CEYLON ELECTRICITY BOARD
SRI LANKA

SUPPORTING ELECTRICITY SUPPLY RELIABILITY IMPROVEMENT PROJECT

(ADB LOAN NO: 3409)

PACKAGE 7: LOT A3

Procurement of Plant

Design, Supply and Install

Single-Stage, Two-Envelope
Bidding Procedure

BIDDING DOCUMENT
For
Procurement
Of

Installation of:

124Mvar Breaker Switched Capacitor Banks in Colombo City Grid Substations and

Replacing the Detuned Breaker Switched Capacitor Banks at Thulhiriya Grid Substation

VOLUME 7 of 8

PART II REQUIREMENTS

Section 6 - Employer's Requirements: Part D-Supplementary Information, Part E-Bank Guaranties and Certificates, Change Orders

Issued on: 11th June 2020

Invitation for Bids No:CEB/AGM/PRO/2019/ IFB/SESRIP-P7-Lot A3

ICB No.: CEB/AGM/PRO/2019/ICB/SESRIP-P7-Lot A3

Employer: Ceylon Electricity Board

Country: Sri Lanka

Projects Division
Ceylon Electricity Board,
P.O. Box 540, Colombo 2
Sri Lanka

Document-Revision C

Preface

This Bidding Document for Procurement of Plant – Design, Supply and Install, has been prepared by Ceylon Electricity Board of Sri Lanka and is based on the Standard Bidding Document for Procurement of Plant – Design, Supply and Installation (SBD Plant) issued by the Asian Development Bank dated December 2016

ADB's SBD Plant has the structure and the provisions of the Master Procurement Document entitled "Procurement of Plant – Design, Supply and Installation", prepared by multilateral development banks and other public international financial institutions except where ADB-specific considerations have required a change.

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Notes on Schedules

The schedules are intended to provide the Employer with essential supplementary information in an organised format. The examples of more commonly used schedules are given herein. Others may be devised and added in accordance with the requirements of the instructions to bidders.

All the schedules are essential for the bid evaluation and some in contract execution; they should all be incorporated in the contract, and appropriate changes introduced with the approval of the employer or its representative.

The schedules are to be completed and submitted as part of the technical proposal in accordance with the instruction to bidders.

There shall be no equipment offered without filling these schedules. These sheets to be copied and filled in separately for each different types of equipment offered.

1 MANUFACTURERS, PLACE OF MANUFACTURE AND TESTING

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
HV SWITCHGEAR 245kV			
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			
HV SWITCHGEAR 145kV			
Outdoor Switchgear			
Circuit Breakers			
Disconnectors			
Earthing Switches			
Current Transformers			
Capacitor Voltage Transformers			
Surge Arresters			
Neutral Current Transformers			
Post Insulators			
Insulator Strings			
Flexible Conductors			

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
Busbars (tubular)			
Connectors			
Steel Structures			
Indoor GIS Switchgear			
Circuit Breakers			
Disconnectors			
Earthing Switches			
Busbars			
Current Transformers			
Capacitor Voltage Transformers			
MV SWITCHGEAR 36kV			
Outdoor Switchgear			
Steel structures			
Circuit Breakers			
Disconnectors			
Busbars (tubular)			
Flexible conductors			
Post Insulators			
Insulator Strings			
Connectors			
Surge arresters			
Indoor GIS Switchgear			
Circuit Breakers			
Disconnectors			
Busbars			
Current Transformers			
Voltage Transformers			
Earthing Switches			

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
ANCILLARY EQUIPMENT			
Gas Handling Equipment			
Testing Equipment			
400V SWITCH BOARDS			
Panels			
Circuit Breakers			
PROTECTION METERING & CONTROL			
Panels			
Instruments			
220 kV Protection Relays			
220 kV Control IEDs			
145 kV Protection Relays			
145 kV Control IEDs			
33 kV Protection Relays			
33 kV / 12kV Control IEDs			
AVR			
Meters			
Substation Automation System.			
DFR System			
DC EQUIPMENT			
Batteries			
Chargers			
Distribution Boards			
220/48 V DC-DC Convertors			
CONTROL CABLES			
PVC insulated Cables			

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
Telecommunication Cables			
POWER CABLES & TERMINATION			
145 kV Cables			
36 kV/12kV 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 220/132kV			
Power Transformers 132/33kV			
Transformers Complete			
Windings			
220 kV Terminal			
132 kV Terminal			
33 kV Terminal			
Insulators			

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
Tap Changers			
Copper			
Core parts			
Tanks			
Radiators			
Fan motors			
Temperature indicators			
Oil valves			
Pressure relief device			
Motor Control equipment			
Alarm Devices			
Gas and Oil actuated relays			
Automatic Voltage regulator panel			
AUXILIARY TRANSFORMER 33/0.4kV			
Transformer Complete			
HV Bushings			
LV Cable Box			
Insulators			
EARTHING TRANSFORMERS 800A/30sec			
Transformer Complete			
HV Bushings			
Insulators			
STEEL STRUCTURES			

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
SCADA EQUIPMENT			
FIBRE OPTIC EQUIPMENT			
CCTV SYSTEM			
SOLAR POWER SYSTEM			
PV Panels			
Solar Inverter			
Combine boxes			
Monitoring and data acquisition system			
CAPACITOR BANKS			
Indoor or prefabricated enclosure capacitor bank			
Outdoor capacitor banks			
DIESEL GENERATOR			
CEMENT			

Please fill the appropriate items for scope of works.

2 TECHNICAL PARTICULARS AND GURANTEES

A - ELECTRICAL WORKS

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Notes : -

1. **There shall be no equipment offered without filling these schedules. These sheets to be copied and filled in separately for each different type of equipment offered.**

2. **Refer scope of work & drawings for detail ratings.**

2.1 245kV OUTDOOR SWITCHGEAR (220/110V DC VOLTAGE) – (Not Applicable)

2.1.1 Circuit Breaker (Not Applicable)

	Item	Units	Required	Tendered
			245kV	**245kV**
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC 62271-100	
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	245	
10.	Impulse withstand voltage on 1.2/50 Wave	kV	1050	
11.	One minute Power frequency withstand voltage			
	Closed	kV	460	
	Open	kV	460	
12.	Rated normal current	A		
13.	Short- time withstand current switchgear – 1 Sec:	rms kA	40	
14.	Rated short-circuit breaking current.			
	Symmetrical	rms kA	40	
	DC component	%	More than 20%	
15.	Short-circuit making current	Peak kA	100	
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		1.3	

	Item	Units	Required	Tendered
			245kV	**245kV**
19.	Rated short circuit Breaking current			
	(a) kV (pk)			
	(b) RRRV			
20.	Rated small inductive breaking current.	A		
21.	Rated line charging breaking current	A	145	
22.	Rated cable charging breaking current.	A	250	
23.	Rated out of phase breaking current	A		
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		
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		

	Item	Units	Required	Tendered
			245kV	**245kV**
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		
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	
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	

	Item	Units	Required	Tendered
			245kV	**245kV**
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	litres		
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		
	(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 Transformer (Not Applicable)

	Item	Units	Required	Tendered
			245kV	**245kV**
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 phase		Single	
7.	Installed location		Outdoor	
8.	Highest system voltage	kV	245	
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		0.2	
	(ii) For Protection			
15.	Rated burden	VA		
16.	Continuous Current Rating Factor		1.2	
17.	Rated short Circuit current 1 sec	rms kA	40	
18.	Rated short time thermal current (as per breaker)	kA Sec	40	
19.	Rated insulation level			
	(i) AC withstand voltage 1 min.dry			
	Primary	kV	460	
	Secondary			

	Item	Units	Required	Tendered
			245kV	**245kV**
	(ii) Impulse withstand voltage full wave	kV	1050	
20.	Knee point voltage	V		
21.	DC Resistance			
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			
26.	Impulse voltage tests on primary terminals			
27.	Electromagnetic Compatibility tests			
28.	Electromagnetic Compatibility tests			
29.	Verification of the degree of protection by enclosures			
30.	Enclosure tightness test at ambient temperature			

2.1.3 Voltage Transformers (Not Applicable)

	Item	Units	Required	Tendered
			245kV	**245kV**
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	460	
	(ii) Impulse withstand voltage full wave	kV	1050	
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		0.2	
14.	Rated accuracy limit factor			
15.	Dimensions (height, width length)			

2.1.4 Insulator Strings

	Item	Units	Required	Tendered
			245kV	245kV
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	395	
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	950	

	Item	Units	Required	Tendered
			245kV	**245kV**
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	6125	
		mm/kV	25	

2.1.5 Disconnectors and Earthing Switches (Not Applicable)

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC62271-102	
5.	Manufacturer's type designation, and type ref or model number			
6.	Rated frequency	Hz	50	
7.	Rated voltage	kV	245	
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	40	
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	

