

SECTION-V

SPECIFICATION OF SAS PROJECT ITEMS

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ANNEXURE-1

1. BASIC MONITORING PARAMETERS.

1.	Switchgear status indication
2.	Measurements (U, I, P, Q, f)
3.	Event
4.	Alarm
5.	Winding temperature of Transformers.
6.	Ambient temperature.
7.	Status and display of 415V LT system, 220V & 48V DC system.
8.	Status & Display of Fire protection System and AC System.
9.	Acquisition of all counters in PLCC panels through potential free contacts from PLCC or independently by counting the receive/send commands.
10.	Acquisition of alarm and fault record from protection relays Disturbance.
11.	Monitoring the state of batteries by displaying DC voltage, charging current and load current etc.
12.	Tap-position of Transformer.

2. COLOURS OF THE MIMIC DIAGRAMS WHICH APPEAR ON THE VDUs OF THE HMI.

The colours used for the mimic diagrams appearing on the VDUs (screens) of the HMI shall be as follows:

1.	400KV Buses and Equipment	: Signal Red
2.	220KV Buses and Equipment	: Light Orange
3.	132KV Buses and Equipment	: Lemon
4.	33KV Buses and Equipment	: Olive Green
5.	220V AC Buses and Equipment	: Dark Violet
6.	220V DC Buses and Equipment	: Black
7.	Earthing (grounding)	: Green
8.	Equipment status	: In accordance with IEC 60073, latest revision
9.	VDU background colour	: Light Grey / Blue colour

ANNEXURE-2

INPUTS,OUTPUTS

A. List of Inputs

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

a. Analogue inputs

For line	
	Current : R ,Y, B Phase.
	Voltage : R,Y,B,Phase
For Transformer	
	Current: R,Y,B phase & N
	WTI (for transformer)
	Tap position (for transformer only)
For Bus coupler	Current: R ,Y,B Phase
Common	
	Voltage for Bus-I, Bus-II and Transfer bus wherever applicable
	Voltage: R-Y phase
	Y-B phase
	B-R phase
	R -N
	Y-N
	B-N
	Frequency for Bus-I and Bus-II
	Ambient temperature (switchyard).
	LT system
	Voltage R-Y, Y-B, B-R of Main Switch Board section-I
	Voltage R-Y, Y-B, B-R of Main Switch Board section-II
	Voltage R-Y, Y-B, B-R of Diesel Generator
	Current from LT transformer-I
	Current from LT transformer-II
	Current from Diesel Generator
	Voltage of 220V DCDB-I
	Voltage of 220V DCDB-II
	Current from 220V Battery set-I
	Current from 220V Battery set-II
	Current from 220V Battery charger-I
	Current from 220V Battery charger-I
	Voltage of 48V DCDB-I
	Voltage of 48V DCDB-II
	Current from 48V Battery set-I
	Current from 48V Battery set-II
	Current from 48V Battery charger-I
	Current from 48V Battery charger-I

b. Digital Inputs

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

1. Line bays

i)	Status of each pole of CB, Isolator, Earth switch
ii)	CB trouble
iii)	CB operation/closing lockout
iv)	Pole discrepancy optd
v)	Trip coil faulty
vi)	LBB optd
vii)	Bus bar protn trip relay optd
viii)	Main bkr auto recloser operated
ix)	Tie/transfer auto recloser operated
x)	A/r lockout
xi)	Tie/transfer bkr a/r lockout
xii)	Direct trip-I/II sent
xiii)	Direct trip-I/II received
xiv)	Main I/II blocking
xv)	Main I/II-Inter trip send
xvi)	Main I/II-Inter trip received
xvii)	O/V STAGE – I operated
xviii)	O/V STAGE – II operated
xix)	FAULT LOCATOR FAULTY
xx)	MAIN-I/II CVT FUSE FAIL
xxi)	MAIN-I PROTN TRIP
xxii)	MAIN-II PROTN TRIP
xxiii)	MAIN-I PSB ALARM
xxiv)	MAIN-I SOTF TRIP
xxv)	MAIN-I R-PH TRIP
xxvi)	MAIN-I Y-PH TRIP
xxvii)	MAIN-I B-PH TRIP
xxviii)	MAIN-I START
xxix)	MAIN-I/II Carrier aided trip
xxx)	MAIN-I/II fault in reverse direction
xxxi)	MAIN-I/II ZONE-2 TRIP
xxxii)	MAIN-I/II ZONE-3 TRIP
xxxiii)	MAIN-I/II weak end infeed optd
xxxiv)	MAIN-II PSB alarm
xxxv)	MAIN-II SOTF TRIP
xxxvi)	MAIN-II R-PH TRIP
xxxvii)	MAIN-II Y-PH TRIP
xxxviii)	MAIN-II B-PH TRIP
xxxix)	MAIN-II start
xl)	MAIN-II aided trip
xli)	MAIN-I/II fault in reverse direction
xlii)	Back-up o/c optd
xliiii)	Back-up e/f optd
xliv)	220V DC-I/II source fail
xlv)	SPEECH CHANNEL FAIL
xlvi)	PLCC Protection Channel-I FAIL
xlvii)	PLCC Protection Channel-II FAIL

2. Transformer bays

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

vi)	LBB optd
vii)	Bus bar protn trip relay optd
viii)	REF OPTD
ix)	DIF OPTD
x)	OVERFLUX ALARM (MV)
xi)	OVERFLUX TRIP (MV)
xii)	OVERFLUX ALARM (HV)
xiii)	OVERFLUX TRIP (HV)
xiv)	HV BUS CVT ½ FUSE FAIL
xv)	MV BUS CVT ½ FUSE FAIL
xvi)	OTI ALARM/TRIP
xvii)	PRD OPTD
xviii)	OVERLOAD ALARM
xix)	BUCHOLZ TRIP
xx)	BUCHOLZ ALARM
xxi)	OLTC BUCHOLZ ALARM
xxii)	OLTC BUCHOLZ TRIP
xxiii)	OIL LOW ALARM
xxiv)	back-up o/c (HV) optd
xxv)	back-up e/f (HV)optd
xxvi)	220v DC-I/II source fail
xxvii)	TAP MISMATCH
xxviii)	GR-A PROTN OPTD
xxix)	GR-B PROTN OPTD
xxx)	back-up o/c (MV) optd
xxxii)	back-up e/f (MV)optd

3. Bus Bar Protection

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

Auxiliary system

i)	Incomer-I On/Off
ii)	Incomer-II On/Off
iii)	415V Bus-I/II U/V
iv)	415v bus coupler breaker on/off
v)	DG set bkr on/off
vi)	Alarm/trip signals as listed in Section: DG set
vii)	LT transformer-I Bucholz Alarm & trip
viii)	LT transformer-II Bucholz Alarm & trip
ix)	LT transformer-I WTI Alarm & trip
x)	LT transformer-II WTI Alarm & trip
xi)	LT transformer-I OTI Alarm & trip
xii)	LT transformer-II OTI Alarm & trip

xiii)	PLCC exchange fail
xiv)	Time sync. Signal absent
xv)	Alarm/trip signals as listed in Section: Battery and
xvi)	xvii) Battery charger
xviii)	220v dc-I earth fault
xix)	220v dc-II earth fault

NOTE:

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

ANNEXURE-3

METHOD OF INSTALLATION AND DELIVERY OF BAY CONTROL UNITS, PROTECTION RELAYS, BUSBAR DIFFERENTIAL RELAYS HMI EQUIPMENT AND OF THE PANELS OF CONVENTIONAL COMMUNICATION:

A. 400kV System

1. Each panel for 400KV transmission line bays shall contain, besides other equipment, the following:
 - a. Two (2) digital distance protection relays with different algorithms preferably with voltage and Auto Reclose (AR) Function .
 - b. One (1) bay control unit.
 - c. Furthermore, one (1) of the panels for the 400KV transmission line bays shall include one (1) bay control unit for the bus section bay. This panel will be designated during the implementation of the contract.
2. Each panel for the 400KV Inter Connecting transformer bays shall contain, besides other equipment, the following:
 - a. One (1) digital autotransformer differential protection relay with over flux function .
 - b. One (1) digital over current earth fault relay with Over/under voltage function. The input & out put relays will be used for Transformer Trouble function.
 - c. One (1) digital REF relay.
 - d. One (1) voltage regulation relay
 - e. One (1) bay control unit
3. Each panel for 400KV Tie / bus coupler shall contain, besides other equipment, the following:
 - a . One (1) bay control unit.
 - b. One digital AR relay with Over Current & Earth fault function.

B. 220kV System

1. Each panel for the 220 KV transmission line bays shall contain, besides other equipment, the following:
 - a. Two (2) distance protection relay with different algorithms preferably with voltage and Auto Reclose (AR) Function .
 - b. One (1) bay control unit
2. Each panel for the 220KV Inter Connecting transformer (400/220kV) bays shall contain, besides other equipment, the following :
 - a. One (1) digital over current earth fault relay with Over/under voltage function. The input & out put relays will be used for Transformer Trouble function.
 - b. One (1) bay control unit.
3. Each panel for the 220KV autotransformer (220/132kV) & Power Transformer (220/33kV) bays shall contain, besides other equipment, the following :
 - a. One (1) digital autotransformer differential protection relay with over flux function .
 - b. One (1) digital over current earth fault relay with Over/under voltage function. The input & out put relays will be used for Transformer Trouble function.
 - c. One (1) digital REF relay.
 - d. One (1) voltage regulation relay

- e. One (1) bay control unit
- 4. Each panel for the 220KV Tie / bus coupler bays shall contain, besides other equipment, the following:
 - a. One bay control unit
 - b. One digital AR relay with Over Current & Earth fault function.

