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NEW GRID

TECHNICAL SPECIFICATION

FOR

SCADA INTERFACE WORK & AUTOMATION

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Volume – I Technical Specification for SCADA interface work & Automation

1.0 INTENT OF SPECIFICATION:

This specification is intended to cover the supply and execute work related to interface of all electrical equipments with RTU panel complete with all materials and accessories for efficient and trouble free operation. In the event of any discrepancy with the listed documents, the stipulation of this specification shall govern.

2.0 SCOPE OF WORK

For substation, it is proposed to lay and terminate panel wirings / control cables if any between the outdoor equipments such as CT, PT, Circuit Breaker, Isolators, 11 KV Switchgear, 66,33,11 KV Control & Relay Panels, Power Transformer & its sensors – OTI, WTI, TPI, AVR, etc, REGDA relay, Capacitor Bank,NIFPS,Smoke Detectors and Battery Charger.

The scope of work under this category would include:

- Supply of SCADA materials - Bay Control Units, Remote Terminal Units with Basic + PLC Licenses (Basic License - IEC 870-5-101,103,104, Modbus Ethernet and Serial, IEC 61850-8-1,IEC -104 Master ,IEC 104 Slave + PLC License),Panels for RTU,Data Concentrator Units,Ethernet Switches with panels,MFM,Cables- FO, CAT-6, RS485, Control Cables,Connectors and GPS for time synchronization should be in SCADA vendor's scope.
- Installation,Testing & Commissioning of SCADA equipments.
- Laying and Termination of armored Communication cables (Ethernet, Fiber Optic Patch Cards/Cable,RS 485 cables) between grid devices (Numerical Relays/BCPU, Transformer Monitoring Modules, Smoke detector, NIFPS panel, MFM, Battery Charger) to RTU/DCU/Gateway.
- Laying and termination of control cables between grid equipments (control and relay panel, NIFPS, Battery Units) to RTU for hardwired signals.
- Installation of cable trays with accessories or trench as required for the cabling work.
- Preparation of cable schedule, Wiring diagrams,Training documents according to the site configuration and Interconnection as built drawings.
- Separate earthing bus bars to be provided for RTU panel and it will be directly connected to grid earthing.Earth BAR material should be Copper.

- Seprate earth pit with connections for Electronic cards,gateway,Switches,DCU.,etc.. earthing.
- All internal wiring between BCU and C&R Panel terminals, All Numerical relays,MFM (Multifunctional meters) and other grid equipment integration should be under SCADA vendor's scope.
- Hardware & software integration of RTU, Bay Control Units along with other equipments viz. Battery Chargers, Multi Function Meters, Fire Fighting System Signals, Transformer relays (for OTI, WTI, TPI, AVR, etc.),Smoke Detector Panels, Numerical Relays, 11&33&66KV Control and Relay panel signals etc. shall be in Vendor's scope.
- FAT and Training arrangements for BSES SCADA team – Travel ,Boarding, accommodation and local conveyance etc..shall be under SCADA Vendor's Scope.

2.1 **Cables**

The following types of cables / wirings will be required for extending signals and commands. Tagging is mandatory for all types of cables. Heat shrinking ferrule sleeves with printed ferrules to be used for identifying cables & Signals.

- 2.5 mm2, multi-stranded flexible copper wire, FRLS 1.1KV HRPVC for AC & DC Supply & 1.5 mm2 multi strand cables for other internal wiring for RTU.
- Red(P)and Black(N) color cable core to be used for AC and DC wiring.
- Fiber Optic Cables (GLASS&PLASTIC Types) & Ethernet cables (CAT6) with conduit pipe for internal connections and Armored Cables for external connections.
- 2 C X 2.5 MM2 cables for external AC / DC Power Supply
- 16 C x 1.5 mm2 for DI (Digital input)
- 3P X 1.5 mm2 for DO (Digital output)
- 2P X 0.5 mm2 Screened Armored PVC cable for external (RTU to BCUs /MFM/BATT.CHG/Transformer Monitoring Devices) RS 485 connections.

The supplied cable shall be as a latest IS, also refer control cable specification.

❖ **Cable Gland**

Double Compression cable glands (PVC for RS 485 cables & Brass for Control Cables) of different sizes for cable entry into the DAU & DCU Panels

❖ **Cable Trays and NS cable Support**

Perforated / ladder type (galvanized Iron) with cover for laying the cables.

2.2 **Multifunction Meters (Accuracy – 0.5)**

To extend the current / voltage / active and reactive power, power factor, etc. to RTU, MFMs, installed in the C & R panel, should be integrated. (Make: RISHABH or Equivalent with MODBUS Protocol). The outputs of these meters **(in groups of 5)** connections should be made using twisted pair screened cable (Typically 22gauge Belden 8761 or equivalent) & two wires (A and B) connections are daisy chained together and integrated with RTUs. All hardware's or protocol converters for having Modbus Protocol output should be in Vendor's scope.

These should be installed in C & R Panel individually for each feeder/ breakers. All CT & PT wirings to MFMs and its Configuration should be in Vendor's scope.

For the protection of MFMs and RTU cards against Surges and electrical leakages, it is necessary to install Surge Protection Devices in RTU or C&R Panel and placed in between RTU & MFM serial loops. The typical diagram for this connection is mentioned in the System Architecture diagram**. (5 MFMs per loop with SPD) MFM should be powered through Grid Battery Voltage (220 Volt or 50 Volts DC).**

The following parameters of MFM must be available for communication with RTU.

- Phase Voltages (L1-N, L2-N, L3-N)
- Line Voltages (L1-L2, L2-L3, L1-L3)
- Line Currents (IL1 , IL2, IL3)
- Active Power & Reactive Power
- Maximum Demand (KW) & Frequency
- Power factor
- Active Energy
- THD mean current & THD mean Voltage
- Neutral Current.
- Phase Angles

Approved Makes – RISH 3440 and Conzerv EM 6400NG

2.3 **Numerical Relays with BCU or Bay Control Protection Units for all feeders (11,33,66KV)**

Numerical Relays & Bay Control Units should be integrated with Remote Terminal Units. All hardware's and protocol converters if required for compatibility with SCADA shall be in Vendor's scope.