	Item	Units	Required	Tendered
			245kV	**245kV**
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		
22.	Operating time			
23.	Lighting impulse withstand voltage			
	(i) to earth	kV	1050	
	(ii) across isolating distance	kV	1050	
24.	Rated one minute Power frequency withstand voltage			
	(i) to earth	kV	460	
	(ii) across isolating distance	kV	460	
	Type Tests *Document reference number and Type tested model shall be written in tendered column.*	Included in the Bid (Yes or No)		
25.	Test to prove satisfactory operation and mechanical endurance test			
26.	Test to prove the short-circuit making performance of earthing switches			
27.	Test to prove satisfactory operation at temperature limits			
28.	Test to prove the proper function of position indicating devices			
29.	Test to prove the bus-transfer current switching capability of disconnectors			
30.	Tests to prove the induced current-switching capability of earthing switches			
31.	Tests to prove the bus-charging current switching ability of disconnectors used in metal enclosed switchgear			

2.1.6 Busbars and Connections

	Item	Units	Required	Tendered
			245kV	245kV
	BUS BARS			
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		

	Item	Units	Required	Tendered
			245kV	245kV
	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 100M 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

	Item	Units	Required	Tendered
			245kV	245kV
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		

	Item	Units	Required	Tendered
			245kV	**245kV**
20.	50Hz 1 minute withstand voltage, wet	kV	460	
21.	Dry lightning impulse withstand			
22.	Voltage, 2/50 micro sec. wave	kV	1050	
23.	Minimum creepage distance			
	(i) Specified Polluted	mm	6125	
	(ii) Guaranteed Polluted	mm		
24.	Protected creepage distance polluted	mm		

2.1.8 Surge Arresters

	Item	Units	Required	Tendered
			245kV	**245kV**
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	245	
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	192	
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		

	Item	Units	Required	Tendered
			245kV	**245kV**
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		
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	6125	
	(ii) Guaranteed Polluted	mm		
	NB: Evidence of substantial service experience is to be submitted.			

2.1.9 Switchgear Insulators

	Item	Units	Required	Tendered
			245kV	245kV
	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	245	
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	1050	
17.	Switching impulse withstand voltage	kV		

2.1.10 Neutral Current Transformers

	Item	Units	Required	Tendered
			245kV	**245kV**
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	245	
7.	50 Hz 1 minute withstand voltage, wet	kV	460	
8.	Type of construction (post, ring , etc.)			
9.	Material of primary insulation			

2.2 145kV OUTDOOR SWITCHGEAR (110/220V DC VOLTAGE)

2.2.1 Circuit Breaker

	Item	Units	Required	Tendered
			145kV	**145kV**
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	62.5	
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	

	Item	Units	Required	Tendered
			145kV	**145kV**
19.	Rated short circuit Breaking current			
	(a) kV (pk)			
	(b) RRRV			
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		

	Item	Units	Required	Tendered
			145kV	**145kV**
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		
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	
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	

	Item	Units	Required	Tendered
			145kV	**145kV**
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	litres		
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		
	(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		

2.2.2 Current Transformer

	Item	Units	Required	Tendered
			145kV	**145kV**
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 phase		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		0.2	
	(ii) For Protection			
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			

	Item	Units	Required	Tendered
			145kV	**145kV**
	(ii) Impulse withstand voltage full wave	kV	650	
20.	Knee point voltage	V		
21.	DC Resistance			
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		

2.2.3 Voltage Transformers

	Item	Units	Required	Tendered
			145kV	**145kV**
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		0.2	
14.	Rated accuracy limit factor			
15.	Dimensions (height, width length)			

2.2.4 Insulator Strings

	Item	Units	Required	Tendered
			145kV	145kV
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	

	Item	Units	Required	Tendered
			145kV	**145kV**
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	

2.2.5 Disconnectors and Earthing Switches

	Item	Units	Required	Tendered
			145kV	**145kV**
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	

	Item	Units	Required	Tendered
			145kV	**145kV**
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		
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			

2.2.6 Busbars and Connections

	Item	Units	Required	Tendered
			145kV	145kV
	BUS BARS			
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		

	Item	Units	Required	Tendered
			145kV	**145kV**
	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 100M 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		

2.2.7 Post and Disconnector Insulators

	Item	Units	Required	Tendered
			145kV	**145kV**
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		

	Item	Units	Required	Tendered
			145kV	**145kV**
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		

2.2.8 Surge Arresters

	Item	Units	Required	Tendered
			145kV	**145kV**
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		

	Item	Units	Required	Tendered
			145kV	**145kV**
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		
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.			

2.2.9 Switchgear Insulators

	Item	Units	Required	Tendered
			145kV	**145kV**
	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		

2.2.10 Neutral Current Transformers

	Item	Units	Required	Tendered
			145kV	**145kV**
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			

2.3 145kV INDOOR SWITCHGEAR & ASSOCIATED EQUIPMENT (110V DC)

(Not Applicable)

2.3.1 High Voltage Gas Insulated Switchgear

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		IEC 62271-203	
5.	Manufacturer's type designation, and type ref or model number			
6.	Rated voltage	kV	145	
7.	Rated frequency	Hz	50	
8.	Maximum continuous system voltage at minimum gas pressure	kV	145	
9.	Impulse withstand voltage (peak) at minimum gas pressure	kV	650	
10.	Power frequency withstand voltage 1 min. at minimum gas pressure	kV	275	
11.	Power frequency withstand voltage 1 min at atmospheric pressure	kV		
12.	Rated short time withstand current	kA	40	
13.	Rated duration of short time withstand current	s	1	
14.	Rated peak short circuit breaking current	kA		
	Symmetrical	rms KA	40	
	DC Component	%	More than 20%	
15	Short Circuit Making current	peak kA	100	
16.	Heaviest part of any feeder for crane	kg		
17.	Feeder Width	mm		

	Item	Units	Required	Tendered
			145kV	145kV
	Depth	mm		
	Height	mm		
18.	SF6 gas replenishing	Yes/No	No	
19.	Material of filter employed for moisture absorption			
20.	Heat losses per feeder at rated Power	kW		
	Type Tests *Document reference number and Type tested model shall be written in tendered column*	Included in the Bid (Yes or No)		
21.	Tests to verify the insulation level of the equipment	Yes/No		
22.	Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of circuits	Yes/No		
23.	Tests to prove the capability of the main and earthing circuits to be subjected to the rated peak and the rated short-time withstand currents	Yes/No		
24.	Tests to prove the making and breaking capacity of the included switching devices	Yes/No		
25.	Tests to prove the satisfactory operation of the included switching devices and removable parts	Yes/No		
26.	Tests to verify the IP protection code	Yes/No		
27.	Tests to verify auxiliary and control circuits	Yes/No		
28.	Tightness tests of gas filled compartments	Yes/No		
29.	Dielectric tests on cable testing circuits	Yes/No		

2.3.2 Busbars

	Item	Units	Required	Tendered
			145kV	**145kV**
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	mm^2		

2.3.3 Circuit Breaker

	Item (These sheets to be copied and filled in for each different type of CBs)	**Units**	**Required**	**Tendered**
			145kV	**145kV**
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	1600	
	- transformer feeder circuit breaker	A	1250	
	- bus coupler circuit breaker	A	3000	
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	40	
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		

	Item	Units	Required	Tendered
			145kV	**145kV**
15.	Voltage drop across terminals of one pole at rated current	mV		
16.	Amplitude factor			
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 autoreclosures 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. 10	
27.	Rated pressure of SF6 for arc quenching	bar		

	Item	Units	Required	Tendered
			145kV	**145kV**
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:			
	- 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	
38.	Material of main contacts			

	Item	Units	Required	Tendered
			145kV	**145kV**
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			
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		
48.	Number of operation before interrupter maintenance required			
	a) At rated short circuit current	Nos	10	
	b) At full load current	Nos	5000	
	Type Tests *Document reference number and Type tested model shall be written in tendered column.*	Included in the Bid (Yes or No)		
49.	Dielectric tests			
50.	Measurement of the resistance of the main circuit	Yes/No		
51.	Temperature-rise tests	Yes/No		

	Item	Units	Required	Tendered
			145kV	**145kV**
52.	Short-time withstand current and peak withstand current tests	Yes/No		
53.	Additional tests on auxiliary and control circuits	Yes/No		
54.	Mechanical operation test at ambient temperature	Yes/No		
55.	Short-circuit current making and breaking tests	Yes/No		

2.3.4 Disconnector Switch

	Item	Units	Required	Tendered
			145kV	**145kV**
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	315	
6.	Lightning impulse withstand voltage across isolating distance	kV	750	
7.	Rated normal current at 20 ^{0}C			
	- feeder disconnecting switch	A	1600	
	- bus coupler disconnecting switch	A	3000	
	- transformer feeder disconnecting switch	A	1250	
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		

	Item	Units	Required	Tendered
			145kV	**145kV**
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:			
	- 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		
	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			

2.3.5 Maintenance Earthing Switch

	Item	Units	Required	Tendered
			145kV	145kV
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 High Speed Earthing Switch

