Government of
Democratic Socialist Republic of Sri Lanka

Ministry of Power

CEYLON ELECTRICITY BOARD

Request for Proposals
Development of 100 MW_{AC} Solar PV Power Plant on Build, Own and Operate (BOO) Basis and Construction of 132 kV Transmission Facility on Turnkey Basis

REQUEST FOR PROPOSALS

(APPENDIX 1-B)

MANUFACTURERS, TECHNICAL PAPRTICULARS AND GUARANTEES (GRID SUBSTATION)

APPENDIX 1-B

MANUFACTURERS, TECHNICAL PARTICULARS AND GUARANTEES

(GRID SUBSTATION)

Contents

1. MANUFACTURERS, PLACES OF MANUFACTURE, TESTING, INSPECTION AND DESIGNING

1.1. MANUFACTURERS, PLACE OF MANUFACTUR AND TESTING

Item	Manufacturer	Place of Manufacture	Place of Testing & Inspection
HV SWITCHGEAR 145 kV			
Outdoor Switchgear			
Circuit Breakers			
Disconnectors			
Earthing Switches			
Current Transformers			
Capacitor Voltage Transformers			
Surge Arresters			
Neutral Current Transformers			
Post Insulators			
Insulator Strings			
Flexible Conductors			
Busbars (tubular)			
Connectors			
Steel Structures			
MV SWITCHGEAR 36 kV			
Outdoor Switchgear			
Steel structures			
Circuit Breakers			
Disconnectors			
Busbars (tubular)			
Flexible conductors			
Post Insulators			
Insulator Strings			
Connectors			
Surge arresters			

Item	Manufacturer	Place of Manufacture	Place of Testing & Inspection
Indoor GIS Switchgear			
Circuit Breakers			
Disconnectors			
Busbars			
Current Transformers			
Voltage Transformers			
Earthing Switches			
ANCILLARY EQUIPMENT			
Gas Handling Equipment			
Testing Equipment			
400V SWITCH BOARDS			
Panels			
Circuit Breakers			
CONTROL & PROTECTION, SUBSTATION AUTOMATION SYSTEM AND METERING			
Control and Protection System including Control & Protection Relays/IEDs and Panels			
Substation Automation System and Gateways including Panels			
Automatic Voltage Regulator System including Automatic Voltage Regulator IEDs and Panels			
Energy Metering System including Energy Meters and Panels Energy Metering System including Energy Meters and Panels			
Communication System including Panels			
DFR, PQ system and Panels			
Bay Marshalling KIOSKS			
Auxiliary Relays			
Terminal Bars			
MIMIC Switches			
MCB's			
Selector Switches			

Item	Manufacturer	Place of Manufacture	Place of Testing & Inspection
DC EQUIPMENT			
Batteries			
Chargers			
Distribution Boards			
110/48 V DC-DC Convertors			
Inverters			
CONTROL CABLES			
PVC insulated Cables			
Telecommunication Cables			
POWER CABLES & TERMINATION			
145 kV Cables			
36 kV Cables			
1 kV Cables			
Sealing Ends and Joints etc			
145 kV Cable Terminations			
36 kV Cable Terminations			
Cable trays			
EARTHING			
Copper Conductor			
Clamps			
Earthing rods			
SITE ERECTION			
To be carried out by:			
TRANSFORMERS			
Power Transformers 132/33 kV			
Transformers Complete			
Windings			
132 kV Terminal			
33 kV Terminal			

Item	Manufacturer	Place of Manufacture	Place of Testing & Inspection
Neutral Terminal			
Tap Changers			
Copper			
Core parts			
Tanks			
Radiators			
Fan motors			
Bushing Current Transformers (For Temperature Sensing)			
Temperature indicators			
Oil valves			
Pressure relief device			
Motor Control equipment			
Optical Fiber, Sensors and hotspot temperature monitoring device			
Alarm Devices			
Oil level indicators			
Gas and Oil actuated relays			
Insulators			
Transformer Oil			
AUXILIARY TRANSFORMER 33/0.4kV			
Transformer Complete			
HV Bushings			
LV Cable Box			
Insulators			
EARTHING TRANSFORMERS 800 A / 30 sec			
Transformer Complete			
HV Bushings			
Insulators			
Steel Structures			
Scada Equipment			

Item	Manufacturer	Place of Manufacture	Place of Testing & Inspection
Fibre Optic Equipment			
CCTV System			
SOLAR POWER SYSTEM			
PV Panels			
Solar Inverter			
Combine boxes			
Monitoring and data acquisition system			
Diesel Generator			
Cement			

2. TECHNICAL PARTICULARS AND GURANTEES

A - ELECTRICAL WORKS

2.1. 145 kV OUTDOOR SWITCHGEAR (110V DC VOLTAGE)

2.1.1. Circuit Breaker

No	Item	Units	Required	Tendered
			145 kV	145 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC62271-100	
5.	Manufacturer's type designation, and type ref or model number			
6.	Interrupting Medium		SF_6	
7.	Number of Phases	Nos.		
8.	Frequency	Hz		
9.	Rated Voltage	kV	145	
10.	Impulse withstand voltage on 1.2/50 Wave	kV	650	
11.	One minute Power frequency withstand voltage			
	Closed	kV	275	
	Open	kV	275	
12.	Rated normal current	A		
13.	Short- time withstand current switchgear – 1 Sec:	rms kA	31.5	
14.	Rated short-circuit breaking current.			
	Symmetrical	rms kA	31.5	
	DC component	%	More than 20%	
15.	Short-circuit making current	Peak kA	78.75	
16.	Rated transient recovery voltage at rated short circuit breaker current	V		
17.	Rated Operating duty cycle		O-0.3Sec- CO-3Min-CO	
18.	First phase to clear factor		1.5	
19.	Rated short circuit Breaking current			
	(a) kV (pk)			
	(b) RRRV			

No	Item	Units	Required	Tendered
			145 kV	145 kV
20.	Rated small inductive breaking current.	A		
21.	Rated line charging breaking current	A	50	
22.	Rated cable charging breaking current.	A	160	
23.	Rated out of phase breaking current	kA	7.875	
24.	Rated characteristic for short line fault as per IEC -60056	A		
25.	Maximum allowable switching over voltage	kV		
26.	Minimum time for arc extinction to contact remake when adapted for auto-reclosing (dead time)	ms	300	
27.	Time from closing of control switch for completion of closing stroke during fault making (make time)	ms		
28.	Type Testing Authority			
29.	Type Test Certificate Report Reference No.			
30.	Opening time			
	- Without current.	ms		
	- at 100% of rated breaking current	ms		
31.	Maximum arcing time of any duty cycle of (IEC 60056-2)	ms		
32.	Duty on which maximum arc duration occurs			
33.	Current at which maximum arc duration occurs	A		
34.	Make time	ms		
35.	Minimum time for arc extinction to contact remake when adopted for auto reclosing	ms		
36.	Time from closing of control switch to completion of closing stroke during fault making.	ms		
37.	Is an external series break incorporated in break?	Yes/No	No	
38.	Is a device used to limit transient recovery voltage?	Yes/No	No	
39.	Method of closing.			
40.	Method of tripping.			
41.	Rated voltage for spring winding motor for closing	V DC	110 or 220V as per the scope	

No	Item	Units	Required	Tendered
			145 kV	145 kV
42.	Closing release coil current	A		
43.	Closing release coil voltage	V DC	110 or 220V as per the scope	
44.	Trip coil current	A		
45.	Trip coil voltage	V DC	110 or 220V as per the scope	
46.	Is the circuit-breaker trip free?	Yes/No	Yes	
47.	Minimum clearances in air:			
	(a) between phases	mm		
	(b) phases to earth	mm		
	(c) across interrupters	mm		
	(d) live parts to ground level	mm		
48.	Material of tank interrupter chamber			
49.	Material of moving contact operating rod			
50.	Material of contact surfaces			
	(a) Main contact			
	(b) Arcing contact			
51.	Number of breaker per phase	Nos.	01	
52.	Length of each break	mm		
53.	Length of stroke	mm		
54.	Weight of circuit-breaker unit complete	kg		
55.	Maximum shock load imposed on floor of foundations when opening under fault conditions (state whether tension or compression)	kg		
56.	Quantity of gas in complete three-phase circuit breaker	Liters		
57.	Maximum pressure rise in circuit breakers due to the making or breaking of rated current.	Bar		
58.	Routine pressure test on circuit breaker tanks or containers	Bar		
59.	Pressure type test on Circuit Breaker tanks or containers	Bar		
60.	Interrupting Gas Pressure			
	(a) at (20^0C) normal	Bar		

No	Item	Units	Required	Tendered
			145 kV	145 kV
	(b) at (30^0C) normal	Bar		
61.	(a) Limits of gas pressure at 20^0 C			
	Maximum	Bar		
	Minimum	Bar		
	(b) Limits of gas pressure at 30^0 C			
	Maximum	Bar		
	Minimum	Bar		
62.	Period of time equipment has been in commercial operation	Years		
63.	Number of operations before interrupter maintenance required.			
	(a) At rated short circuit current	Nos	10	
	(b) At full load current	Nos	5000	
64.	Mechanical Endurance Class		Class M2	
	Type Tests *Document reference number and Type tested model shall be written in tendered column.*	Included in the Bid (Yes or No)		
65.	Dielectric tests	Yes/No		
66.	Measurement of the resistance of the main circuit	Yes/No		
67.	Temperature-rise tests	Yes/No		
68.	Short-time withstand current and peak withstand current tests	Yes/No		
69.	Additional tests on auxiliary and control circuits	Yes/No		
70.	Mechanical operation test at ambient temperature	Yes/No		
71.	Short-circuit current making and breaking tests	Yes/No		

2.1.2. Current Transformers

No	Item	Units	Required	Tendered
			145 kV	145 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		61869-1&2	
5.	Manufacturer's type designation, and type ref or model number			
6.	Number of phases		Single	
7.	Installed location		Outdoor	
8.	Highest system voltage	kV	145	
9.	Rated frequency	Hz	50	
10.	Rated current ratio.	A		
11.	Rated Primary Current	A		
12.	Rated Secondary Current	A		
13.	Number of cores			
14.	Accuracy			
	(i) For revenue metering		As per the scope	
	(ii) For Protection		As per the scope	
15.	Rated burden	VA		
16.	Continuous Current Rating Factor		1.2	
17.	Rated short Circuit current 1 sec	rms kA	31.5	
18.	Rated short time thermal current (as per breaker)	kA Sec		
19.	Rated insulation level			
	(i) AC withstand voltage 1 min.dry			
	Primary	kV	275	
	Secondary			
	(ii) Impulse withstand voltage full wave	kV	650	
20.	Knee point voltage	V		
21.	DC Resistance			

No	Item	Units	Required	Tendered
			145 kV	145 kV
22.	Dimensions			
	(i) Overall height			
	(ii) Total length			
	(iii) Total weight per phase			
23.	Rated Dynamic peak current.	A		
24.	Creepage distance of the insulators	mm		
	Type Tests *Document reference number and Type tested model shall be written in tendered column.*	Included in the Bid (Yes or No)		
25.	Temperature-rise test	Yes		
26.	Impulse voltage tests on primary terminals	Yes		
27.	Electromagnetic Compatibility tests	Yes		
28.	Electromagnetic Compatibility tests	Yes		
29.	Verification of the degree of protection by enclosures	Yes		
30.	Enclosure tightness test at ambient temperature	Yes		

2.1.3. Voltage Transformers

No	Item	Units	Required	Tendered
			145 kV	145 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		61869-1&5	
5.	Manufacturer's type designation, and type ref or model number			
6.	Type		Capacitor	
7.	Rated burden per phase	VA		
8.	Rated insulation level			
	(i) AC withstand voltage 1 min, dry	kV	275	
	(ii) Impulse withstand voltage full wave	kV	650	
9.	Maximum ratio error as per IEC 60186 Clause 25.	%	+/- 1	
10.	Maximum phase angle error as per IEC 60186 Clause 25.	%	40Min/1.2 centiradians	
11.	Total weight of unit complete	kg		
12.	Nominal Voltage Ratio			
13.	Accuracy class		As per the scope	
14.	Rated accuracy limit factor			
15.	Dimensions (height, width length)			

2.1.4. Insulator Strings

No	Item	Units	Required	Tendered
			145 kV	145 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC			
5.	Manufacturer's type designation, and type ref or model number			
6.	Insulator material Glass or Porcelain			
7.	Number of units per string:			
8.	Outside diameters of units	mm		
9.	Distance of centres of units	mm		
10.	Length of string overall	mm		
11.	Maximum working load	kN		
12.	Minimum failing load per unit	kN		
13.	Mechanical routine load test	kN		
14.	Electro-mechanical failing load	kN		
15.	Mechanical failing load	kN		
16.	Electrostatic capacity of unit	pF		
17.	Weight of complete string	kg		
18.	50 Hz 1 minute withstand voltage of unit, dry	kV	275	
19.	50 Hz 1 minute withstand voltage of unit, wet	kV		
20.	Minimum 50 Hz puncture voltage	kV		
21.	Dry lightning impulse withstand voltage of string2/50 micro second wave	kV	650	
22.	Switching impulse withstand voltage, wet	kV		
23.	Minimum total creepage distance per unit			
	(i) Specified Polluted	mm		
	(ii) Guaranteed Polluted	mm		
24.	Protected creepage distance per string	mm	3625	
		mm/kV	25	

2.1.5. Disconnectors and Earthing Switches

No	Item	Units	Required	Tendered
			145 kV	145 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		62271-102	
5.	Manufacturer's type designation, and type ref or model number			
6.	Rated frequency	Hz	50	
7.	Rated voltage	kV	145	
8.	No. of poles per unit		3	
9.	Dimension and weight			
	(i) Overall height	mm		
	(ii) Total length	mm		
	(iii) Total width	mm		
	(iv) Total weight	kg		
10.	Type of contacts			
11.	Material of contact surface		Silver coated	
12.	Rated normal current	A	See Scope of works & Drawing	
13.	Maximum short time withstand current (1 sec)	rms kA	31.5	
14.	Air gap between poles of one phase	mm		
15.	Type of operating mechanism			
	- Disconnector		Motor	
	- Earthing Switch		Motor	
16.	Manual Operating facility	Yes/No	Yes	
17.	Motor Voltage	V DC	110 or 220V as per the scope	
18.	Total weight of three-phase Isolator complete	kg		
19.	Charging current breaking capacity	A		
20.	Magnetizing current breaking capacity	A		
21.	Power consumption of the motor.	kW		

No	Item	Units	Required	Tendered
			145 kV	145 kV
22.	Operating time			
23.	Lighting impulse withstand voltage			
	(i) to earth	kV	650	
	(ii) across isolating distance	kV	750	
24.	Rated one minute Power frequency withstand voltage			
	(i) to earth	kV	275	
	(ii) across isolating distance	kV	315	
	Type Tests *Document reference number and Type tested model shall be written in tendered column.*	Included in the Bid (Yes or No)		
22.	Test to prove satisfactory operation and mechanical endurance test			
23.	Test to prove the short-circuit making performance of earthing switches			
24.	Test to prove satisfactory operation at temperature limits			
25.	Test to prove the proper function of position indicating devices			
26.	Test to prove the bus-transfer current switching capability of disconnectors			
27.	Tests to prove the induced current-switching capability of earthing switches			
28.	Tests to prove the bus-charging current switching ability of disconnectors used in metal enclosed switchgear			

2.1.6. Busbars and Connections

No	Item	Units	Required	Tendered
			145 kV	145 kV
	BUSBARS			
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC			
5.	Manufacturer's type designation, and type ref or model number			
6.	Material	Al Tubes	Al Tubes	
7.	Overall diameter			
8.	Nominal section	mm		
9.	Cross section and make-up	mm^2		
10.	Maximum rated current	A		
11.	Maximum working tension of main connections	kN/m^2		
12.	Resistance of conductors per 100m at 30^0C	ohms		
13.	Tensile breaking stress of material	kN/m^2		
14.	Maximum permissible span length	m		
15.	Maximum sag under own weight of maximum span	mm		

No	Item	Units	Required	Tendered
			145 kV	145 kV
	CIRCUIT CONNECTIONS			
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Material			
4.	Overall diameter	mm		
5.	Nominal section	mm^2		
6.	Cross section and make-up			
7.	Maximum rated current	A		
8.	Maximum working tension of main connections	kN/m^2		
9.	Resistance of conductors per 100 m at 30^0C	ohms		
10.	Tensile breaking stress of material	kN/m^2		
11.	Maximum permissible span length	m		
12.	Maximum sag under own weight of maximum span	mm		

2.1.7. Post and Disconnector Insulators

No	Item	Units	Required	Tendered
			145 kV	145 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC 60168	
5.	Manufacturer's type designation, and type ref or model number			
6.	Insulator material		Porcelain	
7.	Insulator type			
8.	Maximum working vertical load:			
	Tension	kN		
	Compression	kN		
9.	Minimum failing load (tension)	kN		
10.	Maximum horizontal working load	kN		
11.	Minimum failing load(torsion)	Nm		
12.	Minimum failing load(bending)	kN		
13.	Shed profile (to be enclosed with Tender)	Drg. No		
14.	Greatest diameter	mm		
15.	Number of units in one insulator			
16.	Length overall per complete post	mm		
17.	Weight of complete post	kg		
18.	Electrostatic capacity	pF		
19.	50Hz 1 minute withstand voltage, dry	kV		
20.	50Hz 1 minute withstand voltage, wet	kV	275	
21.	Dry lightning impulse withstand			
22.	Voltage, 2/50 micro sec. wave	kV	650	
23.	Minimum creepage distance			
	(i) Specified Polluted	mm	3625	
	(ii) Guaranteed Polluted	mm		
24.	Protected creepage distance polluted	mm		

2.1.8. Surge Arresters

No	Item	Units	Required	Tendered
			145 kV	145 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC 60099	
5.	Manufacturer's type designation, and type ref or model number			
6.	System highest voltage	kV	145	
7.	Protective levels to be less than or equal to:-			
	Transformer	kV	440	
8.	Class of diverter to IEC.60099 :1991 (BS EN 60099-1:1994)			
	-Duty		Heavy	
	-Long duration discharge class		Class 2	
	-Pressure relief class		A	
9.	Rated voltage	rms kV	120	
10.	Rated normal discharge current	kA	10	
11.	50 Hz spark over voltage	Min. rms kV		
12.	100% impulse spark over on 2/50 micro sec. wave	Max. peak kV		
13.	Switching surge spark over.	Max. peak kV		
14.	Discharge residual voltage based on 10/20 wave at			
	5 kA peak	kV		
	10 kA peak	kV		
	20 kA peak	kV		
15.	Current at which resistor elements are stabilized in manufacture	kA		
16.	Current discharge capacity:			
	5/10 micro sec. Wave Peak	kA		
	2,000 micro sec, Peak	kA		
	Rectangular wave Peak	kA		

No	Item	Units	Required	Tendered
			145 kV	145 kV
17.	Minimum reseal voltage	rms kV		
18.	Total height of diverter	mm		
19.	Total weight of diverter	kg		
20.	Type reference of surge counter			
21.	Minimum creepage distance per unit			
	(i) Specified polluted	mm	3625	
	(ii) Guaranteed Polluted	mm		
	NB: Evidence of substantial service experience is to be submitted.			