The respective BCUs of individual Relays/Breakers will be connected to Data concentrator Unit/Remote Terminal Units through **IEC 61850 compatible** industrial grade switches over IEC 61850 protocol (**Dual Ports with PRP & RSTP protocols required to form a Ring or PRP Networks b/w relay to relay connections**).

The respective BCU,BCPU & Numerical Relays must have dual redundancy communication ports (Ethernet port-RJ45) with PRP & RSTP protocols for SCADA connections.

Hot Standby/Dual Power Supply Unit & Redundancy in power source for Numerical Relays,BCU & BCPU - Possibility to increase the BCU,BCPU & Numerical Relays availability by having a second power supply card in case the first one fails **, if any one Power supply card fails the other one should keep the bay control unit continuous live.**

Data Base File must be downloadable and Uploadable from BCPU and BCU.

The following signals are to be taken from Numerical Relays to the BCUs through internal hard wiring. This list is indicative and signals should not be limited to this. Additional signals can be taken based on this. – **Refer Para 2.8 for detail signals list with data format (DPI,DCO,SPI,SCO,Measured Values) types.**

- Online Currents / Voltage & Relay General trip signal
- All breaker,Isolators,Control & Relay Panel indications and commands
- Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).
- Fault Differential and Bias current in Line and Transformer Differential Relay
- Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay).
- Post fault currents (R, Y, B phase separately) **measured value** & Relay Internal Fault
- Fault distance (in case of distance relays - R, Y, B Phase separately)
- Unbalance Current (in case of neutral displacement relay of capacitor feeders).

2.4 **Transformer Signal**

OTI, WTI, TPI, AVR and Transformer auxiliary protection signals should be integrated with an RTU through Ethernet communication (RS 485 cables) via TMD (REGDA, A-EBERLE relays) having **IEC 61850 Protocol output**.

Relays must have dual redundancy communication ports (Ethernet port-RJ45) & TMM **must have the option of RSTP and PRP Protocols for SCADA Connections.**

All field installations of these sensors and its wiring/cabling and configuration along with hardware's or protocol converters, if any, should be in Contractor's scope. - **Refer Para 2.8 for detail Transformer & Transformer Monitoring Device signal's list with data types.**

2.5 Battery Charger

All signals of Battery Chargers should have MODBUS Protocol output and integrated with an RTU through serial communication (RS 485) cables.

Laying communication cables through conduit pipe and battery charger signals (Soft & Hard Signals) integration with an RTU shall be in Vendor's Scope. - **Refer Para 2.8 for detail Battery Charger signal's list with data types.**

2.6 Data Concentrator Unit/Gateway & Remote Terminal Units

For extending the signals from the grid to the Master Control Centre & Backup Control Centre, BCUs and RTUs are to be installed. BCUs needs to be initially physically integrated with Numerical relays of respective breakers to enable soft signals and commands for breakers to be configured there and respectice BCU or BCPU integrated with Remote Terminal Units through IEC – 61850 protocol. However the options for IEC-60870-103 protocol along with the MODBUS protocol option is required. BCU/BCPU BCUs can be of **ABB, Siemens,Schneider Electric, etc .,** make is depending on the type/ make of switch gears.**Remote Terminal Units need to be installed for interface between the BCUs and Control Centers (Main and Backup) through IEC – 60870 – 104 Protocol.** The size of RTU will depend on the size of the substation, no. of the feeders/ number of signals and command outputs along with sufficient spares (20%) for future requirement.

All associated equipments and Supply of accessories including software &Operating tool / multiple user licenses for RTU & BCU, MCBs for DC and AC Supply, DC to DC Converter (in case station battery voltage level is 220 volts DC), etc. should be in Vendor's scope.

Hardware & software integration of RTUs, BCU along with other equipments viz. Battery Chargers, Multi Function Meters, Fire Fighting Systems, Signals, Transformer relays (for OTI, WTI, TPI, AVR, etc.), Numerical Relays, etc. should be in Vendor's scope.

In case of more than one BCPU,RTU,DATA Concentrator than these units must be able to communicate with other units on internal local IPs (Ex – 192.168.0.1) other than LAN IP(Ex-10.125.107.1) series.

Hot redundancy is required for Main Processor cards, rack/board and Gateway for MCC & BCC Communications.Each main processor must have two Ethernet ports dedicated for communication with SCADA servers over IEC 60870-104 protocol. First card will be live and 2nd card will be hot standby. Communication switchover between either cards in case of failure.

Main Processor cards along with Rack for MCC communication should be separate from the IO cards.

Data Base File must be downloadable and Uploadable from RTU,CPU and Gateway.

Approved RTU makes – ABB and Siemens (AK3).

Note : System shall be approved if they are agree to fulfill the following terms & Conditions,

- ***AMC period should be given 3 years along with this proposal.***
- ***AMC period should be started after handovering the system to BSES.***
- ***During AMC period all the issues pertaiting to RTU/Gateway/BCU should be handled by OEM at site(this included unlimited site visit)***
- ***5 Year replacement warranty is applicable for all OEM for Electronic cards & Gateway Units…If any hardware (or) Software fails during this period will be rectified by OEM.***

RTU,Data Concentrator Unit Features & Performance capabilities

2.6.1 RTU,DCU Size and Expandability

20% Spare for RTU,DCU - Provision for 20 % (Basic IO Count +20% Spare) of the total DI / DO signals (hard/soft) as a spare should be made available for future requirement.

Spare Ports – 20% Spare ports **(Minimum – 3 to 4 No's Serial ports are essential)** for IEC 103/Mod Bus Protocol Connections

20% Spare for BCU,BCPU - Each Control and Relay panel BCU must have 20% (Basic + 20% Spare) of the particular bay DI/DO signals as a spare should be available.