C. 132kV System

- 5. Each panel for the 132 KV transmission line bays shall contain, besides other equipment, the following:
 - a. One distance protection relay.
 - b. One (1) digital over current earth fault relay with Over/under voltage function & Frequency function.
 - c. One (1) bay control unit
- 6. Each panel for the 132kV autotransformer (220/132kV) bays shall contain, besides other equipment, the following :
 - a. One (1) digital over current earth fault relay with LBB function.
 - b. One (1) bay control unit.
- 7. Each panel for the 132kV Power transformer (132/33kV) bays shall contain, besides other equipment, the following :
 - a. One (1) digital autotransformer differential protection relay with over flux function .
 - b. One (1) digital over current earth fault relay with Over/under voltage function. The input & out put relays will be used for Transformer Trouble & LBB function.
 - c. One (1) REF relay.
 - d. One (1) voltage regulation relay
 - e. One (1) bay control unit.
- 8. Each panel for the 132KV bus coupler bays shall contain, besides other equipment, the following:
 - a. One bay control unit
 - b. One digital Over Current & Earth fault relay with LBB function.

D. 33kV System

- 1. Each panel for the 33kV bay shall contain, besides other equipment, the following:
 - a. One (1) bay control unit with over current & Earth fault Function (BCPU).

E. General Requirement

- 1. The Existing numerical IEC 61850 compliant numerical busbar differential protection systems 400KV and 220kV system will be integrated to the SAS. If not available same is to be provided
- 2. By this term <<other equipment >> is mentioned basically the following: microcircuit breakers, auxiliary relays, terminal blocks etc.
- 3. All fiber optic cables necessary for the connection of bay control units, protection relays to the HMI center must be supplied.
- 4. All panels shall be equipped with 25% spare terminals blocks which will be used for the wiring of signals and commands from the outdoor primary

equipment.

In the wiring drawings the points of the terminal blocks on where the signals or commands are to be wired, shall be clearly indicated. All terminal blocks shall be suitable for conductors of 8mm^2 in cross section.

5. All panels, which shall bear protection relays, shall be equipped with test sockets (current, voltage and trip circuits) used for the testing of relays. A number of the corresponding male plugs must also be supplied
6. All incoming voltage feeds for each panel must be run through voltage sockets of type omega (Ω) for isolation purposes.
7. All panels of the system must be wired with 1.5mm^2 control cables and all control cables must be equipped with copper strip of 0.1mm^2 in thickness and must also bear protection against rodents.
8. All panels which are to be provided for the entire system shall be of the IP52 protection class as per IEC-60529.
9. All panels of the system must bear doors of Plexiglas.
10. The protection and control panels of the 400KV, 220kV, 132kV and 133V bays, will be installed inside the relay kiosks of the corresponding bays.

ANNEXURE-4

A. TIME SYNCHRONIZATION

1. Time synchronization shall be achieved through GPS and automatically by internal clock , should the EHV substation's antenna can not locate the GPS satellites.

For this purpose a GPS antenna, GPS receiver and all necessary links and devices associated with this application shall be included in the supply and be in accordance with the requirements of paragraph XI below.

2. For the GPS time signal distribution to all relevant units within the ehv substation, a master clock must be provided with no more than eight (8) units per branch.

B. GPS ANTENNA AND RECEIVER

1	Antenna location	The antenna will be located on the roof of the ehv substation's control building
2	Antenna housing	The antenna shall be placed in a weather proof plastic housing.
3	Lightning Protection	Surge protector with response time of ≤ 1 nsec and a discharge current of 10KA, housed in an aluminum case.
4	Signal strength at the input of the antenna	$\sim 1 \times 10^{-16}$ Watt, i.e. below the general noise level.
5	Temperature Range	30°C to $+85^{\circ}\text{C}$
6	Antenna supports	The antenna will be supported by brackets of anodized aluminum and designed to withstand strong winds.
7	GPS-receiver location	Inside the EHV substation's control building, rail mounted
8	GPS-receiver supply voltage	220V AC/ DC
9	Display	Min. 2x20 Character Super twist LCD
	Functions	<ul style="list-style-type: none">▪ Time: UTC or Local▪ Position: Latitude, Longitude and Elevation▪ Display : Clock & Receiver Status
10	Status LEDs	Operate (Green), Unlocked (Red)
11	Timing Accuracy	GPS / UTC time $\pm 1 \mu\text{s}$
12	Antenna cable type	RG-6 weatherproof, 15 m provided
13	Protocol	IRIG-B / SNTP / PTP
14	GPS-receiver configuration and setup	Via professional "windows" based software which must be included in the supply.
15	GPS-receiver configuration and	Serial interfaces with RS 422 hardware or RS 232 or RS 485

	setup	
16	Cabling	All required cabling for the connection of antenna, preamplifier and receiver and of the GPS system to the HMI center unit, must be included in the supply. Furthermore the cables must be described in great detail in the offer.
17	The length of the cable	~ 100meter
18	Accessories	Rack mounting kit, Power Cord & Operation Manual

ANNEXURE-5

FIBER OPTIC CABLES

- a. The fiber optic cables which will be used to connect bay control units with the HMI center will be about 500 m long (the exact length will be derived from the ehv substation's layout drawings) and shall consist of glass fibre.
- b. The fiber optic cables which will be used to connect bay control units with protection relays with distances up to 3-6 m will be glass fibre. In the case which the protections relays are connected directly to the HMI center with a distance of about 500m long, the connection shall be with glass fibre.
- c. The fiber optic cable which will be used to connect bus-bar differential relays to the HMI center will be about 50 meters long and will consist of glass fibre.
- d. If the structure of the substation automation system is of a double loop, this loop shall be of glass fibre.
- e. The glass fiber optic cables shall be equipped with rodent protection.
- f. Temperature range withstand of the glass fiber optic cables shall be as follows:
 - In service : -5^oC to 70^oC
 - In storage : -5^oC to 70^oC
- g. Fibers in all other aspects will be as per IEC 60794-1 and IEC 60794-2

S.No	Equipment	Specification
1	Cable Type	6F Multimode Cable 62.5/125 um
2	Armoured / Un-armoured	Armoured
3	Wavelength	850nm/1300nm
4	Attenuation	< 3.5 dB/km @850nm, <1.0 dB/km @1300nm
5	Band Width	>= 200 MHz/km @850nm, >=500 MHz/km @1300nm
6	No. of Fibers	6 (2 for ring formation and 4 for spare)
7	Color of Fiber	BLUE, WHITE, ORANGE, GREEN, BROWN & SLATE
8	Cladding Diameter	125um ± 2
9	Core Diameter	62.5 um ± 3
10	Numeric Aperture	0.275 ±0.015
11	Cable Diameter	>=8 mm ± 0.5

ANNEXURE-6

SPECIFICATION OF AC KIOSK

The air conditioned Kiosks shall be provided for housing of panels having control and protection IEDs for performing sub-station automation and protection functions generally confirm to relevant IS codes as detailed in section GTR. These kiosks shall be placed in the switchyard area generally unmanned; therefore, the air-conditioning system shall be rugged, reliable, maintenance free and designed for long life.

1.0 CONSTRUCTION:

Prefabricated Kiosk size: 4500mmx4000mmx3300mm/4000mmX4000mmX3300mm

Sr.	Description	Unit	Qty
1	Pre-fabricated Kiosk- as per specified dimension.	Set	1
2	Air conditioning for prefabricated kiosk as per specifications	Set	1
3	Illumination for prefabricated AC Kiosk as per specifications	Lot	1
4	Civil foundation works for prefabricated AC kiosk (As per	Lot	1
5	Installation of Kiosk at site	Lot	1
6	Freight	Lot	1

The Kiosk shall be made of “sandwich insulated panels” 80 mm thick with poly Urethane Foam (PUF) as filler material between polyester pre-coated cold rolled steel. The insulation characteristics of PUF material shall conform to following requirement:

Sr.No.	Particular	Parameters
1.	Thickness	78.6 mm
2.	Density	40 kg/m ³
3.	Compressive Strength	1.2 kg/cm ²
4.	Tensile Strength	3.6 kg/cm ²
5.	Bending Strength	4.0 Kg/cm ²
6.	Adhesion Strength	2.9 Kg/cm ²
7.	Dimension Stability	At -25 ^o C : 0.1% at 38 ^o C : 0.1% ant at 38 ^o C : 0.4%
8.	Temperature Range	-15 ^o C to 95 ^o C
9.	Thermal Conductivity	0.02 kcal/hr/m/ ^o C
10.	Fire Resistance	As per BS-4735 Horizontal Burn
11.	Water absorption	0.2% @ 100% RH
12.	Vapour Permeability	0.08/0.12 g/hr/m ²
13.	Self Extinguishing	Yes
14.	Biodegradable	Yes

The thickness of the inner-side and outer steel sheet except floor panel sheet shall be minimum 0.8 mm and 0.6 mm respectively. The outer bottom sheet shall be hot dip galvanized steel sheets of minimum 1.0 mm thickness to avoid rusting at bottom. The sandwich panels shall be manufactured by high pressure injection techniques. The floor of the kiosk shall be suitably designed for accommodating the control and relay IEDs in the panels. The adequate lighting shall be provided in the kiosk. The Kiosk shall have adequate space for working and maintain clearances as per requirement of Indian Electricity Rules. the kiosk shall be provided with locking arrangement.

2.0 General Technical Requirement.

2.1. Internal Dimension

4500 (L) x 3500 (W) x 3300(H) (Single Side Tapered)
4500 (L) x 4000 (W) x 3500(H) (Single Side Tapered)
5000 (L) x 4000 (W) x 3300(H) (Single Side Tapered)
6000 (L) x 4500 (W) x 3300(H) (Single Side Tapered)

)

2.2. Environmental Conditions

Temperature Range	:	-15 °C to 95 °C
Humidity	:	100% RH
Resistance to -		1. All volumes of rain dust and sand impinging from all directions at different duration at different speeds. 2. Corrosion against water, Industrial air & saline air 3. Decomposing, vegetation, Rodents, termites and Microorganisms

2.3. Walls

Panel Thickness -	80 mm
Cladding - Inner -	0.8mm Polyester Precoated Steel Sheet
- Outer -	0.6mm Polyester Pre-coated Steel Sheet
Wall size -	Appropriate wall size as per kiosk heights 1: 50 for the roof

2.4 Floor

Thickness -	80mm
Cladding - Outer -	1.0 mm Galvanized Steel Sheet
- Inner -	0.8 mm Polyester Precoated Steel Sheet
Additional Floor -	19mm Marine Ply covered with antistatic PVC flooring (<i>not less than 2 mm</i>) over it. False floor will be made with the particle board at a height of min 250 mm. False floor will be made with Sq. tubes 50x50x2.9mm grid structure <i>with 130X5 mm MS plate at base</i> to accommodate Marine Plywood. <i>False floor shall be suitably joined with wall panels for strength and support.</i>

All the panel cabling can be done under the false floor.