2.1.9. Switchgear Insulators

No	Item	Units	Required	Tendered
			145 kV	145 kV
	Including hollow and post insulators for minimum oil or gas circuit breakers, hollow insulators for current transformers, capacitor type voltage transformers and coupling capacitors.			
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC			
5.	Manufacturer's type designation, and type ref or model number			
6.	Rated service voltage	kV	145	
7.	Principal insulating material		Porcelain	
8.	Length of insulator overall	mm		
9.	Shed profile (to be enclosed with Tender)	Drg. No.		
10.	Weight of insulator complete with fittings	kg		
11.	Electrostatic capacity complete insulator	pF		
12.	Material of fittings			
13.	Total creepage distance over porcelain of complete post (based on highest system voltage)	mm/kV	25	
14.	Protected creepage distance	mm		
15.	Voltage below which no corona shall be visible	kV		
16.	Dry lightning impulse withstand (1.2/50 microsecond wave)	kV	650	
17.	Switching impulse withstand voltage	kV		

2.1.10. Neutral Current Transformers

No	Item	Units	Required	Tendered
			145 kV	145 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC			
5.	Manufacturer's type designation, and type ref or model number			
6.	Rated voltage	kV	42	
7.	50 Hz 1 minute withstand voltage, wet	kV	275	
8.	Type of construction (post, ring, etc.)			
9.	Material of primary insulation			

2.2. 36 kV outdoor switchgear

2.2.1. Disconnector

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC 62271-102	
5.	Manufacturer's type designation, and type ref or model number			
6.	Rated frequency	Hz	50	
7.	Rated voltage	kV	36	
8.	No. of poles per unit		3	
9.	Dimension and weight			
	(i) Overall height	mm		
	(ii) Total length	mm		
	(iii) Total width	mm		
	(iv) Total weight	kg		
10.	Type of contacts			
11.	Material of contact surface		Silver coated	
12.	Rated normal current	A	See Scope of works & Drawing	
13.	Maximum short time withstand current (1 sec)	rms kA	25	
14.	Air gap between poles of one phase	mm		
15.	Type of operating mechanism			
	- Disconnector		Motor	
16.	Manual Operating facility	Yes/No	yes	
17.	Total weight of three-phase Isolator complete	kg		
18.	Charging current breaking capacity	A		
19.	Magnetizing current breaking capacity	A		
20.	Operating time			

No	Item	Units	Required	Tendered
			36 kV	36 kV
21.	Lighting impulse withstand voltage			
	(i) to earth	kV	170	
	(ii) across isolating distance	kV	195	
22.	Rated one minute Power frequency withstand voltage			
	(i) to earth	kV	70	
	(ii) across isolating distance	kV	80	
	Type Tests *Document reference number and Type tested model shall be written in tendered column.*	*Included in the Bid (Yes or No)*		
23.	Test to prove satisfactory operation and mechanical endurance test			
24.	Test to prove the short-circuit making performance of earthing switches			
25.	Test to prove satisfactory operation at temperature limits			
26.	Test to prove the proper function of position indicating devices			
27.	Test to prove the bus-transfer current switching capability of disconnectors			
28.	Tests to prove the induced current-switching capability of earthing switches			
29.	Tests to prove the bus-charging current switching ability of disconnectors used in metal enclosed switchgear			

2.2.2. Insulator Strings

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC			
5.	Manufacturer's type designation, and type ref or model number			
6.	Insulator material Glass or Porcelain			
7.	Number of units per string:			
8.	Outside diameters of units	mm		
9.	Distance of centres of units	mm		
10.	Length of string overall	mm		
11.	Maximum working load	kN		
12.	Minimum failing load per unit	kN		
13.	Mechanical routine load test	kN		
14.	Electro-mechanical failing load	kN		
15.	Mechanical failing load	kN		
16.	Electrostatic capacity of unit	pF		
17.	Weight of complete string	kg		
18.	50 Hz 1 minute withstand voltage of unit , dry	kV	70	
19.	50 Hz 1 minute withstand voltage of unit , wet	kV		
20.	Minimum 50 Hz puncture voltage	kV		
21.	Dry lightning impulse withstand voltage of string2/50 micro second wave	kV	170	
22.	Switching impulse withstand voltage, wet	kV		
23.	Minimum total creepage distance per unit			
	(i) Specified Polluted	mm		
	(ii) Guaranteed Polluted	mm		

No	Item	Units	Required	Tendered
			36 kV	36 kV
24.	Protected creepage distance per string	mm	900	
		mm/kV	25	

2.2.3. Post and Disconnector Insulators

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC 60168	
5.	Manufacturer's type designation, and type ref or model number			
6.	Insulator material		Porcelain	
7.	Insulator type			
8.	Maximum working vertical load:			
	Tension	kN		
	Compression	kN		
9.	Minimum failing load (tension)	kN		
10.	Maximum horizontal working load	kN		
11.	Minimum failing load(torsion)	Nm		
12.	Minimum failing load(bending)	kN		
13.	Shed profile (to be enclosed with Tender)	Drg. No		
14.	Greatest diameter	mm		
15.	Number of units in one insulator			
16.	Length overall per complete post	mm		
17.	Weight of complete post	kg		
18.	Electrostatic capacity	pF		
19.	50Hz 1 minute withstand voltage, dry	kV		
20.	50Hz 1 minute withstand voltage, wet	kV	70	
21.	Dry lightning impulse withstand			
22.	Voltage, 2/50 micro sec. wave	kV	170	
23.	Minimum creepage distance			
	(i) Specified Polluted	mm	900	
	(ii) Guaranteed Polluted	mm		

No	Item	Units	Required	Tendered
			36 kV	36 kV
24.	Protected creepage distance polluted	mm		

2.2.4. Surge Arrester

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC 60099	
5.	Manufacturer's type designation, and type ref or model number			
6.	System highest voltage	kV	36	
7.	Protective levels to be less than or equal to:			
	Transformer	kV	136	
8.	Class of diverter to IEC.60099 :1991 (BS EN 60099-1:1994)			
	-Duty		Heavy	
	-Long duration discharge class		Class 2	
	-Pressure relief class		A	
9.	Rated voltage	rms kV	36	
10.	Rated normal discharge current	kA	10	
11.	50 Hz spark over voltage	Min. rms kV		
12.	100% impulse spark over on 2/50 micro sec. wave	Max. peak kV		
13.	Switching surge spark over.	Max. peak kV		
14.	Discharge residual voltage based on 10/20 wave at			
	5 kA peak	kV		
	10 kA peak	kV		
	20 kA peak	kV		
15.	Current at which resistor elements are stabilized in manufacture	kA		
16.	Current discharge capacity:			
	5/10 micro sec. Wave Peak	kA		
	2,000 micro sec, Peak	kA		
	Rectangular wave Peak	kA		

No	Item	Units	Required	Tendered
			36 kV	36 kV
17.	Minimum reseal voltage	rms kV		
18.	Total height of diverter	mm		
19.	Total weight of diverter	kg		
20.	Type reference of surge counter			
21.	Minimum creepage distance per unit			
	(i) Specified polluted	mm	900	
	(ii) Guaranteed Polluted	mm		
	NB: Evidence of substantial service experience is to be submitted.			

2.2.5. Neutral Current Transformers

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC			
5.	Manufacturer's type designation, and type ref or model number			
6.	Rated voltage	kV	36	
7.	50 Hz 1 minute withstand voltage, wet	kV	70	
8.	Type of construction (post, ring , etc.)			
9.	Material of primary insulation			

2.2.6. Busbars

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's name			
2.	Country of manufacture			
3.	Rated normal current	A		
4.	Rated current at max. ambient temperature	A		
5.	Conductor material			
6.	Standard applicable			
7.	Single conductor cross section	mm²		

2.3. 36 kV INDOOR SWITCHGEAR & ASSOCIATED EQUIPMENT

2.3.1. Medium Voltage Gas Insulated Switchgear

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC			
5.	Manufacturer's type designation, and type ref or model number			
6.	Rated voltage	kV	36	
7.	Rated frequency	Hz	50	
8.	Maximum continuous system voltage at minimum gas pressure	kV	36	
9.	Impulse withstand voltage (peak) at minimum gas pressure	kV	170	
10.	Power frequency withstand voltage 1 min. at minimum gas pressure	kV	70	
11.	Power frequency withstand voltage 1 min at atmospheric pressure	kV		
12.	Rated short time withstand current	kA	25	
13.	Rated duration of short time withstand current	s	1	
14.	Rated peak short circuit current	kA		
15.	Heaviest part of any feeder for crane	kg		
16.	Feeder Width	mm		
	Depth	mm		
	Height	mm		
17.	Current SF6 gas replenishing	Yes/No	No	
18.	Material of filter employed for moisture absorption			
19.	Heat losses per feeder at rated Power	kW		

2.3.2. Busbars

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Rated normal current	A		
4.	Rated current at max. ambient temperature	A		
5.	Conductor material			
6.	Standard applicable			
7.	Single conductor cross section	mm²		

2.3.3. Circuit Breaker

No	Item	Units	Required	Tendered
			36 kV	36 kV
	(These sheets to be copied and filled in for each different type of CBs)			
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Manufacturer's Type Designation and Model No.			
4.	Applicable Standard			
5.	Type tested	Yes/No	Yes	
6.	Type test report, Ref. No.			
7.	Rated normal current at 20deg. C			
	- line feeder circuit breaker	A	As per the scope	
	- transformer feeder circuit breaker	A	As per the scope	
	- bus coupler circuit breaker	A	As per the scope	
8.	Rated current at max. ambient temperature	A		
	- line feeder circuit breaker	A		
	- transformer feeder circuit breaker	A		
	- bus coupler circuit breaker	A		
	- BSC feeder circuit breaker	A		
9.	Rated short circuit breaking current (symmetrical, r.m.s.)	kA		
10.	Rated short circuit breaking current (asymmetrical, r.m.s.)	kA		
11.	Rated short circuit making current (peak)	kA		
12.	Rated cable charging breaking current	A		
13.	Rated line charging breaking current	A		
14.	Rated small inductive breaking current	A		
15.	Voltage drop across terminals of one pole at rated current	mV		
16.	Amplitude factor			

No	Item	Units	Required	Tendered
			36 kV	36 kV
17.	First pole-to-clear factor		1.5	
18.	Rated operating sequence:		O-t-CO-t'-CO	
	- with t	sec.	0.3	
	- with t'	min.	3	
19.	Min. time t" between two successful three phase auto reclosures at full rated breaking current (sequence O-t-C-t"-O-t-C)	min.		
20.	Closing time	ms		
	- tolerances	ms		
21.	Dead time (max.)	ms		
	- tolerances	ms		
22.	Break time (max.) at full rated breaking current	ms		
	- tolerances	ms		
23.	Make time (max.)	ms		
	- tolerances	ms		
24.	Arcing time (max.) at full short circuit duty	ms		
	- tolerances	ms		
25.	Life duration of main contacts (no load mechanical operations)	operations		
26.	Number of switching operations at rated breaking capacity before contact maintenance becomes necessary	No.	min. 100	
27.	Rated pressure of SF6 for arc quenching	bar		
28.	Auxiliary contacts:			
	- number (NO/NC)			
	- voltage rating	V DC	110	
	- current rating	A DC		
29.	SF6 pressure at which lockout operates	bar		
30.	To be filled in only in case of hydraulic operating mechanism:			

No	Item	Units	Required	Tendered
			36 kV	36 kV
	- Setting of pressure relief device	bar		
	- Rated pressure of hydraulic oil	bar		
	- Lowest oil pressure at which lockout	bar		
31.	Making coil			
	- Rated voltage	V DC	110	
	- min. operating voltage	V	88	
	- Rated power each	W		
32.	Trip coil			
	- Rated voltage	V DC	110	
	- min. operating voltage	V	55	
	- Rated power each	W		
33.	Motor voltage	V DC	110	
34.	Motor power	W		
35.	Total loss of heaters for 3 poles	W		
36.	Max. temperature rise of contacts at rated normal Current	K		
37.	Arc quenching medium		SF_6/VACUUM	
38.	Material of main contacts			
39.	Number of breaks in series (per pole)	No.		
	- for closing			
	- for opening			
40.	Single pole operation (only in Line Feeder Breakers)	Yes/No	No	
41.	Making coil:			
	- number	pcs		
42.	Trip coil:			
	- number	pcs	2	
43.	Gas quantity of complete breaker (3 Phase)	kg		
44.	Material of filter employed for the absorption of the products of combustion			

No	Item	Units	Required	Tendered
			36 kV	36 kV
45.	Method of controlling voltage distribution between breaks (capacitor, resistor etc.)			
46.	Weight of complete 3 pole breaker	kg		
47.	Weight of heaviest part for shipment	kg		

2.3.4. Disconnecting Switch

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Model No.			
2.	Type tested	Yes/No	Yes	
3.	Type test report, Ref. No.			
4.	Standards to which disconnector conforms		IEC 62271-200	
5.	Power frequency withstand voltage across isolating distance	kV	80	
6.	Lightning impulse withstand voltage across isolating distance	kV	195	
7.	Rated normal current at 20 ^{0}C			
	- feeder disconnecting switch	A	1250	
	- bus coupler disconnecting switch	A	As per scope	
	- BSC feeder disconnecting switch	A	1250	
	- transformer feeder disconnecting switch	A	As per scope	
8.	Rated current at max. ambient temperature:			
	- line feeder disconnecting switch	A		
	- bus coupler disconnecting switch	A		
	- BSC feeder disconnecting switch	A		
	- transformer feeder disconnecting switch	A		
9.	Voltage drop across terminals of one pole at rated current	mV		
10.	Rated breaking current (capacitive)	A		
11.	Rated momentary current (peak)	kA		
12.	Life duration of main contacts	operations		
13.	Material of main contacts			
14.	Auxiliary contacts:			
	- number (NO/NC)	pcs/pcs		
	- voltage rating	V DC	110	
	- current rating	A DC		
15.	Operating mechanism:			

No	Item	Units	Required	Tendered
			36 kV	36 kV
	- for closing		electric motor	
	- for opening		electric motor	
16.	Manual operating facility	Yes/No	Yes	
17.	Motor voltage	V DC	110	
18.	Motor power	W		
19.	Hand operating facilities	Yes/No		
20.	Weight			
	- 3 phase unit with driving mechanism	kg		
21	Mechanism heater loss	W		

2.3.5. Maintenance Earthing Switch

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Type tested	Yes/No	Yes	
2.	Type test report, Ref. No.			
3.	Standards to which earthing switch conforms			
4.	Life duration of main contacts	operations		
5.	Material of main contacts			
6.	Auxiliary contacts:			
	- number (NO/NC)	pcs/pcs		
	- voltage	V DC	110	
7.	Operating mechanism:			
	- for opening		Electric motor	
	- for closing		Electric motor	
8.	Motor voltage	V DC	110	
9.	Motor power	W		
10.	Hand operating facilities	Yes/No	Yes	

2.3.6. Current Transformer

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Type			
4.	Standards to which CT conforms	IEC	61869-1&2	
5.	Rated secondary current	A	1	
6.	Rated primary current and number of cores	A	See Scope of Works and drawings	
7.	Rated momentary current (peak)	kA		
8.	Rated short-time current	kA		
9.	Measuring cores:			
	- Accuracy class		0.2	
	- Burden			
	- Resistance of secondary winding at 75 ^{0}C	Ohms		
	- Instrument security factor			
10.	Protection cores:			
	- accuracy class protection cores min. (higher class to be used wherever necessitated due to protection requirements)		5P	
	- Resistance of secondary winding protection cores at 75 0C	Ohms		
	- Resistance of secondary winding busbar protection cores at 75 0C	Ohms		
11.	Number of cores	Nos.	See Scope of Works and drawings	
12.	Knee point e.m.f. of protection cores	V		
13.	Knee point e.m.f. of busbar protection cores	V		
14.	Insulation material for windings			
15.	Limits on exciting current	A		
16.	Partial discharge			

2.3.7. Voltage Transformer

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Type			
4.	Standards	IEC	IEC 61869-1&3	
5.	Method of transformation (inductive or capacitive)		inductive	
6.	Nominal primary voltage	kV	33/√3	
7.	Number of secondaries and accuracy class		See Scope of Works & Drawings	
8.	Thermal capacity of ground-fault detection winding	A/h		
9.	Rated burden (total on all secondaries)	VA		
10.	Partial discharge		acc.IEC 60044-4	
11.	Height	mm		
12.	Weight of single pole unit	kg		

2.3.8. Local Control Unit

No	Item	Units	Required	Tendered
			36 kV	36 kV
1.	Type			
2.	Manufacturer			
3.	Country of manufacture			
4.	Standards			
5.	Material			
6.	Thickness	mm		
7.	Surface finish			
8.	Dimensions: -			
	length	mm		
	width	mm		
	height	mm		
9.	Total net mass	kg		

2.4. LVAC EQUIPMENT

No	Item	Units	Required	Tendered
			400/230 V	400/230 V
(a)	DISTRIBUTION BOARD			
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Manufacturer's type designation and type ref number or Model number			
4.	Rating	A	1000	
5.	Fault Rating	kA	16	
6.	Voltage	V	400/230	
(b)	MCCB			
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Manufacturer's type designation and type ref number or Model number			
4.	Type			
5.	Rating	A		
6.	Fault Rating	kA	16	
(c)	ACB			
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Manufacturer's type designation and type ref number or Model number			
4.	Type			
5.	Rating	A		
6.	Fault Rating	kA	16	

2.5. BATTERIES AND CHARGERS

2.5.1. 110V DC

No	Item	Units	Required	Tendered
			110 V	110 V
(a)	**Battery**			
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		60623	
5.	Type		Ni-Cd	
6.	Manufacturer's type designation, and type ref or model number			
7.	Voltage	V DC	110	
8.	Capacity at 6 hour rate	Ah		
9.	Number of cells			
10.	Voltage per cell	V		
11.	Battery voltage at end of the duty cycle	V		
12.	Normal charging rate	A		
13.	Maximum charging rate	A		
14.	Ampere-hour efficiency at ten hour rate	%		
15.	Ampere-hour efficiency at one hour rate	%		
16.	Dimensions of cells	mm		
17.	Dimensions of battery complete	mm		
18.	Weight of cell complete with electrolyte	kg		
19.	Total weight of battery complete	kg		
20.	Internal resistance per cell when fully charged	ohms		
21.	Material of battery case			
(b)	**Battery Charger**			
1.	Manufacturer's name			
2.	Manufacturer's address			
3.	Place of Testing			

No	Item	Units	Required	Tendered
			110 V	110 V
4.	Manufacturer's type designation and type ref number			
5.	Applied standard			
6.	Number of phases	Three	3	
7.	Type of charger control	Micro processor		
8.	AC Input Nominal Voltage	V	400	
9.	AC Input Voltage range	%		
10.	Operating frequency	Hz		
11.	AC input to charger at full load	kVA		
12.	AC input current	A		
13.	DC Nominal Voltage	V	110	
14.	DC output of the charger	kW		
15.	Constant voltage			
	(i) Floating charge	V		
	(ii) Equalizing charge	V		
16.	Maximum output voltage			
	(i) at automatic control	V		
	(ii) at Boost charge	V		
17.	Regulation	%		
18.	Range of DC voltage control			
19.	Output voltage ripple	%	4	
20.	Protection class		IP 51	
21.	Operating ambient temperature	deg.	40^0C	
22.	Dimension			
	(i) Height	mm		
	(ii) Width	mm		
	(iii) Depth	mm		
23.	Normal and Boost charge are Independent Units	Yes/No		
24.	Test report reference No:			