Panel Size & Hardware Capacity - The RTU panel sizing should be capable of accommodating additional 50% of the basic I/O counts by way of addition of hardware such as modules, racks, panels, Terminal Blocks of basic I/O counts.

Software Capacity - The RTU software and database generation should be sized to accommodate for additional 50% of the basic I/O count without requiring software or database regeneration or License.

2.6.2 Remote database, downloading of RTU from master station/SCADA control center.

2.6.3 RTU shall have the capability of automatic start-up and initialization following restoration of power after an outage without the need for manual intervention. All restarts shall be reported to the connected master stations.

2.6.4 Act as a data concentrator on IEC60870-5-101/104/MODBUS/IEC 61850 protocols and Support for IEC 60870-5-103, IEC 60870-5-101, IEC 61850,MODBUS TCP IP and RS485 Modbus RTU protocols & ability to act as a gateway for Numerical relays.

2.6.5 **Security**

As the SCADA system will use public domain, such LAN/VSAT/GPRS/CDMA etc. therefore it is mandatory to guard the data/ equipment from intrusion/damage/breach of security & shall have SSL/VPN based security.

2.6.6 Internal battery backup to hold data in SOE buffer memory & also maintaining the time & date.

2.6.7 RTU must have the capability of time synchronization with a GPS receiver and the GPS at the control room will be used for this synchronization purpose. In case of failure of the GPS receiver, the RTUs time synchronization should be through the Master's SCADA clock.

2.6.8 **GPS for Time Synchronization** - The RTU must have inbuilt (or) external GPS with antenna & internal real time clock to synchronize the IEDs connected to it over their respective protocol. **GPS must have dual redundant LAN port for time synchronizations.**

2.6.9 **Main Processor(CPU in RTU & Gateway) HOT Retundancy for MCC & BCC communication**

Main processor (DCU) /RTU should have adequate capacity for data handling / processing and main processor/CPU must have required number of communication ports for simultaneous communication with Master Stations (MCC & BCC), /MFTs and RTU configuration & maintenance tool.**RTU main processor and Gateway must have HOT redundancy features for control center communications.**

2.6.10 **Hot Standby/Dual Power Supply Unit & Redundancy in power source for RTU and BCU/BCPU** - Possibility to increase the RTU,BCU main rack availability by having a second power supply card in case the first one fails **, if any one Power supply card fails the other one should keep the system continuous live.**

2.6.11 **CPU/RTU Soft Configuration Future (Communicate to multiple master stations simultaneously on IEC60870-5-104.)**

RTU/DAU must have multiple location (minimum 5 Locations) data transmission facility VAZ Master Control Centre, Backup Control Centre, etc.

2.6.12 **Protection Devices for RTU,BCPU –** All modules (**all Digital, Analog Input modules**) and ports (**Serial and Ethernet ports**) must have in-built or external surge protection devices and optical isolation

2.6.13 **Diagnostic Software & Multi user tool/License for RTU/(Numerical Relay) BCU** -

Diagnostic Software tool with licensed version shall be provided to continuously monitor the operation of the RTU and report RTU hardware errors to the connected master stations. The software shall check for memory, processor, and input/output ports errors and failures of other functional areas defined in the specification of the RTU**. If any system tries to connect to RTU for download/ Upload files,itshould be stored as a log in RTU.**

2.6.14 **RTU Panels**

At least 50% of the space inside each enclosure shall be unused (spare) space that shall be reserved for future use. The Contractor shall provide required panels conforming to IEC 529 for housing the RTU modules/racks, relays etc. and other required hardware. The panels shall meet the following requirements:

- Shall be free standing, floor mounted and height shall not exceed 2200 mm.
- **RTU Panel should have air conditioner and should be mounted on side wall of RTU panel with temperature/humidity control facility.** FAN with Filters shall be considered for for back up cooling.
- All doors and removable panels shall be fitted with long life rubber beading.
- All non load bearing panels/doors ,top and bottom portion, rear cover shall be fabricated from minimum 2.0 mm thickness steel sheet and all load bearing panels, frames, top & bottom panels shall be fabricated from minimum 3.0 mm thickness steel sheet.
- Shall have maintenance access to the hardware and wiring through lockable full height doors.
- Shall have the provisions for bottom cable entry.
- All panels shall be supplied with 230V AC, 50 Hz, single-phase switch and 15/5A duplex socket arrangement for the maintenance.
- All panels shall be provided with an internal maintenance lamp, space heaters and gaskets.
- All panels shall be indoor, dust-proof with rodent protection, and meet IP54 class of Ingress protection.
- There shall be no sharp corners or edges. All edges shall be rounded to prevent injury.

- Document Holder shall be provided inside the cabinet to keep test report, drawing, maintenance register etc.
- All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trims shall be made of flame retardant material and shall not produce toxic gases under fire conditions.

2.6.15 **RTU Grounding**

The safety ground shall be isolated from the signal ground and shall be connected to the ground network. Safety ground shall be a copper bus bar. The contractor shall connect the panel's safety ground to the grid grounding network. Separate grounding is created for communication equipments and Signal ground shall be connected to the communication equipment signal ground.

2.7 Ethernet /Fiber Switch

The Ethernet/Fiber optic switches Should be a managed switch and are intended to be installed in the control room and shall be complaint to IEC-61850 electrical substation networks and IEEE 1613 standards. Provisions for additional feeders on the Ring Configuration should be provided on the same switch.

Laying of Ethernet/Fiber cables for relay/BCU port to the RTU via switch through conduit pipe and integration with an RTU shall be in Vendor's Scope.

Switch, Standard Features

Switch design should withstand for power substation automation applications that operate in extremely harsh environments (High and medium voltage S/Stn environments) and it also **withstands vibration, electrical surges, fast transients, electrostatic discharge, and extreme temperatures and humidity.**

Switch features and configuration should be easy to user interface and it must directly integrate with any other IEC-61850 devices. Shall be managed type and **have KEMA certifications for IEC 61850.**

The FO switch shall support Multimode fiber and single mode fiber in 10/100Mbps ports on an SFP (simple form factor pluggable), for ease of functionality and maintenance.