	Item	Units	Required	Tendered
			145kV	145kV
1.	Type tested	Yes/No	Yes	
2.	Type test report, Ref. No.			
3.	Standards to which earthing switch conforms			
4.	Making current	kA r.m.s	40	
5.	Number of closing operations with maximum short circuit current before the contact maintenance becomes necessary	No	2	
6.	Short circuit withstand duration	s	1	
7.	Life duration of main contacts	operations		
8.	Material of main contacts			
9.	Auxiliary contacts:			
	- number (NO/NC)	pcs/pcs		
	- voltage	V DC	110	
10.	Operating mechanism:			
	- for closing			
	- for opening			
11.	Max. Operating time			
	- for closing	ms		
	- for opening	ms		
12.	Motor voltage	V DC	110	
13.	Motor power	W		
14.	Hand operating facilities	Yes/No	Yes	

2.3.7 Current Transformer

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Type			
4.	Standards to which CT conforms	IEC	61869	
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	100	
8.	Rated short-time current	kA	40	
9.	Measuring cores:			
	- Accuracy class		0.5	
	- 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 ^{0}C	Ohms		
	- Resistance of secondary winding busbar protection cores at 75 ^{0}C	Ohms		

	Item	Units	Required	Tendered
			145kV	**145kV**
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		According to IEC 61869	
	Type Tests *Document reference number and Type tested model shall be written in tendered column.*	Included in the Bid (Yes or No)		
17.	Temperature-rise test			
18.	Impulse voltage tests on primary terminals			
19.	Electromagnetic Compatibility tests			
20.	Electromagnetic Compatibility tests			
21.	Verification of the degree of protection by enclosures			
22.	Enclosure tightness test at ambient temperature			

2.3.8 Voltage Transformer

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Type			
4.	Standards	IEC	IEC 61869	
5.	Method of transformation (inductive or capacitive)		inductive	
6.	Nominal primary voltage	kV	132/√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		According to IEC 61869	
11.	Height	mm		
12.	Weight of single pole unit	kg		

2.3.9 Local Control Unit for each bay

	Item	Units	Required	Tendered
			145kV	145kV
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 36KV OUTDOOR SWITCHGEAR

2.4.1 Insulator Strings

	Item	Units	Required	Tendered
			36kV	36kV
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	

	Item	Units	Required	Tendered
			36kV	**36kV**
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	900	
		mm/kV	25	

2.4.2 Post and Disconnector Insulators

	Item	Units	Required	Tendered
			36kV	36kV
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		

	Item	Units	Required	Tendered
			36kV	**36kV**
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		
24.	Protected creepage distance polluted	mm		

2.4.3 Disconnectors and Earthing Switches

	Item	Units	Required	Tendered
			36kV	36kV
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	
	- Earthing Switch		Motor	
16.	Manual Operating facility	Yes/No	yes	

	Item	Units	Required	Tendered
			36kV	**36kV**
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		
22.	Operating time			
23.	Lighting impulse withstand voltage			
	(i) to earth	kV	170	
	(ii) across isolating distance	kV	195	
24.	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)		
25.	Test to prove satisfactory operation and mechanical endurance test			
26.	Test to prove the short-circuit making performance of earthing switches			
27.	Test to prove satisfactory operation at temperature limits			
28.	Test to prove the proper function of position indicating devices			
29.	Test to prove the bus-transfer current switching capability of disconnectors			
30.	Tests to prove the induced current-switching capability of earthing switches			
31.	Tests to prove the bus-charging current switching ability of disconnectors used in metal enclosed switchgear			

2.4.4 Surge Arresters

	Item	Units	Required	Tendered
			36kV	**36kV**
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		

	Item	Units	Required	Tendered
			36kV	**36kV**
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		
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.			

2.4.5 Switchgear Insulators

	Item	Units	Required	Tendered
			36kV	36kV
	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	36	
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	170	
17.	Switching impulse withstand voltage	kV		

2.4.6 Neutral Current Transformers

	Item	Units	Required	Tendered
			36kV	36kV
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			

2.4.7 Busbars

	Item	Units	Required	Tendered
			36kV	**36kV**
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	mm^2		

2.4.8 Circuit Breaker

	Item	Units	Required	Tendered
			36kV	**36kV**
1.	Manufacturer's Name			
2.	Country of manufacture			
3	Applicable Standard		IEC 62271-100	
4.	Type tested	yes/no	Yes	
5.	Type test report, Ref. No.			
6.	Rated normal current at 20deg. C			
	- line feeder circuit breaker	A	1250	
	- transformer feeder circuit breaker	A	1250	
	- bus section circuit breaker	A	As per the Scope	
7.	Rated current at max. ambient temperature	A		
	- line feeder circuit breaker	A		
	- transformer feeder circuit breaker	A		
	- bus coupler circuit breaker	A		
8.	Rated short circuit breaking current (symmetrical, r.m.s.)	kA		
9.	Rated short circuit breaking current (asymmetrical, r.m.s.)	kA		
10.	Rated short circuit making current (peak)	kA		
11.	Rated cable charging breaking current	A		
12.	Rated line charging breaking current	A		
13.	Rated small inductive breaking current	A		
14.	Voltage drop across terminals of one pole at rated current	mV		
15.	Amplitude factor			
16.	First pole-to-clear factor		1.5	

	Item	Units	Required	Tendered
			36kV	**36kV**
17.	Rated operating sequence:		O-t-CO-t'-CO	
	- with t	sec.	0.3	
	- with t'	min.	3	
18.	Min. time t'' between two successful three phase autoreclosures at full rated breaking current (sequence O-t-C-t''-O-t-C)	min.		
19.	Closing time	ms		
	- tolerances	ms		
20.	Dead time (max.)	ms		
	- tolerances	ms		
21.	Break time (max.) at full rated breaking current	ms		
	- tolerances	ms		
22.	Make time (max.)	ms		
	- tolerances	ms		
23.	Arcing time (max.) at full short circuit duty	ms		
	- tolerances	ms		
24.	Life duration of main contacts (no load mechanical operations)	operations		
25.	Number of switching operations at rated breaking capacity before contact maintenance becomes necessary	No.	min. 100	
26.	Rated pressure of SF6 for arc quenching	bar		
27.	Auxiliary contacts voltage	V DC	110 or 220V as per the scope	

	Item	Units	Required	Tendered
			36kV	**36kV**
28.	SF6 pressure at which lockout operates	bar		
29.	To be filled in only in case of hydraulic operating mechanism:			
	- Setting of pressure relief device	bar		
	- Rated pressure of hydraulic oil	bar		
	- Lowest oil pressure at which lockout	bar		
30.	Making coil			
	- Rated voltage	V DC	110	
	- min. operating voltage	V	88	
	- Rated power each	W		
31.	Trip coil			
	- Rated voltage	V DC	110	
	- min. operating voltage	V	55	
	- Rated power each	W		
32.	Motor voltage	V DC	110	
33.	Motor power	W		
34.	Total loss of heaters for 3 poles	W		
35.	Max. temperature rise of contacts at rated normal Current	K		
36.	Arc quenching medium		SF_6/vaccum	
37.	Material of main contacts			
38.	Number of breaks in series (per pole)	No.		
	- for closing			
	- for opening			

	Item	Units	Required	Tendered
			36kV	36kV
39.	Single pole operation (only in Line Feeder Breakers)	Yes/No	No	
40.	Making coil:			
	- number	pcs		
41.	Trip coil:			
	- number	pcs	2	
42.	Gas quantity of complete breaker (3 Phase)	kg		
43.	Material of filter employed for the absorption of the products of combustion			
44.	Method of controlling voltage distribution between breaks (capacitor, resistor etc.)			
45.	Weight of complete 3 pole breaker	kg		
46.	Weight of heaviest part for shipment	kg		

2.4.9 Disconnecting Switch

	Item	Units	Required	Tendered
			36kV	**36kV**
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Manufacturer's Type Designation and Model No.			
4.	Model No.			
5.	Type tested	Yes/No	Yes	
6.	Type test report, Ref. No.			
7.	Standards to which disconnector conforms		IEC 60129	
8.	Power frequency withstand voltage across isolating distance	kV	80	
9.	Lightning impulse withstand voltage across isolating distance	kV	195	
10.	Rated normal current at 20 ^{0}C			
	- feeder disconnecting switch	A	1250	
	- bus coupler disconnecting switch	A		
	- bus section disconnecting switch	A	2000	
	- transformer feeder disconnecting switch	A	1250	
11.	Rated current at max. ambient temperature:			
	- line feeder disconnecting switch	A		
	- bus coupler disconnecting switch	A		
	- bus section disconnecting switch			
	- transformer feeder disconnecting switch	A		
12.	Voltage drop across terminals of one pole at rated current	mV		
13.	Rated breaking current (capacitive)	A		

	Item	Units	Required	Tendered
			36kV	**36kV**
14.	Rated momentary current (peak)	kA		
15.	Life duration of main contacts	operations		
16.	Material of main contacts			
17.	Auxiliary contacts:			
	- number (NO/NC)	pcs/pcs		
	- voltage rating	V DC	110	
	- current rating	A DC		
18.	Operating mechanism:			
	- for closing		electric motor	
	- for opening		electric motor	
19.	Manual operating facility	Yes/No	Yes	
20.	Motor voltage	V DC	110	
21.	Motor power	W		
22.	Hand operating facilities	Yes/No		
23.	Weight			
	- 3 phase unit with driving mechanism	kg		
24.	Mechanism heater loss	W		