No	Item	Units	Required	Tendered
			110 V	110 V
(c)	**D.C. Switchboards**			
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Place of Testing			
4.	Type of construction			
5.	Manufacturer's type designation and type ref number			
6.	Busbars:			
	(i) Maximum current rating	A		
	(ii) Dimensions	mm		
7.	Boost charge contactors:			
	(i) Manufacturer			
	(ii) Maximum current rating	A		
	(iii) Coil rating	W		
	(iv) Method of interlocking			
8.	Alarm relays:			
	(i) Manufacturer			
	(ii) Type and reference			
	(iii) Power consumption:			
	a) Quiescent	A		
	b) Operated	mA		
9.	Number and rating of distribution circuits			
10.	Overall dimensions	mm		
11.	Total weight	kg		

2.6. DC-DC CONVERTER

No	Item	Units	Required	Tendered
1	Make			
2	Model			
3	Name & Address of Manufacturer			
4	Output voltage of individual convertors	V	48 V +/- 5%	
5	Output current rating of individual convertors			
6	No. of convertors		≥ 2	
7	Is the load current shared equally among all convertors?		Yes	
8	Manufacturer recommended input breaker current rating for DC-DC convertor(s)			
9	Overall efficiency of the convertor(s) %		>88%	
10	Final output voltage of the power supply system	V	48 V +/- 5%	
11	Is output and input of the power supply system galvanically isolated?		Yes	
12	Maximum output voltage ripple	mV	100mV p-p (20MHz Bandwidth)	
13	Output overvoltage detection threshold	V	52	
14	Output overvoltage cut-off threshold	V	56	
15	Output undervoltage detection threshold	V	42	
16	Output undervoltage cut-off threshold	V	35	
17	Nominal input voltage (110V DC or 220V DC) (This shall be same as station DC supply voltage)	V	110V or 220V DC as per Scope of Works	
18	Input overvoltage detection threshold	V	118V	
19	Input overvoltage cut-off threshold	V	125V	
20	Input undervoltage detection threshold	V	105	
21	Input undervoltage cut-off threshold (if any)	V	90	

No	Item	Units	Required	Tendered
22	Current rating of individual DC- DC convertors (without derating due to ambient temperature)			
23	Total current rating of the power supply system (without derating due to ambient temperature)	A	≥25	
24	Total current rating of the power supply system at a failure of one DC-DC convertor (without derating due to ambient temperature)			
25	48V DC supply output voltmeter		Yes	
26	48V DC supply output ammeter		Yes	
27	Operating temperature range		0°C to 55°C	
28	Storage temperature range		-20°C to 85°C	
29	Operating humidity range		5% to 95%	
30	Storage humidity range		5% to 95%	
31	Operation and maintenance manual in English language		Yes	
32	A complete set of manufacturer recommended spares		Yes	
33	Availability of spares for next five years (please provide details)		5 years or more	
34	Warranty		2 years or more	

2.7. Control/ Protection IEDs, Annunciator, TCS relays, Lockout relays

2.7.1. 132kV line/Cable protection IED Main 1/ Main 2

No	Item	Description	Required	Tendered
1.	Basic Information	Relay type		
		Model no.		
2.	Dimensions	Width		
		Height		
		Depth		
3.	Current Inputs	**Current Transformer**		
		secondary current (In)	1A	
		No. of Inputs	4	
		Thermal rating of current circuits		
		Continuous	4 x In	
		For 10s	30 x In	
		For 1s	100 x In	
		Burden	≤0.1VA	
		Rated Frequency	50Hz	
		Operating range	47Hz-53Hz	
4.	Voltage Inputs	Voltage transformer secondary		
		Voltage (Phase-Phase) (Un)	110V	
		Operating Range	0-300V	
		No. of Inputs	5	
		Thermal rating of voltage		
		circuit (10s)	450V	
		Burden	≤ 0.1VA at 110V	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
5.	Station DC voltage	Station DC voltage Vdc=110V or ~~220V~~	Vdc +10% to -15%	
		DC auxiliary Operating Voltage Range		

No	Item	Description	Required	Tendered
		for 110V dc system	88Vdc – 132Vdc	
		~~for 220V dc system~~	~~176Vdc-264Vdc~~	
		Maximum Relay Burden	50VA	
6.	Binary Outputs	No. of Output Contacts	≥ 31	
		Voltage Vdc = ~~220V~~ or 110V	Vdc ± 15%	
		Breaking Capacity with L/R=40ms		
		For nominal dc voltage 110V Systems	0.3A at 125V DC	
		~~For nominal dc voltage 220V Systems~~	~~0.2A at 250V DC~~	
		Carry Continuous	6A	
		Make and Carry for 0.2s	30A	
7.	Binary Inputs	No. of Binary Inputs	≥ 53	
		Nominal Voltage Rating for 110V DC supply	110V DC	
		Pickup Threshold for 110V DC supply	88V DC	
		Drop off Threshold for 110V DC supply	66V DC	
		~~Nominal Voltage Rating for 220V DC supply~~	~~220V DC~~	
		~~Pickup Threshold for 220V DC supply~~	~~176V DC~~	
		~~Drop off Threshold for 220V DC supply~~	~~132V DC~~	
8.	LED	LED indications	≥ 15	
9.	Spares	Spare parts guarantee	10 years	
10.	Warranty	Warranty period and Warranty certificate	At least 10 years from the date of Commissioning	
11.	Origin	Country of Origin		
12.	Manufacture	Country of Manufacture		
13.	Design	Design Features	As Specified in chapter 5 of volume 5	

No	Item	Description	Required	Tendered
14.	Communication	Standard for communication with Remote equipment	Direct Fibre 1550nm single mode, IEEEC37.94 850nm multimode fibre 1km	
15.	Substation Automation	Protocol	IEC61850	
16.	Standards	Temperature tests Cold - IEC 60068-2-1 (2007),		
		Dry Heat - IEC 60068-2-2 (2007)		
		Operation 0ºC to +70ºC		
		Storage 0ºC to +85ºC		
		Humidity IEC 68-2-3(1984)		
		Insulation IEC 60255-27 (2013)		
		Dielectric Test 2kV AC 50Hz, 1min		
		Insulation resistance tests 500V DC		
		Impulse Voltage Test 5kV, 1.2/50 µs, 0.5J		
		1MHz burst disturbance tests IEC 255-22-1(1988), ANSI/IEEE C37, 90.1-1989		
		Electrostatic discharge tests IEC 60255-26 (2013)		
		2, 4, 6,8kV contact discharge		
		2, 4, 8,15kV air discharge		
		Fast transient tests (Burst) IEC 60255-26 (2013)		
		2kV/4kV 5kHz		
		Power frequency magnetic IEC 61000-4-9 (2001)1000 A/m 50/60Hz permanent field		
		Field immunity test Level 5		
		Radio frequency IEC 60255-26 (2013)		
		Conducted RFI Immunity 10Vrms		

No	Item	Description	Required	Tendered
		Radiated RFI Immunity 10V/m (Unmodulated)		
		Emission		
		Cl.A EN 50081-2(1994)		
		(Industrial environment) EN 55011(1992)		
		CISPR 11(1990)		
		EN 55022(1995)		
		CISPR 22(1995)		
		Seismic Test IEC 60255-27(2013) / IEC 60255-21-3		
		Class 2		
17.	Functions	Distance - 21M, 21Q,	REQUIRED	
		No. of Forward Zones Available (Min 4)	-do-	
		No. of Reverse Zones Available (Min 1)	-do-	
		Availability of additional zone for tele-protection signalling		
		Power Swing Blocking - 68	REQUIRED	
		Load Encroachment	-do-	
		Tele Protection Aided Distance Protection - 85, 21	-do-	
		Available Schemes PUTT, POTT, Blocking	-do-	
		Current reversal and weak-end infeed logic	-do-	
		SOTF Protection	-do-	
		Possibility to integrate with circuit breaker close command		
		Possibility to integrate with a distance element		
		Possibility to integrate with a overcurrent element		
		Synchrocheck - 25	REQUIRED	
		Availability of separate Synchrocheck for Autoreclosing and Manual closing	-do-	
		Availability of separate Synchrocheck for each circuit		

No	Item	Description	Required	Tendered
		breaker in 1.5 circuit breaker stations		
		Negative-sequence overcurrent protection - 46	REQUIRED	
		Broken Conductor Protection - 46BC	-do-	
		Thermal overload protection - 49	-do-	
		Stub protection for 1.5 Circuit Breaker Stations - 50STB		
		Over Current and Earth Fault Protection - 50, 50N, 51, 51N	REQUIRED	
		No. of Definite Time Stages Available (Min 2)	-do-	
		No. of IDMT Stages Available (Min 2)	-do-	
		Directional Over Current and Earth Fault Protection -67, 67N	-do-	
		No. of Definite Time Stages Available (Min 2)	-do-	
		No. of IDMT Stages Available (Min 2)	-do-	
		Tele Protection Aided Directional Earth Fault Protection - 85, 67N	-do-	
		Required Schemes POTT, Blocking	-do-	
		Current reversal and weak-end infeed logic	-do-	
		Voltage Protection - 27/59	-do-	
		Two step under voltage protection	-do-	
		Two step over voltage protection	-do-	
		Auto Reclose - 79	-do-	
		Support for single pole or three pole operation	-do-	
		Support for one shot or multi shot operation	-do-	
		Optional triggering from external signal e.g. binary input	-do-	
		Two A/R Functions for 1.5 Circuit Breaker Stations		
		Differential protection - 87L	REQUIRED	

No	Item	Description	Required	Tendered
		Charging Current Compensation	-do-	
		Ability to transfer 8 binary signals	-do-	
		Differential protection for lines with 3 ends - 87L		
		Stub protection for 1.5 Circuit Breaker Stations - 87STB		
		Availability of two sets of CT inputs for 1.5 Circuit Breaker Stations		
		BCU	REQUIRED	
		VTFF	-do-	
		CT circuit failure supervision	-do-	
		Fault Locator	-do-	
		Ability to improve accuracy based on information collected from remote ends.		
		Availability of fault locater based on travelling wave principle accurate to nearest tower		
		Ability to communicate with remote end relays with single mode direct fibre and via multiplexer (using C37.94 protocol) in hot/standby mode	REQUIRED	
		Ability to send/receive tele-protection signals (21, 67N, 50BF) via single mode direct fibre	-do-	
		Ability to send/receive tele-protection signals (21, 67N, 50BF) via multiplexer	-do-	
		Ability to measure	-do-	
		Active Power	-do-	
		Reactive Power	-do-	
		Apparent Power	-do-	
		Power Factor	-do-	
		Recording of Minimum /Maximum value	-do-	
		Active Energy (Forward/Reverse)	-do-	

No	Item	Description	Required	Tendered
		Reactive Energy (Forward/Reverse)	-do-	
		Basic Power Quality Measurements.		
		Voltage unbalance; voltage changes: overvoltage, dip, interruption; TDD(Total Demand Distortion), THD (Total Harmonic Distortion), and harmonics		
		GPS Time Synchronization	REQUIRED	
		Support for SNTP protocol	-do-	
		Support for IEEE 1588 protocol	-do-	
		Rugged Design with Conformal Coating	-do-	
		DC Power Supply Supervision		
		Circuit breaker condition monitoring		
18.		Minimum of fifteen (15) years successful experience in the manufacturing of equipment in rated voltage and capacity, comparable to the equipment offered under the contract	REQUIRED	
19.		Minimum of ten (10) years of experience in manufacturing for orders from outside the country of the manufacturer	REQUIRED	
20.		Offered model in successful operation in substations for at least three years	REQUIRED	
21.	IED Data Sets	Data sets as per Annexures in Chapter 5 Specifications	Annexure 38	
22.	IEC 61850 Conformance certificate	tested according to IEC61850 issued by an Independent laboratory empowered by UCA	REQUIRED	

2.7.2. HV/LV Transformer HV Protection IED

No	Item	Description	Required	Tendered
1.	Basic Information	Relay type		
		Model no.		
2.	Dimensions	Width		
		Height		
		Depth		
3.	Current Inputs	Current Transformer		
		secondary current (In)	1A	
		No. of Inputs	8	
		Thermal rating of current circuits		
		Continuous	4 x In	
		For 10s	30 x In	
		For 1s	100 x In	
		Burden	≤0.1 VA	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
4.	Voltage Inputs	Voltage transformer secondary		
		Voltage (Phase-Phase) (Un)	110V	
		Operating Range	0-300V	
		No. of Inputs	5	
		Thermal rating of voltage		
		circuit (10s)	450V	
		Burden	≤ 0.2VA at 110V	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
5.	Station DC voltage	Station DC voltage Vdc=110V	Vdc +10% to -15%	
		DC auxiliary Operating Voltage Range		
		for 110V dc system	88Vdc – 132Vdc	

No	Item	Description	Required	Tendered
		Maximum Relay Burden	50VA	
6.	Binary Outputs	No. of Output Contacts	≥ 23	
		Voltage Vdc = or 110V	Vdc ± 15%	
		Breaking Capacity with L/R=40ms		
		For nominal dc voltage 110V Systems	0.3A at 125V DC	
		Carry Continuous	6A	
		Make and carry for 0.2s	30A	
7.	Binary Inputs	No. of Binary Inputs	≥ 42	
		Nominal Voltage Rating for 110V DC supply	110V DC	
		Pickup Threshold for 110V DC supply	88V DC	
		Drop off Threshold for 110V DC supply	66V DC	
8.	LED	LED indications	≥ 15	
9.	Spares	Spare parts guarantee	10 years	
10.	Warranty	Warranty period and Warranty certificate	At least 10 years from the date of Commissioning	
11.	Origin	Country of Origin		
12.	Manufacture	Country of Manufacture		
13.	Design	Design Features	As Specified in chapter 5 of volume 5	
14.	Communication	Standard for communication with Remote equipment		
15.	Substation Automation	Protocol	IEC61850	
16.	Standards	Temperature tests Cold - IEC 60068-2-1 (2007),		
		Dry Heat - IEC 60068-2-2 (2007)		
		Operation 0ºC to +70ºC		
		Storage 0ºC to +85ºC		
		Humidity IEC 68-2-3(1984)		

No	Item	Description	Required	Tendered
		Insulation IEC 60255-27 (2013)		
		Dielectric Test 2kV AC 50Hz, 1min		
		Insulation resistance tests 500V DC		
		Impulse Voltage Test 5kV, 1.2/50 µs, 0.5J		
		1MHz burst disturbance tests IEC 255-22-1(1988), ANSI/IEEE C37, 90.1-1989		
		Electrostatic discharge tests IEC 60255-26 (2013)		
		2, 4, 6,8kV contact discharge		
		2, 4, 8,15kV air discharge		
		Fast transient tests (Burst) IEC 60255-26 (2013)		
		2kV/4kV 5kHz		
		Power frequency magnetic IEC 61000-4-9 (2001)1000 A/m 50/60Hz permanent field		
		Field immunity test Level 5		
		Radio frequency IEC 60255-26 (2013)		
		Conducted RFI Immunity 10Vrms		
		Radiated RFI Immunity 10V/m (Unmodulated)		
		Emission		
		Cl.A EN 50081-2(1994)		
		(Industrial environment) EN 55011(1992)		
		CISPR 11(1990)		
		EN 55022(1995)		
		CISPR 22(1995)		
		Seismic Test IEC 60255-27(2013) / IEC 60255-21-3		
		Class 2		
17.	Functions	Overexcitation protection - 24	REQUIRED	
		Synchrocheck - 25	-do-	

No	Item	Description	Required	Tendered
		For HV Circuit Breaker	-do-	
		Availability of separate Synchrocheck for each circuit breaker in 1.5 circuit breaker stations		
		Negative-sequence system overcurrent protection, Unbalanced-load protection (thermal) - 46		
		Thermal overload protection - 49	REQUIRED	
		HV Over Current Protection - 50/51 HV	-do-	
		HV Earth Fault Protection - 50N/51N HV	-do-	
		HV Directional Over Current & Earth Fault Protection - 67/67N HV	-do-	
		HV Stand by Earth fault Protection - 51G HV	-do-	
		HV Over/Under Voltage Protection - 27/59	-do-	
		MV Over Current Protection - 50/51 MV	-do-	
		MV Earth Fault Protection - 50N/51N MV	-do-	
		LV Stand by Earth fault Protection - 51G LV	-do-	
		Transformer differential Protection - 87T	-do-	
		HV Transformer Restricted Ground-Fault Protection - 87N T	-do-	
		LV Transformer Restricted Ground-Fault Protection - 87N T	-do-	
		Availability of two sets of CT inputs for 1.5 Circuit Breaker Stations		
		BCU function for HV side	REQUIRED	
		VTFF	-do-	
		Ability to measure	-do-	
		Active Power	-do-	
		Reactive Power	-do-	

No	Item	Description	Required	Tendered
		Apparent Power	-do-	
		Power Factor	-do-	
		Recording of Minimum /Maximum value	-do-	
		Active Energy (Forward/Reverse)	-do-	
		Reactive Energy (Forward/Reverse)	-do-	
		Basic Power Quality Measurements.		
		Voltage unbalance; voltage changes: overvoltage, dip, interruption; TDD(Total Demand Distortion), THD (Total Harmonic Distortion), and harmonics		
		GPS Time Synchronization	REQUIRED	
		Support for SNTP protocol	-do-	
		Support for IEEE 1588 protocol	-do-	
		Rugged Design with Conformal Coating	-do-	
18.		Minimum of fifteen (15) years successful experience in the manufacturing of equipment in rated voltage and capacity, comparable to the equipment offered under the contract	REQUIRED	
19.		Minimum of ten (10) years of experience in manufacturing for orders from outside the country of the manufacturer	REQUIRED	
20.		Offered model in successful operation in substations for at least three years	REQUIRED	
21.	IED Data Sets	Data sets as per Annexures in Chapter 5 Specifications	Annexure 42	
22.	IEC 61850 Conformance certificate	tested according to IEC61850 issued by an Independent laboratory empowered by UCA	REQUIRED	

2.7.3. HV/LV Transformer LV/MV Protection IED

No	Item	Description	Required	Tendered
1.	Basic Information	Relay type		
		Model no.		
2.	Dimensions	Width		
		Height		
		Depth		
3.	Current Inputs	Current Transformer		
		secondary current (In)	1A	
		No. of Inputs	4	
		Thermal rating of current circuits		
		Continuous	4 x In	
		For 10s	30 x In	
		For 1s	100 x In	
		Burden	≤0.1VA	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
4.	Voltage Inputs	Voltage transformer secondary		
		Voltage (Phase-Phase) (Un)	110V	
		Operating Range	0-300V	
		No. of Inputs	5	
		Thermal rating of voltage		
		circuit (10s)	450V	
		Burden	≤ 0.1VA at 110V	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
5.	Station DC voltage	Station DC voltage Vdc=110V or ~~220V~~	Vdc +10% to -15%	
		DC auxiliary Operating Voltage Range		
		for 110V dc system	88Vdc – 132Vdc	

No	Item	Description	Required	Tendered
		~~for 220V dc system~~	~~176Vdc-264Vdc~~	
		Maximum Relay Burden	50VA	
6.	Binary Outputs	No. of Output Contacts	≥ 12	
		Voltage Vdc = ~~220V~~ or 110V	Vdc ± 15%	
		Breaking Capacity with L/R=40ms		
		For nominal dc voltage 110V Systems	0.3A at 125V DC	
		Carry Continuous	6A	
		Make and Carry for 0.2s	30A	
7.	Binary Inputs	No. of Binary Inputs	≥ 46	
		Nominal Voltage Rating for 110V DC supply	110V DC	
		Pickup Threshold for 110V DC supply	88V DC	
		Drop off Threshold for 110V DC supply	66V DC	
8.	LED	LED indications	≥ 15	
9.	Spares	Spare parts guarantee	10 years	
10.	Warranty	Warranty period and Warranty certificate	At least 10 years from the date of Commissioning	
11.	Origin	Country of Origin		
12.	Manufacture	Country of Manufacture		
13.	Design	Design Features	As Specified in chapter 5 of volume 5	
14.	Communication	Standard for communication with Remote equipment		
15.	Substation Automation	Protocol	IEC61850	
16.	Standards	Temperature tests Cold - IEC 60068-2-1 (2007),		
		Dry Heat - IEC 60068-2-2 (2007)		
		Operation 0ºC to +70ºC		