- MS square tube joints shall be with ISA 30 30 3

Floor reinforcements - Floor *sub frame* made of ISMC/ISMB sections appropriately support the Kiosk floor evenly and throughout the area. Reinforcement shall be through 78X38X2.9 mm MS tube in floor panels.

Designed Floor Load - 700 Kg/m²

Cut outs & support structure for the Panel & Equipment - Cut outs & support structure shall be done by supplier as per the approved drawings and requirement of the panels & equipment.

2.5. Roof

Panel Thickness - 80 mm

Cladding - Inner - 0.8 mm Polyester Precoated Steel Sheet

- Outer - 0.6 mm Polyester Precoated Steel Sheet

Secondary roof - *It shall be provided on Kioks roof panel.*

- It shall be profiled sheet of PPGI having thickness not less than 0.6 mm and suitably covered with PPCI flashing.

Roof Slope - 1 in 50 along the width of the kiosk.

- *Roof slope shall be formed with C-Channels of GI having thickness not less than 1.6 mm.*

Direction of Slope - Single side sloping along the width

Over Hang - 100mm on all sides, 500mm projection on rear side.

Designed Roof load - 200 Kg/m²

Roof joints - *Shall be with self-drilling screws and covered with suitable stiffeners.*

2.6. Doors

Size - Main Door - 1200(W) x 2400 (H)

- Outer to outer - 1 No.

- Emergency Door -750(W) x 2400 (H)
- Outer to outer – 1No.
- Thickness of Panel - 80mm
- Cladding
 - Inner 0.6mm Pre Coated Steel
 - Outer - 0.6mm Pre Coated Steel
- Door Profiles - Steel Extruded sections
- Door Lock - Standard Dorset Type door-lock integrated in the door. Door Lock provided with 3 keys
- Weather Strip - Mounted above the doors
- Door Opening - Opening outward Hinged to the right
- Gasketting - Replaceable neoprene based rubber gaskets. It shall be as per type test – IP55.

2.7. Openings - For Air-conditioning, cables, lighting, luminaries, fire detectors etc – as per requirement.

2.8. Survival speed - 260 KMPH

2.9 Load Capacity - Floor - 700 Kg/m² uniformly distributed load
 - Roof - 200 Kg/m² uniformly distributed load (*Supported by load bearing calculations in STAAD model*)

2.10 Insulation

- A. Foam - CFC Free, High Pressure Injected, Rigid PU Foam
- B. Density - 42 +/- 2Kg/m³
- C. K value - FOAM - 0.02 W/m² deg K per Hour (of foam)
- D. K value - SHELTER - =< 0.3 W/m² deg K per Hour
- E. Fire Resistance - As Per BS-4735 Horizontal Burn <125mm
 - Self extinguishing (*Supported by relevant test reports*)

2.11. Joints - Panels shall be joined using eccentric cam-locks, Sealed with

Compressive strength - 2.1 Kg/cm²

Tensile Strength - 3.7 Kg/cm²

Bending Strength - 4.0 Kg/cm²

Adhesion Strength - 2.9 Kg/cm²

Thermal Conductivity - 0.02 W/m²/Hr/m/°K

2.1

8. Steel Work

- All steel works shall conform to IS-2062 and IS-2262.
- Structural MS pipes shall correspond to IS-1239 Part 2.
- All steel work shall be galvanized as per IS-4759.
- Minimum coating thickness as per IS standards.
- All welding as per IS-816

2.1

9. Tolerances

- Post installation will have an overall dimensional tolerance of +/- 10mm (Max).

3.0 AIR-CONDITIONING:

The air conditionings system shall be provided in the Kiosks to be used for housing panels having control and protection IEDs for performing sub-station automation and protection functions generally conform to relevant IS codes as detailed ins section GTR. These kiosks shall be placed in the switchyard area generally unmanned; therefore, the air-conditioning system shall be rugged, reliable, maintenance free and designed for long life.

Sr. No.	Parameter	Specification
1	Power Supply	1 -Ø 230 V -50 Hz AC
2	A/C Package contains	Twin A/C Machines
3	Capacity in Ton	1.5 T/ 2.0 T (considering size of the Kiosk)
4	Operation	LCD Remote
5	Refrigerant	R- 22
6	Compressor type	Rotary
7	Features:	Auto change over in case of one m/c faulty. Special feature narrated in detailed spec.
8	Potential free contacts	4 C/O required for ON/OFF

		status for SCADA.
9	Warranty	3 years on site 7 years compressor replacement.

i **OPERATION:**

The air conditioning is required for critical application i.e. for maintaining the temperature for critical sub-station control and protection equipment. To provide redundancy for such critical applications, each kiosk shall be installed with environment control system comprising of two units of air conditioners working in conjunction through a micro processor based controller for desired operation.

The system shall be designed for 24 Hours, 365 Days of the year to maintain the inside kiosk temperature for proper operation of the critical equipment. One of the air-

conditioner shall be running at a time and on failure of the same or as described hereunder, the other unit shall start automatically. To ensure longer life of the system, the redundant units shall also be running in cyclic operation through the controller. However, during running of one air-conditioner unit, if inside temperature of the shelter reaches to a predefined (i.e. 35^oC), the other unit shall start running to maintain the temperature to specified value (i.e. 23+2^oC) and gives alarm for such situation. After achieving this temperature, the other unit shall again shut off.

ii **SEQUENCE OF OPERATION OF THE UNIT:**

Suitable arrangement shall be made to operate the unit in the following order.

However, the actual operation arrangement shall be finalized during detailed engineering.

1. Evaporator Fan
2. Condenser Fan
3. Compressor

iii **CONSTRUCTION:**

The air conditioning unit shall be completely self-contained. All components of the units shall be enclosed in a powder coated cabinet and colour of same shall be matched with kiosk colour. The unit shall be assembled, wired, piped, charged with refrigerant and fully factory tested as a system to ensure trouble free installation and start up. Suitable isolation or other by passing arrangement shall be provided such that any unit/component could be maintained/repaired without affecting the running standby unit. The maintenance of unit shall be possible from outside the kiosk.

iv **REQUIRED FEATURES OF VARIOUS COMPONENTS:**

The compressor shall be very reliable, trouble free and long life i.e. hermitically sealed Scroll type of reputed make suitable for operation. Compressor should be installed on vibration isolated mountings or manufacturers recommended approved mounting. Valve shall be provided for charging/topping up of refrigerant. The bidder shall furnish details of their compressor indicating the MTBF, life of compressor and continuous run time of compressor without failure. The contractor shall also furnish details of all accessories i.e. refrigeration system, evaporator coil, condenser coil, evaporator blower filter, cabinet, indoor supply and return grill etc.

V The kiosk shall be erected at least 300 mm above the finished ground level with suitable pedestal to avoid any entry of water.

4.0. **PROTO TESTING:**

One kiosk meeting the specified requirement as described above, shall be fabricated at the factory and offered for proto inspection at the factory. This proto shall be equipped with all required accessories like air-conditioning system, fire and smoke detector, lighting, various cut outs etc. The offered kiosk shall be inspected for finish, all fittings and accessories, opening including doors and locks. The kiosk shall be tested for dust and rain protection to check out any leakage and air tightness. The following main tests shall be carried out:

- a) Illumination inside the kiosk shall be switched off and it shall be checked that no light enters through panel joints, holes and other joints in the kiosk.
- b) Water Leakage Test (with a water pipe with suitable pressure from all sides for one hour.)
- c) Working and functional tests of all accessories like air-conditioning system, fire and smoke detector, lighting arrangements as per technical specification
- d) Start up test for air conditioner
- e) Satisfactory operation of air conditioner installed on Kiosk.
- f) The total heat load for panels and devices to be placed inside the kiosk including PLCC, all IEDs etc. shall be calculated and equivalent calculated heating load (maximum value from among the calculated values for various kiosk) shall be placed inside the kiosk and the kiosk shall be made operational for four hours with all accessories and inside & outside temperature of kiosk shall be recorded.

On successful completion of proto testing, all other system shall be manufactured after incorporation of all alteration/modifications observed/suggested during/after proto testing.

The detail test procedure shall be submitted by the contractor and get it approved from the owner before commencement of proto testing.

