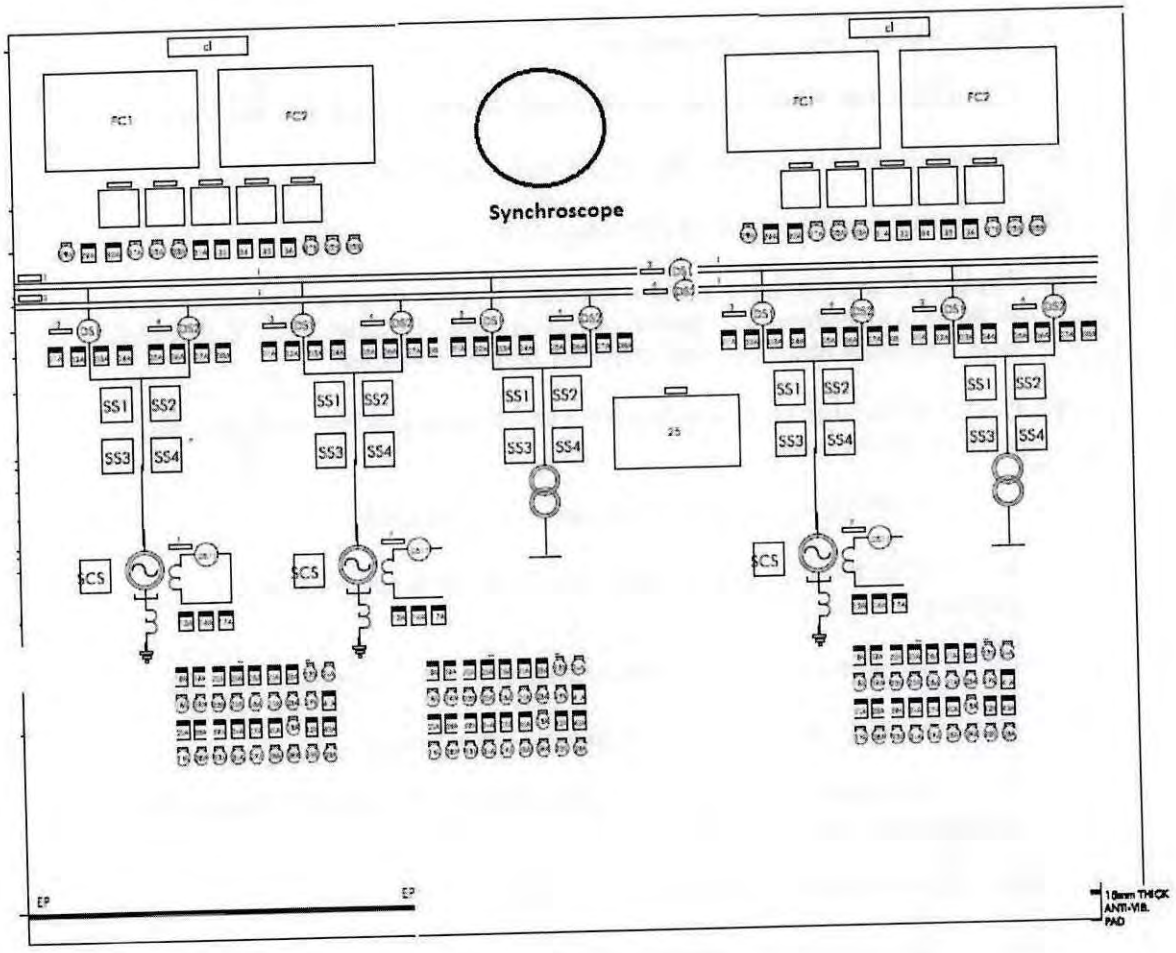
9. Panel shall be provided with LED lamps of suitable rating for illumination. Also, panel space heater with switch to be provided.

10. The SLD shall be provided on SCAP and same shall be as per detailed SLD of complete system. (overlaid Aluminum strip) & control switches for breakers to be provided accordingly.

11. Earthing bus of suitable size to be provided at the bottom of the panel running throughout the board.

12. All components shall be labeled properly through Anodized Aluminum strip with Black background & white inscriptions.

Indicate Layout of the SCAP.



General indicative drawing for SCAP