No	Item	Description	Required	Tendered
		Storage 0ºC to +85ºC		
		Humidity IEC 68-2-3(1984)		
		Insulation IEC 60255-27 (2013)		
		Dielectric Test 2kV AC 50Hz, 1min		
		Insulation resistance tests 500V DC		
		Impulse Voltage Test 5kV, 1.2/50 µs, 0.5J		
		1MHz burst disturbance tests IEC 255-22-1(1988), ANSI/IEEE C37, 90.1-1989		
		Electrostatic discharge tests IEC 60255-26 (2013)		
		2, 4, 6,8kV contact discharge		
		2, 4, 8,15kV air discharge		
		Fast transient tests (Burst) IEC 60255-26 (2013)		
		2kV/4kV 5kHz		
		Power frequency magnetic IEC 61000-4-9 (2001)1000 A/m 50/60Hz permanent field		
		Field immunity test Level 5		
		Radio frequency IEC 60255-26 (2013)		
		Conducted RFI Immunity 10Vrms		
		Radiated RFI Immunity 10V/m (Unmodulated)		
		Emission		
		Cl.A EN 50081-2(1994)		
		(Industrial environment) EN 55011(1992)		
		CISPR 11(1990)		
		EN 55022(1995)		
		CISPR 22(1995)		
		Seismic Test IEC 60255-27(2013) / IEC 60255-21-3		
		Class 2		

No	Item	Description	Required	Tendered
17.	Functions	Synchrocheck - 25	REQUIRED	
		For MV Circuit Breaker	-do-	
		Availability of separate Synchrocheck for each circuit breaker in 1.5 circuit breaker stations		
		MV Over Current Protection - 50/51 MV	REQUIRED	
		MV Earth Fault Protection - 50N/51N MV	-do-	
		MV Directional Over Current & Earth Fault Protection - 67/67N MV	-do-	
		MV Over/Under Voltage Protection - 27/59	-do-	
		Availability of two sets of CT inputs for 1.5 Circuit Breaker Stations		
		LV Breaker Failure Protection - 50BF LV	REQUIRED	
		BCU function for MV side	-do-	
		VTFF	-do-	
		Ability to measure	-do-	
		Active Power	-do-	
		Reactive Power	-do-	
		Apparent Power	-do-	
		Power Factor	-do-	
		Recording of Minimum /Maximum value	-do-	
		Active Energy (Forward/Reverse)	-do-	
		Reactive Energy (Forward/Reverse)	-do-	
		Basic Power Quality Measurements.		
		Voltage unbalance; voltage changes: overvoltage, dip, interruption; TDD(Total Demand Distortion), THD (Total Harmonic Distortion), and harmonics		
		GPS Time Synchronization	REQUIRED	

No	Item	Description	Required	Tendered
		Support for SNTP protocol	-do-	
		Support for IEEE 1588 protocol	-do-	
		Rugged Design with Conformal Coating	-do-	
18.		Minimum of fifteen (15) years successful experience in the manufacturing of equipment in rated voltage and capacity, comparable to the equipment offered under the contract	REQUIRED	
19.		Minimum of ten (10) years of experience in manufacturing for orders from outside the country of the manufacturer	REQUIRED	
20.		Offered model in successful operation in substations for at least three years	REQUIRED	
21.	IED Data Sets	Data sets as per Annexures in Chapter 5 Specifications	Annexure 41	
22.	IEC 61850 Conformance certificate	tested according to IEC61850 issued by an Independent laboratory empowered by UCA	REQUIRED	

2.7.4. 132kV/ 33kV Bus Coupler/ Section Protection IED

No	Item	Description	Required	Tendered
1.	Basic Information	Relay type		
		Model no.		
2.	Dimensions	Width		
		Height		
		Depth		
3.	Current Inputs	Current Transformer		
		secondary current (In)	1A	
		No. of Inputs	5	
		Thermal rating of current circuits		
		Continuous	4 x In	
		For 10s	30 x In	
		For 1s	100 x In	
		Burden	≤0.1VA	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
4.	Voltage Inputs	Voltage transformer secondary		
		Voltage (Phase-Phase) (Un)	110 V	
		Operating Range	0-300V	
		No. of Inputs	5	
		Thermal rating of voltage		
		circuit (10s)	450V	
		Burden	≤ 0.1 VA at 110V	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
5.	Station DC voltage	Station DC voltage Vdc=110V	Vdc +10% to -15%	
		DC auxiliary Operating Voltage Range		
		for 110V dc system	88Vdc – 132Vdc	

No	Item	Description	Required	Tendered
		Maximum Relay Burden	50VA	
6.	Binary Outputs	No. of Output Contacts	≥ 18	
		Voltage Vdc = 220V or 110V	Vdc ± 15%	
		Breaking Capacity with L/R=40ms		
		For nominal dc voltage 110V Systems	0.3A at 125V DC	
		Carry Continuous	6A	
		Make and Carry for 0.2s	30A	
7.	Binary Inputs	No. of Binary Inputs	≥ 42	
		Nominal Voltage Rating for 110V DC supply	110V DC	
		Pickup Threshold for 110V DC supply	88V DC	
		Drop off Threshold for 110V DC supply	66V DC	
8.	LED	LED indications	≥ 15	
9.	Spares	Spare parts guarantee	10 years	
10.	Warranty	Warranty period and Warranty certificate	At least 10 years from the date of Commissioning	
11.	Origin	Country of Origin		
12.	Manufacture	Country of Manufacture		
13.	Design	Design Features	As Specified in chapter 5 of volume 5	
14.	Communication	Standard for communication with Remote equipment		
15.	Substation Automation	Protocol	IEC61850	
16.	Standards	Temperature tests Cold - IEC 60068-2-1 (2007),		
		Dry Heat - IEC 60068-2-2 (2007)		
		Operation 0ºC to +70ºC		
		Storage 0ºC to +85ºC		
		Humidity IEC 68-2-3(1984)		

No	Item	Description	Required	Tendered
		Insulation IEC 60255-27 (2013)		
		Dielectric Test 2kV AC 50Hz, 1min		
		Insulation resistance tests 500V DC		
		Impulse Voltage Test 5kV, 1.2/50 µs, 0.5J		
		1MHz burst disturbance tests IEC 255-22-1(1988), ANSI/IEEE C37, 90.1-1989		
		Electrostatic discharge tests IEC 60255-26 (2013)		
		2, 4, 6,8kV contact discharge		
		2, 4, 8,15kV air discharge		
		Fast transient tests (Burst) IEC 60255-26 (2013)		
		2kV/4kV 5kHz		
		Power frequency magnetic IEC 61000-4-9 (2001)1000 A/m 50/60Hz permanent field		
		Field immunity test Level 5		
		Radio frequency IEC 60255-26 (2013)		
		Conducted RFI Immunity 10Vrms		
		Radiated RFI Immunity 10V/m (Unmodulated)		
		Emission		
		Cl.A EN 50081-2(1994)		
		(Industrial environment) EN 55011(1992)		
		CISPR 11(1990)		
		EN 55022(1995)		
		CISPR 22(1995)		
		Seismic Test IEC 60255-27(2013) / IEC 60255-21-3		
		Class 2		
17.	Functions	Synchrocheck - 25	REQUIRED	
		Over Current Protection - 50/51 MV	-do-	

No	Item	Description	Required	Tendered
		Earth Fault Protection - 50N/51N MV	-do-	
		Directional Over Current & Earth Fault Protection - 67/67N MV	-do-	
		Over/Under Voltage Protection - 27/59	-do-	
		Breaker Failure Protection - 50BF (For LV)	-do-	
		BCU function	-do-	
		VTFF	-do-	
		Ability to measure	-do-	
		Active Power	-do-	
		Reactive Power	-do-	
		Apparent Power	-do-	
		Power Factor	-do-	
		Recording of Minimum /Maximum value	-do-	
		Active Energy (Forward/Reverse)	-do-	
		Reactive Energy (Forward/Reverse)	-do-	
		Basic Power Quality Measurements.		
		Voltage unbalance; voltage changes: overvoltage, dip, interruption; TDD(Total Demand Distortion), THD (Total Harmonic Distortion), and harmonics		
		GPS Time Synchronization	REQUIRED	
		Support for SNTP protocol	-do-	
		Support for IEEE 1588 protocol	-do-	
		Rugged Design with Conformal Coating	-do-	
18.		Minimum of fifteen (15) years successful experience in the manufacturing of equipment in rated voltage and capacity, comparable to the equipment offered under the contract	REQUIRED	

No	Item	Description	Required	Tendered
19.		Minimum of ten (10) years of experience in manufacturing for orders from outside the country of the manufacturer	REQUIRED	
20.		Offered model in successful operation in substations for at least three years	REQUIRED	
21.	IED Data Sets	Data sets as per Annexures in Chapter 5 Specifications	Annexure 47	
22.	IEC 61850 Conformance certificate	tested according to IEC61850 issued by an Independent laboratory empowered by UCA	REQUIRED	

2.7.5. 132kV Bus bar Protection Central IED

No	Item	Description	Required	Tendered
1.	Basic Information	Relay type		
		Model no.		
2.	Dimensions	Width		
		Height		
		Depth		
3.	Current Inputs	Current Transformer		
		secondary current (In)		
		No. of Inputs	0	
		Thermal rating of current circuits		
		Continuous		
		For 10s		
		For 1s		
		Burden		
		Rated Frequency		
		operating range		
4.	Voltage Inputs	Voltage transformer secondary		
		Voltage (Phase-Phase) (Un)		
		Operating Range		
		No. of Inputs	0	
		Thermal rating of voltage		
		circuit (10s)		
		Burden		
		Rated Frequency		
		operating range		
5.	Station DC voltage	Station DC voltage Vdc=110V or 220V	Vdc +10% to -15%	
		DC auxiliary Operating Voltage Range		
		for 110V dc system	88Vdc – 132Vdc	

No	Item	Description	Required	Tendered
		~~for 220V dc system~~	~~176Vdc-264Vdc~~	
		Maximum Relay Burden	50VA	
6.	Binary Outputs	No. of Output Contacts	≥ 2	
		Voltage Vdc = 110V	Vdc ± 15%	
		Breaking Capacity with L/R=40ms		
		For nominal dc voltage 110V Systems	0.3A at 125V DC	
		Carry Continuous	6A	
		Make and Carry for 0.2s	30A	
7.	Binary Inputs	No. of Binary Inputs	≥ 3	
		Nominal Voltage Rating for 110V DC supply	110V DC	
		Pickup Threshold for 110V DC supply	88V DC	
		Drop off Threshold for 110V DC supply	66V DC	
8.	LED	LED indications	≥ 15	
9.	Spares	Spare parts guarantee	10 years	
10.	Warranty	Warranty period and Warranty certificate	At least 10 years from the date of Commissioning	
11.	Origin	Country of Origin		
12.	Manufacture	Country of Manufacture		
13.	Design	Design Features	As Specified in chapter 5 of volume 5	
14.	Communication	Standard for communication with Remote equipment		
15.	Substation Automation	Protocol	IEC61850	
16.	Standards	Temperature tests Cold - IEC 60068-2-1 (2007),		
		Dry Heat - IEC 60068-2-2 (2007)		
		Operation 0ºC to +70ºC		

No	Item	Description	Required	Tendered
		Storage 0ºC to +85ºC		
		Humidity IEC 68-2-3(1984)		
		Insulation IEC 60255-27 (2013)		
		Dielectric Test 2kV AC 50Hz, 1min		
		Insulation resistance tests 500V DC		
		Impulse Voltage Test 5kV, 1.2/50 µs, 0.5J		
		1MHz burst disturbance tests IEC 255-22-1(1988), ANSI/IEEE C37, 90.1-1989		
		Electrostatic discharge tests IEC 60255-26 (2013)		
		2, 4, 6,8kV contact discharge		
		2, 4, 8,15kV air discharge		
		Fast transient tests (Burst) IEC 60255-26 (2013)		
		2kV/4kV 5kHz		
		Power frequency magnetic IEC 61000-4-9 (2001)1000 A/m 50/60Hz permanent field		
		Field immunity test Level 5		
		Radio frequency IEC 60255-26 (2013)		
		Conducted RFI Immunity 10Vrms		
		Radiated RFI Immunity 10V/m (Unmodulated)		
		Emission		
		Cl.A EN 50081-2(1994)		
		(Industrial environment) EN 55011(1992)		
		CISPR 11(1990)		
		EN 55022(1995)		
		CISPR 22(1995)		
		Seismic Test IEC 60255-27(2013) / IEC 60255-21-3		
		Class 2		

No	Item	Description	Required	Tendered
17.	Functions	Busbar differential protection - 87B	REQUIRED	
		1/3-pole or 3-pole circuit-breaker failure protection - 50BF	-do-	
		End-fault protection - 50EFP	-do-	
		Over Current Protection - 50/51	-do-	
		Earth Fault Protection - 50N/51N	-do-	
		Disconnector-independent check zone as additional tripping criterion	-do-	
		HMI (LCD Display)	-do-	
		Event Log	-do-	
		Capacity of event log		
		Fault Recorder: It shall be possible to record all analogue inputs, binary inputs and binary outputs.	REQUIRED	
		Sampling frequency		
		Recording duration		
		no. of records possible with available storage		
		User-friendliness	REQUIRED	
		Configuration by the user during the entire service life	-do-	
18.		Minimum of fifteen (15) years successful experience in the manufacturing of equipment in rated voltage and capacity, comparable to the equipment offered under the contract	REQUIRED	
19.		Minimum of ten (10) years of experience in manufacturing for orders from outside the country of the manufacturer	REQUIRED	
20.		Offered model in successful operation in substations for at least three years	REQUIRED	
21.	IED Data Sets	Data sets as per Annexures in Chapter 5 Specifications	Annexure 44	

No	Item	Description	Required	Tendered
22.	IEC 61850 Conformance certificate	tested according to IEC61850 issued by an Independent laboratory empowered by UCA	REQUIRED	

2.7.6. 132kV Bus bar Protection Bay IED

No	Item	Description	Required	Tendered
1.	Basic Information	Relay type		
		Model no.		
2.	Dimensions	Width		
		Height		
		Depth		
3.	Current Inputs	Current Transformer		
		secondary current (In)	1A	
		No. of Inputs	4	
		Thermal rating of current circuits		
		Continuous	4 x In	
		For 10s	30 x In	
		For 1s	100 x In	
		Burden	≤0.1VA	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
4.	Voltage Inputs	Voltage transformer secondary		
		Voltage (Phase-Phase) (Un)		
		Operating Range		
		No. of Inputs	0	
		Thermal rating of voltage		
		circuit (10s)		
		Burden		
		Rated Frequency		
		operating range		
5.	Station DC voltage	Station DC voltage Vdc=110V or ~~220V~~	Vdc +10% to -15%	
		DC auxiliary Operating Voltage Range		
		for 110V dc system	88Vdc – 132Vdc	

No	Item	Description	Required	Tendered
		Maximum Relay Burden	50VA	
6.	Binary Outputs	No. of Output Contacts	≥ 3	
		Voltage Vdc = ~~220V~~ or 110V	Vdc ± 15%	
		Breaking Capacity with L/R=40ms		
		For nominal dc voltage 110V Systems	0.3A at 125V DC	
		Carry Continuous	6A	
		Make and Carry for 0.2s	30A	
7.	Binary Inputs	No. of Binary Inputs	≥ 13	
		Nominal Voltage Rating for 110V DC supply	110V DC	
		Pickup Threshold for 110V DC supply	88V DC	
		Drop off Threshold for 110V DC supply	66V DC	
8.	LED	LED indications	≥ 15	
9.	Spares	Spare parts guarantee	10 years	
10.	Warranty	Warranty period and Warranty certificate	At least 10 years from the date of Commissioning	
11.	Origin	Country of Origin		
12.	Manufacture	Country of Manufacture		
13.	Design	Design Features	As Specified in chapter 5 of volume 5	
14.	Communication	Standard for communication with Remote equipment		
15.	Substation Automation	Protocol	IEC61850	
16.	Standards	Temperature tests Cold - IEC 60068-2-1 (2007),		
		Dry Heat - IEC 60068-2-2 (2007)		
		Operation 0ºC to +70ºC		
		Storage 0ºC to +85ºC		
		Humidity IEC 68-2-3(1984)		

No	Item	Description	Required	Tendered
		Insulation IEC 60255-27 (2013)		
		Dielectric Test 2kV AC 50Hz, 1min		
		Insulation resistance tests 500V DC		
		Impulse Voltage Test 5kV, 1.2/50 µs, 0.5J		
		1MHz burst disturbance tests IEC 255-22-1(1988), ANSI/IEEE C37, 90.1-1989		
		Electrostatic discharge tests IEC 60255-26 (2013)		
		2, 4, 6,8kV contact discharge		
		2, 4, 8,15kV air discharge		
		Fast transient tests (Burst) IEC 60255-26 (2013)		
		2kV/4kV 5kHz		
		Power frequency magnetic IEC 61000-4-9 (2001)1000 A/m 50/60Hz permanent field		
		Field immunity test Level 5		
		Radio frequency IEC 60255-26 (2013)		
		Conducted RFI Immunity 10Vrms		
		Radiated RFI Immunity 10V/m (Unmodulated)		
		Emission		
		Cl.A EN 50081-2(1994)		
		(Industrial environment) EN 55011(1992)		
		CISPR 11(1990)		
		EN 55022(1995)		
		CISPR 22(1995)		
		Seismic Test IEC 60255-27(2013) / IEC 60255-21-3		
		Class 2		
17.	Functions	Busbar differential protection - 87B	REQUIRED	

No	Item	Description	Required	Tendered
		1/3-pole or 3-pole circuit-breaker failure protection - 50BF	-do-	
		End-fault protection - 50EFP	-do-	
		Over Current Protection - 50/51	-do-	
		Earth Fault Protection - 50N/51N	-do-	
		Disconnector-independent check zone as additional tripping criterion	-do-	
		HMI (LCD Display)	-do-	
		Event Log	-do-	
		Capacity of event log		
		Fault Recorder: It shall be possible to record all analogue inputs, binary inputs and binary outputs.	REQUIRED	
		Sampling frequency		
		Recording duration		
		no. of records possible with available storage		
		User-friendliness	REQUIRED	
		Configuration by the user during the entire service life	-do-	
18.		Minimum of fifteen (15) years successful experience in the manufacturing of equipment in rated voltage and capacity, comparable to the equipment offered under the contract	REQUIRED	
19.		Minimum of ten (10) years of experience in manufacturing for orders from outside the country of the manufacturer	REQUIRED	
20.		Offered model in successful operation in substations for at least three years	REQUIRED	
21.	IED Data Sets	Data sets as per Annexures in Chapter 5 Specifications		
22.	IEC 61850 Conformance certificate	tested according to IEC61850 issued by an Independent laboratory empowered by UCA	REQUIRED	