2.4.10 Maintenance Earthing Switch

	Item	Units	Required	Tendered
			36kV	**36kV**
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	

2.4.11 Current Transformer

	Item	Units	Required	Tendered
			36kV	**36kV**
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Manufacturer's Type Designation and Model No.			
4.	Type			
5.	Standards to which CT conforms	IEC	61869-1&2	
6.	Rated secondary current	A	1	
7.	Rated primary current and number of cores	A	See Scope of Works and drawings	
8.	Rated momentary current (peak)	kA		
9.	Rated short-time current	kA		
10.	Measuring cores:			
	- Accuracy class		0.2	
	- Burden			
	- Resistance of secondary winding at 75 ^{0}C	Ohms		
	- Instrument security factor			
11.	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 ^{0}C	Ohms		
	- Resistance of secondary winding busbar protection cores at 75 ^{0}C	Ohms		

	Item	Units	Required	Tendered
			36kV	**36kV**
12.	Number of cores	Nos.	See Scope of Works and drawings	
13.	Knee point e.m.f. of protection cores	V		
14.	Knee point e.m.f. of busbar protection cores	V		
15.	Insulation material for windings			
16.	Limits on exciting current	A		
17.	Partial discharge			

2.4.12 Voltage Transformer

	Item	Units	Required	Tendered
			36kV	**36kV**
1.	Manufacturer's Name			
2.	Manufacturer's Address			
3.	Manufacturer's Type Designation and Model No.			
4.	Type			
5.	Standards	IEC	61869-1&3	
6.	Method of transformation (inductive or capacitive)		inductive	
7.	Nominal primary voltage	kV	33/v3	
8.	Number of secondaries and accuracy class		See Scope of Works & Drawings	
9.	Thermal capacity of ground-fault detection winding	A/h		
10.	Rated burden (total on all secondaries)	VA		
11.	Partial discharge		acc.IEC 60044-4	
12.	Height	mm		
13.	Weight of single pole unit	kg		

2.5 36kV INDOOR SWITCHGEAR & ASSOCIATED EQUIPMENT

2.5.1 Medium Voltage Gas Insulated Switchgear

	Item	Units	Required	Tendered
			36kV	36kV
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	

	Item	Units	Required	Tendered
			36kV	**36kV**
18.	Material of filter employed for moisture absorption			
19.	Heat losses per feeder at rated Power	kW		

2.5.2 Busbars

	Item	Units	Required	Tendered
			36kV	**36kV**
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	mm^2		

2.5.3 Circuit Breaker

	Item (These sheets to be copied and filled in for each different type of CBs)	Units	Required	Tendered
			36kV	36kV
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	1250	
	- transformer feeder circuit breaker	A	1250	
	- 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		

	Item	Units	Required	Tendered
			36kV	36kV
15.	Voltage drop across terminals of one pole at rated current	mV		
16.	Amplitude factor			
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 autoreclosures 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		

	Item	Units	Required	Tendered
			36kV	**36kV**
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:			
	- 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/vaccum	
38.	Material of main contacts			

	Item	Units	Required	Tendered
			36kV	**36kV**
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			
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		

2.5.4 Disconnecting Switch

	Item	Units	Required	Tendered
			36kV	**36kV**
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	1250	
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		

	Item	Units	Required	Tendered
			36kV	**36kV**
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:			
	- 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		

2.5.5 Maintenance Earthing Switch

	Item	Units	Required	Tendered
			36kV	36kV
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	

2.5.6 High Speed Earthing Switch

	Item	Units	Required	Tendered
			36kV	36kV
1.	Type tested	Yes/No	Yes	
2.	Type test report, Ref. No.			
3.	Standards to which earthing switch conforms			
4.	Making current	kA r.m.s	25	
5.	Number of closing operations with maximum short circuit current before the contact maintenance becomes necessary	No	2	
6.	Short circuit withstand duration	s	1	
7.	Life duration of main contacts	operations		
8.	Material of main contacts			
9.	Auxiliary contacts:			
	- number (NO/NC)	pcs/pcs		
	- voltage	V DC	110	
10.	Operating mechanism:			
	- for closing			
	- for opening			
11.	Max. Operating time			
	- for closing	ms		
	- for opening	ms		
12.	Motor voltage	V DC	110	
13.	Motor power	W		
14.	Hand operating facilities	Yes/No	Yes	

2.5.7 Current Transformer

	Item	Units	Required	Tendered
			36kV	**36kV**
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 ^{0}C	Ohms		
	- Resistance of secondary winding busbar protection cores at 75 ^{0}C	Ohms		

	Item	Units	Required	Tendered
			36kV	**36kV**
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			

2.5.8 Voltage Transformer

	Item	Units	Required	Tendered
			36kV	**36kV**
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/v3	
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		

2.5.9 Local Control Unit

	Item	Units	Required	Tendered
			36kV	36kV
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		

2.6 LVAC EQUIPMENT

	Item	Units	Required	Tendered
(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	

2.7 BATTERIES AND CHARGERS

2.7.1 220V / 110V DC

	Item	Units	Required	Tendered
			220V /110V	**220V /110V**
(a)	**Battery**			
1.	Manufacturer's Name			
2.	Country of Manufacture			
3.	Place of Testing			
4.	Applicable Standard - IEC		60623	
5.	Type		NiCd	
6.	Manufacturer's type designation, and type ref or model number			
7.	Voltage	V DC	220 or 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			

	Item	Units	Required	Tendered
			220V /110V	**220V /110V**
(b)	**Battery Charger**			
1.	Manufacturer's name			
2.	Manufacturer's address			
3.	Place of Testing			
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	220 or 110	
14.	DC output of the charger	kW		
15.	Constant voltage			
	(i) Floating charge	V		
	(ii) Equalizing charge	V		
16.	Maximum out put voltage			
	(i) at automatic control	V		
	(ii) at Boost charge	V		
17.	Regulation	%		
18.	Range of DC voltage control			

	Item	Units	Required	Tendered
			220V /110V	220V /110V
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:			
(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			

	Item	Units	Required	Tendered
			220V /110V	220V /110V
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		

2.8 DC-DC CONVERTER

	Description	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	
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	

2.9 245 kV PROTECTION EQUIPMENT (Not Applicable)

2.9.1 220/132/33 kV Transformer Biased Differential Protection

	Item	Units	Required	Tendered
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Range of operating coil settings	% of CT rating		
4.	Range of bias coil settings	% of CT rating		
5.	Recommended operating coil setting			
6.	Recommended bias coil setting			
7.	Number of bias coils			
8.	Minimum sensitivity			
	(i) Earth faults	% of CT rating		
	(ii) Phase faults	% of CT rating		
9.	Maximum through fault at which the protective			
	equipment is stable with recommended settings			
	(i) Earth faults	% of CT rating		
	(ii) Phase faults	% of CT rating		
10.	Maximum time delay between initiation of fault and energizing of breaker trip circuit.	ms		
11.	Test plugs given as per clause 5.5.2 of Technical Specification – Grid Substation	Yes/No	Yes	

2.9.2 Transformer Restricted Earth Fault Protection

	Item	Units	Required	Tendered
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Operating principle, high impedance/ low impedance		Low impedance	
4.	Minimum relay setting	A		
5.	Sensitivity of scheme(Allowing for CT magnetizing current , etc.)	A		
6.	Maximum through fault current at which protection is stable.	A		
7.	CT requirements.			
8.	Operating time at twice relay minimum setting.	ms		
9.	Operating time at ten times relay minimum setting.	ms		

2.9.3 Busbar Protection

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number.			
3.	Operating principle ,e.g., high impedance, low impedance		Low impedance	
4.	Minimum relay setting			
5.	Sensitivity of scheme(Allowing for CT magnetizing current , etc.)			
6.	Maximum through fault current at which protection is stable	A		
7.	CT requirements			
8.	Estimated magnetizing current at relay setting			
9.	Operating time at twice relay minimum setting	ms		
10.	Operating time at ten times relay minimum setting	ms		
11.	Maximum No of input to the relay			
12.	Burden per relay input	VA		

2.9.4 Tripping Relays

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation and model number			
3.	Nominal operating voltage	V		
4.	Minimum operating voltage	V		
5.	Operating indicator			
6.	Operating time at nominal voltage	ms		
7.	Contact rating :			
	Make and carry continuously	V/A		
	Break resistive watts inductive	VA		

2.9.5 Inverse Time Overcurrent and Earth Fault Protection

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Inverse time element			
4.	Range of current settings:			
	(i) over current	A		
	(ii) earth fault	A		
5.	Range of operating times at highest timing setting at ten times current setting	s		
6.	Range of operating times at highest timing setting at twice current setting	s		
7.	High set instantaneous element			
8.	Range of settings:			
	- over current	A		
9.	Transient over- reach	%		
10.	Operating times:			
	at twice setting	s		
	at ten times setting	s		
11.	Burden of relay on minimum inverse time element current setting at a current ten times setting			
	- overcurrent	VA		
	- earth fault	VA		
12.	Directional element (where applicable)			