GENERAL TECHNICAL PARTICULAR FOR AC BAY KIOSK

Sr. No.	Description	Design Data	Verification status	Remarks
1	Manufacturer			
2	Type & Designation			
3	Internal Dimensions			
	(a)			
	(b)			
3	Environmental Condition			
	Temp. Range	-15 to 95 Deg. C		
	Humidity	100% RH		
	Resistance to	1.All volumes of Rain, Sand and Dust impinging from all directions at different duration with different speed.		
		2. Corrosion against industrial air, Saline air and		

		water.		
		3. Decomposing,		
		Vegetation, Rodents,		
		Termites and		
		Microorganisms		
4	Walls			
	Panel Thickness	80mm		
	Cladding	Inner - 0.8 mm Polyester Pre coated Sheet		
		Outer - 0.6 mm Polyester Pre coated Sheet		
	Wall size	Appropriate as per Kioks height ensuring slope of 1:50 for roof		
5	Floor			
	Panel Thickness	80mm		
	Cladding	Inner - 0.8 mm Polyester Pre coated Sheet steel		
		Outer - 1.0. mm GI sheet steel		
	Additional Floor	19 mm marine ply covered with anti static PVC flooring over it. 2 mm Thick Anti static PVC Flooring		
	False floor	Particle board at 250mm height; with grid structure of square tubes 50x50x2.9 mm with 130X5 mm MS plate at base. Joining of False floor with wall panel MS square tune joints with ISA 30 30 3		
	Cabling provision	Under false floor		
	Floor reinforcement	MS tube 78X38X2.9		
	Designed Floor load	700 Kg/ Sq.m		
	Cutout and support structure for panel and equipment	As per panel arrangement and equipment approvals		
6	ROOF			
	Panel Thickness	80mm		

	Cladding	Inner - 0.8 mm Polyester Pre coated Sheet		
		Outer - 0.6 mm Polyester Pre coated Sheet		
	Secondary roof	0.6 mm PPGI profiled sheet with PPCI flashing		
	Roof slope	With 1.6 mm GI C- Channel		
	Secondary roof Joints	With self drilling screws		
	Slope	1 to 50 along width of Kiosk		
	Direction of slope	Single side sloping along with width		
	Over hang	100 mm all sides, 500 mm projection on rear side		
	Designed Roof load	200 Kg/ Sq.m		
7	DOOR			
	Main Door size	1200 mm (W) x 2400 mm (H) - Outer to Outer		
	Emergency Door size	750 mm (W) x (H) - Outer to Outer Panel Thickness 80mm		
	Cladding	Inner - 0.6 mm Pre coated steel		
		Outer - 0.6 mm Pre coated steel		
	Door profile	Steel extruded sections		
	Door Locks	Standard door set type door locks integrated in door with 3 sets of keys		
	Weather strip	Weather strip		
	Opening	Opening outward hinged to the right		
	Gasket	Replaceable neoprene base rubber gasket as per IP-55 test		
8	Insulation			
	Foam	High pressure injected, CFC free, Rigid PU		

	Density	42 +/- 2 Kg/m ³		
	K-Value Foam	0.02 W / m ² per Deg Kelvin Per Hr		
	K-Value Shelter	=< 0.3 W / m ² per Deg Kelvin Per Hr		
	Fire resistance	As per BS-4735, Horizontal Burn < 125 mm Self Extinguishing		
9	Joints	With eccentric cam locks, sealed with sealant		
	Angles	External super structure with press break GI sheet. - 150x150x1.6 Inside full MS frame 75X75X1.6 at all corners Internal mid frame 50x50x2.9 square tubes		
10	Sealant	Silicon based "Natural Cure Sealant"		
11	Sub Frame	Hot dip GI ISMB- 200/ 250 & ISMC-150/ 200 based on pedestal foundation. Section receiving Kiosk are to be anchored to base grid with appropriate corner anchoring elements. Nos. of ISMB & ISMC Sections Joining by suitable Clits and M10 fastener (type, Nos. and size of clits) Anchoring suitable clit and M10X250 anchor fastener		
12	Electrical conductivity	All metal parts shall be inter connected for good electrical conductivity and earthed suitably with Kiosk earthing.		

13	PUF Properties			
	Density	40 +/- 2 Kg/m ³ CFC free		
	Compressive Strength	2.1 Kg./ cm ²		
	Tensile strength	3.7 Kg./ cm ²		
	Bending strength	4.0 Kg./ cm ²		
	Adhesion strength	2.9 Kg./ cm ²		
	Thermal conductivity	0.02 W / m ² / Deg Kelvin / Hr		
	Steel Work	IS 2026, IS 2262 Structure MS pipes - IS 1329 Part 2 Steel work GI - As per IS 4759 Minimum coating thickness - As per IS All welding - As per IS 816		
14	Air conditioning			
	Power Supply	1 -Ø 230 V -50 Hz AC		
	A/C Package	Twin A/C Machines		
	contains			
	Capacity in Ton	1.5 T/ 2.0 T		
	Operation	LCD Remote		
	Refrigerant	R- 22		
	Compressor type	Rotary		
	Features:	Auto change over in case of one m/c faulty. Special feature narrated in detailed spec.		
	Potential free contacts	4 C/O required for ON/OFF status for SCADA.		
	Warranty	3 years on site 7 years compressor replacement Details to be mentioned by bidder		
15	Illumination			
16	Smoke Detector			
	Type	Ionization		
	Make			
	Nos.	2 / Kiosk		
17	Type test	IP-55 test <i>from NABL accredited Lab</i>		

18	Colour shade	RAL 7032		
19	Steps	Suitable robust steps of GI Flats / Channels / Angels with sufficient height and stepping shall be provided.		
20	Tie Rod	12 mm Dia through Tie Rod in corner panels from Floor, Side wall to Roof & connected to ISMB shall be provided.		
21	Wiring	Wiring shall be industrial grade high quality with 1.1 KV FRLS cables of appropriate rating. Wiring for all the accessories (Illumination, Smoke detectors, Air conditioning system etc.)supplied with Kioks shall be considered in scope of Kiosk supply.		
22	Other Accessories	Temperature transducer WITH 4-20 mA output DC Emergency lamp		

ANNEXURE-7
SPECIFICATION FOR PROTECTION IED.

A. General

The Numerical Relays in general shall comply with the following requirements:

1. All relays shall conform to the requirements of IS: 3231/IEC-60255/IEC 61000 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear.
2. **The offered relays shall be completely numerical.**
 - The communication protocol shall be as per IEC 61850 & IEC60870-5-103
 - The test levels of EMI as indicated in IEC 61850 shall be applicable to these relays.
 - Protection elements should be realised using software algorithm.
 - Hardware based measurement shall not be acceptable.
3. The relay shall be provided with both 1A and 5A CT inputs and shall be selectable at site.
4. It shall be possible to energise the relay from either AC or DC auxiliary supply.
5. The offered relay shall have a comprehensive local MMI for interface. It shall have the following minimum elements so that the features of the relay can be accessed and setting changes can be done locally.
 - At least 48 character alphanumeric backlit LCD display unit
 - Fixed LEDs (for trip, Alarm, Relay available & Relay out of service) & programmable LEDs which can be assigned to any protection function for local annunciation.
 - Tactile keypad for browsing and setting the relay menu
6. The relay shall have the facility to set the pickup threshold for type of DC system 220 V DC systems as per site requirement. To prevent the spurious pick up of binary during inputs DC earth fault condition. The minimum pickup voltage for 220 V DC systems must be 176 V (80%)
7. The relays supplied should be compatible to redundant communication architecture, shall be complied with the IEC 62439-3 standards of parallel redundancy protocol (PRP).
8. The relays provided should be complied with the international standards of NERC CIP for cyber security to provide protection against unauthorized disclosure, transfer, modification, or destruction of information and/or information systems, whether accidental or intentional.
9. All PCB used in relays should have harsh environmental coating as per standard IEC 60068

(HEC) to increase the particle repellency and thereby increasing the life of relay

10. The offered relays shall be completely numerical and **should comply to IEC 61850 protocol. The relay** must support following requirements for communication ports and protocols,

- The relays shall generate GOOSE messages as per IEC 61850 standards for interlocking and also to ensure interoperability with third party relays.
- The relay should be capable to process bus interface 61850-9-2LE (Process Bus) to receive SV from non-conventional CT /PT and merging unit. **(Requirement will be asked specifically)**
- The relay must have front RS232/USB/RJ45 port for local communication with the device
- The communication protocol shall be as per IEC 61850
- The relay should be compatible to redundant communication architecture and shall be complied with IEC 62439-3 standards of parallel redundancy protocol (PRP)
- The relays shall generate GOOSE messages as per IEC 61850 standards for interlocking and also to ensure interoperability with third party relays.
- Necessary user friendly configuration tool shall be provided to configure the relays. It should be compatible with SCL/SCD files generated by a third party system.
- GOOSE signals shall be freely configurable for any kind of signals using graphic tool/user friendly software.
- The offered relay must support at least 4 no's of 61850 clients
- The relay must support time synchronization through SNTP/IRIG B demodulated.
- The relay must be capable of IEEE 1588 PTP time synchronisation Allows reliable time synchronisation via sstation bus instead of separate IRIGB cabling.
- The relays provided should be complied with the international standards of NERC CIP for cyber security to provide protection against unauthorized disclosure, transfer, modification, or destruction of information and/or information systems, whether accidental or intentional.
- The relay settings shall be provided with adequate password protection. The password of the relay should be of 4 character upper case text to provide security to setting parameter

11. The relays shall have the following tools for fault diagnostics

- Fault record – The relay shall have the facility to store at least 5 last fault records with information on cause of trip, date, time, trip values of electrical parameters.

- Event record – The relay shall have the facility to store at least 512 time stamped event records with 1ms resolution.
 - Disturbance records – The relay shall have capacity to store the waveforms for a minimum duration of at least 5 secs with settable pre and post fault duration times at a minimum sampling rate of 800 Hz or Higher.
 - Except for differential protection the disturbance recorder must have capability to capture at least 8 analogue channels (IA, IB, IC, IN, VA, VB, VC, and VN) and 15 digital channels (start of protection element, trip of protection element, binary input, trip output etc) selectable at site.
 - For differential protection relay, the disturbance recorder must have capability to capture at least 15 analogue channels and 30 digital channels.
 - Necessary software shall be provided for retrieving and analyzing the records.
12. The relay settings shall be provided with adequate password protection. The password of the relay should be of 4 character upper case text to provide security to setting parameter
13. The relay shall have comprehensive self-diagnostic feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure detected shall be annunciated through a output watchdog contact. The fault diagnosis information shall be displayed on the LCD and also through the communication port.
14. The Numerical Relays shall be provided with 1 Set of common support software compatible with both Windows 7 and higher which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, measurements.
- The relay settings shall also be changed from local or remote using the same software.
 - Additional functions can be added to relay by software upgradation and downloading this upgraded software to the relays by simple communication through PC.
15. All protective relays shall be in draw out or plug-in type/modular cases with proper testing facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in contractor's scope of supply.