2.7.7. 33kV Feeder Protection IED

No	Item	Description	Required	Tendered
1.	Basic Information	Relay type		
		Model no.		
2.	Dimensions	Width		
		Height		
		Depth		
3.	Current Inputs	Current Transformer		
		secondary current (In)	1A	
		No. of Inputs	5	
		Thermal rating of current circuits		
		Continuous	4 x In	
		For 10s	30 x In	
		For 1s	100 x In	
		Burden	≤0.1VA	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
4.	Voltage Inputs	Voltage transformer secondary		
		Voltage (Phase-Phase) (Un)	110V	
		Operating Range	0-300V	
		No. of Inputs	5	
		Thermal rating of voltage		
		circuit (10s)	450V	
		Burden	≤ 0.1VA at 110V	
		Rated Frequency	50Hz	
		operating range	47Hz-53Hz	
5.	Station DC voltage	Station DC voltage Vdc=110V or ~~220V~~	Vdc +10% to -15%	
		DC auxiliary Operating Voltage Range		
		for 110V dc system	88Vdc – 132Vdc	

No	Item	Description	Required	Tendered
		Maximum Relay Burden	50VA	
6.	Binary Outputs	No. of Output Contacts	≥ 18	
		Voltage Vdc = ~~220V~~ or 110V	Vdc ± 15%	
		Breaking Capacity with L/R=40ms		
		For nominal dc voltage 110V Systems	0.3A at 125V DC	
		Carry Continuous	6A	
		Make and Carry for 0.2s	30A	
7.	Binary Inputs	No. of Binary Inputs	≥ 42	
		Nominal Voltage Rating for 110V DC supply	110V DC	
		Pickup Threshold for 110V DC supply	88V DC	
		Drop off Threshold for 110V DC supply	66V DC	
8.	LED	LED indications	≥ 15	
9.	Spares	Spare parts guarantee	10 years	
10.	Warranty	Warranty period and Warranty certificate	At least 10 years from the date of Commissioning	
11.	Origin	Country of Origin		
12.	Manufacture	Country of Manufacture		
13.	Design	Design Features	As Specified in chapter 5 of volume 5	
14.	Communication	Standard for communication with Remote equipment		
15.	Substation Automation	Protocol	IEC61850	
16.	Standards	Temperature tests Cold - IEC 60068-2-1 (2007),		
		Dry Heat - IEC 60068-2-2 (2007)		
		Operation 0ºC to +70ºC		
		Storage 0ºC to +85ºC		
		Humidity IEC 68-2-3(1984)		

No	Item	Description	Required	Tendered
		Insulation IEC 60255-27 (2013)		
		Dielectric Test 2kV AC 50Hz, 1min		
		Insulation resistance tests 500V DC		
		Impulse Voltage Test 5kV, 1.2/50 µs, 0.5J		
		1MHz burst disturbance tests IEC 255-22-1(1988), ANSI/IEEE C37, 90.1-1989		
		Electrostatic discharge tests IEC 60255-26 (2013)		
		2, 4, 6,8kV contact discharge		
		2, 4, 8,15kV air discharge		
		Fast transient tests (Burst) IEC 60255-26 (2013)		
		2kV/4kV 5kHz		
		Power frequency magnetic IEC 61000-4-9 (2001)1000 A/m 50/60Hz permanent field		
		Field immunity test Level 5		
		Radio frequency IEC 60255-26 (2013)		
		Conducted RFI Immunity 10Vrms		
		Radiated RFI Immunity 10V/m (Unmodulated)		
		Emission		
		Cl.A EN 50081-2(1994)		
		(Industrial environment) EN 55011(1992)		
		CISPR 11(1990)		
		EN 55022(1995)		
		CISPR 22(1995)		
		Seismic Test IEC 60255-27(2013) / IEC 60255-21-3		
		Class 2		
17.	Functions	Synchrocheck - 25	REQUIRED	
		Over Current Protection - 50/51	-do-	

No	Item	Description	Required	Tendered
		Earth Fault Protection - 50N/51N	-do-	
		Directional Over Current & Earth Fault Protection - 67/67N	-do-	
		Over/Under Voltage Protection - 27/59	-do-	
		Breaker Failure Protection - 50BF	-do-	
		Auto Reclose - 79		
		Frequency protection - 81, 81O, 81U, 81R		
		BCU	-do-	
		VTFF	-do-	
		Ability to measure	-do-	
		Active Power	-do-	
		Reactive Power	-do-	
		Apparent Power	-do-	
		Power Factor	-do-	
		Recording of Minimum /Maximum value	-do-	
		Active Energy (Forward/Reverse)	-do-	
		Reactive Energy (Forward/Reverse)	-do-	
		Basic Power Quality Measurements.		
		Voltage unbalance; voltage changes: overvoltage, dip, interruption; TDD(Total Demand Distortion), THD (Total Harmonic Distortion), and harmonics		
		GPS Time Synchronization	REQUIRED	
		Support for SNTP protocol	-do-	
		Support for IEEE 1588 protocol	-do-	
		Rugged Design with Conformal Coating	-do-	
18.		Minimum of fifteen (15) years successful experience in the manufacturing of equipment	REQUIRED	

No	Item	Description	Required	Tendered
		in rated voltage and capacity, comparable to the equipment offered under the contract		
19.		Minimum of ten (10) years of experience in manufacturing for orders from outside the country of the manufacturer	REQUIRED	
20.		Offered model in successful operation in substations for at least three years	REQUIRED	
21.	IED Data Sets	Data sets as per Annexures in Chapter 5 Specifications	Annexure 45	
22.	IEC 61850 Conformance certificate	tested according to IEC61850 issued by an Independent laboratory empowered by UCA	REQUIRED	

2.8. Substation Automation System

No	Item	Units	Required	Tendered
1.	General			
	SAS Manufacturer & Address			
	Owner of the SAS Software			
	SAS Software			
	SAS Model number			
	Number of Licensed data points for SAS configuration software		More than 10,000	
	Number of Licensed data points for SAS runtime software		More than 10,000	
	SAS architecture of Substation		To be provided in color by the SAS manufacturer	
	Country of Manufacture			
	Place of testing		At Factory of OEM	
	Warranty	Years	5	
2.	Compliance with standard for Substation Automation system			
	Communication protocol at all levels		IEC 61850 Edition 2 Fully complying to the standard	
	Interoperability and IEC 61850 conformance certificate		Independent laboratory empowered by UCA International Users Group	
	Temperature range (min/max) Computer	Deg.	5 - 60	
	Relative humidity	%	20 to 90% non-condensing	
3.	Detailed Requirements			
	Number of years of proven field experience of offered system	Years	15	
	(Note: proof of experience should be furnished. The components used in the offered system and			

No	Item	Units	Required	Tendered
	those with field experience should be the same)			
	No of years of proven field experience of offered system outside country of manufacture	Years	5	
	Design life of substation Automation System	Years	20	
	Number of Years to discounted the offered product & spare parts	Years	15	
	High quality Single Line Diagram included SCD file complete with all ICD files & station topology			
	SAS equipment excluding GPS server should be in redundant		02 HMIs, 02 Gateways, 02 SAS Ethernet Switches	
	Cyber Security		Required	
	Remote Web HMI		Required	
	OPC server / Client		Required	
	SNMP facility		Required	
	Manufacturers quality assurance system		ISO 9001/9002	
	Dimensions of SAS cubicle			
	Width	mm		
	Depth	mm		
	Height	mm		
	Floor load	N/m^2	600	
	Proper ventilation method should be provided to dissipate the heat generator inside SAS cubicle		Specify	
	Manufacturer of SAS Cubicle		Same as OEM	
	SAS Station Level Equipment			
4.	**Workstation Computer**		19" Rack Mounted Industrial PC	
(i)	**Main Services**			
	Manufacturer Name & Address			

No	Item	Units	Required	Tendered
	Country of Origin			
	Model			
	Warranty	Years	5	
	Display		Dual 27" LED Displays HDMI Type	
	Display cable between workstation and monitor		Fiber optic HDMI cable	
	Processer		7th Generation Intel® Xeon® and Core™ Processor or latest	
	Random Access Memory (RAM)	GB	16	
	Storage	TB	1 TB SSD Type with RAID Redundancy	
	Power supply		Redundant (Dual) DC from 2 Battery Banks	
	Operating System		Latest Microsoft Windows Server	
	SAS Software and Version			
	Web Server facility in HMI of SAS software		Required	
	Number of years of proven field experience of offered software	Years	10	
	Cyber Security and Anti Virus Software		Required	
	Other software		Latest Microsoft Office	
	MTBF (Mean time between Failures)	Hours		
	MTTR (Mean time to repair)	Hours		
	Redundant hot and standby configuration		Yes	
	Hot standby take over time	Seconds		
	Auto starting of application in both servers and both monitors			
	IED provided for Alarms & indications			

No	Item	Units	Required	Tendered
	All standard picture as per spec included in HMI			
	Process Status Display & Command Procedures			
	Event processing as per spec			
	Alarm processing as per spec			
	Reports as per spec			
	Customizable location to save Reports at the end of each month			
	Trend Display as per spec			
	User Authority levels as per spec			
	System supervision & monitoring as per specs			
	Standard		IEC 61850	
	Working Temperature Range	Deg. C	5 - 60	
	Working Voltage Range	V DC	110 - 220	
	Relative humidity	%	5 - 95	
	Power Consumption	W		
	Type of Mounting		19" Rack	
	Size (W x D x H)			
(ii)	**Interface & Function**			
	Number of Electrical signal Ethernet Ports (RJ45)		>= 4	
	Connectivity		Up to 128 Devices	
	Access by the Engineering PC		Yes	
	No of Data Points with the License			
	License for Configuration, Maintenance and Operation		Required	
5.	**Ethernet Switch**			
	Manufacturer			
	Country of Origin			
	Type		Industrial Grade	

No	Item	Units	Required	Tendered
	Power supply		Redundant (Dual) DC	
	Model			
	Warranty	Years	5	
	Ethernet Switch Communication		RSTP Ring Network with IEC 61850	
	Ethernet Ring Physical Medium		Glass Fiber	
	Bay Level Physical Medium		Glass Fiber	
	Spare ports		at least 50% spare ports available over total ports at time of commissioning	
6.	**GPS Time Server**			
	Manufacturer			
	Country of Origin			
	Model			
	Warranty	Years	5	
	Protection again direct/indirect lightning		Surge Protected	
	Redundant communication link should be provided to SAS Ethernet Switch 01 & 02			
7.	**Gateway to National System Control Center**			
(i)	**Main Services**			
	Manufacturer Name & Address			
	Country of Origin			
	Model			
	Gateway Software and Version			
	Warranty	Years	5	
	Type		Industrial grade hardware with no moving parts (PC	

No	Item	Units	Required	Tendered
			based gateway is not accepted)	
	Number of years of proven filed experience of offered unit	Years	10	
	Insulation tests			
	Fast disturbance tests			
	Industrial environment			
	Design life of offered equipment	Years	20	
	Communication channels		Three IEC 60870-5-104 one IEC 60870-5-101	
	Power Supply		Redundant (Dual) DC	
	MTBF (Mean time between Failures)	Hours		
	MTTR (Mean time to repair)	Hours		
	Standard		IEC 60870 & 61850	
	Working Temperature Range	Deg. C	5 - 60	
	Working Voltage Range	V DC	110 - 220	
	Relative humidity	%	5 - 95	
	Power Consumption	W		
	Type of Mounting		19" Rack	
	Size (W x D x H)			
(ii)	**Interface & Function**			
	Number of Electrical signal Ethernet Ports (RJ45)		>= 2	
	Number of IEC60870-5-101 Serial Ports		>= 2	
	Number of IEC60870-5-104 Ethernet Ports		>= 4	
	Connectivity		Up to 128 Devices	
	Access by the Engineering PC		Yes	
	No of Data Points with the License			

No	Item	Units	Required	Tendered
	License for Configuration, Maintenance and Operation		Required	
8.	**Audible Alarm System**			
	Make of the Alarm Device			
	Make of the Hootor			
9.	**System Performance**			
	Time to start the application after a shutdown	Minutes		
	Exchange of display (First reaction)	Seconds	< 2 S	
	Presentation of a binary change in the process display	Seconds	< 1 S	
	Presentation of an analogue change in the process display	Seconds	< 1 S	
	From order to process output	Seconds	< 1 S	
	From order to updated of display	Seconds	< 1 S	
10.	**Engineering Workstation Software**			
	SAS Configuration and Engineering Tool software with the license		Required	
	SAS Configuration and Engineering Tool software Name and Version			
	IED Configuration software with the license		Required	
	IED Configuration software Name and Version			
	Single Line Diagram included SCD file		Required	
	ICD files (IEC device capability files)		Required	
	Protection Project		Required	
11.	**SAS Signal List**			
	SAS Signal list of 220kV/132kV Lines		Required	
	SAS Signal list of 220kV side of 220kV/132kV/LV Transformer		Required	
	SAS Signal list of AVR		Required	

No	Item	Units	Required	Tendered
	SAS Signal list of 132 kV side of 220kV/132kV/LV Transformer		Required	
	SAS Signal list of HV side of HV/LV Transformer		Required	
	SAS Signal list of 220kV/132kV Bus Coupler		Required	
	SAS Signal list of Bas Bar Protection		Required	
	SAS Signal list of LV Transformer Bay		Required	
	SAS Signal list of LV Feeder		Required	
	SAS Signal list of LV Bus Coupler		Required	
12.	IEC61850 Conformance certificate tested according to IEC61850-10 issued by an Independent Laboratory empowered by UCA		Required	

2.9. Digital Disturbance Recorder (DDR) System

No	Item	Units	Required	Tendered
(a)	General			
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Power Supply	VDC	110V	
	-Power Supply for Printer	VAC	230	
(b)	Analogue Inputs			
1.	Number of channel		Min 55	
2.	Nominal Current	Amp	1A/5A/4-20 mA	
3.	Nominal Voltage	Vac / Vdc		
4.	Frequency Response			
5.	Cut-off frequency			
a	Bandwidth,	dB		
b	Attenuation at	dB		
c	Auto adjusted Anti - aliasing filters for chosen sampling rate	Yes/No	Yes	
d	Simultaneously Programmable Sample rate		Min 2 for FAST and SLOW recording	
	-Locally Changeable	Yes/No	Yes	
	-Remotely Changeable	Yes/No	Yes	
e	Possible Sample rates systems		3 different sampling rates:	
		Samples /sec	slow: 10 - 500 Hz	
		Samples /sec	fast: 0.5 - 10 kHz	
6	DC coupled inputs	yes / no	yes	
7	Resolution	bits	16	
8	Accuracy	%	Min 0.5	
9	Burden			
	1. Current circuit at IN	VA		
	2. Voltage circuit	VA		

No	Item	Units	Required	Tendered
10	Over load			
	1. Current	%In	100% In continuously, 700% In for 1 second	
	2. Voltage	%Vn	2Vn and max. 350 Vn	
(c)	**Digital Input**			
1	Number of channels - Expandability (without any time skew)		Min 66	
2	Selectable Input level	Vdc	N/O or N/C , 24 V-250 V DC	
3	Type		Potential or potential free contact	
4	Resolution	ms		
(d)	**Memory**			
1	Size		128MB or higher	
2	Type		Solid state	
3	Pre-fault time (fast scanning rate)	sec	0.1 – 2 user programmable	
4	Post fault (fast scanning rate)	sec	0.1 – 20 programmable	
5	Pre- and Post-fault time (slow scanning rate)	sec	min. 180 user programmable	
6	In-built hard disk (auto-maintained	GB	min. 4 GB	
7	Features		Preferably programmable and virtually recordable	
(e)	**Sensor** /Triggering Circuits			
	All sensors/ triggers are preferably programmable and virtually recordable			
1	Logical combination sensor	Yes / No	yes	
2	Three phase over or under voltage / current	Yes / No	yes	
3	Mono phase over or under voltage / current	Yes / No	yes	

No	Item	Units	Required	Tendered
4	du / dt , dp/ dt, dg/dt,(sigl/3phase)df/dt,etc	Yes / No	yes	
5	RMS (voltage/current)	Yes / No	yes	
6	Zero sequence	Yes / No	yes	
7	Negative, positive sequence	Yes / No	yes	
8	Frequency	Yes / No	yes	
9	DC signal step	Yes / No	yes	
10	Pending /swing	Yes / No	yes	
11	Digital level and edge	Yes / No	yes	
12	Sensor trigger	Yes / No	yes	
13	Event trigger	Yes / No	yes	
14	Manual trigger	Yes / No	yes	
15	Remote trigger	Yes / No	yes	
(f)	Clock System			
1	Internal clock	Yes / No	yes	
2	Accuracy			
3	External Synchronization	Yes / No	yes	
4	Time resolution between 2 synchronized pulses			
5	GPS Synchronisation	Yes/No	yes	
(g)	Output Alarm Relay Contact			
1	Max. operating voltage DC / AC	Vac / Vdc	250Vac or above 60 V dc or above	
2	Make and carry for 0.5 sec	A	Min 8A	
3	Carry continuously	A	Min 5A	
4	Break (DC) - resistive	W		
(h)	Interface for Data Communication			
1	Full definition compression	yes / No	yes	
2	Maximum transmission rate	bits / sec		
3	TCP/IP(10/100 Mbps) Ethernet port(Rj45)	yes / No	yes	
4	Standard serial port (EIA _ 232_D)	yes / No	yes	

No	Item	Units	Required	Tendered
5	Printer port	yes / No	yes	
6	Dedicated serial port for modem	yes / No	yes	
7	TCP/IP port for Master Station	yes / No	yes	
(i)	**Printer Data**			
1	Printer amplitude (scaling peak to peak)			
2	Time Scale (mm / s)			
3	Printer resolution	mm		
4	Auto printing	yes / No	Yes	
(j)	Fault priority transmission	yes / No	Yes	
(k)	Fault location (Distance calculation)	yes / No	Yes	
(l)	Test certificates from Internationally recognised Laboratories	Yes / No	Yes	
(m)	**Communication and Remote Analyzing Unit**			
1.	Processor Pentium	(MHz) Yes/No	At least 2 GHz Pentium	
2.	Co- processor Pentium	yes / No	Yes	
3.	Main memory capacity	(MB) Yes/No	At least 2GB	
4.	Colour graphics board S-VGA	yes / No	Yes	
5.	Screen S-VGA	yes / No	Yes	
6.	Hard disk unit	yes / No	At least 80GB	
7.	Printer	yes / No	Yes	
8.	Modem	yes / No	Yes	

2.10. Power Quality Analyzer

No	Item	Units	Required	Tendered
(a)	General			
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Power Supply	VDC	110V	
4.	Relevant Standard			
	- Equipment		IEC/EN 61010-1, IEC 61010-2-031 IEC/EN 61326-1 IEC 61000-4-7	
	- Power Quality		EN 50160 IEEE 1159 IEC 61000-4	
(b)	Analogue Inputs			
1.	Number of channel		32 (**24 voltage** -16 for permanent & 8 for bay monitoring. **8 current -** 8 bay)	
2.	Nominal Current	Amp	1A	
3.	Nominal Voltage	Vac / Vdc	110	
4.	Error		Less than 1%	
5.	A to D Converter		At least 16bit	
	Anti - aliasing filters	Yes/No	Yes	
6.	Insulation		600V CAT III	
7.	Possible sample rate		500Hz or higher	
8.	Transient sample rate		Up to 10MHz	
(c)	Digital Input			
1	Number of channels		As per specification	
2	Selectable Input level	Vdc	N/O or N/C , 110V DC	
3	Type		Potential or	