	Item	Units	Required	Tendered
			245kV	245kV
13.	Operating time			
14.	Direction discrimination Minimum voltage required at currents between			
	(i) 1 X rated current			
	(ii) 10 X rated current			
15.	Whether directional element controls the overcurrent protection			
16.	Reset time after removal of ten times CT rated current for			
	(i) phase element (100%)	ms		
	(ii) EF element (40%)	ms		

2.9.6 Distance Protection for Overhead Lines

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Phase switches	Yes/No		
4.	Zone switched	Yes/No		
5.	Number of zones			
6.	Shape of impedance characteristic			
	Zone 1			
	Zone 2			
	Zone 3			
	Reverse looking element (blocking signal initiation)			
7.	Sensitivity :			
	(i) Minimum operating current	A		
	Earth faults			
	Phase faults			
	(ii) Minimum necessary voltage at Zone 1 reach point (if applicable)	V		
	Earth faults			
	Phase faults			
	(iii) Minimum zone 1 ohmic impedance to which relay can be set	ohms		
	(iv) Maximum zone 1 ohmic impedance to which relay can be set and maintain accuracy	ohms		

	Item	Units	Required	Tendered
			245kV	245kV
	(v) Minimum zone 2 ohmic impedance to which relay can be set	ohms		
	(vi) Maximum zone 2 ohmic impedance to which relay can be set and	ohms		
	(vii) Maximum zone 3 ohmic reach	ohms		
	Forward reach			
	Reverse reach			
8.	Are forward and reverse reach setting independent of each other?	Yes/No		
9.	Can resistance and reactance reaches be set independent of each other?	Yes/No		
10.	Directional sensitivity	V		
11.	Current transformer requirements			
12.	Voltage transformer requirements			
13.	Back up zone time ranges	s		
	Zone 2			
	Zone 3			
14.	Method used to clear close-in faults			
	(i) which occur when line is already energized in service			
	(ii) which exist upon line energisation			

	Item	Units	Required	Tendered
			245kV	245kV
15.	Has distance protection been previously used in the type of blocking scheme specified for this contract?	Yes/No		
	(i) If yes, year of going into service	Years		
	(ii) Year of first going in to service			
	(iii)Approximate number of years in service	Years		
	(A complete reference list should be submitted stating client, system voltage and year of going into service)			
	Zone 1 operating times when relay fed from capacitive voltage transformer. This section must be completed in addition to supplying diagrams showing the effect of source to line ration and fault position on operating times.			

2.9.7 Line Differential Relay

	Item	Units	Required	Tendered
			245kV	**245kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Independent measurement per phase	Yes/No		
4.	Integrated backup distance protection	Yes/No	Yes	
5.	Continuous supervision of protection signal communication	Yes/No	Yes	
6.	Emergency operation as over current back-up protection	Yes/No	Yes	
7.	Max. Protection range without add. Transmission device	km		
8.	Max. Protection range with add. Transmission device	km		
9.	Typical operating time	ms		
10.	Restraint criteria			
11.	Basic setting range			
12.	Provision for transmitting binary signals	Yes/No	Yes	

2.9.8 Faults

	Source to Line Ratio	Fault Position % of Relay Setting	Operating Time m.sec	
			Minimum	Maximum
(a)	**Earth Faults**			
	1	0(relay point)		
		50		
		90		
	10	0(relay point)		
		50		
		90		
	30	0(relay point)		
		50		
		90		
(b)	**Phase to Phase Faults**			
	1	0(relay point)		
		50		
		90		
	10	0(relay point)		
		50		
		90		
	30	0(relay point)		
		50		
		90		

	Source to Line Ratio	Fault Position % of Relay Setting	Operating Time m.sec	
			Minimum	Maximum
(c)	**Three Phase Faults**			
	1	0(relay point)		
		50		
		90		
	10	0(relay point)		
		50		
		90		
	30	0(relay point)		
		50		
		90		

2.9.9 Dead Line Check Relays

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Voltage setting ranges			
	(i) Busbar Voltage	V		
	(ii) Line Voltage	V		
4.	Any time delays (Specify function and value)			

2.9.10 Synchronising Check Relays

	Item	Units	Required	Tendered
			245kV	**245kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation			
3.	Setting ranges			
	(i) Phase angles	degrees		
	(ii) Voltage difference	V		
	(iii) Frequency	Hz		
4.	Any time delays (Specify function and value)			

2.9.11 Breaker Failure Protection

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation			
3.	Setting of current elements :			
	(i) phase faults			
	(ii) earth faults			
4.	Timer setting			
5.	Burden of relay at minimum current setting at 10 times CT secondary rated current during :			
	(i) phase faults			
	(ii) earth faults			

2.9.12 Intertripping Send/Receiver Relays

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designations & model number			
	(i) send relay			
	(ii) receive relay			
3.	Send relay :			
	(i) Insulation level : kV(minimum 15kV)			
	(ii) Rated operating voltage :	V		
	(iii) Operating time at nominal volts:	ms		
	(iv) Is operation indicator fitted:			
	(v) Is injection resistor required:			
	(vi) Insulation level of injection resistor:			
4.	Receive relay:			
	(i) Insulation level :kV (minimum 15kV)			
	(ii) Degree of surge proofing	Amps a.c.& 50Hz		
	(iii) Minimum operating voltage/current:	V/A		
	(iv) Nominal operating voltage/current	V/A		
	(v) Operating time at nominal operating	ms		
	(vi) Voltage/Current	V/A		
	(vii) Is operation indicator fitted			

2.9.13 Under Frequency Relay

	Item	Units	Required	Tendered
			245kV	245kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Frequency setting range	Hz		
4.	Accuracy			
5.	Time delay setting ranges	s		

2.9.14 Substation Automation System

	Item	Units	Required	Tendered
1.	Manufacturer's Name			
2.	Manufacturer's Country			
3.	Manufacturer's type designation & model number			
4.	Temperature range			
	a. Operation	℃	-10 to +50	
	b. Transport and storage	℃	10 to +70	
5.	Relative humidity			
	a. Operation max./min.	%	95/5	
	b. Transport and storage	%	> 95/5	
6.	All independent circuits fully galvanically isolated		Yes	
7.	Dielectric strength, AC 50Hz, 1Min.	kV	2	
8.	MTBF of I/O board	h	>100,000	
9.	MTBF of CPU board	h	>80,000	
10.	MTTR	h	<1	
11.	Self-test system		Yes	
12.	Transmission protocol standard		IEC 61850	
13.	Transmission modes (programmable and by parameter changes)		Yes	
14.	Parallel transmission on two channels and receiving on the best one		Yes	
15.	Parallel transmission on both channels and receiving on both channels		Yes	
16.	Transmitted information chronology			
17.	Status changes transmitted with time tag (1ms)		Yes	

	Item	Units	Required	Tendered
18.	Type of Station Computer			
19.	Type of Engineering Work Station			
20.	Type of Laptop Computer			
21.	Type of Display and Size			
22.	Type of Printer			
23.	Type of Hard Copy Printer			
24.	OS type and version			
25.	LAN Topology			
26.	LAN Redundancy		Duplicate	
27.	Type of Switch			
28.	Clock Synchronism		GPS	
29.	Type of Alarm Indication Unit			

	Item	Units	Required	Tendered
30	Gateway			
1)	Manufacturer's name & address			
2)	Manufacturer's type designation & model number			
3)	Standards		IEC 60870 & 61850	
4)	Working temperature range	Deg C		
5)	Relative humidity			
6)	Working voltage	V DC	-48V DC	
7)	Power consumption	W		
8)	Type of Mounting		in server rack	
9)	Size (W x D x H)	mm		
	Interface & Function			
1	Number of optical signal Ethernet ports		≥ 02	
2	Number of electro signal Ethernet ports		≥ 02	
3	Numbers of IEC60870-5-101 serial ports		≥ 04	
4	Number of IEC 60870-5-104 Ethernet ports		> 04	
5	Connectivity		Up to 128 devices	
6	No of Data points (capacity) available with the given licences			
7	Access port by the maintenance laptop PC		Yes	
8	License for Configuration and maintenance of Gateway		Equipped	

2.9.15 Digital Disturbance Recorder (DDR) System

	Item	Units	Required	Tendered
(a)	**General**			
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Power Supply	VDC		
	-Power Supply for Printer	VAC	230	
(b)	**Analogue Inputs**			
1.	Number of channel		Min 192	
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	

	Item	Units	Required	Tendered
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		
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 576	
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	

	Item	Units	Required	Tendered
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	
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	

	Item	Units	Required	Tendered
(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	
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	

	Item	Units	Required	Tendered
(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	

2.10 145 kV PROTECTION EQUIPMENT

2.10.1 132/33 kV Transformer Biased Differential Protection

	Item	Units	Required	Tendered
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Range of operating coil settings	% of CT rating		
4.	Range of bias coil settings	% of CT rating		
5.	Recommended operating coil setting			
6.	Recommended bias coil setting			
7.	Number of bias coils			
8.	Minimum sensitivity			
	(i) Earth faults	% of CT rating		
	(ii) Phase faults	% of CT rating		
9.	Maximum through fault at which the protective			
	equipment is stable with recommended settings			
	(i) Earth faults	% of CT rating		
	(ii) Phase faults	% of CT rating		
10.	Maximum time delay between initiation of fault and energizing of breaker trip circuit.	ms		
11.	Test plugs given as per clause 5.5.2 of Technical Specification – Grid Substation	Yes/No	Yes	