16. All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.
17. The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme; contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.
- 18 Timers shall be of solid state type. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not preferred and shall be avoided.
- No control relay, which shall trip the power circuit breaker when the relay is de-energised, shall be employed in the circuits.
 - Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.
 - Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type.
 - The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.
19. 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 OPTCL.
20. The relay must be able to continuously measure following parameters with a typical accuracy of $\pm 1\%$.
- Current (0.05 to 3 In) $\pm 1.5\%$ of reading,
 - Voltage (0.05 to 2 Vn) $\pm 1.0\%$ of reading
 - Frequency (40 to 70 Hz) ± 0.03 Hz
 - Phase 0° to 360° $\pm 5.0\%$

- Power (W) +/- 5.0% of reading at unity power factor
- Reactive power (VARs) +/- 5.0% of reading at zero power factor
- Apparent power (VA) +/- 5.0% of reading

B. Specifications for Distance protection relay:

- a. The IEC 60255-121 standard “Functional requirements for distance protection” published in March 2014, specifies the minimum requirements for functional and performance evaluation of distance protection relays, describes the tests to be performed and how to publish the test results. The relay should conform to above standard.
- b. The protection should be fully numerical and be based on a non-switched scheme.
- c. Provide protection for the transmission line from all types of faults-phase to earth faults as well as multiphase faults. The protection algorithm shall have dual redundant distance protection algorithms to detect all types of power system faults so as to arrive at a secure trip decision with correct phase selection and proper direction discrimination in the shortest possible time.
- d. The protection should have non-switched measurement, which implies processing of six possible fault loops (six –loop measurement)
- e. It should have polygonal characteristics with independently adjustable reactive and resistive reaches for maximum selectivity and maximum fault resistance coverage. The zones shall have independent settable earth fault compensation factors to cater to adjacent lines with different zero sequence to positive sequence ratios.
- f. Selection shall be so that the first zone of the relay can be set to about 80% - 85% of the protected line without any risk of non-selective tripping.
- g. The second and third zone elements shall provide back up protection in the event of the carrier protection or the first zone element failing to clear the fault, zone-2 shall cover full protected section plus 50 % of the next section, zone-3 shall normally cover the two adjacent sections completely.
- h. It must have load encroachment features and must support blocking of the

selected zones during heavy load condition.

- i. It should have adequate number of forward zones (minimum three) and a reverse zone. The zone reach setting ranges shall be sufficient to cover line lengths appropriate to each zone. Carrier aided scheme options such as permissive under reach, over reach, & blocking and non-carrier aided schemes of zone 1 extension and Loss of load accelerated tripping schemes shall be available as standard. Weak in feed logic and current reversal guard also shall be provided.
- j. In case the carrier channel fails, one out of the non-carrier based schemes cited above should come into operation automatically to ensure high speed and simultaneous opening of breakers at both ends of the line.
- k. In addition to the conventional impedance measuring algorithm the distance protection relay should have a separate measuring technique in the same hardware completely different to the conventional impedance measuring principal. Both the algorithms should run in parallel and should take trip decisions independently.
- l. Have a maximum operating time up to trip impulse to circuit breaker (complete protection time including applicable carrier and trip relay time) with CVT being used on the line :
 - For SIR 0.01-4 : as 40ms at the nearest end and 60ms at the other end of line
 - For SIR 4-15 : as 45ms at the nearest end and 65ms at the other end of line
 - With carrier transmission time taken as 20ms.
- m. Have a secure directional response under all conditions, achieved by memory voltage polarizing and/or healthy phase voltage polarizing as appropriate.
- n. Shall have an independent Directional Earth Fault (DEF) protection element to detect highly resistive faults. This element shall have an inverse time/definite time characteristic with a possibility to configure the DEF as a channel-aided DEF or a channel-independent DEF

- o. Have logic to detect loss of single/two phase voltage input as well as three phase voltage loss during energisation and normal load conditions. The voltage circuit monitoring logic should in addition to blocking the distance protection element, enable an emergency overcurrent element to provide a standby protection to the feeder till the re-appearance of voltage signal.
- The VT fuse failure function shall function properly irrespective of the loading on the line. In other words the function shall not be inhibited during operation of line under very low load conditions.
- p. Have necessary logic to take care of switch-on-to-fault condition. Energisation of transformers at remote line ends and the accompanying inrush current shall not cause any instability to the operation of relay.
- q. The line protection IED should have power swing blocking feature, with facilities for :
- i. fast detection of power swing
 - ii. selective blocking of zones
 - iii. settable unblocking criteria for earth faults, phase faults and three phase faults.
- r. Also the Distance protection IED should have following features in built in it.
- suitable for single pole or three pole tripping.
 - Shall have inbuilt CT supervision facility. A time-delayed alarm shall be issued if a CT open circuit is detected.
 - Shall have inbuilt Trip circuit supervision facility to monitor both pre- and post close supervision facilities. An alarm shall be generated.
 - Shall have inbuilt Circuit Breaker Failure protection based on undercurrent detection and/or circuit breaker auxiliary contact status and/or distance protection reset status. Provision shall be given to initiate the breaker fail logic using a digital input from external protection devices.
 - Shall have inbuilt broken conductor detection by measuring the ratio of I_2 & I_1 . The sensitivity of the logic shall not be affected during operation under low load.
- s. Shall have a fault locator with an accuracy of $\pm 3\%$. The display shall be in kilometers, miles or percentage impedance . The fault locator should have built in mutual compensation for parallel circuit.

- t. The Distance protection should be capable of performing basic instrumentation functions and display various instantaneous parameters like Voltage, current, active power, reactive power etc. in primary values. Additionally all sequence current and voltage values shall be displayed on-line. Also the direction of power flow shall be displayed.

- u. The relay shall have a built-in auto-reclose function with facilities for single pole / three pole / single and three pole tripping. It shall be possible to trigger the A/R function from an external protection. A voltage check function which can be programmed for dead line charging/dead bus charging / check synchronising shall be included.

- v. Records containing discrete data on the last five faults shall be made available. In particular the fault resistance value shall be available for each record.

- w. Facility for developing customized logic schemes inside the relay based on Boolean logic gates and timers should be available. Facility for renaming the menu texts as required by operating staff at site should be provided.

- x. The protection relay should have the following additional elements
 - i. Under / Over voltage protection. The relay shall have two stages of voltage protections where each stage can be set as under/over voltage. The drop off/Pickup ratio can be set up to 99.5%.
 - ii. The relay shall have built in Circuit Breaker Supervision Functions for Condition based Circuit Breaker Maintenance
 - iii. The relay shall be able to detect any discrepancy found between NO & NC contacts of breaker
 - iv. The relay shall monitor number of breaker trip operations
 - v. The relay shall record the sum of the broken current quantity
 - vi. The relay shall also monitor the breaker operating time
 - vii. In all the above cases the relay shall generate an alarm if the value crosses the threshold value.

C. Specification for Numerical Transformer Differential Protection

a. General requirements for transformer protection scheme : The differential protection iED

- The offered relay must be suitable providing complete protection for 2 winding transformer, 3 winding transformer and auto transformer
- For 2 winding differential protection, it must have 8 CT input, 3 for phase CT HV side, 3 for phase CT LV side, 1 Neutral CT HV side, 1 Neutral CT LV side.
- For 3 winding differential Protection, it must have 12 CT input, 3 for phase CT HV side, 3 for phase CT LV side, 3 for Phase CT TV side, 1 for neutral CT HV, 1 for neutral CT LV, 1 for neutral CT TV.
- The relay must be suitable for providing low impedance REF protection for auto transformer.
- For 2 Winding transformer, 1 VT input and for 3 winding transformer 4 VT input are required.
- The protection function requirement for Transformer protection relays are as mentioned below,
- Differential protection (Low Impedance type with 3 slope characteristic)
- 2 elements of REF Protection for 2 winding transformer and must be selectable between Low Impedance and High impedance REF as per the site requirement's
- 3 elements of REF protection for 3 winding transformer and must be selectable between Low and High impedance REF
- REF protection for autotransformers.
- Backup Over current and Earth fault for each winding
- Thermal overload protection
- Over excitation protection
- Over and Under frequency protection
- CB Fail protection for each Winding (CT) input
- Shall be stable during magnetizing inrush and over fluxing conditions. Stabilization under inrush conditions shall be based on the presence of second harmonic components in the differential currents. The second harmonic blocking threshold shall be programmable one.
- Shall have facility to deactivate harmonic restraint and over fluxing restraint functions.
- Shall have saturation discriminator as an additional safeguard for stability under through fault conditions.
- The relay should be capable of detecting the CT saturation. Relay should use appropriate algorithm to detect light saturation condition.