Retundancy Ring : Dual Ring to be consider between Ethernet switches for maintaining redundancy network.

Hot Standby/Dual PSU & Redundancy in power source - Possibility to increase the switch availability by having a second power source in case the first one fails & should be available with 48VDC.Each PSU should be connected with a different power source**, if any one power source or Power supply card fails then other one should keep the switch continuous operation**.

20% Spare ports - Each switch must have 20% spare ports for future/back up requirements.

Link Failure contact alarm - Failure contact alarm shall be achieved by hardware contact that is activated when a link problem occurs.

Logs and alarms with Time Stamp - Statistics about link status alarms are to be stored with the accurate timestamp duly tracing all events.

Advanced security features - The FO switches shall support different user levels with different passwords, including the facility to work with different VLANs, following the 802.1Q standard, port security based on MAC addresses, possibility to disable unused ports, authentication protocols shall be provided.

High Speed Implementation of RSTP protocol - The FO switches shall support STP and RSTP protocols, and shall facilitate for recovery and the fault recovery times shall be within 5 -10msec per switch, always fulfilling the RST protocol.

Time Synchronization to RTU/Server and Connected IED/BCU - The FO switch shall have an internal clock and shall be synchronized from a network SNTP/NTP server, so all time stamped events shall be with a reliable time reference.

Tools with License - Diagnostics tool, other necessary tools with a multi user license to be provided along with the switch.

Mounting Options - Switch should be DIN Rail Mountable & also need to quote for Optional Wall/Rack Mountable kit.

Local USB port for emergency boot is Mandatory.

Network based distributed security by having a firewall on each port of the switch for all the standard Industrial protocol like IEC-61850 should be available.

The FO switch shall have the facility of Port mirroring and the user shall configure one port to replicate traffic flows of different ports, so the system administrator can monitor the incoming, outgoing, or all kinds of traffic that is going through the ports under study.

ITU-T G.8032 support for Ethernet Ring redundancy, ensuring fast failure detection is preferred.

They FO switches shall sustain the stringent levels in temperature range and electromagnetic immunity defined in the 61850-3, but also the advanced functional requirements defined for operation with other IEC-61850 devices. The Switch should be certified on IEC-61850, functional & Environmental specifications by KEMA.

The FO switches shall have advanced security features to be implemented to avoid unauthorized access to the system Such as RADIUS/TACACS & VPN gateway support with IP Sec & SSH.

2.8 SIGNAL LIST (11/33/66KV)

List of Abbreviations
AI - Analog Input/Analog Values
MV - Measured Value
MFM - Multi Function Meter
DCO - Double Command Output
DPI - Double Point Indication
SCO - Single Command Output
SPI - Single Point Indication
RTU - Remote Terminal Units
BCU - Bay Control Units

Signals - 11KV Out Going Feeders	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	N.Relay Protocol
Breaker ON	√			√		IEC-61850 with Dual Communication Ports
Breaker OFF				√	DPI	
Trip Ckt Healthy -1 & 2	√				SPI	
Spring Charge	√				SPI	
Breaker in service	√				SPI	
Breaker in Test					SPI	
Auto Trip(86) Operated	√			√	SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				SPI	
L/R Switch in SCADA				√	SPI	
Relay Int Fault.			√		SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	

BKR Close COMMAND		√		√		
BKR Open COMMAND					DCO	
AutoTrip(86) relay reset from Remote		√			SCO	
3Phase R,Y,B - Current & Voltage,Active Power,Reactive Power,Power Factor,Max.Demand,Neu.Current	√				AI/MV	
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	13 DI + Analog , Measurand Values	3 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	3 DI	2 DO				

Signals - 11KV Incomers	**Digital Input/AI soft through N.Relay/BCU**	**Digital Out Put soft through N.Relay/BCU**	**Digital Input/Output Hard Wire to RTU**	**Additional signals Hard wire to RTU for backup**	**Signal Type**	**N.Relay Protocol**
Breaker ON	√			√	DPI	IEC-61850 with dual Communication Ports
Breaker OFF				√		
Trip Ckt Healthy -1 & 2	√				SPI	
Spring Charge	√				SPI	
Breaker in service	√				SPI	
Breaker in Test					SPI	
Auto Trip(86) Operated	√			√	SPI	
VT fuse Blown - Metering.	√				SPI	
VT fuse Blown - Protection	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				SPI	
L/R Switch in SCADA				√	SPI	
Relay Int Fault.			√		SPI	
Over Current Operated(All stages)	√				SPI	
Earth Fault Operated (All stages)	√				SPI	
Under Voltage Prot.Operated	√				SPI	
Over Voltage Prot.Operated	√				SPI	
REF Operated	√				SPI	
BKR Close COMMAND		√		√		
BKR Open COMMAND				√	DCO	
AutoTrip(86) relay reset from Remote		√			SCO	
3Phase R,Y,B - Current & Voltage,Active Power,Reactive Power,Power Factor,Max.Demand,Neu.Current	√				AI/MV	

Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	17 DI + Analog , Measurand Values	3 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	3 DI	2 DO				

Signals - 11KV Bus Coupler	**Digital Input/AI soft through N.Relay/BCU**	**Digital Out Put soft through N.Relay/BCU**	**Digital Input/Output Hard Wire to RTU**	**Additional signals Hard wire to RTU for backup**	**Signal Type**	**N.Relay Protocol**
Breaker ON	√			√		IEC-61850 with Dual Communication Ports
Breaker OFF				√	DPI	
Trip Ckt Healthy -1 & 2	√				SPI	
Spring Charge	√				SPI	
Breaker in service	√				SPI	
Breaker in Test					SPI	
Auto Trip(86) Operated	√			√	SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				SPI	
L/R Switch in SCADA				√	SPI	
Relay Int Fault.			√		SPI	
PT MCB - Metering operated	√				SPI	
PT MCB - Protection operated	√				SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	
BKR Close COMMAND		√		√		
BKR Open COMMAND					DCO	
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	14DI + Analog , Measurand Values	3 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	3 DI	2 DO				