2.10.2 Transformer Restricted Earth Fault Protection

	Item	Units	Required	Tendered
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Operating principle, high impedance / low impedance		Low Impedance	
4.	Minimum relay setting	A		
5.	Sensitivity of scheme(Allowing for CT magnetizing current , etc.)	A		
6.	Maximum through fault current at which protection is stable.	A		
7.	CT requirements.			
8.	Operating time at twice relay minimum setting.	ms		
9.	Operating time at ten times relay minimum setting.	ms		

2.10.3 Busbar Protection

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number.			
3.	Operating principle ,e.g., high impedance, low impedance		Low impedance	
4.	Minimum relay setting			
5.	Sensitivity of scheme(Allowing for CT magnetizing current , etc.)			
6.	Maximum through fault current at which protection is stable	A		
7.	CT requirements			
8.	Estimated magnetizing current at relay setting			
9.	Operating time at twice relay minimum setting	ms		
10.	Operating time at ten times relay minimum setting	ms		
11.	Maximum No of input to the relay			
12.	Burden per relay input	VA		

2.10.4 Tripping Relays

	Item	Units	Required	Tendered
			145kV	145kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation and model number			
3.	Nominal operating voltage	V		
4.	Minimum operating voltage	V		
5.	Operating indicator			
6.	Operating time at nominal voltage	ms		
7.	Contact rating :			
	Make and carry continuously	V/A		
	Break resistive watts inductive	VA		

2.10.5 Inverse Time Overcurrent and Earth Fault Protection

	Item	Units	Required	Tendered
			145kV	145kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Inverse time element			
4.	Range of current settings:			
	(i) over current	A		
	(ii) earth fault	A		
5.	Range of operating times at highest timing setting at ten times current setting	s		
6.	Range of operating times at highest timing setting at twice current setting	s		
7.	High set instantaneous element			
8.	Range of settings:			
	- over current	A		
9.	Transient over- reach	%		
10.	Operating times:			
	at twice setting	s		
	at ten times setting	s		
11.	Burden of relay on minimum inverse time element current setting at a current ten times setting			
	- overcurrent	VA		
	- earth fault	VA		
12.	Directional element (where applicable)			

	Item	Units	Required	Tendered
			145kV	**145kV**
13.	Operating time			
14.	Direction discrimination Minimum voltage required at currents between			
	(i) 1 X rated current			
	(ii) 10 X rated current			
15.	Whether directional element controls the overcurrent protection			
16.	Reset time after removal of ten times CT rated current for			
	(i) phase element (100%)	ms		
	(ii) EF element (40%)	ms		

2.10.6 Distance Protection for Overhead Lines

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Phase switches	Yes/No		
4.	Zone switched	Yes/No		
5.	Number of zones			
6.	Shape of impedance characteristic			
	Zone 1			
	Zone 2			
	Zone 3			
	Reverse looking element (blocking signal initiation)			
7.	Sensitivity :			
	(i) Minimum operating current	A		
	Earth faults			
	Phase faults			
	(ii) Minimum necessary voltage at Zone 1 reach point (if applicable)	V		
	Earth faults			
	Phase faults			
	(iii) Minimum zone 1 ohmic impedance to which relay can be set	ohms		
	(iv) Maximum zone 1 ohmic impedance to which relay can be set and maintain accuracy	ohms		

	Item	Units	Required	Tendered
			145kV	145kV
	(v) Minimum zone 2 ohmic impedance to which relay can be set	ohms		
	(vi) Maximum zone 2 ohmic impedance to which relay can be set and	ohms		
	(vii) Maximum zone 3 ohmic reach	ohms		
	Forward reach			
	Reverse reach			
8.	Are forward and reverse reach setting independent of each other?	Yes/No		
9.	Can resistance and reactance reaches be set independent of each other?	Yes/No		
10.	Directional sensitivity	V		
11.	Current transformer requirements			
12.	Voltage transformer requirements			
13.	Back up zone time ranges	s		
	Zone 2			
	Zone 3			
14.	Method used to clear close-in faults			
	(i) which occur when line is already energized in service			
	(ii) which exist upon line energisation			

	Item	Units	Required	Tendered
			145kV	**145kV**
15.	Has distance protection been previously used in the type of blocking scheme specified for this contract?	Yes/No		
	(i) If yes, year of going into service	Years		
	(ii) Year of first going in to service			
	(iii)Approximate number of years in service	Years		
	(A complete reference list should be submitted stating client, system voltage and year of going into service)			
	Zone 1 operating times when relay fed from capacitive voltage transformer. This section must be completed in addition to supplying diagrams showing the effect of source to line ration and fault position on operating times.			

2.10.7 Line Differential Relay

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Independent measurement per phase	Yes/No		
4.	Integrated backup distance protection	Yes/No	Yes	
5.	Continuous supervision of protection signal communication	Yes/No	Yes	
6.	Emergency operation as over current back-up protection	Yes/No	Yes	
7.	Max. Protection range without add. Transmission device	km		
8.	Max. Protection range with add. Transmission device	km		
9.	Typical operating time	ms		
10.	Restraint criteria			
11.	Basic setting range			
12.	Provision for transmitting binary signals	Yes/No	Yes	

2.10.8 Faults

	Source to Line Ratio	Fault Position % of Relay Setting	Operating Time m.sec	
			Minimum	Maximum
(a)	**Earth Faults**			
	1	0(relay point)		
		50		
		90		
	10	0(relay point)		
		50		
		90		
	30	0(relay point)		
		50		
		90		
(b)	**Phase to Phase Faults**			
	1	0(relay point)		
		50		
		90		
	10	0(relay point)		
		50		
		90		
	30	0(relay point)		
		50		
		90		

	Source to Line Ratio	Fault Position % of Relay Setting	Operating Time m.sec	
			Minimum	Maximum
(c)	**Three Phase Faults**			
	1	0(relay point)		
		50		
		90		
	10	0(relay point)		
		50		
		90		
	30	0(relay point)		
		50		
		90		

2.10.9 Dead Line Check Relays

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Voltage setting ranges			
	(i) Busbar Voltage	V		
	(ii) Line Voltage	V		
4.	Any time delays (Specify function and value)			

2.10.10 Synchronising Check Relays

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation			
3.	Setting ranges			
	(i) Phase angles	degrees		
	(ii) Voltage difference	V		
	(iii) Frequency	Hz		
4.	Any time delays (Specify function and value)			

2.10.11 Breaker Failure Protection

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation			
3.	Setting of current elements :			
	(i) phase faults			
	(ii) earth faults			
4.	Timer setting			
5.	Burden of relay at minimum current setting at 10 times CT secondary rated current during :			
	(i) phase faults			
	(ii) earth faults			

2.10.12 Intertripping Send/Receiver Relays

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designations & model number			
	(i) send relay			
	(ii) receive relay			
3.	Send relay :			
	(i) Insulation level : kV(minimum 15kV)			
	(ii) Rated operating voltage :	V		
	(iii) Operating time at nominal volts:	ms		
	(iv) Is operation indicator fitted:			
	(v) Is injection resistor required:			
	(vi) Insulation level of injection resistor:			
4.	Receive relay:			
	(i) Insulation level :kV (minimum 15kV)			
	(ii) Degree of surge proofing	Amps a.c.& 50Hz		
	(iii) Minimum operating voltage/current:	V/A		
	(iv) Nominal operating voltage/current	V/A		
	(v) Operating time at nominal operating	ms		
	(vi) Voltage/Current	V/A		
	(vii) Is operation indicator fitted			

2.10.13 Under Frequency Relay

	Item	Units	Required	Tendered
			145kV	**145kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Frequency setting range	Hz		
4.	Accuracy			
5.	Time delay setting ranges	s		

2.11 36 kV PROTECTION EQUIPMENT

2.11.1 Transformer Restricted Earth Fault Protection

	Item	Units	Required	Tendered
			36kV	36kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Operating principle, high impedance			
4.	Minimum relay setting	A		
5.	Sensitivity of scheme(Allowing for CT magnetizing current , etc.)	A		
6.	Maximum through fault current at which protection is stable.	A		
7.	CT requirements.			
8.	Operating time at twice relay minimum setting.	ms		
9.	Operating time at ten times relay minimum setting.	ms		

2.11.2 Tripping Relays

	Item	Units	Required	Tendered
			36kV	36kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation and model number			
3.	Nominal operating voltage	V		
4.	Minimum operating voltage	V		
5.	Operating indicator			
6.	Operating time at nominal voltage	ms		
7.	Contact rating :			
	Make and carry continuously	V/A		
	Break resistive watts inductive	VA		