- It shall be possible in the relay to individually set MVA rating of transformer per winding.
- Relay should have vector group and magnitude correction. Relay should have facility for filtering zero seq. current for stability of X-mer differential protection (87T) during through fault.
- Thermal overload protection as per IEC 60255.
- The relay shall have loss of life functionality as per IEEE C57.91-1995
- The relay shall have through fault monitoring element to monitor the HV, the LV or the TV winding to give the fault current level, the duration of the faulty condition, the date & time for each through fault.
- The relay shall have REF protection, be selectable separately for each winding and programmable as either high or low impedance. The REF function should be able to share CT's with the biased differential function. The REF protection provided should be suitable for auto transformer also.
- Shall have all output relays suitable for both signals and trip duties.
- Shall be stable during magnetizing inrush and over fluxing conditions. Stabilization under inrush conditions shall be based on the presence of second harmonic components in the differential currents. The second harmonic blocking threshold shall be programmable one.
- Shall have facility to deactivate harmonic restraint and over fluxing restraint functions.
- Shall have saturation discriminator as an additional safeguard for stability under through fault conditions.
- Shall have software for interposing current transformers for angle and ratio correction to take care of the angle & ratio correction.
- Shall have all output relays suitable for both signals and trip duties.
- Shall have transient bias to enhance the stability of differential element during external fault condition.
- The relay should have combined harmonic blocking and restraint features to provide maximum security during transformer magnetizing inrush conditions

b. Functional Description.

i. Differential Protection

- The relay shall be biased differential protection with triple slope tripping characteristics with faulty phase identification / indication . The range for the differential pick-up shall be from 0.1 to 2.5 pu. Its operating time shall not exceed 30 ms at 5 times rated current.
- The relay shall have adjustable bias slopes m1 from 0 % to 150 % and slope m2 from 15% to 150 % so as to provide maximum sensitivity for internal faults with high stability for through faults.
- The relay shall have an unrestrained highset element to back up the biased differential function and the setting range for it shall have a minimum setting of 5pu and a maximum setting of 30pu.
- The relay shall have the stability under inrush conditions . The ratio of the second harmonic component to the fundamental wave for the differential currents of the measuring system shall serve as the criterion.
- The device shall have reliable detection technique, preferably no gap detection technique to ensure stability during inrush. Any type of time delay is not acceptable to differentiate inrush and fault condition.
- The relay shall provide restraint for over fluxing condition for the transformer by measuring the ratio of the fifth harmonic to the fundamental for the differential current if subjected to transient over fluxing. The fifth harmonic blocking feature should have variable percentage setting.

ii. Restricted Earthfault Protection (64 R)

This function should be provided to maximise the sensitivity of the protection of earthfaults. The REF function should be selected separately for each winding and programmable as either high or low impedance. The REF function should be able to share CT's with the biased differential function. As in traditional REF protections, the function should respond only to the fundamental frequency component of the currents. The REF protection provided should be suitable for auto transformer also.

iii. Overfluxing Protection (99 GT)

The relay shall Over fluxing protection Volts/Hertz protection to the transformers protected. By pairs of v/f and t , it shall be possible to plot the overfluxing

characteristics in the relay so that accurate adaptation of the power transformer Over fluxing characteristics is ensured.

In addition the relay should have a definite time element for alarm. The reset ratio for Over fluxing Protection shall be 98%.

iv. Overload Protection.

Shall have thermal overload protection for alarm and trip condition with continuously adjustable setting range of 10-400% of rated current

v. Overcurrent Protection (50,51)

The relay shall have three stages of definite time overcurrent protection as backup operating with separate measuring systems for the evaluation of the three phase currents ,the negative sequence current and the residual current.

In addition the relay shall have three stages of Inverse time overcurrent protection operating on the basis of one measuring system each for the three phase currents ,the negative sequence current and the residual current.

vi. Over / Under frequency

The relay shall have four stages of frequency protections where each stage can be set as under/over frequency, under/over frequency with df/dt

vii. Over / Under Voltage

The relay shall have two stages of voltage protections where each stage can be set as under/over voltage. The adjustable drop off/Pickup ratio better than 97% should be available.

viii. Local Breaker Back up protection:

The relay shall in built LBB protection to detect the failure in the local breaker using the undercurrent criteria and trip the upstream breaker.

D. Protection and Control function requirements for feeder Management Relay.

- The Relay provides the following current based protection functions:
 - Phase/Neutral/Ground instantaneous overcurrent
 - Phase/neutral/ground time overcurrent
 - Negative sequence Timed overcurrent
 - Phase/neutral directional overcurrent

- Restricted Ground Fault (87REF)
- Breaker Failure (50BF)
- Thermal Model (49)
- Cold Load Pickup (CLP)
- The Relay provides the following voltage based functions:
 - Phase Over and Under Voltage
 - Neutral Over Voltage
 - Directional Power
 - Forward Power
- The Relay provides the following control functions:
 - 4 Shot Auto Reclose (79)
 - VT Fuse failure (VTFF)
 - Over/Under Frequency (81O/81U)
 - Rate of change of Frequency (81df/dt)
 - Synchrocheck (25)
 - Breaker Failure (50BF)
- At least 5 user configurable commands for local and remote (Remote through SCADA on MMS)
- Configurable one line diagram for the substation bay
- The relay should have 2 switchable setting groups for dynamic reconfiguration of the protection elements due to changed conditions
- Programmable LOGIC
- Relay supports user defined logic to build control schemes supporting logic gates, timers, nonvolatile latches.
- The Relay configuration tool has an embedded graphical user interface to build programmable logic.

FRONT-PANEL VISUALIZATION

- The front panel includes user-programmable LEDs and pushbuttons and navigation keys.
- For bay information that includes user programmable screens for:
 - One line diagram displaying
 - Switchgear operation
 - Access to metering information
 - Alarm panel display.
 - I/O status display.
 - Relay settings

E. BACKUP RELAYS (Current Protection).

The combined overcurrent and earth-fault relay is connected to the current transformers of the object to be protected. The overcurrent unit and the earth-fault unit continuously measure the phase currents and the neutral current of the object. On detection of a fault, the relay will start, trip the circuit breaker, provide alarms, record fault data, etc., in accordance with the application and the configured relay functions.

FUNCTIONAL DESCRIPTION;

Three-Phase Overcurrent (50/51) & Earth Overcurrent (50N/51N)

Three independent stages are available either for phase and earth fault protection. For the first and second stage the user may independently select definite time delay (DTOC) or inverse time delay (IDMT) with different type of curves (IEC, IEEE/ANSI, IS 3231:1987).

Three-Phase & Earth-Fault Directional Overcurrent (67/67N)

Each of the three-phase overcurrent stages & earth fault stages can be independently configured as directional protection and with specific characteristic angle (RCA) and boundaries as per IEC, IEEE/ANSI, IS . The phase fault directional elements should be internally polarised by quadrature phase to phase voltages. A synchronous polarising function or any other suitable algorithm may be provided to ensure a correct operation of the overcurrent elements for close-up three phase faults where the collapse of the polarising line voltages occurs.

Under / Over Voltage (27/59)

Independent under-voltage stage and two or more over-voltage stages may be provided. They should be definite time elements. Each stage can be configured to operate from either phase-neutral or phase-phase voltages. The drop off to pick up ratio should be 99.5%.

Under / Over Frequency (81U/O)

Time delayed under and over frequency protection on the fundamental form of frequency protection is to be provided. When the frequency measured is crossed 6 pre-defined thresholds, the relays should generate a start signal and after a user settable time delay, a trip signal.

Rate of Frequency (81R)

Time delayed rate of frequency protection should be available for severe disturbances when shedding load in small steps may not be sufficient. It can also compliment the generator control system to reduce or shed generation when the frequency rises above the nominal frequency at a high rate.

Circuit Breaker Failure Protection (50BF)

The circuit breaker failure verifies the effective opening of the CB by a dedicated undercurrent threshold. The circuit breaker failure function can be activated by trip of a generic protection

or/and external command by the relevant digital input. The circuit breaker failure protection can be used for tripping upstream circuit breakers too.

F. For numerical relays, the scope shall include the following:

1. Necessary software and hardware to up/down load the data to/from the relay from/to the personal computer installed in the substation. However, the supply of PC is not covered under this clause.
2. The relay shall have suitable communication facility for connectivity to SCADA.
3. IED should be IEC 61850 compliant.
4. IED should support PRP (Parallel Redundancy Protocol)
5. In case of line protection and transformer/reactor protection, the features like fault recorder and event logging function as available including available as optional feature in these relays shall be supplied and activated at no extra cost to the owner. Also necessary software/ hardware for automatic uploading to station HMI/DR work station (as applicable) shall be supplied.

E. Technical Particulars of IED

1. Standards and regulations:

IEEE/IEC/ANSI/CE/IS	IS: 3231/IEC-60255/IEC 61000
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2. Analogue Inputs and Outputs

Nominal Frequency fN	50 Hz
Nominal Current	1A/5A
Power Consumption	0.05VAat IN=1A, 0.3VAat IN=5A
Current Overload Capability per Current Input thermal (rms)	100* IN for 1Sec. 30*IN for 10Sec 4*IN continuous
Dynamic (pulse Current)	1250A (half cycle)
Nominal Voltage Ph-Ph rms (VN)	110V
Operating range Ph-Ph rms	0-200V
Continuous	2*VN
10 seconds	2.6*VN

3. Auxiliary voltage

Nominal Range	Operative Range
220V dc	180-300Vdc
Power Consumption dc	< 50W
Ripple superimposed AC Voltage	≤ 15% auxiliary nominal voltage.
230VAC	90-270VAC
Power Input AC	< 30VA

4. Input output modules

Binary inputs	
a) number of input	a) Minimum 8 Nos for Backup relays. b) Minimum 16 Nos for feeder management relays c) Minimum 10/16 Nos for Transformer Differential Relays (2 Winding/3 winding). d) Minimum 24Nos for Distance Protection Relays
b) voltage range	240V \pm 20%
c) power consumption	< 0.4W
Output contacts	
i. number of output contact	a) Minimum 8 Nos for Backup relays. e) Minimum 12 Nos for feeder management relays f) Minimum 8/16 Nos for Transformer Differential Relays. (2 Winding/3 winding). g) Minimum 32 Nos for Distance Protection Relays
ii. Nominal Voltage	240V DC \pm 20
iii. permissible current	Make & carry 30A for 0.2sec. ANSI C37.90 Continuous; 6A IEEE C37.90

5. LED

LED displays:	
Status LED	(I) Relay Healthy
	(II) Relay Start
	(III) Relay Trip
Alarm Indication	Configurable LED for indication. h) Minimum 8Nos for Backup relays. i) Minimum 8 Nos for feeder management relays j) Minimum 8 Nos for Transformer Differential Relays. k) Minimum 14Nos for Distance Protection Relays.