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Signals - 11KV Capacitors	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	N.Relay Protocol
Breaker ON	√			√		IEC-61850 with Dual Communication Ports
Breaker OFF				√	DPI	
Bank ISO ON	√					
Bank ISO OFF					DPI	
Trip Ckt Healthy -1 & 2	√				SPI	
Spring Charge	√				SPI	
Breaker in service	√				SPI	
Breaker in Test					SPI	
Master Trip(86) Operated	√			√	SPI	
Bus PT fuse Blown - Metering.	√				SPI	
Bus PT fuse Blown - Protection	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				SPI	
L/R Switch in SCADA	√			√	SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	
Under Voltage Prot.Operated	√				SPI	
Over Voltage Prot.Operated	√				SPI	
Neg.Phase.sequence Operated	√				SPI	
Timer Relay operated/Normal	√				DPI	
Relay Int Fault.			√		SPI	
BKR Close COMMAND		√		√		
BKR Open COMMAND					DCO	
BANK ISO OPN		√				
BANK ISO CLS					DCO	
Master trip (86)reset from remote		√			SCO	
3Phase R,Y,B - Current&Voltage,Reactive Power,Neu.Current	√				AI/MV	
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	19 DI + Analog , Measurand Values	5 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	3 DI	2 DO				

Signals - 33 & 66KV Incomers/Out Going	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input/Output Hard Wire to RTU	Additional Spare signals (Hard wire to RTU for backup)	Signal Type	Protocol
Breaker ON	√			√	DPI	Dual Comm
Breaker OFF				√		

Front Bus (89A) ISO ON(In-Case of O/D)	√				DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)						
Rear Bus (89B) ISO ON (In-Case of O/D)	√				DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)						
LINE ISO (89L) ON (In-Case of O/D)	√				DPI	
LINE ISO (89L) OFF (In-Case of O/D)						
Earth Switch (89LE) -1 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) -1 OFF (In-Case of O/D)						
Earth Switch (89LE) - 2 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) - 2 OFF (In-Case of O/D)						
Breaker in service (In-case of I/D BKR)	√				SPI	
Breaker in Test (In-case of I/D BKR)	√				SPI	
Trip coil Ckt Healthy - 1 & 2	√				SPI	
Spring Charge	√				SPI	
Master trip(86) Operated	√			√	SPI	
SF6 Pressure Low & SF6 Lock Out	√				SPI	
VT fuse Fail	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				DPI	
L/R Switch in Remote	√			√		
LBB Operated	√				SPI	
Relay Int Fault.			√		SPI	
Over Current Operated (All stages)	√				SPI	
Earth Fault Operated (All stages)	√				SPI	
DIFF.Prot Operated	√				SPI	
DIST.Ptot Operated	√				SPI	
BKR CLS COMMAND		√		√	DCO	
BKR OPN COMMAND				√		
Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO	
Front Bus (89A) ISO CLS COMMAND (In-Case of O/D)						
Rear Bus (89B) ISO CLS COMMAND (In-Case of O/D)		√			DCO	
Rear Bus (89B) ISO OPN COMMAND (In-Case of O/D)						
LINE ISO (89L) OPN COMMAND (In-Case of O/D)		√			DCO	
LINE ISO (89L) CLS COMMAND (In-Case of O/D)						
Master Trip(86) relay reset from Remote		√			SCO	
3Phase R,Y,B -Current&Voltage,Active&Reactive Power,PowerFactor,Max.Demand,Neu.Current etc	√				AI/MV	

Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Fault Differential and Bias current in Line and Transformer Differential Relay ,Fault distance (in Distance Relay) ,Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	29 DI + Analog , Measurand Values	9 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	6 DI	3 DO				

Signals - 33 & 66KV Transformer	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	Protocol
Breaker ON	√			√	DPI	IEC-61850 with dual Communication Ports
Breaker OFF				√		
Front Bus (89A) ISO ON(In-Case of O/D)	√				DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)						
Rear Bus (89B) ISO ON (In-Case of O/D)	√				DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)						
TRF ISO (89T) ON (In-Case of O/D)	√				DPI	
TRF ISO (89T) OFF (In-Case of O/D)						
Earth Switch (89LE) -1 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) -1 OFF (In-Case of O/D)						
Earth Switch (89LE) - 2 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) - 2 OFF (In-Case of O/D)						
Breaker in service (In-case of I/D BKR)	√				DPI	
Breaker in Test (In-case of I/D BKR)						
Trip coil Ckt Healthy - 1 & 2	√				SPI	
Spring Charge	√				SPI	
Auto Trip(86) Operated	√			√	SPI	
Differential Operated	√				SPI	
LBB Operated	√				SPI	
REF/SEF Prot Operated	√				SPI	
SF6 Pressure Low & SF6 Lock Out	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				DPI	
L/R Switch in Remote	√			√		
Relay Int Fault.			√		SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	
BKR CLS COMMAND		√		√	DCO	
BKR OPN COMMAND				√		
Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO	
Front Bus (89A) ISO CLS COMMAND (In-Case of O/D)						

Rear Bus (89B) ISO CLS COMMAND (In-Case of O/D)		√			DCO	
Rear Bus (89B) ISO OPN COMMAND (In-Case of O/D)						
Trf ISO (89T) OPN COMMAND (In-Case of O/D)		√			DCO	
Trf ISO (89T) CLS COMMAND (In-Case of O/D)						
Mastertrip (86) relay reset from Remote		√			SCO	
3Phase R,Y,B -Current&Voltage,Active&Reactive Power,PowerFactor,Max.Demand,Neu.Current	√				AI/MV	
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Fault Differential and Bias current in Line and Transformer Differential Relay ,Fault distance (in Distance Relay) ,Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	28 DI + Analog , Measurand Values	9 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	6 DI	3 DO				