2.11.3 Inverse Time Overcurrent & Earth Fault Protection

	Item	Units	Required	Tendered
			36kV	36kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Inverse time element			
4.	Range of current settings:			
	(i) over current	A		
	(ii) earth fault	A		
5.	Range of operating times at highest timing setting at ten times current setting	s		
6.	Range of operating times at highest timing setting at twice current setting	s		
7.	High set instantaneous element			
8.	Range of settings:			
	- over current	A		
9.	Transient over- reach	%		
10.	Operating times:			
	at twice setting	s		
	at ten times setting	s		
11.	Burden of relay on minimum inverse time element current setting at a current ten times setting			
	- overcurrent	VA		
	- earth fault	VA		
12.	Directional element (where applicable)			

	Item	Units	Required	Tendered
			36kV	36kV
13.	Operating time			
14.	Direction discrimination Minimum voltage required at currents between			
	(i) 1 X rated current			
	(ii) 10 X rated current			
15.	Whether directional element controls the overcurrent protection			
16.	Reset time after removal of ten times CT rated current for			
	(i) phase element (100%)	ms		
	(ii) EF element (40%)	ms		

2.11.4 Directional Over Current/ Directional Under Current Protection

	Item	Units	Required	Tendered
			36kV	36kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Inverse time element			
4.	Range of current settings:			
	(i) over current	A		
	(ii) earth fault	A		
5.	Range of operating times at highest timing setting at ten times current setting	s		
6.	Range of operating times at highest timing setting at twice current setting	s		
7.	High set instantaneous element			
8.	Range of settings:			
	- over current	A		
9.	Transient over- reach	%		
10.	Operating times:			
	at twice setting	s		
	at ten times setting	s		
11.	Burden of relay on minimum inverse time element current setting at a current ten times setting			
	- overcurrent	VA		
	- earth fault	VA		
12.	Directional element (where applicable)			

	Item	Units	Required	Tendered
			36kV	36kV
13.	Operating time			
14.	Direction discrimination Minimum voltage required at currents between			
	(i) 1 X rated current			
	(ii) 10 X rated current			
15.	Whether directional element controls the overcurrent protection			
16.	Reset time after removal of ten times CT rated current for			
	(i) phase element (100%)	ms		
	(ii) EF element (40%)	ms		

2.11.5 Dead Line Check Relays

	Item	Units	Required	Tendered
			36kV	36kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Voltage setting ranges			
	(i) Busbar voltage	V		
	(ii) Line Voltage	V		
4.	Any time delays (Specify function and value)			

2.11.6 Synchronising Check Relays

	Item	Units	Required	Tendered
			36kV	**36kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation			
3.	Setting ranges			
	(i) Phase angles	degrees		
	(ii) Voltage difference	V		
	(iii) Frequency	Hz		
4.	Any time delays (Specify function and value)			

2.11.7 Intertripping Send/Receiver Relays

	Item	Units	Required	Tendered
			36kV	36kV
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designations & model number			
	(i) send relay			
	(ii) receive relay			
3.	Send relay :			
	(i) Insulation level : kV(minimum 15kV)			
	(ii) Rated operating voltage :	V		
	(iii) Operating time at nominal volts:	ms		
	(iv) Is operation indicator fitted:			
	(v) Is injection resistor required:			
	(vi) Insulation level of injection resistor:			
4.	Receive relay:			
	(i) Insulation level :kV (minimum 15kV)			
	(ii) Degree of surge proofing	Amps a.c.& 50Hz		
	(iii) Minimum operating voltage/current:	V/A		
	(iv) Nominal operating voltage/current	V/A		
	(v) Operating time at nominal operating			
	(vi) voltage/current	ms		
	(vii) Is operation indicator fitted			

2.11.8 Under Frequency Relay

	Item	Units	Required	Tendered
			36kV	**36kV**
1.	Manufacturer's Name & Address			
2.	Manufacturer's type designation & model number			
3.	Frequency setting range	Hz		
4.	Accuracy			
5.	Time delay setting ranges	s		

2.12 FIBER OPTIC & SCADA EQUIPMENT

2.12.1 Optical Fibre Equipment

	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		$\geq$ 2x128 Mbps	
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		

	Item	Units	Required	Tendered
	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	
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	

	Item	Units	Required	Tendered
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 Physical ports		≥5	
2	Bit Rates		10/100/1000 Base T	
3	Features		L2 Switching, VLAN	
4	L2 switching		Min 8 independent switching instances	
6	Traffic Protection		STP, RSTP	
(iv)	**FXO Module**	pcs		
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	

	Item	Units	Required	Tendered
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 (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	

2.13 GROUNDING MATERIALS

	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		

	Item	Units	Required	Tendered
(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			

2.14 CABLES

2.14.1 1000V Cables

	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		

2.14.2 Multicore Control Cables

	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		

2.14.3 36kV/12kV XLPE Power Cables (Include separate column for each type or cross-section of cable)

	Item	Units	Required	Tendered
1.	System Highest Voltage (phase to phase) (U_m to IEC 60502)	kV	36 and 12	
2.	Number of cores		One	
3.	Conductor			
	- Cross sectional area	mm^2		
	- Material		Cu	
	- Design			
	- Overall Dimensions	mm		
	- Welding or soldering temp.	^0C		
4.	Conductor Screen			
	- Material			
	- Thickness Approx:	mm		
5.	Insulation			
	- Material	mm		
	- Thickness Approx	mm		
6.	Core Screen			
	- Material			
	- Thickness, approx.	mm		
	- Diameter over screen	mm		
7.	Metallic Layer			
	- Material			
	- No. Of Wires or Tapes	mm		
	- Size Of Wire or Tapes	mm		
	- Cross Section	mm^2		

	Item	Units	Required	Tendered
8.	Metal Sheath			
	- Material			
	- Nominal Thickness	mm		
	- External Diameter	mm^2		
9.	Lead Alloy Sheath Composition			
	- Tin	%		
	- Cadmium	%		
	- Antimony	%		
	- Lead	%		
10.	Aluminum			
	- Maximum Working Hoop	kpa		
	- Stress			
	- 0.1% Proff Stress	kpa		
	- Purity	%		
	- Plumbing Temperature	^0C		
11.	Outer Covering			
	- Material			
	- Minimum Average Thickness	mm		
	- Type Of Termite Repellent			
12.	Completed Cable			
	- Overall Diameter, approx.	mm		
	- Weight Per Meter	kg		
	- Drum Length	m		
	- Nominal			

	Item	Units	Required	Tendered
13.	Cable Drums			
	- Overall Diameter	m		
	- Width	m		
	- Weight Loaded	kg		
14.	Conditions Upon which current carrying			
	capacities laying in trefoil formation are based			
	- Axial spacing between phase cable	mm		
	- Axial spacing between circuits	mm		
	- Soil thermal resistively	Deg.		
	- Ground Temperature	^{0}C		
	- Air Temperature	^{0}C		
	- Burial depth	m		
	- Type Of earth bonding: Single Point	Yes/No		
15.	Maximum dielectric stress at the Sector screen (assumed smooth)	kV/mm		
16.	Minimum radius of bend around which can be laid.			
	- Laid direct.	m		
	- In ducts.	m		
	- In Air.	m		
17.	Nominal internal diameter of pipes or ducts through which cable may be pulled.	mm		

	Item	Units	Required	Tendered
18.	Maximum D.C Resistance of conductor per meter of cable 20^0C			
	- Of Conductor	microhm		
	- Of metallic layers	microhm		
19.	Maximum A.C. Resistance of conductor per meter of cable at maximum conductor temperature.	microhm		
20.	Insulation Resistance Of Cable Per Core			
	- 20^0C	megaohm		
	- at max. rated temp.	megaohm		
21.	Equivalent Star Reactance per meter of 3-phase Circuit at nominal frequency	microhm		
22.	Maximum Electrostatic Capacitance Per Meter Of Cable	pF		
23.	Maximum Charging Current per core per meter of Cable at nominal voltage U_0	A		
24.	Current Carrying Capacity Based On the conditions specified			
	Main Transformer Feeders (31.5MVA)	A		
	Main Transformer Feeders (45MVA)	A		
	Line Feeders	A		
	Generator Feeders	A		
	Auxiliary Transformer Feeders	A		
25.	Maximum Conductor Temperature			
	-Laid direct In Ground	^{0}C		
	-Drawn into ducts	^{0}C		
	-Erected In Air	^{0}C		

	Item	Units	Required	Tendered
			36kV	36kV
26.	Conductor Short Circuit Current carrying capacity for one second, cable loaded as above prior to short circuit and final conductor temperature of 250^0C	kA		
27.	Metallic layer earth faulty current Carrying Capacity for one second, cable loaded as above Prior to earth fault and final screen temperature	^{0}C		
28.	Maximum dielectric loss of cable per meter of three-phase circuit when laid direct in the ground at nominal voltage Uo, nominal frequency and operating oil pressure at maximum conductor Temperature	W/m		
29.	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 20^0C			
	-Maximum Conductor Temperature	tan d		
30.	Maximum dielectric loss angle of charging VA of cable at normal frequency conductor temperature of 20^0C at			
	-50% rated voltage Uo	tan d		
	-125% rated voltage Uo	tan d		
	-200% rated voltage Uo	tan d		
31.	Metallic layer loss (including amour if applicable) Of cable per meter of three-phase circuit at nominal voltage Uo and normal frequency at the circuit rating stated above	W		
32.	Horizontal distance between cable supporting racks			