No	Item	Units	Required	Tendered
			potential free contact	
4	LED for each channel Y e s	Yes / No	Yes	
(d)	**Memory**			
1	Size		2GB	
2	Parameters & Configuration		Non Volatile	
(e)	**Digital Output**			
	No of programmable type		6 nos.	
(f)	**Clock System**			
1	Internal clock	Yes / No	yes	
2	Accuracy			
5	GPS Synchronisation	Yes/No	yes	
(g)	**Communication & Data transmission**			
1	Ethernet	Yes/No	Yes	
2	RS 232	Yes/No	Yes	
3	Dial Up modem	Yes/No	Yes	
(h)	**Measuring Cycle**			
1	Standard		IEC 61000-4-7 IEC 60868	

2.11. FIBER OPTIC & SCADA EQUIPMENT

2.11.1. Optical Fibre Equipment

No	Item	Units	Required	Tendered
	SDH-Multiplexer			
(a)	Main Services			
1.	Manufacturer's name & address			
2.	Manufacturer's type designation & model number			
3.	Remote Management via existing NMS		yes	
4.	Working temperature range	Deg C	30-40	
5.	Working voltage	V DC	-48V DC	
6.	PDH Cross connection capacity		≥ 2x128Mbps	
7.	SDH cross connection		VC-12, VC-3,VC-4	
8.	Relative Humidity			
9.	Power Consumption	W		
10.	Output aggregate bit rate		STM-1/STM-4	
11.	User Interface		Ethernet	
12.	Power supply inputs		2 Nos. -48VDC inputs	
13.	Central Processing Units		2 nos. (Main and Standby)	
14.	Size of panel (W x D x H)	mm		
(b)	SDH Aggregate module	pcs		
1.	Bit Rate		STM-1/STM-4	
2.	Number of SDH ports		> 4	
3.	Traffic protection		SNCP/MSP	
4	Number of Ethernet ports		>4	
(c)	Tributary modules			
(i)	PDH E1 Module	pcs		
1.	No of electrical ports		> 4	
2.	Bit rate		2048 kbps±50 PPM	

No	Item	Units	Required	Tendered
3.	Traffic protection		SNCP on 64kbps and P12 layer for transparent E1 channels	
(ii)	V.24/V.28 Data Access Module	pcs		
1.	Bit rate	kbps	0.6 to 38.4 asynchronous and 48,56, 64 synchronous	
2.	No of ports		> 4	
3.	Point to multipoint and point to point data conferencing facility		yes	
(iii)	Ethernet switching and routing module for IEC 104 SCADA	pcs		
1.	No of physical ports		> 4	
2.	Bit rates		10/100 Base T	
3.	Features		L2 switching, L3 routing	
4.	L2 switching		Min 8 independent switching instances	
5.	L3 routing		OSPF routing, Static routing, VRRP, Inter VLAN routing	
6.	Traffic protection		STP, RSTP	
(iv)	Ethernet module for other IT applications	pcs		
1	No of ports 10/100/1000 BaseT physical ports		>8	
2	No of GbE/10 GbE , SFP based physical ports		>4	
3	Features		L2 Switching, VLAN	
4	L2 switching		Min 8 independent switching instances	
5	Traffic Protection		STP, RSTP	
(iv)	FXO Module	pcs		

No	Item	Units	Required	Tendered
1.	No of ports		>12	
2.	Input level (from Exchange)	dBr	-5…….+4 Programmable	
3.	Output level (to Exchange)	dBr	-7.5…..-1, programmable	
4.	Nominal Impedance	ohm	600	
5.	Channel bandwidth	Hz	300-3400	
6.	Signalling		Pulse, DTMF	
(v)	**FXS Module (2 wire)**	pcs		
1.	No of ports		≥10	
2.	Input level(from subscriber)	dBr	-5….+4 , programmable	
3.	Output level (from subscriber)	dBr	-7.5….-1, programmable	
4.	Nominal Impedance	ohm	600	
5.	Channel Bandwidth	Hz	300-3400	
(vi)	**4 wire E & M Voice Interface**			
	No of Ports		≥4	
	Input Level	dBr		
	Output level	dBr		
	Power Consumption	W		
	Signalling			
	Bandwidth	KHz		
	Tele protection			
(vii)	**Line protection module**	pcs		
1.	No of ports		≥4	
2.	Connector		Terminal block for direct wiring	
3.	Protection Voltage	VDC	24 – 250, programmable	
4.	Traffic protection		1+1 protection (	

No	Item	Units	Required	Tendered
			with typically 3.5 ms switch over time)	
5.	Propagation Delay time	ms		
6.	No of auxiliary ports		≥8	
7.	**Features**			
	Protection link addressing		yes	
	Remote supervision and management		yes	
	Command drop and insert		yes	
	Event recorder		yes	
	Auxiliary relay outputs		yes	
(viii)	**Differential Protection Module**	pcs		
1.	Protection port Bitrate	kbps	≥ 64	
2.	1+1 path traffic protection		yes	
3.	No of Ports		≥ 4	

2.12. GROUNDING MATERIALS

No	Item	Units	Required	Tendered
(a)	**Shield Wire System**			
1.	Manufacturer's name and address			
2.	Material			
3.	Overall diameter	mm		
4.	Nominal section	mm^2		
5.	Cross section and make-up			
6.	Maximum rated current (3 Sec.)	A		
7.	Maximum working tension of main connections	kg/m^2		
8.	Resistance of conductor per 100 m at 30 ^0C	ohm		
9.	Tensile breaking stress of material	N/mm^2		
10.	Maximum permissible span length	m		
11.	Maximum sag under own weight of maximum span	mm		
(b)	**Earthing Grid**			
1.	Manufacturer's name and address			
2.	Material			
3.	Overall diameter	mm		
4.	Nominal section	mm^2		
5.	Maximum rated current (3 Sec)	A		
6.	Resistance of conductor per 100 m at 30 ^0C	ohm		
(c)	**Grounding Electrodes**			
1.	Manufacturer's name and address			
2.	Material			
3.	Dimensions			
4.	Number of electrode per group			
5.	Number of earthing points per substation			
6.	Calculated resistance of combined earth grid and points			

2.13. Cables

2.13.1. 1000 V Cables

No	Item	Units	Required	Tendered
(a)	1000V Cables			
1.	Identification nos.			
2.	Manufacturers name & address			
3.	Number of cores			
4.	Cross sectional area	mm^2		
5.	Core stranding			
	(i) Number			
	(ii) Diameter	mm		
6.	Insulation thickness	mm		
7.	Materials of insulation			
8.	Type of filler			
9.	Type of tape			
10.	Bedding thickness	mm		
11.	Bedding outer diameter	mm		
12.	Type of sheath	mm		
13.	Sheath thickness	mm		
14.	Completed cable:			
	(i) Diameter	mm		
	(ii) Weight per meter	kg		
	(iii) Max. drum length	m		
15.	Minimum installed bending radius	mm		
16.	Maximum conductor temperature	^0C		
17.	Maximum DC resistance of conductor per km of cable at 20 ^0C	ohm		

2.13.2. Multicore Control Cables

No	Item	Units	Required	Tendered
(b)	Multicore Control Cables			
	Items Nos: (List types)			
1.	Identification nos.			
2.	Manufacturers name & address			
3.	Number of cores			
4.	Cross section area	mm^2		
5.	Core stranding			
	(i) Number			
	(ii) Diameter	mm		
6.	Insulation thickness	mm		
7.	Materials of insulation			
8.	Type of filter			
9.	Type of tape			
10.	Bedding thickness	mm		
11.	Bedding outer diameter	mm		
12.	Type of sheath	mm		
13.	Sheath thickness	mm		
14.	Completed cable:			
	(i) Diameter	mm		
	(ii) Weight per meter	kg		
	(iii) Max. drum length	m		
15.	Minimum installed bending radius	mm		
16.	Maximum conductor temperature	^0C		
17.	Maximum DC resistance of conductor per km of cable at 20 ^0C	ohm		

2.13.3. XLPE Power Cables

36 kV XLPE Power Cables

No	Item	Units	Required	Tendered
1	Name of the Manufacturer			
2	Country of Origin			
3	Rated Voltage category	kV	33	
4	System Highest Voltage (phase to phase) (U_m to IEC 60502)	kV	36	
5	Number of cores		One	
6	Basic Insulation level(Minimum)	kV	194kV	
7	Maximum Nominal Operating temperature	^{0}C	90 ^{0}C	
8	Applicable Standards		BS 6622-2007/IEC 60502-2-2014 as applicable	
9	Conductor			
	-Design fault current and duration for a conductor	kA/sec	25kA/1sec	
	- Cross sectional area	mm^2		
	- Diameter			
	-Number of strands			
	-Diameter of strands			
	- Material		Annealed Copper	
	- Shape		Round	
	- Overall Dimensions	mm		
	-Type			
	i. Solid/Stranded		Stranded	
	ii. Compact/Non Compact		Compact	
	- Welding or soldering temp.	^{0}C		
10	Longitudinal water swellable tape			
	-Form of water blocking material			
	-Thickness	mm		
11	Conductor Screen			
	- Material			

No	Item	Units	Required	Tendered
	- Thickness Approx:	mm	As per applicable standard	
	- Method of application		Extruded	
12	Insulation			
	- Material		XLPE	
	-Extrusion process		Triple	
	i. Minimum Average Thickness	mm	As per applicable standard	
	ii. Minimum at a point	mm	As per applicable standard	
13	Insulation screen			
	- Type		Non metallic semi conducting	
	i.Semi conducting layer		Extruded	
	ii.Metallic		No	
	iii.strippability		Cold	
	-Material		Extruded semi conducting compound	
	-Maximum electrical Stress		As per applicable standard	
	- Thickness, approx.	mm		
	- Diameter over screen	mm		
14	Longitudinal water swellable tape			
	-Form of water blocking material			
	-Thickness	mm		
15	Metallic Layer			
	- Material		Copper	
	- No. Of Wires or Tapes	mm		
	- Size Of Wire or Tapes	mm		
	- Cross Section	mm^2		
	-Fault current carrying capacity of metallic screen	kA	25kA/1 sec	
16	Longitudinal water swellable tape			

No	Item	Units	Required	Tendered
	Form of water blocking material			
	Thickness	mm		
17	Metal Sheath		Not applicable	
	- Material		Not applicable	
	- Nominal Thickness	mm	Not applicable	
	- External Diameter	mm^2	Not applicable	
	Lead Alloy Sheath Composition		Not applicable	
	- Tin	%	Not applicable	
	- Cadmium	%	Not applicable	
	- Antimony	%	Not applicable	
	- Lead	%	Not applicable	
18	Innersheath			
	-Type/Material			
	-Thickness	mm		
19	Metallic armour			
	-Material		Aluminium Alloy	
	-Diameter of wire		As per applicable standard	
	-Maximum Working Hoop		kPa	
	-Stress			
	-Purity	%		
	- Plumbing Temperature	^0C		
20	Longitudinal water blocking material			
	-Form of water blocking material			
	-Thickness	mm		
21	Oversheath			
	- Type/Material		PVC-ST2 or Type 9	
	- Thickness	mm		
	i.Nominal	mm	As per applicable standard	

No	Item	Units	Required	Tendered
	ii. Minimum at a point	mm	As per applicable standard	
	-Whether Graphite layer provided		Yes	
	-Whether DC test on oversheath carried out			
	- Type of Termite Repellent			
22	Completed Cable			
	- Overall Diameter, approx.	mm		
	- Approximate weight of cable	Kg/m		
	- Drum Length	m		
23	Cable Drums			
	-Material of the drum		steel	
	- Overall Diameter	m		
	- Width	m		
	- Weight Loaded	kg		
24	Conditions Upon which current carrying capacity calculated			
	- Axial spacing between phase cable	mm		
	- Axial spacing between circuits	mm		
	- Soil thermal resistively	m.K/w		
	- Ground Temperature	^{0}C		
	- Air Temperature	^{0}C		
	- Burial depth	m		
	- Type Of earth bonding: Single Point	Yes/No		
25.	Current Carrying Capacity Based On the conditions specified			
	Main Transformer Feeders (31.5MVA)	A	800	
	Main Transformer Feeders (63MVA)	A	1400	
	Line Feeders	A	400	
	Generator Feeders	A	800	

No	Item		Units	Required	Tendered
	Auxiliary Transformer Feeders		A	5	
26	Current Ratings				
	-Laid Direct	Trefoil	A		
		Flat			
	-Laid in Ducts	Trefoil	A		
		Flat			
	-Laid in air	Trefoil	A		
		Flat			
	-whether the maximum symmetrical short circuit current rating curves for 0.2 to 0.3 sec. duration Furnished			Yes	
27	Maximum dielectric stress at the Sector screen (assumed smooth)		kV/mm		
28	Minimum radius of bend around which can be laid.				
	- Laid direct.		m		
	- In ducts.		m		
	- In Air.		m		
29	Nominal internal diameter of pipes or ducts through which cable may be pulled.		mm		
30	Maximum D.C Resistance of conductor per meter of cable 20^0C			As per applicable standard	
	- of Conductor		μΩ/m		
	- of metallic layers		μΩ/m		
31	Maximum A.C. Resistance of conductor per meter of cable at maximum conductor temperature.		μΩ/m		
32	Insulation Resistance Of Cable Per Core				
	- 20^0C		MΩ		
	- at max. rated temp.		MΩ		
33	Maximum conductor reactance at 50Hz		μΩ/m		

No	Item	Units	Required	Tendered
34	Maximum conductor capacitance at 50Hz	pF/m		
35	Coefficient of thermal variations of the electrical parameters			
36	Maximum Charging Current per core per meter of Cable at nominal voltage U_0	A		
37	Maximum Conductor Temperature at and duration			
	-Full load condition/Duration	^{0}C		
	-Short circuit condition/Duration	^{0}C		
	-Overload condition/Duration	^{0}C		
	-Allowable maximum overloading in determining the above	%		
38	Conductor Short Circuit Current carrying capacity for one second, cable loaded as above prior to short circuit and final conductor temperature of 250^{0}C	kA	25kA/1 sec	
39	Metallic layer earth faulty current Carrying Capacity for one second, cable loaded as above Prior to earth fault and final screen temperature	kA	25kA/1 Sec	
40	Maximum dielectric loss of cable per meter of three-phase circuit when laid direct in the ground at nominal voltage U_o, nominal frequency and operating at maximum conductor Temperature	W/m		
41	Maximum dielectric loss angle of charging VA of Cable when laid direct in the ground at nominal voltage, Uo, normal frequency at	tan d		
	-A conductor temperature of 20^{0}C			
	-Maximum Conductor Temperature	tan d		
42	Maximum dielectric loss angle of charging VA of cable at normal			

No	Item	Units	Required	Tendered
	frequency conductor temperature of 20^0C at			
	-50% rated voltage U_o	tan d		
	-125% rated voltage U_o	tan d		
	-200% rated voltage U_o	tan d		
43	Metallic layer loss (including amour if applicable) Of cable per meter of three-phase circuit at nominal voltage U_o and normal frequency at the circuit rating stated above	W		
44	Horizontal distance between cable supporting racks			
45	Creepage distance of sealing end porcelain			
	Specified	mm		
	Guaranteed	mm		
46	Partial discharge at $2U_0$	%	<=5	
47	Whether a certified copy of ISO 9001:2015 or latest furnished with the offer			
48	Whether all the Type test certificates specified in BS 6622:2007 or IEC 60502:2014 submitted		Yes/No	
	-Whether Copy of Accreditation certificate of type test laboratory submitted		Yes/No	
49	Incase cables are type tested for IEC standards, whether supplier/manufacturer is agreeing to perform tests according to BS 6622 during pre shipment(for the tests which are less stringent than BS 6622:2007 and not covered)		To be agreed	

2.14. POWER TRANSFORMERS

2.14.1. 63 MVA, 132/33 kV Transformer

No	Item	Units	Required	Tendered
(A)	Rating and Performance			
1.	Manufacturer's name and address			
2.	Continuous maximum rating (ONAN/ONAF)	MVA	46/63	
3.	Number of phases		3	
4.	Rated Frequency	Hz	50	
5.	Number of Windings		2	
6.	Applicable standards		IEC 60076:2011	
7.	System maximum voltages			
	- HV	kV	145	
	- MV	kV	36	
8.	Winding Insulation			
	- HV		Graded	
	- MV		Uniform	
9.	Highest voltage for equipment			
	- HV	kV	145	
	- MV	kV	36	
10.	Winding insulation levels			
	- HV		LI: 650, AC: 275	
	- MV		LI: 170, AC: 70	
11.	Transformer nominal ratio		132 kV/ 33 kV	
12.	Phase connections			
	- HV winding		Star	
	- MV winding		Delta	
	- Vector group		YNd1	

No	Item	Units	Required	Tendered
13.	Short circuit withstand fault level at terminals of			
	- 145 kV Busbars	kA	31.5	
	- 36 kV Busbars - Short circuit current duration	kA sec	25 3	
14.	Type of cooling		ONAN/ONAF	
15.	External cooling medium		Air	
16.	Service conditions			
	• Altitude not exceeding	m	1000	
	• Air temperature not exceeding	^{0}C	40	
	• Average air temperature in any one year not exceeding - In any one day - Average in one year	 ^{0}C ^{0}C	 32 30	
17.	On load tap changer			
	(a) Type		M.R. Germany	
	(b) Category of voltage control		CFVV	
	(c) HV or LV winding		HV	
	(d) Range (+ & -) (e) Interrupter		+7 to -10 Vacuum Type	
	(f) Step size	%	1.5	
	(g) Power frequency withstand test voltage between first and last contacts of the selector switch between any two adjacent contacts of the selector between diverter and switch contacts	kV		
	(h) Type test certificate reference			
	(i) Tap position indication	2nos BCD		
18.	Size of tapping step with position nos.		18 taps 1.5% step voltage	
19.	Approximate ONAN rating	MVA	46	

No	Item	Units	Required	Tendered
20.	Winding temperature rise at CMR	^{0}C	55	
21.	Top oil temperature rise			
	(a) CMR	^{0}C	50	
	(b) ONAN rating	^{0}C		
22.	Maximum hot spot temperature at CMR	^{0}C	98	
23.	Maximum winding hot spot temperature of transformer at			
	(a) Normal Cyclic Loading (IEC 60076-7)	^{0}C	120	
	(b) Long time emergency loadings (IEC 60076-7)	^{0}C	140	
	(c) Short time emergency loading (IEC 60076-7)	^{0}C	160	
24.	Flux density in iron at nominal voltage and frequency and at nominal ratio – (no load)			
	(a) Core	Tesla	1.6	
	(b) Yokes	Tesla	1.6	
25.	Magnetizing current (approx) at nominal ratio and			
	- At 0.9 x nominal voltage	%		
	- At 1.0 x nominal voltage	%		
	- At 1.1 x normal voltage	%		
	- At 1.2 x normal voltage	%		
26.	Guaranteed losses at 75 ^{0}C			
	- No load losses at rated voltage, frequency and at nominal tap position	kW	Maximum 35	
	- Load losses at maximum tap position at ONAN base	kW		
	- Load losses at nominal tap position at ONAN base	kW		
	- Load loss at minimum tap position at ONAN base	kW		
	- Load losses at maximum tap position at ONAF base	kW		
	- Load losses at nominal tap position at ONAF base	kW	Maximum 210	
	- Load loss at minimum tap position at ONAF base	kW		