Transformer - RTCC/A-Eberle Signals	Digital Input/AI soft through TMM	Digital Out Put soft through TMM	Digital Input/Output Hard Wire to RTU	Analog Input soft through TMM	Signal Type	Protocol
A-Eberle Unit Faulty/DC Fail			√		SPI	IEC-61850 with Dual Communication Ports
Oil Temp Alarm	√				SPI	
Oil Temp trip	√				SPI	
Winding Temp Alarm	√				SPI	
Winding Temp Trip	√				SPI	
Buchholz Alarm	√				SPI	
Buchholz Trip	√				SPI	
PRV TRIP	√				SPI	
OLTC OSR	√				SPI	
MOG/LOW Oil level Alarm	√				SPI	
SPR Trip	√				SPI	
OSR Main Tank	√				SPI	
L/R Switch in Local	√				DPI	
L/R Switch in Remote	√					
Auto Mode	√				DPI	
Manual Mode	√					
Fan Fail	√				SPI	
Tap Changer Fail	√				SPI	
OLTC Out of Step/Stuck Up/Motor trip	√				SPI	
Tap Rise/Tap Low Command		√			DCO/RCO	
Tap Rise/Tap Low Command		√				
Oil Temp				√	AI	

Winding Temp				√	AI	
Tap Position				√	AI	
Total Signals - BCPU & RTU	19 DI	2 Command	1 DI	3 Analog , Measurand Values		
Essential inbuilt Spare in BCPU,BCU	2 DI	1 DO				

Signals - 33 & 66KV BusCoupler	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	Protocol
Breaker ON	√			√	DPI	IEC-61850 with Dual Communication Ports
Breaker OFF				√		
Front Bus (89A) ISO ON(In-Case of O/D)	√				DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)						
Rear Bus (89B) ISO ON (In-Case of O/D)	√				DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)						
Earth Switch (89AE-1) - ON (In-Case of O/D)	√				DPI	
Earth Switch (89AE-1) - OFF (In-Case of O/D)						
Earth Switch (89AE-2) - ON (In-Case of O/D)					DPI	
Earth Switch (89AE-2) - OFF (In-Case of O/D)						
Earth Switch(89BE-3) - ON (In-Case of O/D)	√				DPI	
Earth Switch(89BE-3) - OFF (In-Case of O/D)						
Earth Switch(89BE-4) - ON (In-Case of O/D)					DPI	
Earth Switch(89BE-4) - OFF (In-Case of O/D)						
Breaker in service (In-case of I/D BKR)	√				DPI	
Breaker in Test (In-case of I/D BKR)						
Trip coil Ckt Healthy - 1 & 2	√				SPI	
Spring Charge	√				SPI	
Auto Trip(86) Operated	√			√	SPI	
SF6 Pressure Low	√				SPI	
SF6 Lock Out	√				SPI	
VT fuse-1 Blown	√				SPI	
VT fuse-2 Blown	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				DPI	
L/R Switch in Remote	√			√		
LBB Operated	√				SPI	
Relay Int Fault.			√		SPI	
Over Current Operated (All stages)	√				SPI	
Earth Fault Operated(All stages)	√				SPI	
BKR CLS COMMAND		√		√	DCO	
BKR OPN COMMAND				√		
Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO	
Front Bus (89A) ISO CLS COMMAND (In-Case of O/D)						
Rear Bus (89B) ISO CLS COMMAND (In-Case of O/D)		√			DCO	
Rear Bus (89B) ISO OPN COMMAND (In-Case of O/D)						

AutoTrip(86) relay reset from Remote		√			SCO	
3Phase R,Y,B - Current ,BUS PT-01 & BUS PT02 3Phase votages.	√				AI/MV	
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Fault Differential and Bias current in Line and Transformer Differential Relay ,Fault distance (in Distance Relay) ,Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	31 DI + Analog , Measurand Values	9 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	6 DI	3 DO				

Signals - 33 & 66KV CAP Bank	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	Protocol
Breaker ON	√			√	DPI	IEC-61850 With Dual Communication Ports
Breaker OFF				√		
Front Bus (89A) ISO ON(In-Case of O/D)	√				DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)						
Rear Bus (89B) ISO ON (In-Case of O/D)	√				DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)						
CAP Bank ISO ON (In-Case of O/D)	√				DPI	
CAP Bank ISO OFF (In-Case of O/D)						
Earth Switch ON (In-Case of O/D)	√				DPI	
Earth Switch OFF (In-Case of O/D)						
Trip coil Ckt Healthy - 1 & 2	√				SPI	
Spring Charge	√				SPI	
Auto Trip(86) Operated	√			√	SPI	
SF6 Pressure Low & SF6 Lock Out of all chambers	√				SPI	
VT fuse Blown	√				SPI	
Cap Discharge Time	√				SPI	
Netural Displacement	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local/Remote	√			√	DPI	
LBB Operated	√				SPI	
Relay Int Fault.			√		SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	
Under Voltage Prot.Operated	√				SPI	
Over Voltage Prot.Operated	√				SPI	
BKR CLS COMMAND		√		√	DCO	
BKR OPN COMMAND				√		

Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO	
Front Bus (89A) ISO CLS COMMAND (In-Case of O/D)						
Rear Bus (89B) ISO CLS COMMAND (In-Case of O/D)		√			DCO	
Rear Bus (89B) ISO OPN COMMAND (In-Case of O/D)						
CAP Bank ISO OPN COMMAND (In-case of O/D)		√			DCO	
CAP Bank ISO CLS COMMAND (In-case of O/D)						
3Phase R,Y,B - Current&Voltage,Reactive Power,Neu.Current	√				AI/MV	
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Fault Differential and Bias current in Line and Transformer Differential Relay ,Fault distance (in Distance Relay) ,Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	26 DI + Analog , Measurand Values	9 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	6 DI	3 DO				