6. Protection Function

DISTANCE PROTECTION :	
21P	Distance protection 21
21G	Distance protection zones (PDIS)
25	Synchocheck
27/59	Under/Over Voltage (2 stage over voltages)
46	Negative Phase Sequence
46BC	Broken Conductor
50/51,50N/51N	Instantaneous/Time overcurrent.
50BF	Breaker failure
67/67N	Direction Over current

79	Auto Reclose
81	Frequency Function.
FL	Fault Locator
DR	Disturbance Recorder
EL	Event Log.
MES.	Measurement.
CTS	CT Supervision
VTS	VT Supervision
TCS	Trip Ckt Super vision
TRANSFORMER DIFFERENTIAL RELAY	
24	Over-excitation.
27/59	Under/Over Voltage
49	Thermal Overload
46	Negative Phase Sequence
50/51,50N/51N	Instantaneous/Time overcurrent.
50BF	Breaker failure
87G	Restricted Earthfault.
67/67N	Direction Over current
87	Differential Protection.
81	Frequency Function.
FL	Fault Locator
DR	Disturbance Recorder
EL	Event Log.
MES.	Measurement.
CTS	CT Supervision
VTS	VT Supervision
TCS	Trip Ckt Super vision
CURRENT PROTECTION	
50	Instantaneous phase overcurrent protection
51/67	Four step phase overcurrent protection
50N	Instantaneous residual overcurrent protection
51N/67N	Four step residual overcurrent protection
50BF	Breaker failure protection (RBR
81	Under frequency
FEEDER MANGEMENT RELAY	
50	Instantaneous phase overcurrent protection
51/67	Four step phase overcurrent protection
50N	Instantaneous residual overcurrent protection
51N/67N	Four step residual overcurrent protection
27 /59	Under Over Voltage
50BF	Breaker failure protection
81U	Under frequency
81R	df/dt
25	Check synchronise
32	Power Protection
79	Multi shot Auto Recloser
Control	Switchgear Control Capability.

7.Secondary Supervision & Communication

Secondary system supervision	
	Current circuit supervision Fuse failure supervision
Monitoring	

	Measurements Event counter Disturbance report Fault locator
Communication	
	IEC61850-8-1 Communication IEC60870-5-103 communication protocol Single command, 16 signals Multiple command and transmit. PRP compliant.
a)Synchronization facility with GPS Cloak	IRIG-B
b)Front port communication	RS 232/Ethernet/USB
c)Rear port	FO and RJ45 port for IEC 61850-8-1
d)Optional port	RS232/485
Process Bus Interface IEC 61850-9-2LE	
	If asked.

8. Mechanical design

i) type of mounting	Rack or panel mounting
ii) degree of protection	IP52 & above
iii. permissible mechanical stress during operation b. permissible mechanical stress during transport Impedance starter	<ul style="list-style-type: none"> •Vibration IEC 60255-21-1:1996 Response Class 2 Endurance Class 2 •Shock and bump IEC 60255-21-2:1995 Shock response Class 2 Shock withstand Class 1 •Seismic IEC 60255-21-3:1995 Class 2

9. Insulation test:

	As per IEC 60255-5:1977
1. high voltage test on all circuits except auxiliary voltage	2KV for 1 min
2. high voltage test on voltage circuit only	2KV for 1 min
3. impulse voltage test on all circuits	5KV peak, 1.2/50 micro s ,0.5

10. Noise immunity test

(a)	
(b) high frequency	IEC 60255-22-1:1988 Class III At 1MHz, for 2s with 200 Source Impedance: 2.5kV peak between independent circuits and independent circuits and case earth. 1.0kV peak across terminals of the same circuit.

(c) electrostatic discharge	Electrostatic discharge IEC 60255-22-2:1996 Class 4 15kV discharge in air to user interface, display and exposed metal work. IEC 60255-22-2:1996 Class 3 8kV discharge in air to all communication ports.6kV point contact discharge to any part of the front of the product.
(d) radio frequency electromagnetic field, non modulated	C37.90.2:1995 25MHz to 1000MHz,zero and 100%square wave modulated. Field strength of 35V/m.
(e) radio frequency electromagnetic field, amplitude modulated	
(f) power frequency magnetic field	
(g) radio frequency electromagnetic field, pulse modulated	
(h) fast transient	IEC 60255-22-4 :1992 Class IV 4kV,2.5kHz applied directly to auxiliary supply 4kV,2.5kHz applied to all inputs.
(i) conducted disturbance induced by radio frequency field, amplitude modulated	IEC 61000-4-6:1996 Level 3 10V,150kHz to 80MHz at 1kHz 80%am
Interference emission test	89/336/EEC EN50081-2:1994
a. radio interference voltage	EN50082-2:1995
b. radio interference field strength	

11. Climate stress test

1. permissible ambient temperature during operation	-25 °C to +55 °C
2. permissible ambient temperature during storage	-25 °C to +55 °C
3. permissible ambient temperature during transport	-25 °C to +70 °C
4. permissible humidity	56 days at 93%RH and +40 °C

Detail Type Test Requirement

The following norms and standards compliance shall be demonstrated. All shall be carried out at an ILAC or NABL accredited laboratory.

a) Ambient Temperature Range

As per IEC 60255-27: 2005

- Operating temperature range: -25°C to +55°C (or -13°F to +131°F).
 - Storage and transit: -25°C to +70°C (or -13°F to +158°F)
- Tested as per IEC 60068-2-1: 2007:
- -25°C storage (96 hours), -40°C operation (96 hours)
- IEC 60068-2-2: 2007: +85°C storage (96 hours)

- b) Ambient Humidity Range
- As per IEC 60068-2-78: 2001: 56 days at 93% relative humidity and +40°C
 - As per IEC 60068-2-30: 2005: Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 to +55°C

c) Corrosive Environments

The device shall provide harsh environmental coating of printed circuit boards as standard. The coating shall be applied after printed circuit boards have been subjected to a cleaning and drying process.

The environmental claims achieved shall be:

- As per IEC 60068-2-60: 1995, Part 2, Test Ke, Method (class) 3. Industrial corrosive environment/poor environmental control, mixed gas flow test. 21 days at 75% relative humidity and +30°C exposure to elevated concentrations of H₂S, (100 ppb) NO₂, (200 ppb) Cl₂ (20 ppb).
- As per IEC 60068-2-52 Salt mist (7 days)
- As per IEC 60068-2-43 for H₂S (21 days), 15 ppm
- As per IEC 60068-2-42 for SO₂ (21 days), 25 ppm

d) Insulation

As per IEC 60255-27: 2005

- Insulation resistance > 100M Ω at 500Vdc (using only electronic/brushless insulation tester).

e) Creepage Distances and Clearances

As per IEC 60255-27: 2005

- Pollution degree 3,
- Overvoltage category III,
- Impulse test voltage 5 kV.

f) High Voltage (Dielectric) Withstand

EIA(RS)232 ports excepted.

- (i) As per IEC 60255-27: 2005, 2 kV rms AC, 1 minute:

Between all case terminals connected together, and the case earth.

Also, between all terminals of independent circuits.

- 1kV rms AC for 1 minute, across open watchdog contacts.
 - 1kV rms AC for 1 minute, across open contacts of changeover output relays.
- (ii) As per ANSI/IEEE C37.90-2005:
- 1.5 kV rms AC for 1 minute, across open contacts of changeover output relays.

g) Impulse Voltage Withstand Test

As per IEC 60255-27: 2005

- Front time: 1.2 μ s, Time to half-value: 50 μ s,
- Peak value: 5 kV, 0.5J
- Between all terminals, and all terminals and case earth.

EMC / EMI Requirements

The relay should have high immunity to electrical and electromagnetic interference. Relay should confirm to following mandatory type tests for safe operation of relay:

h) 1 MHz Burst High Frequency Disturbance Test

As per IEC 60255-22-1: 2008, Class III, and IEC 60255-26: 2013

- Common-mode test voltage: 2.5 kV,
- Differential test voltage: 1.0 kV,
- Test duration: 2s, Source impedance: 200 Ω
- EIA(RS)232 ports excepted.

i) 100kHz Damped Oscillatory Test

As per EN61000-4-18: 2011: Level 3, 100 kHz and 1 MHz. Level 4: 3 MHz, 10 MHz and 30 MHz, IEC 60255-26:2013:

- Common mode test voltage: 2.5kV and 4kV
- Differential mode test voltage: 1kV

j) Immunity to Electrostatic Discharge

As per IEC 60255-22-2: 2009 Class 3 and Class 4, IEC 60255-26:2013:

- 15kV discharge in air to user interface, display, and exposed metalwork.