No	Item	Units	Required	Tendered
	- Auxiliary losses at CMR corrected to 75^{0}C	kW	Maximum 3	
	- Total losses at nominal tap position at ONAN base	kW		
	- Total losses at nominal tap position at ONAF base	kW		
27.	Efficiency referred to 75 ^{0}C and nominal ratio			
	(a) 100 % CMR at unity power factor	%		
	(b) 75 % CMR at unity power factor	%		
	(c) 50 % CMR at unity power factor	%		
	(d) 25 % CMR at unity power factor	%		
	(e) 100 % CMR at 0.8 power factor	%		
	(f) 75 % CMR at 0.8 power factor	%		
	(g) 50 % CMR at 0.8 power factor	%		
	(h) 25 % CMR at 0.8 power factor	%		
28.	Voltage regulation referred to 75 ^{0}C and nominal ratio			
	(a) 100 % CMR at unity power factor	%		
	(b) 75 % CMR at unity power factor	%		
	(c) 50 % CMR at unity power factor	%		
	(d) 25 % CMR at unity power factor	%		
	(e) 100 % CMR at 0.8 power factor	%		
	(f) 75 % CMR at 0.8 power factor	%		
	(g) 50 % CMR at 0.8 power factor	%		
	(h) 25 % CMR at 0.8 power factor	%		

No	Item	Units	Required	Tendered
29.	Impedance voltage at 75 ^{0}C			
	(a) For nominal tap position between HV and MV windings at ONAN rating	%		
	(b) For nominal tap position between HV and MV windings at ONAF rating	%	12.5	
	(c) For maximum tap position between HV and MV windings at ONAN rating	%		
	(d) For maximum tap position between HV and MV windings at ONAF rating	%		
	(e) For minimum tap position between HV and MV windings at ONAN rating	%		
	(f) For minimum tap position between HV and MV windings at ONAF rating	%		
30.	Equivalent zero sequence impedance between HV and LV windings			
31.	Maximum current density in windings at CMR			
	(a) HV winding	A/mm^2		
	(b) MV winding	A/mm^2		
32	Transformer warranty period	Years	2	
(B)	Control Circuits			
1.	Type of controls for on load tap changer and cooler controls		Automatic	
2.	Whether automatic control required		Yes	
	Reference voltage (VT output line to line)	V	110 AC (50 Hz)	
3.	Whether load compensation required on the AVR		Yes	
4.	Whether separate remote control panel required		Yes	
5.	Estimated distance between remote control point and transformer	m	<110	

No	Item	Units	Required	Tendered
6.	DC Supply (Control voltage)			
	- Nominal	V DC	110	
	- Maximum float voltage	V DC		
7.	AC supply voltage for tap changer operating motor 3 phase		400 V AC 50 Hz	
8.	Whether provision for supervisory control required, including AVR setting		Yes	
9.	Whether marshalling kiosk required		Yes/No	
10.	Transformer terminals for line and neutral			
	(a) HV line		Outdoor Bushings	
	(b) MV line		Outdoor Bushings	
	(c) Neutral		Outdoor Bushings	
	(Attach all technical data of all types of bushings & ducts)			
11.	Accommodation for current transformers bushings at			
	(a) HV line			
	(b) MV line			
	(c) Neutral			
12.	Accommodation of tank for outdoor weatherproof HV neutral current transformers			
13.	Pollution category of bushings Creepage distance based on system highest voltage		43.3mm/kV (USCD)	
(C)	Cooling			
1.	Minimum number of radiators per transformer			
2.	Maximum rating of each radiator as percentage of total loss at CMR	%		
3.	Cooling capacity 100% with one fan out of order		Yes	
(D)	General			
1.	Type of oil preservation system		Conservator with silica gel breather	
2.	Whether wheels, skid or flat base required		Wheels	
3.	Whether anti-vibration pads		No	

No	Item	Units	Required	Tendered
	required			
4.	Transformer Sound Pressure Level	dB(A)	79	
(E)	**Details of Construction**			
1.	Types of winding			
	(a) HV			
	(b) MV			
2.	Material of Insulation			
	(a) HV			
	(b) MV			
3.	Insulation of tapping connections			
4.	Insulation of			
	(a) Yoke bolts			
	(b) Side plates			
5.	Winding connection brazed or crimped (specify winding and joint material)			
6.	Is facility for adjustment of axial pressure on windings	Yes/ No		
7	Thickness of transformer tank			
	(a) Sides	mm		
	(b) Bottom	mm		
	(c) Cover	mm		
8.	Material used for gaskets for oil tight joints			
9.	Cover Flange			
	- Level	Low/high		
	- Joint	Welded		
10.	Maximum vacuum pressure safely withstand by tank	Pa		
(F)	**Radiators and Fans**			
1.	Thickness of radiator plates and/ or cooling tubes			

No	Item	Units	Required	Tendered
2.	Equipment for ONAN cooling state (a) or (b) (a) Radiator on main tank (b) Separate cooler bank			
3.	Number of cooling air blowers per transformer			
4.	Speed of air blowers and air flow	rpm/m^3 per min		
5.	Rating of each air blower motor	kW		
6.	Starting current of each air blower motor	A		
(G)	**Oil volumes, weights and dimensions**			
1.	Total oil required including cooler system	Liters		
2.	Volume of oil to fill transformer above the top yoke	Liters		
3.	Capacity of conservator	Liters		
4.	Volume of oil in conservator between highest and lowest visible points	Liters		
5.	Weight of core and winding assembly	Tons		
6.	Weight of each oil cooler bank complete with oil if mounted separately from transformer	Tons		
7.	Total weight of complete transformer, including attached coolers, voltage regulating equipment, all fittings and oil	Tons		
8.	Weight of transformer arranged for transport	Tons		
9.	Overall dimensions including bushings			
	- Height	mm		
	- Depth	mm		
	- Width	mm		
10.	Shipping dimensions			
	- Height	mm		
	- Depth	mm		
	- Width	mm		

No	Item	Units	Required	Tendered
11.	Minimum space required for transformer bay			
	- Depth	mm		
	- Width	mm		
(H)	**Transformer oil**			
1.	Manufacturer			
2.	Type		Uninhibited	
3.	Class		1	
4.	Standard		IEC60296	
(I)	**Transformer parts subject to Short circuit test**			
1.	Demonstration of ability to withstand short circuit as per IEC 60076-5: 2006	(Yes / No)	Yes	
(J)	**Transformer bushing**			
1.	132 kV Bushings			
	- Manufacturer			
	- Insulator material (Solid/oil-paper)			
	- Manufacturer's type reference and rated voltage			
	- Rated current	A		
	- Manufacturer of porcelain			
	- Length of insulator (Overall)	mm		
	- Weight of insulator	kg		
	- Electrostatic capacity of complete bushings.	pF		
	- Dry lightning impulse voltage (1.2/50 wave) test voltage	kV		
	- 50 Hz dry voltage withstand test voltage without arching horns	kV		
	- 50 Hz wet voltage withstand test voltage without arching horns	kV		
	- Total creepage distance of shed (USCD minimum 43.3mm/kV based on maximum system voltage)	mm		
	- Capacitive voltage tap available for testing purposes		Yes	

No	Item	Units	Required	Tendered
2.	33 kV Bushings			
	- Manufacturer			
	- Insulator material (Solid/oil-paper)			
	- Manufacturer's type reference and rated voltage			
	- Rated current	A		
	- Manufacturer of porcelain			
	- Length of insulator (Overall)	mm		
	- Weight of insulator	kg		
	- Electrostatic capacity of complete bushings.	pF		
	- Dry lightning impulse voltage (1.2/50 wave) test voltage	kV		
	- 50 Hz dry voltage withstand test voltage without arching horns	kV		
	- 50 Hz wet voltage withstand test voltage without arching horns	kV		
	- Total creepage distance of shed (USCD minimum 43.3mm/kV based on maximum system voltage)	mm		
	- Capacitive voltage tap available for testing purposes		Yes/No	
3.	132 Neutral Bushings			
	- Manufacturer			
	- Insulator material (Solid/oil-paper)			
	- Manufacturer's type reference and rated voltage			
	- Rated current	A		
	- Manufacturer of porcelain			
	- Length of insulator (Overall)	mm		
	- Weight of insulator	kg		
	- Electrostatic capacity of complete bushings.	pF		
	- Dry lightning impulse voltage (1.2/50 wave) test voltage	kV		
	- 50 Hz dry voltage withstand test voltage without arching horns	kV		

No	Item	Units	Required	Tendered
	- 50 Hz wet voltage withstand test voltage without arching horns	kV		
	- Total creepage distance of shed (USCD minimum 43.3mm/kV based on maximum system voltage)	mm		
	- Capacitive voltage tap available for testing purposes		Yes/No	
(K)	**Transformer tank Fittings**			
1	Draining and filter valves (a) Type (b) Material for 75 mm and below (c) Material for above 75 mm		Yes Gate/ Ball Gunmetal	
2	Valves for tank oil sampling (a) Type (b) Material		Yes Gunmetal	
3	Radiator isolation valves (a) Type (b) Material for 75 mm and below (c) Material for above 75 mm		Yes Gunmetal	
4	Pulling eyes for complete transformer		yes	
5	Supports for hydraulic jacks		yes	
6	Lifting lugs		yes	
7	Tank earth terminals		yes	
8	Core earth terminal box		yes	
9	Inspection manholes		yes	
10	Ladder		yes	
11	Skids or wheels adjustable in two directions		yes	
(L)	**Transformer accessories**			
1	Oil preservation system with or without rubber bag		Yes	
2	Dehydrating breather		Yes	
3	Oil level indicator of magnetic type		Yes	
4	Contact thermometer for the oil temperature		Yes	
5	Winding temperature indicator		Yes	
6	Direct winding temperature measurement using fibre optic sensors		Yes	

No	Item	Units	Required	Tendered
7	Pressure relief device		Yes	
8	Rapid pressure relay		Yes	
9	Buchholz relay		Yes	
10	Buchholz relay gas sampling		Yes	
11	On-line gas monitor		No	
12	On-line monitoring system		No	
13	Fire protection system		Yes	
(M)	**Quality Assurance**			
1	Manufacturer quality assurance acc. to ISO 9001 and 14001		Yes	
2	Manufacturer Quality Manual is submitted with offer		Yes	
3	Manufacturer a sample of Quality Inspection and Test Plan is submitted with offer		Yes	
(N)	**Other Information**			
1.	Negative pressure tank can withstand			
2.	Type & Special test Certificate for similar category transformer	To be annexed	Yes	
3.	Customer reference list for similar category Transformers	To be annexed	Yes	
4.	Tests carried out at the manufacture's work as per IEC 60076-1:2011	To be annexed	Yes	
(O)	**Routine tests at manufacturers works (IEC 60076-1:2011)**			
1	Measurement of winding resistance (11.2).		Yes	
2	Measurement of voltage ratio and check of phase displacement (11.3).		Yes	
3	Measurement of short-circuit impedance and load loss (11.4).		Yes	
4	Measurement of no-load loss and current (11.5).		Yes	
5	Dielectric routine tests (IEC60076-3). For non-uniformly insulated transformers of category 72,5 kV < Um ≤ 170 kV as per Table 1 of IEC 60076-3-2013, LTAC shall be performed on all units.		Yes	
6	Tests on on-load tap-changers (11.7).		Yes	

No	Item	Units	Required	Tendered
7	Leak testing with pressure for liquid- immersed transformers (tightness test) (11.8).		Yes	
8	Check of the ratio and polarity of built-in current transformers.		Yes	
9	Check of core and frame insulation for liquid immersed transformers with core or frame insulation (11.12).		Yes	
10	Insulation of Auxiliary wiring (IEC 60076 , part 3)		Yes	
11	Partial discharge measurement (IEC 60076 , part 3		Yes	
12	Determination of capacitances windings- to-earth and between windings		Yes	
13	Measurement of d.c. insulation resistance and polarity index between each winding to earth and between windings.		Yes	
14	Measurement of dissipation factor (tan δ) of the insulation system capacitances.		Yes	
15	Measurement of no-load loss and current at 90 % and 110 % of rated voltage(11.5).		Yes	
(P)	**Type tests**			
1	Temperature-rise type test (IEC60076-2).		Yes	
2	Dielectric type tests (IEC60076-3).		Yes	
3	Determination of sound level (IEC60076-10) for each method of cooling		Yes	
4	Measurement of the power taken by the fan and liquid pump motors.		Yes	
5	Measurement of no-load loss and current at 90% and 110% of rated voltage		Yes	
(Q)	**Special tests**			
1	Dielectric special tests (IEC60076-3).		Yes	
2	Winding hot-spot temperature-rise measurements.		Yes	
3	Determination of capacitances windings- to-earth, and between windings.		Yes	

No	Item	Units	Required	Tendered
4	Measurement of dissipation factor (tan δ) of the insulation system capacitances.		Yes	
5	Determination of transient voltage transfer characteristics (Annex B of IEC60076-3:2000).		Yes	
6	Measurement of zero-sequence impedance(s) on three-phase transformers (11.6).		Yes	
7	Short-circuit withstand test (IEC60076-5) (If theoretical evaluation is unsuccessful)		Yes (At an independent test lab such as KEMA or CESI)	
8	Measurement of DC insulation resistance each winding to earth and between windings.		Yes	
9	Vacuum deflection test on liquid immersed transformers (11.9).		Yes	
10	Pressure deflection test on liquid immersed transformers (11.10).		Yes	
11	Vacuum tightness test on site on liquid immersed transformers (11.11).		Yes	
12	Measurement of frequency response (Frequency Response Analysis or FRA). The test procedure shall be agreed between manufacturer and purchaser. (shall be performed on all units)		Yes	
13	Check of external coating (ISO 2178 and ISO 2409 or as specified).		Yes	
14	Measurement of dissolved gasses in dielectric liquid.		Yes	
15	Mechanical test or assessment of tank for suitability for transport (to customer specification).		Yes	
16	Determination of weight with transformer arranged for transport. For transformers up to 1,6 MVA by measurement. For larger transformers by measurement or calculation as agreed between manufacturer and purchaser.		Yes	
17	Measurement of the harmonics of the no- load current		Yes	

No	Item	Units	Required	Tendered
18	Insulation test of oil and Measurement of dielectric strength of oil		Yes	
(R)	**Site tests**			
1	insulation resistance measurement of core and frame insulation, winding insulation to earth and between windings		Yes	
2	frequency response analysis		Yes	
3	interrogation of shock recorders fitted for transport		Yes	
4	Voltage ratio		Yes	
5	Vector group		Yes	
6	Dielectric tests on transformer oil		Yes	
7	Temperature rise test with rated load for 6 hrs		Yes	
8	Thermograph imaging from all possible views		Yes	
9	Measurement of Moisture in oil & DGA after temperature rise test		Yes	
10	Any other oil tests (Please specify)		Yes/No	
11	Winding resistance on each tap		Yes	
12	Insulation resistance measurement		Yes	
13	Check of protective earthing connections		Yes	
14	Current transformer polarity check		Yes	
15	Control equipment circuit check		Yes	
16	Operation test of supervisory equipment		Yes	
17	Operation test of cooling equipment		Yes	
18	Operation test of on load tap changer		Yes	
19	Visual Inspections and adjustments as per clause 10.24 of technical specifications		Yes	
20	fingerprint tests (Um>72 kV)		Yes	
(S)	**Type test reports submitted with the bid**			
1	Temperature-rise type test (IEC60076-2).		Yes	

No	Item	Units	Required	Tendered
2	Dielectric type tests (IEC60076-3).		Yes	
3	Determination of sound level (IEC60076- 10) for each method of cooling		Yes	
4	Measurement of the power taken by the fan and liquid pump motors.		Yes	
5	Measurement of no-load loss and current at 90% and 110% of rated voltage		Yes	
(T)	**Special test reports submitted with the bid**			
1	Short circuit withstand test on similar transformer as per IEC 60076-5 at an internationally recognized test laboratory such as KEMA or CESI		Yes	

2.15. Earthing Transformers

No	Item	Units	Required	Tendered
	33kV EARTHING TRANSFORMERS 800A/30sec			
(a)	General			
1.	Manufacturer's Name & Address			
2.	Location of installation			
3.	Standards			
4.	Single or three-phase unit		Three- phase unit	
5.	Core or shell type			
6.	Type of tank			
7.	Tank fully vacuum proof		Yes	
8.	Number of windings			
9.	Specification of oil			
10.	Connection of HV phases			
11.	Connection of HV neutral			
12.	System voltages			
	- primary	kV		
(b)	Ratings			
1.	Rated symmetrical short circuit current of 33 kV system	kA		
2.	Rating of interconnected star winding on 3sec. basis	A		
3.	Earth-fault current duty (10 s)	A		
4.	Continuous rated current in Neutral	A		
5.	Rated voltages	kV		
6.	Vector group symbol	kV		
7.	Rated frequency	Hz		
(c)	Service Conditions			
1.	- Maximum ambient temperature	^{0}C		
2.	- Maximum service altitude	m		
3.	Temperature rise limit- oil / windings	K		

No	Item	Units	Required	Tendered
4.	Zero sequence impedance per phase (L.V. winding unloaded)	Ohms	70-80	
5.	Magnetic flux density at rated voltage and frequency	Tesla		
6.	No-load losses	kW		
(d)	**Insulation level and Tests**			
1.	Highest voltage for equipment			
	- windings / Bushings	kV		
2.	Minimum specific creepage distance of bushings based on highest system voltage	mm/kV	43.3 (USCD)	
3.	Routine tests according to IEC 60076 on each unit			
4.	Full-wave lightning Type test & impulse test on each unit			
	- test Voltage	kV		
(e)	**Operating Details**			
1.	Cooling method			
2.	Noise level at measuring distance of 0.3 m	dB(A)		
(f)	**Construction Details**			
1.	Bottom base type			
2.	Terminals:			
(g)	**Masses, Measures and Drawings**			
1.	Overall dimensions including bushings			
	- height	mm		
	- depth	mm		
	Shipping dimensions			
	- height	mm		
	- depth	mm		
	- width	mm		
2.	Total mass of transformer complete as in service	kg		
3.	Transportation mass	kg		

No	Item	Units	Required	Tendered
4.	Un-tanking mass	kg		
5.	Mass of insulating liquid	kg		
6.	Minimum space requirements for transformer bay			
	- width	m		
	- depth	m		

2.16. Auxiliary Transformers 33/0.4 kV

No	Item	Units	Required	Tendered
	AUXILIARY TRANSFORMERS 160 kVA, 33/0.4 kV			
(a)	General			
1.	Manufacturer's Name & Address			
2.	Location of installation			
4.	Single or three-phase unit		Three-phase unit	
5.	Core or shell type			
6.	Type of tank			
7.	Tank fully vacuum proof			
8.	Number of windings			
9.	Specification of oil			
10.	System voltages			
	- primary	kV		
	- secondary	kV		
(b)	Ratings			
1.	Rated power	kVA	160	
2.	Rated symmetrical short circuit current	kA		
3.	Rated voltages (no load)			
	- primary	kV		
	- secondary	kV		
4.	Vector group symbol		Dyn11	
5.	Rated frequency	Hz		
(c)	Service Conditions			
	- Maximum ambient temperature	^0C		
	- Maximum service altitude	m		
1.	Temperature rise limit '- top oil / windings	K		
2.	Impedance voltage at rated power	%	on HV base 4.5	
	between H.V. and L.V. windings			

No	Item	Units	Required	Tendered
3.	Zero sequence impedance per phase (L.V. winding unloaded)	Ohms		
4.	Magnetic flux density at rated voltage and frequency	Tesla		
5.	No-load losses	kW		
6.	Load losses at full rated power of L.V. winding	kW		
(d)	**Insulation level and Tests**			
1.	Highest voltage for equipment			
	- primary winding	kV		
	- secondary winding	kV		
2.	Routine tests according to IEC 60076 series on each unit			
3.	Full-wave lightning impulse test			
	Type test on each unit			
	- test Voltage / primary	kV		
(e)	**Operating Details**			
1.	Cooling method		ONAN	
2.	Noise level at measuring distance of 0.3 m	dB(A)		
(f)	**Construction Details**			
1.	Bottom base type			
2.	Terminations:			
	- HV		Outdoor Bushing	
	- LV		Cable Box	
	- Neutral		Cable Box	
(g)	**Masses, Measures and Drawings**			
1.	Overall dimensions including bushings			
	- height	mm		
	- depth	mm		
	- width	mm		