Signals - BUS PT-1&2	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	Protocol
BUS A (89A) ON	√				DPI	IEC-61850 with Dual Communication Ports
BUS A (89A) OFF						
BUS B (89B) ON	√				DPI	
BUS B (89B) OFF						
Earth Switch (89LE) - 1 ON	√				DPI	
Earth Switch (89LE) - 1 OFF						
Earth Switch (89LE) - 2 ON	√				DPI	
Earth Switch (89LE) - 2 OFF						
BUS-A ISO OPN COMMAND		√			DCO	
BUS-A ISO CLS COMMAND						
BUS-B ISO OPN COMMAND		√			DCO	
BUS-B ISO CLS COMMAND						
Total Signals - BCPU & RTU	8 DI	4 DO				
Essential Spare in BCPU,BCU	2 DI	1 DO				

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Signals - Smoke Detector - ALL Sensors,Manual Call Points Integration with RTU over MODBUS TCPIP Protocol.	Soft Signals	Signal Type	Protocol
All Sensors Alarm operated Signals (10 to 20 Sensors)	√	SPI	MODBUS TCP/IP Protocol with Dual Communication Ports
All Manual Call Points - MCP-1,MCP-2.etc…	√	SPI	

Signals - Battery Charger	Digital Input/AI soft through RTU	AI from Transducer(4 to 20MA) /AI Hard wire signal to RTU	Signal Type	Protocol
CHG A AC M/F CUM AC U/V	√		SPI	Modbus Protocol with Dual ports
CHG A AC OVER VOLTAGE	√		SPI	
CHG A RECTIFIER FUSE BLOWN	√		SPI	
CHG A FILTER FUSE BLOWN	√		SPI	
CHG A DC MCB TRIP/OFF	√		SPI	
CHG A DC UNDER VOLTAGE	√		SPI	
CHG A DC OVER VOLTAGE	√		SPI	
CHG A FLOAT	√		SPI	
CHG A BOOST	√		SPI	
CHG A DC FAIL	√		SPI	
CHG B AC M/F CUM AC U/V	√		SPI	
CHG B AC OVER VOLTAGE	√		SPI	
CHG B RECTIFIER FUSE BLOWN	√		SPI	
CHG B FILTER FUSE BLOWN	√		SPI	
CHG B DC MCB TRIP/OFF	√		SPI	
CHG B DC UNDER VOLTAGE	√		SPI	
CHG B DC OVER VOLTAGE	√		SPI	
CHG B FLOAT	√		SPI	
CHG B BOOST	√		SPI	
CHG B DC FAIL	√		SPI	
BATTERY MCCB TRIP/OFF	√		SPI	
DC system Earth	√		SPI	
Insulation fault	√		SPI	
Charger A AC INPUT CURRENT	√		AI	
Charger A AC INPUT VOLTAGE	√		AI	
Charger A DC OUTPUT CURRENT	√		AI	
Charger A DC OUTPUT VOLTAGE	√		AI	
Charger B AC INPUT CURRENT	√		AI	
Charger B AC INPUT VOLTAGE	√		AI	
Charger B DC OUTPUT CURRENT	√		AI	
Charger B DC OUTPUT VOLTAGE	√		AI	
Battery Current	√		AI	
Battery Load Voltage	√		AI	
Battery Voltage from Transducer		√	AI	4 to 20 MA O/P
Battery Current from Transducer		√	AI	

Signals - LT Board	Digital Input Hard Wire to RTU	MFM data through Modbus protocol	Signal Type & Meter OP – Modbus with Dual Ports.
LT AC Fail	√		SPI
R,Y,B Phase Current		√	AI

Signals - Fire Fighting(All Transformers)	Digital Input Hard Wire to RTU	Signal Type
SYSTEM OPERATED	√	SPI
SYSTEM OUT OF SERVICE	√	SPI
TCIV CLOSED	√	SPI
FIRE DETECTOR TRIP	√	SPI
N2 CYLINDER PRESSURE LOW	√	SPI
FIRE SYSTEM ALARM	√	SPI
DC SUPPLY FAIL	√	SPI

MFM - BUS PT -1 ,2 Signals (Front & Rear BUS)	Data Type	Protocol
R-Phase Current	MV/MFI	Modbus
Y-Phase Current	MV/MFI	
B-Phase Current	MV/MFI	
Neutral Current	MV/MFI	
R-Y Phase Voltage	MV/MFI	
Y-B Phase Voltage	MV/MFI	
B-R Phase Voltage	MV/MFI	

MFM - Signals - All Feeders (Including Bus Section/Coupler OF 11/33/66 KV)	Data Type	Protocol
R-Phase Current	MV/MFI	Modbus
Y-Phase Current	MV/MFI	
B-Phase Current	MV/MFI	
Neutral Current	MV/MFI	
R-Y Phase Voltage	MV/MFI	
Y-B Phase Voltage	MV/MFI	
B-R Phase Voltage	MV/MFI	
Active Power	MV/MFI	
Active Energy	MV/MFI	
Reactive Power	MV/MFI	
Power Factor	MV/MFI	
Maximum Demand	MV/MFI	
Phase angle 1	MV/MFI	
Phase angle 2	MV/MFI	
Phase angle 3	MV/MFI	

THD Mean Current	MV/MFI	
THD Mean Voltage	MV/MFI	

Note1 : Suitable Heavy Duty Relay /Contactor's with free Wheeling Diode to be placed in between RTU- DO card & Trip/Close Coil circuits of respective breakers for all breaker /Isolator open & Close circuits..It should be placed either at RTU (or) Breaker panel end.Its Potential free contact will be connected in the Closing/Tripping Coil Circuits.

Note 2: SF6 Low/Lockout of all chamber signal to be wired up to RTU.

2.8.1.Comments -

Analog signals (Fault Current levels,Disturbance records, Fault graphs for remote diagnosis, etc,) from Numerical relays needs to be confirmed by vendor before finalize the tender documents.