- 8kV discharge in air to all communication ports.
- k) Electrical Fast Transient or Burst Requirements
As per IEC 60255-22-4: 2008 and EN61000-4-4:2004. Test severity level III and IV, IEC 60255-26:2013:
- Applied to communication inputs: Amplitude: 2 kV, burst frequency 5 kHz and 100 KHz (level 4)
 - Applied to power supply and all other inputs except for communication inputs: Amplitude: 4 kV, burst frequency 5 kHz and 100 KHz (level 4)
- l) Surge Withstand Capability
As per IEEE/ANSI C37.90.1:2002:
- 4kV fast transient and 2.5kV oscillatory applied common mode and differential mode to opto inputs (filtered), output relays, and power supply.
 - 4kV fast transient and 2.5kV oscillatory applied common mode to communications.
- m) Surge Immunity Test
EIA(RS)232 ports excepted. As per IEC 61000-4-5: 2005 Level 4,
- Time to half-value: 1.2/50 μ s,
 - Amplitude: 4kV between all groups and case earth,
 - Amplitude: 2kV between terminals of each group.
- n) Immunity to Radiated Electromagnetic Energy
As per IEC 60255-22-3: 2007, Class III, and IEC 60255-26:2013:
- Frequency band 80 MHz to 3.0 GHz
 - Spot tests at 80, 160, 380, 450, 900, 1850, 2150 MHz
 - Test field strength 10 V/m
 - Test using AM 1 kHz @ 80%
- As per IEEE/ANSI C37.90.2: 2004:
- 80MHz to 1000MHz, zero and 100% square wave modulated.
 - Field strength of 35V/m.
- o) Radiated Immunity from Digital Communications
As per EN61000-4-3: 2006, Level 4:
- Test field strength, frequency band 800 to 960 MHz, and 1.4 to 2.0 GHz: 30 V/m,
 - Test using AM: 1 kHz / 80%.
- p) Radiated Immunity from Digital Radio Telephones
As per IEC 61000-4-3: 2006, and IEC 60255-26: 2013:
- 10 V/m, 900MHz and 1.89GHz.
- q) Immunity to Conducted Disturbances Induced by Radio Frequency Fields
As per IEC 61000-4-6: 2008, Level 3,
- Disturbing test voltage: 10 V
- r) Power Frequency Magnetic Field Immunity
As per IEC 61000-4-8: 2009, Level 5,
- 100A/m applied continuously,
 - 1000A/m applied for 3s.
- As per IEC 61000-4-9: 2001, Level 5,
- 1000A/m applied in all planes.
- As per IEC 61000-4-10: 2001, Level 5,
- 100A/m applied in all planes at 100kHz/1MHz with a burst duration of 2s.
- s) Conducted Emissions
As per EN 55022: 2010: Class A:
- 0.15 - 0.5MHz, 79dB μ V (quasi peak), 66dB μ V (average)
 - 0.5 - 30MHz, 73dB μ V (quasi peak), 60dB μ V (average).
- t) Radiated Emissions
As per EN 55022: 2010: Class A:
- 30 - 230MHz, 40dB μ V/m at 10m measurement distance
 - 230 - 1GHz, 47dB μ V/m at 10m measurement distance
 - 1 - 2 GHz, 76 dB μ V/m at 10 m measurement distance
- u) Power Frequency
As per IEC 60255-22-7:2003, IEC 60255-26:2013:

- 300 V common-mode (Class A)
- 150 V differential mode (Class A)

ANNEXURE-8

INDOOR CONTROL RELAY PANEL

1	Type of Construction	Simplex Indoor Rack type Panel – Front swing & rear closed. With Plexiglas front cover.
2	Thickness of sheet steel.	
3	(i) Front / Load Bearing members (ii) Back (iii) Sides	3mm 2mm 2mm
4	Paint treatment	
5	Degree of Protection	IP54
6	Earthing arrangement	Perforated 25x6mm tinned copper bar
7	Overall dimensions of each type of panels	As per the table below.
8	Paint shade Interior Exterior Base Frame	White Shade RAL 7032 (Pebble Grey) Black
9	Aux DC Voltage	220V DC
10	Aux AC Voltage	230V Ac
11	Illumination	LED lamp
12	Panel wiring	1100 V grade Single core, standard copper conductor wires with PVC insulation conforming to IS 694 or equivalent International Standard.

System:	Dimension & number of Simplex Cubicle type for process bus equipment , Swing frame front access (VSG),
400kV Line.	2300mm (H) X 900mm (D) X 900mm (W), 2 Nos. per line
400kV ICT	2300mm (H) X 900mm (D) X 900mm (W), 1No. per ICT
400kV TIE	2300mm (H) X 900mm (D) X 900mm (W), 1 No. per Tie.
220kV Line	2300mm (H) X 900mm (D) X 900mm (W), 1 No. per line
220kV AT/Transf.	2300mm (H) X 900mm (D) X 900mm (W), 1 No. per Trfr.
220kV BC/TBC	2300mm (H) X 900mm (D) X 900mm (W), 1 Nos. per BC/TBC
132kV Line	2300mm (H) X 900mm (D) X 900mm (W), 1 No. per 2 line
132kV AT/Transf.	2300mm (H) X 900mm (D) X 900mm (W), 1 No. per 2 Trfr.
132kV BC/TBC	2300mm (H) X 900mm (D) X 900mm (W), 1 Nos. per 2 bays.
33kVLine/Trfr/BC	2300mm (H) X 900mm (D) X 900mm (W), 1 No. per 3 feeders.

ANNEXURE-9**FIBRE OPTIC CABLE**

Sl.	Item.	Specification
1	Cable Type	6F Multimode Cable 62.5/125 um
2	Armoured /Un-armoured	Armoured
3	Wavelength	850nm/1300nm
4	Attenuation	< 3.5 dB/km @850nm, <1.0 dB/km @1300nm
5	Band Width	>= 200 MHz/km @850nm, >=500 MHz/km @1300nm
6	No. of Fibers	6 (2 are used for ring formation and 4 are spare)
7	Color of Fiber	BLUE , WHITE, ORANGE, GREEN, BROWN & SLATE
8	Cladding Diameter	125um ± 2
9	Core Diameter	62.5 um ± 3
10	Numeric Aperture	0.275 ±0.015
11	Cable Diameter	>=8 mm ± 0.5

ETHERNET SWITCH

Sl.	Item.	Specification
1	Equipment	MANAGED SWITCH
2	Type	Modular Managed
3	Connector Type	MTRJ/ST/LC/RJ45
4	Network Speed	10/100 Mbps
	Auxiliary Voltage	88-300V DC / 85-264V AC
	Features	Compliant to IEEE1588 Graphic user interface, Secure Web management 802.1p QoS Prioritization Up to 4K VLans & 32K mac address IPv4 & IPv6 support for broadcast, multicast & unicast IGMP V2/V3 & MLD V1/V2 support SNMP V3 Virtual LAN capability
	Latency Time (Packet Switching time)	Performed entirely in hardware with Switching fabric > 48GBPS
	Packet Buffer Size	Upto 32 MB
	Forwarding Mode	Store and Forward
	Relative Humidity	10% to 95% (non-condensing)
	Protocol	Complies with IEC 61850 protocol
	Key features	High Immunity to EMI Compliance to International standards IEC61850-3, IEEE1613, IEC61000-4, IEC60255-5, IEC60068-2
	Shock	IEC60068-2-27
	Free fall	IEC60068-2-32
	Vibration	IEC60068-2-6

ANNEXURE-11**SERVER AND MONITOR**

Equipment	SERVER CUM HMI PCI
Power Supply	230 V AC / 220V DC, 300W
Single Board Computer	Intel Core 2 Duo Industrial Grade processor
Processor	Intel Xenon(R) @ 3.0 GHz or above
RAM	24 GB DDR3
HDD	500 GB SATA Drive or above, which includes 20GB for owners use.
CD Drive	DVD RW Support at least Read (48x), Write (24x) & Rewrite (10x) operations with multi-session capacity.
I/O	- VGA 1 - USB 6 - Audio 2 (LINE-Out and MIC-In) - Serial 2 (RS-232, 1 port and 1 onboard pin header) - Parallel 1 (SPP/EPP/ECP) - USB Keyboard and Mouse
Ethernet Port	- Dual Gigabit Ethernet Interface: 10/100/1000Base-T Connector: RJ-45 x 2
Operating Temp	0° to 55°C
Relative Humidity	10 to 85% non-condensing
Vibration	5 – 500 Hz
Acoustic noise	Less than 52 db sound pressure at 5 – 28 °C
Operating System	Windows 7 and above

Equipment	MONITOR
Type	TFT
Viewable Size	21”
Resolution	1280 x 1024 or better
Interface	Analogue/Digital
Input video signal	Analogue RGB, TMDS Digital Link
Input connectors	15 pin D-Sub/USB, DVI-D
Power Consumption	100W (max.),230V AC 50Hz
Stand Type	4-way adjustable (height, pivot, tilt, swivel)
Viewing Angle	160 vertical / 170 horizontal
Contrast Ratio	1000 to 1 (typical)
Operating Temperature	0° to 40 ° C
Operating Humidity Range	10 - 80% (non-condensing)
Antiglare	Yes
Antireflection	Yes

ANNEXURE-12

TIME SYNCHRONIZATION UNIT

Equipment	TIME SYNCHRONISATION UNIT
Operating Temperature	-40° to +85°C
Time sync protocols	PTP,SNTP,PPS
Relative Humidity	5% to 95% (non-condensing)
GPS RECEIVER	
SIZE	19" RACK MOUNT
Auxiliary Voltage	220V AC/DC
Display	16 column LCD display
Functions	Time reference : UTC or Local Position : Latitude & Longitude 0.1PPM (input) Deviation Clock & receiver status Network configuration
Status LED	Locked - ON (Time reference ok) / OFF (Time reference lost) Alarm - ON (Unit not operating) / OFF Unit in operation
Accuracy	100ns
Output ports	RJ45 - 2no. Serial port - 1no. IRIG-B port - 1no. PPS (FO) - 2nos. PPS (electrical) - 2nos.
GPS ANTENNA	
Antenna	Roof mounted
Antenna cable	RG-6 weather proof , low loss, 15m
Accessories	
	Rack mounting kit & Power Cord
	Operation Manual

ANNXURE-13**PRINTERS****1. DOT MATRIX PRINTER**

S.No .	Equipment	Specification
1	Print Head	24 pin
2	Print Modes	Draft and LQ
3	Print Width	136 Column
4	Print Method	Impact dot matrix
5	Paper Feed	Tractor (Push and Pull) Rear in, Top out
6	Paper Type	Cut sheet & Fan-Fold continuous stationary
7	Print Attributes	Bold, Italics, underline, wide-font, super and sub-scripting
8	Interface	10/100 Base TX External Print Server
9	Power supply	AC 90 to 270V, Approx. 30W

2. LASERJET PRINTER

S.No .	Equipment	Specification
1	Make	HP / CANON / EQUIVALENT
2	Type	A4 Colour LaserJet
3	Print Speed (Black	17 ppm or above
4	Print Speed (Colour)	17 ppm or above
5	Resolution	Up to 600 X 600 DOI or above
6	Interface	Hi-Speed USB 2.0 Port, Ethernet
7	Memory	64 MB or above
8	Standard Input Capacity	Up to 350 (Sheets) or above
9	Power supply	220V +/- 10V (50Hz AC supply)
10	Power Consumption	Active: 445W, Ready: 18W