No	Item	Units	Required	Tendered
	Shipping dimensions			
	- height	mm		
	- depth	mm		
	- width	mm		
2.	Total mass of transformer complete as in service	kg		
3.	Transportation mass	kg		
4.	Un-tanking mass	kg		
5.	Mass of insulating liquid	kg		
6.	Minimum space requirements for transformer bay			
	- width	m		
	- depth	m		

2.17. Diesel Generator

No	Item	Units	Required	Tendered
	DIESEL GENERATOR			
1.	Manufacturer's Name & Address			
2.	Type			
3.	Rating	kVA	See Scope of Works	

2.18. Energy Meters

No	Item	Units	Required	Tendered
A	General			
A.1	Name of the Manufacturer			
A.2	Address of the Manufacturer			
A.3	Country of Manufacture			
A.4	Make			
	Model No.			
	Manufacturers Catalogue Ref. No.			
A.5	Type		3P4W	
A.6	Applicable Standards		As per clause 2.0	
B	Principle Parameters			
B.1	Reference voltage and operating range	V	110	
B.2	Standard Rated Current	A	1	
B.3	Rated Maximum Current (Imax)		1.2 times of the rated current	
B.4	Starting Current of Meter		at 0.001 of basic current	
B.5	Auxiliary Supply	V	60-240 V AC/DC	
C	Basic Features			
C.1	Limit of errors 1. Active Energy Reactive Energy		 Class 0.2S Class 2	
C.2	Capability of measurement in full p.f range		Accuracy in full p.f range	
C.3	TOD measurement		Yes	
	Minimum TOD intervals		6	
C.4	Demand integration period	min	15	
C.5	Maximum demand reset both Locally and Remotely		Yes	
C.6	Password Authorization Levels		Min 2 levels	
C.7	No. of Blinking LEDs		Min 2	

No	Item	Units	Required	Tendered
A.3	Blinking LED analogues to 1. Active Energy consumption 2. Reactive Energy consumption		Yes Yes	
C.8	Battery lifetime of calendar clock battery		Min 10 years	
C.9	Display Sequence		As per in Clause 3.2.8 of this specification	
C.10	Meter Sampling rate		30s or less	
C.11	Memory retention period (months)		12 months	
C.12	Programming parameters		As per Clause 3.2.9 of this specification	
C.13	Logging Load profile		as per Clause 3.2.9 of this specification	
C.14	Event log		as per Clause 3.2.9 of this specification	
C.15	Display memory type		non-volatile	
D	Remote/ Local Communication			
D.1	Types of communication ports available		Optical Port	
B.5	Auxiliary Supply		RS 232	
C	Basic Features		Ethernet	
D.2	Remote meter access via a GSM and 2G/3G/4G modem		Yes	
D.3	Software and manuals		As per Clause 3.3.4 of this specification	
D.4	Meter communication 1. software name 2. version			
D.5	Facilities provided by remote operation			
	(a) To programme each meter		Yes	
	(b) To take the relevant meter reading individually		Yes	

No	Item	Units	Required	Tendered
	(c) To download stored data from meter		Yes	
D.6	Type of Modem		Dual band GSM modem (900/1800 MHz) or 2G/3G/4G modem	
D.7	Mounting of Modem		Built In	
D.8	Power Supply to the modem		Through Meter	
D.9	Minimum speed of the modem (kbps)			
D.10	Type of the Network Switch		Unmanageable	
D.11	Number of IP Ports and the speed		Minimum 24 No.s 10/100 Mbps	
D.12	Download data to be stored in MS Access/SQL		Yes	
D.13	Tamper proof SIM card holder		Yes	
D.14	DLMS based communication enable		Yes	
D.15	APIs are provided		Yes	
E	**Mechanical Requirement**			
E.1	Protective class		Class 2 (Double Insulation)	
E.1	Type of meter cover and terminal cover		As per clause 3.4.1 and 3.4.3 of this specification	
E.2	Bore Size of the terminals and number of screws provided		As per clause 3.4.2 of this specification	
E.3	Degree of protection (IP Category)		IP 51 (minimum)	
E.4	No. of digits in the LCD display		Minimum 10 including three decimals	
E.5	Size of numbers in the LCD display		Minimum 4mm high and 4 mm width	
E.6	Seal-ability of meters to prevent from: • Access to adjustment or calibration		Yes	

No	Item	Units	Required	Tendered
	devices on meter • Access to terminals of incoming current or potential wiring		Yes	
F	**Climate Condition**			
F.1	Operating Temperature range		As per table 5 of IEC 62052-11 for indoor meters	
F.2	Conform to operate accurately under Maximum Relative Humidity of 90%		Yes	
G	**Electrical Requirement**			
G.1	Active and apparent power consumption in the voltage and current circuits of the meter at a reference voltage, frequency, temperature		not more than that stipulated in table 1 of IEC 62053-22	
G.2	Permissible error due to voltage variation		conform to the table 7 of IEC 62052-11	
G.3	Meter operation during Voltage dips and short interruptions		conform to Clause 7.1.2 of IEC 62052-11	
G.4	Meter operation during short time over current		as per the clause 7.2 of IEC 62053-22.	
G.5	Variation of error due to self – heating		not exceed the value given in IEC 62053-22	
G.6	Reference Temperature and Temperature coefficient			
G.7	Insulation Level			
	(a) Power Frequency Withstand voltage for 1 min		4 kV	
	(b) Impulse Voltage at 1.2/50 µsec		6 kV	
H	**Electromagnetic compatibility**			
H.1	meter operation conform to the clause 3.7 of this specification		Yes	
I	**Accuracy Requirements**			
I.1	Limits of error due to variation in current and influence quantities		do not exceed the limit given in IEC 62053-22 for class 0.2S	

No	Item	Units	Required	Tendered
I.2	Meter starting and running with no-load		conform to the clause 3.8 (a) of this specification	
I.3	Meter constant		conform to the clause 3.8 (b) of this specification	
J	**Marking of Meters**			
J.1	Making of Meters		as per clause 3.9 of this specification is possible	
K	**Quality Assurance**			
K.1	Quality Assurance conforming ISO 9001		Yes	
K.2	ISO/IEC 17025 accreditation for the Laboratory		Yes	
L	**Additional Requirements**			
L.1	Guaranteed Life Span of the meters and communication module		10 years	
L.2	Warranty for meters and accessories		5 years minimum	
M	Testing, Installation and Commissioning			
M.1	Test certificate			
	Test of insulating properties			
M.1.1	Impulse test voltage		Required	
M.1.2	A.C. Voltage Test		Required	
	Test of Accuracy requirements			
M.1.3	Test of meter constant		Required	
M.1.4	Test of starting condition		Required	
M.1.5	Test of no-load condition		Required	
M.1.6	Test of influence quantities		Required	
	Test of electrical requirements			
M.1.7	Test of power consumption		Required	
M.1.8	Test of influence of supply voltage		Required	
M.1.9	Test of influence of short-time current		Required	
M.1.10	Test of influence of self-heating		Required	

No	Item	Units	Required	Tendered
M.1.11	Test of influence of heating		Required	
M.1.12	Test of immunity to earth fault		Required	
	Test of electromagnetic compatibility			
M.1.13	Radio interference suppression		Required	
M.1.14	Fast transient burst test		Required	
M.1.15	Damped oscillatory waves immunity test		Required	
M.1.16	Test of immunity to electromagnetic RF fields		Required	
M.1.17	Test of immunity to conducted disturbances, induced by radio-frequency fields		Required	
M.1.18	Test of immunity to electrostatic discharges.		Required	
M.1.19	Surge immunity test		Required	
	Tests of the effect of the climatic environments			
M.1.20	Dry heat test		Required	
M.1.21	Cold test		Required	
M.1.22	Damp heat cyclic test		Required	
M.1.23	Solar radiation test		Required	
	Mechanical Tests			
M.1.24	Vibration Test		Required	
M.1.25	Shock test		Required	
M.1.26	Spring Hammer Test		Required	
M.1.27	Tests of protection against penetration of dust and water		Required	
M.1.28	Test of resistance to heat and fire		Required	
M.2	Acceptance / Sample tests		as per clause 5.2 of this specification	
N	**Technical Literature and Drawings**			
N.1	Submission of complete set of technical literature on installation, calibration and operation and maintenance of the meter		Required	

No	Item	Units	Required	Tendered
N.2	Submission of User Manuals for communication software		Required	

2.19. SOLAR PHOTO VOLTAIC SYSTEM

2.19.1. Solar PV Module

No	Item	Units	Required	Tendered
1.	Manufactures Name			
2.	Country of Origin			
3.	Country of Manufacture			
4.	Make			
5.	Model No.			
6.	Dimension			
7.	Total Area Required			
8	Weight			
9.	Output Cables			
10	No. of Modules Required			
11.	Place of Testing			
12.	Applicable Standard (latest)		IEC 61215 or Equivalent / IEC 61730 or Equivalent	
13.	Quality Management		ISO 9001: 2008 or Equivalent	
14.	System Capacity			
15.	Total System Rated Power			
16.	Minimum Rating of a Solar Module	Wp	> 260	
17.	Electrical Conversion Efficiency of SPV Module	%	>15	
18.	Product Warranty (materials and workmanship)	years	Minimum 10	
19.	Power Output Warranty	years	25 (linear performance: 80% or more power output at the end of 25 years)	
20.	Module Architecture		60 cell (10x6) prefers)	
21.	Panel Voltage (Nominal)	V		

No	Item	Units	Required	Tendered
22.	Module Power Tolerance			
23.	Maximum Power Voltage of a Module (Vmpp)			
24.	Maximum Power Current of a Module (Immp)			
25.	Open Circuit Voltage (Voc)			
26.	Short Circuit Current (Isc)			
27.	Maximum String Voltage of SPV Array			
28.	High voltage safety measures for fire, electrical hazards and automatic shutdown at a fault			
29.	Operational Temperature Range	^0C	-40 - 85	
30.	Nominal Operating Cell Temperature (NOCT)	^0C	45 (±2)	
31.	Module Efficiency	%		
32.	Cell Type		Mono/Poly	
33.	Junction Box		Sealable and Resistance	
34.	Junction Box Protection		IP65	
35.	Frame		Aluminium or resist to corrosion	
36.	Front Glass	mm	3.2 tempered high transmission glass.	
37.	Linear Performance	Depreciation Rate %		
38.	Expected Life time	years	25 minimum	
39.	Number of bypass diodes			

2.19.2. Inverter and Other Parts

No	Item	Units	Required	Tendered
1.	Manufactures Name			
2.	Country of Origin			
3.	Country of Manufacture			
4.	Model No.			
5.	Inverter Technology		Transformer less	
6.	Place of Testing			
7.	Applicable Standard (latest)		IEC 62109-1 IEC 61683, IEC 61727: ed2.0, IEC 62116, IEEE 1547	
8.	Total Inverter Capacity			
9.	Minimum Efficiency at maximum solar generation	%	97	
10.	Inverter Rated Power Output	W		
11.	Maximum AC Power Output	W		
12.	Maximum DC Input Power	W		
13.	Housing		IP65	
14.	Inverter Installation		Indoor/Outdoor	
15.	Product Warranty	years	Minimum 10	
16.	Inverter Performance Monitoring			
17.	Remote monitoring system, module level monitoring ability			
18.	Upgradability of the system			
19.	System performance under shaded conditions (comparison)			
20.	System performance under module mismatch conditions (comparison)			
21.	Ability to have different string lengths in a same inverter			
22.	Availability of individual MPP trackers for different strings			
23.	Reverse-Polarity Protection			
24.	Ground-Fault Isolation Detection			

No	Item	Units	Required	Tendered
25.	Dimensions			
26.	Operating Temperature Range	0_C	-20 to +60	
27.	Inverter Type			
28.	No. of Inverter Required			
29.	Cooling Method			
30.	Protection Rating		IP-65	
31.	DC Protection			
32.	AC Protection			
33.	Lightning surge Protection			
34.	Relative Humidity	%	0 - 100	
35.	MPPT Voltage Range	V DC Minimum to Maximum		
36.	Maximum Input Voltage (DC)	V		
37.	Minimum Input Voltage / Start-up, I = input voltage (DC)	V		
38.	Maximum Continues Output Current	A		
39.	Rated Grid Voltage	V	230	
40.	Rated Grid Frequency	Hz	50	
41.	Maximum AC Output Apparent Power	W		
42.	Power Factor			
43.	Short Circuit Proof			
44.	Internal Consumption at Night			
45.	Ground Fault Monitoring			

2.19.3. Supporting Structures and Cabling

No	Item	Units	Required		Tendered	
			DC	AC	DC	AC
1.	Manufacturer's Name					
2.	Country of Manufacture					
3.	Place of Testing					
4.	Applicable Standard		IEE 17th Edition Wiring Regulations			
5.	Application Range					
6.	Design					
7.	Product Feature					
8.	Corrosion protection of Al railing and other components					
9.	Ability to withstand dead, live and wind loads					
10.	Solar PV System Cabling					
11.	DC cables					
12.	Minimum Bending Radius	mm				
13.	Nominal Voltage	V				
14.	Temperature Range	°C				
15.	Voltage Drop	%				
16.	Mounting Structure					
i.	Railing		GI Coated steel or Aluminium			
ii.	Nuts & Bolts, clips, etc		Stainless steel			
iii.	Other fixing components		Stainless steel			

2.19.4. Other Facilities

No	Item	Units	Required	Tendered
1.	After sales services	Years	Minimum 10/25	
2.	After sales staff capacity			
3.	Minimum duration to attend to a after sales issue	hours	48	
4.	Past local project experience			
5.	Company Existence in Sri Lanka	Years (Min)		
6.	Manufacture Authorization for Products. (Attach the Supplier Authorization certifications separately)		The supplier should be authorized as the direct local dealer and installer of the product	
7.	Number of local projects with capacities greater than 25 kW			
8.	Number of local projects with capacities greater than 100 kW			
9.	Reference projects local (Attach separately)			
10.	Quality certificates (ISO, UL, etc)			
11.	Qualification and experience of local staff			
12.	System Installation Standards			

2 TECHNICAL PARTICULARS AND GURANTEES

B - CIVIL WORKS

2.20. AIR CONDITIONING & VENTILATING INSTALLATIONS

2.20.1. Air Conditioning Units

No	Item	Units	Required	Tendered
(a)	Split type Air Conditioning Unit			
	Manufacturer's name & address			
3.	Number of units			
	Country of origin			
	Type			
	Model No			
	Cooling duty (latent)	kW		
	Cooling duty (sensible)	kW		
	On – coil condition	DB/WB ^{0}C		
	Off – coil condition	DB/WB ^{0}C		
	Total electrical input	kW		
	Air volume	m^3/hr		
	Total electrical input	kW		
	Electrical supply	N/m^2		
	Pre-filter manufacturer and type			
	Pre-filter size and pressure drop (clean)			
	Thermal insulation for refrigerant pipe work (if applicable)			
(b)	Air Cooled Condensing Units			
	Number of Units			
	Manufacturer's name and address			
	Country of origin			
	Type			
	Model No.			
	Refrigeration effect	kW each		
	Compressor type			
	Compressor input	kW each		

No	Item	Units	Required	Tendered
	Suction temperature	^{0}C		
	Condenser ambient temperature	^{0}C		
	Fan motor(s)	Total kW		
	Capacity steps	%		
(c)	Self-contained Air Conditioning Units			
	Number of units			
	Manufacturer's name and address			
	Country of origin			
	Type			
	Model No.			
	Refrigeration effect	kW each		
	Compressor input	kW each		
	Fan Motor	kW each		

2.20.2. Ventilation Works

No	Item	Units	Required	Tendered
(d)	Ventilation Works			
	Manufacturer's name and address			
	Number of units			
	Air volume	M^3/hr		
	System resistance	N/m^2		
	Fan Motor size	KW		
	Corrosion protection			

2.21. CCTV System

No	Item	Units	Required	Tendered
	Manufacturer's name and address			
	Country of origin			
	Type			
	Model No.			
	Image Sensor		½" CCD	
	Horizontal resolution			
	Minimum illumination (when IR on)			
	S/N Ratio		More than 50dB	
	Scanning System			
	Video output signal			
	IR Range			
	Number of Motion detection zones			
	Back Light Compensation			
	Auto Gain Control			
	IP Rating		IP 65	
	Supply voltage			
a)	Digital Video Recorder			
	Number of channels			
	Video compression			
	Hard disk capacity			
	Video monitor size			

2.22. FIRE SAFETY EQUIPMENT

No	Item	Units	Required	Tendered
(a)	Trolley Mounted Extinguishers CO_2 50kg			
	Manufactures name and address			
	Dimensions	mm		
	Total weight	kg		
	Length of hose	mm		
	Type of powder			
	Working Pressure	kg/cm^2		
	Test Pressure	kg/cm^2		
	Numbers to be provided at			
(b)	Wall Mounted Extinguishers CF 5.5 kg			
	Manufactures name and address			
	Dimensions	mm		
	Total weight	kg		
	Length of hose	mm		
	Type of powder			
	Working Pressure	kg/cm^2		
	Test Pressure	kg/cm^2		
	Number to be provided at			
(c)	Trolley Mounted Extinguishers BCF 50kg			
	Manufactures name and address			
	Dimensions	mm		
	Total weight	kg		
	Length of hose	mm		
	Type of powder			
	Working Pressure	kg/cm^2		
	Test Pressure	kg/cm^2		
	Numbers to be provided at			

2.23. External Lighting and Small Power Supply Services

No	Item	Units	Required	Tendered
(a)	Distribution Boards (fitted with fuses)			
	Manufacturer's name and address			
	Type and/or Figure No.			
	Rating	A		
	Fault rating	kA		
	Voltage	V		
(b)	Distribution Boards (fitted with Circuit breakers)			
	Manufacturer's name and address			
	Type and/or Figure No.			
	Rating	A		
	Fault rating	kA		
	Voltage	V		
(c)	PVC Cable			
	Manufacturer's name and address			
	Type			
	Voltage rating	V		
(d)	Conduit			
	Manufacturer's name and address			
	Type			
(e)	Conduit Accessories			
	Manufacturer's name and address			
	Type			
(f)	Cable Termination's			
	Manufacturer's name and address			
	Type			
	Material			
(g)	Switches			
	Manufacturer's name and address			

No	Item	Units	Required	Tendered
	Type			
	Rating	W		
(h)	Socket Outlets			
	Manufacturer's name and address			
	Type and/or Figure No.			
	Rating	W		
	Finish			
(i)	Contactors			
	Manufacturer's name and address			
	Type			
	Rating	W		
	Number of contacts			
	Rating of coil AC	VA		
(j)	Miniature Circuit Breakers			
	Manufacturer's name and address			
	Type			
	Rating	A		
	Fault rating	kA		
(k)	Earthing Material			
	Manufacturer's name and address			
	Material & size			
(l)	Clocks			
	Manufacturer's name and address			
	Type			
	Size			
	Type of operation			
(m)	Lighting fittings – Fluorescent			
	Manufacturer's name and address			
	Type			
	Rating			

No	Item	Units	Required	Tendered
	Harmonic content			
(n)	Lighting fittings - emergency			
	Manufacturer's name and address			
	Type			
	Rating	W		
(o)	Switch yard lighting			
	Manufacturer's name and address			
	Type			
	Rating	W		