All the above mentioned signals(Refer Signal List -2.8) including Notifier /Smoke Detector Signal are compulsory and additional signal (10%) will be considered during detailed engineering.

Following indications data format should be configured as a DPS (Double point Status) in Relay(BCPU).

- All Feeders Circuit Breaker ON & Circuit Breaker OFF
- All Feeders BUS Isolators (89A,89B,89L,89T) - ON & OFF
- All Earth Switches ON & OFF

Following command data format should be configured as a DPC (Double point control) in Relay(BCPU).

- All Feeders Circuit Breaker - Open & Close
- All Feeders BUS Isolators (89A,89B,89L,89T) - Open & Close
- All Earth Switches – Open & Close.

3.0 Key Points -

1 All SCADA equipments viz DAU / DCU, MFM, Battery Charger, A-Eberle relays, etc. Should be powered through auxiliary supply of 48 V (or) 220 Volt DC.

2 Space for Energy Meter – Only Space (**Length - 185 mm & Height - 256 mm with CT, PT, Auxiliary Supply terminals & wiring**) without cut out is required to install energy meters.

3 Power Supply for Routers/ Gateway (IT Equipments) through an existing battery bank via DC to DC Converters (Input: 48 VDC/220 VDC, Output: 12 Volt DC) or as per the requirements of Routers.

Converter 01 Speifications : Input 220 Volt DC & Output 48 Volt DC

Converter 02 Specifications:Input 220 Volt DC (or) 48 Volt DC & OutPut 12 Volt DC

4 Any other wiring / cabling if required due to non availability of serial communication /MODBUS/IEC 61850 protocols (with justified reason) should be hardwired and that is in Contractor's scope.

5 Suitable transducers with an output of 4-20 mA have to be installed in the RTCC /Battery charger if required and the outputs of these transducers should be extended to terminal for further extension to the RTU.

6 STATION BUS : Topology

- **Dual Homing (or) Redundant Ring with Ehernet/Copper Cable – From BCPU,BCU to Switch**
- **Redundant Ring with Fiber Optic Cable – From Switch to RTU/Gateway.**
- **Note : Dual Homing (or) Redunt Ring Network topology will be decided during the detail engineering stage.**

7 The C & R ,RTCC,Battery Charger Panel should have additional spare contacts (potential free) for all SCADA signals – **Refer Signal List 2.8**

8 Data Base File must be downloadable and Uploadable from RTU,CPU,BCPU,BCU and Gateway.

9 Warranty (5 Years) for SCADA products - All Supplied SCADA material should cover warranty for the duration of 5 years & Warranty period will start after successful commissioning of the SCADA equipments at site. If any SCADA materials found faulty during warranty period should be replaced within two weeks.

10 **Training** should be provided on configuration, installation, commissioning aspects of RTU,DCU,BCU and Numerical Relay - BCPU at your training/work center to the BSES SCADA team (**4 to 5 persons**) & **Training Expenses** (Air & Local Travel, boarding and Lodging for 4 to 5 persons) at factory/training center(4 days) comes under Vendor's scope.

Training documents to be submitted for approval & Documents should contain all the necessary installations,connections and Data Base development procedure & further trouble shooting procedure,etc..shall also be provided in the manual.

11 Antivirus/Cyber Security solution for Gateway/RTU unit need to be considered.

12 **FAT expenses** for BSES SCADA team (2 Persons) – Air & Local Travels, boarding and Lodging to be arranged by vendor during FAT inspections.Complete expenditure (Air & Local Travel, boarding and Lodging) comes under vendor scope.

13 **Loose Spares (10%) -** loose Spare Materials for following items with below mentioned quantity to be supplied for emergency back up/maintenance purpose.

- **CPU (Main Processor) Card in DCU,RTU – 1 No**
- **CPU(Main Processor Module in BCPU) – 1 No**
- **Gateway / Gateway CPU– 1 No**
- **RTU Rack – 1 No**
- **BCPU Rack – 1 No**
- **Serial Server if any – 1 No**
- **Communication Module for IEC-103 & Modbus Communications – 1 No**
- **CPU in Bay Control Units – 10% of supplied qty.**
- **Communication Extended Module/Serial Ports for Modbus & IEC-103 protocols– 10%**
- **DO Contactots – 10% of supplied qty.**
- **DI/DO/AI/ Cards – 10% of the total IO signals**
- **PSU Cards in RTU – 1 No**
- **PSU Cards in BCPU – 1 No**
- **PSU Cards in Switches – 5% of supplied qty.**
- **Ethernet Switches (9 ,16 & 24 Ports) – 1 No's**
- **Ethernet Switches (16 & 24 Ports) – 2 No's**
- **LIU Unit – 1 No**
- **Fiber Optic Patch Cards with Connectors - 20% of total installed cables.**
- **MFM – 5% of Supplied Qty.**
- **DC to DC converters if any for RTU Supply – 2 No.**

14 **Protection devices for all SCADA Equipmentes –**

- Surge Protection devices installation between RTU & MFM Serial loops.
- SPD for Main DC Source.
- HDR/Inter Posing Relay for all Digital Output Signal's.
- All modules (**All Digital, Analog Input modules in BCPU and RTU**) and ports (**Serial and Ethernet ports**) must have in-built or external surge protection devices and optical isolation.

15 Local HMI shoid be consider along with RTU :

- Human machine interface (HMI) with control software package, which shall contain an extensive range of system monitoring and data acquisition (SCADA) functions.
- Incase of failure of communication equipments then DR shall be extracted from HMI for further diagonosis purpose only.So,It will not be used as a Gateway for control center data process.

16 All the above features are indicative only and detailed engineering and deviation will be analyzed just before actual procurement and with discussion through a supplier/ vendor.

4.0 System Architecture Diagram

The Tentative System Architecture diagram is enclosed for reference. It will be revised during the approval stage of drawings..

5.0 DEVIATIONS

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless the owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.No deviations will be acceptable post order.