	Item	Units	Required	Tendered
			36kV	**36kV**
33.	Creepage distance of sealing end porcelain			
	Specified	mm		
	Guaranteed	mm		
34.	Type test certificate		Yes	
35.	Partial discharge at 2U0	%	<=5	

2.14.4 245kV XLPE Power Cables (Not Applicable)

	Item	Units	Required	Tendered
			245kV	245kV
1.	Voltage phase to phase (Uo/U(U_m) to IEC 62067)	kV	245	
2.	Number of cores		One	
3.	Conductor			
	- Cross sectional area	mm^2	240/800	
	- Material		Cu	
	- Design			
	- Overall Dimensions	mm		
	- Welding or soldering temp.	^0C		
4.	Conductor Screen			
	- Material			
	- Thickness Approx:	mm		
5.	Insulation			
	- Material		XLPE	
	- Thickness Approx	mm		
6.	Core Screen			
	- Material			
	- Thickness, approx.	mm		
	- Diameter over screen	mm		
7.	Metallic Layer			
	- Material			
	- No. Of Wires or Tapes	mm		
	- Size Of Wire or Tapes	mm		
	- Cross Section	mm^2		

	Item	Units	Required	Tendered
			245kV	245kV
8.	Metal Sheath			
	- Material			
	- Nominal Thickness	mm		
	- External Diameter	mm^2		
9.	Lead Alloy Sheath Composition			
	- Tin	%		
	- Cadmium	%		
	- Antimony	%		
	- Lead	%		
10.	Aluminum			
	- Maximum Working Hoop	kpa		
	- Stress			
	- 0.1% Proff Stress	kpa		
	- Purity	%		
	- Plumbing Temperature	^0C		
11.	Outer Covering			
	- Material			
	- Minimum Average Thickness	mm		
	- Type Of Termite Repellent			
12.	Completed Cable			
	- Overall Diameter, approx.	mm		
	- Weight Per Meter	kg		
	- Drum Length	m		
	- Nominal			

	Item	Units	Required	Tendered
			245kV	245kV
13.	Cable Drums			
	- Overall Diameter	m		
	- Width	m		
	- Weight Loaded	kg		
14.	Conditions Upon which current carrying			
	capacities laying in trefoil formation are based			
	- Axial spacing between phase cable	mm		
	- Axial spacing between circuits	mm		
	- Soil thermal resistively	Deg.		
	- Ground Temperature	^{0}C		
	- Air Temperature	^{0}C		
	- Burial depth	m		
	- Type Of earth bonding: Single Point	Yes/No		
15.	Maximum dielectric stress at the Sector screen (assumed smooth)	kV/mm		
16.	Minimum radius of bend around which can be laid.			
	- Laid direct.	m		
	- In ducts.	m		
	- In Air.	m		
17.	Nominal internal diameter of pipes or ducts through which cable may be pulled.	mm		

	Item	Units	Required	Tendered
			245kV	245kV
18.	Maximum D.C Resistance of conductor per meter of cable 20^0C			
	- Of Conductor	microhm		
	- Of metallic layers	microhm		
19.	Maximum A.C. Resistance of conductor per meter of cable at maximum conductor temperature.	microhm		
20.	Insulation Resistance Of Cable Per Core			
	- 20^0C	microhm		
	- at max. rated temp.	microhm		
21.	Equivalent Star Reactance per meter of 3-phase Circuit at nominal frequency	microhm		
22.	Maximum Electrostatic Capacitance Per Meter Of Cable	pF		
23.	Maximum Charging Current per core per meter of Cable at nominal voltage U_0	A		
24.	Current Carrying Capacity Based On the conditions specified			
	Main Transformer Feeders	A	400	
	Line Feeders	A	1200	
25.	Maximum Conductor Temperature			
	-Laid direct In Ground	^{0}C		
	-Drawn into ducts	^{0}C		
	-Erected In Air	^{0}C		

	Item	Units	Required	Tendered
			245kV	245kV
26.	Conductor Short Circuit Current carrying capacity for one second, cable loaded as above prior to short circuit and final conductor temperature of 250^0C	kA		
27.	Metallic layer earth faulty current Carrying Capacity for one second, cable loaded as above Prior to earth fault and final screen temperature	^{0}C		
28.	Maximum dielectric loss of cable per meter of three-phase circuit when laid direct in the ground at nominal voltage Uo, nominal frequency and operating oil pressure at maximum conductor Temperature	W/m		
29.	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 20^0C			
	-Maximum Conductor Temperature	tan d		
30.	Maximum dielectric loss angle of charging VA of cable at normal frequency conductor temperature of 20^0C at			
	-50% rated voltage Uo	tan d		
	-125% rated voltage Uo	tan d		
	-200% rated voltage Uo	tan d		
31.	Metallic layer loss (including amour if applicable) Of cable per meter of three-phase circuit at nominal voltage Uo and normal frequency at the circuit rating stated above	W		
32.	Horizontal distance between cable supporting racks			

	Item	Units	Required	Tendered
			245kV	**245kV**
33.	Creepage distance of sealing end porcelain			
	Specified	mm		
	Guaranteed	mm		
34.	Type test certificate		Yes	
35.	Partial discharge at 2U0	%	<=5	

2.15 POWER TRANSFORMERS

2.15.1 63 MVA, 220/33kV Transformer (220 V dc Voltage) – (Not Applicable)

	Item	Units	Required	Tendered
(a)	**Rating and Performance**			
1.	Manufacturer's Name & Address			
2.	Continuous maximum rating (ONAN/ONAF)	MVA		
	Auto winding			
	Tertiary Winding		44/63	
3.	Number of phases		3	
4.	Rated Frequency	Hz	50	
5.	Number of windings		2	
6.	Applicable standards		IEC 60076:2011	
7.	System maximum voltage for both windings Um	HV	245kV	
		MV	36	
8.	Insulation type	HV	Graded	
		MV	Uniform	
9.	Highest Voltage for equipment	HV	245kV	
		MV	36kV	
10.	Winding insulation level.	HV	LI: 1050kV, AC:460 kV	
		MV	LI:170 kV, AC:70kV	
11.	Transformer Nominal Ratio		220kV / 33kV	
12.	Phase connections :			
	HV winding		Star auto	
	MV winding		Delta	
	Vector Group		YNa0d1	

	Item	Units	Required	Tendered
13.	Short circuit withstand fault level at terminals of			
	245 kV busbars	kA	40	
	36 kV busbars	kA	25	
	Short Circuit withstand current	sec	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	^{0}C	32	
	Average in one year	^{0}C	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 (+ & -)		+7 to -10 (18 tap positions)	
	(E) Step size	%	1.5	
	(F) 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)		
	(G) Type test certificate reference			
	Tap position Indication	2nos BCD		

	Item	Units	Required	Tendered
18.	Size of tapping step with position nos.		18 taps/1.5% step voltage	
19.	Approximate ONAN rating	MVA	44	
20.	Winding temperature rise at CMR	^{0}C	65 – (Annual Average temperature - 20)	
21.	Top oil temperature rise			
	(A) CMR	^{0}C	60 – (Annual Average temperature - 20)	
	(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) b) Long time emergency loadings(IEC 60076-7) c) Short time emergency loading(IEC 60076-7)	 ^{0}C ^{0}C ^{0}C	 120 140 160	
24.	Flux density in iron at normal voltage and frequency and at normal ratio - (no load).			
	(A) Core	Tesla		
	(B) Yokes	Tesla		
25.	Magnetising current (approx) at nominal ratio and			
	at 0.9 x nominal voltage	%		
	at 1.0 x nominal voltage	%		
	at 1.1 x nominal voltage	%		
	at 1.2 x nominal voltage	%		

	Item	Units	Required	Tendered
26.	Guaranteed Losses at nominal ratio			
	(A) No Load losses (at rated voltage and frequency)	kW	Max. 35	
	(B) Copper losses at CMR corrected to 75^0C	kW	Max. 225	
	(C) Auxiliary losses at CMR corrected to 75^0C	kW		
27.	Regulation at 75^0C and normal ratio			
	(A) At unity power factor	%		
	(B) At 0.8 lagging power factor	%		
28.	Impedance voltage at 75 ^{0}C and CMR. Between			
	HV and LV Windings at Tap			
	Maximum	%		
	Nominal	%	30	
	Minimum	%		
29.	Equivalent circuit zero sequence impedance between HV and LV windings	ohms		
30.	Maximum current density in windings at C.M.R.			
	(A) HV Winding	A/mm^2		
	(B) LV Winding	A/mm^2		

	Item	Units	Required	Tendered
(b)	**Control Circuits**			
1.	Type of controls for on load tap changer and cooler controls		Automatic	
2.	Whether automatic control required and the		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	
6.	DC supply (control voltage) :			
	Nominal	V	220 V DC	
	Maximum float voltage	V		
7.	AC supply voltage for tap changer operating motor 3 phase.		400V AC 50Hz	
8.	Whether provision for supervisory control required, including AVR setting		No	
9.	Whether marshalling kiosk required			
10.	Whether provision for supervisory control required, including AVR setting			
11.	Number of transformers for which automatic control is to be provided		All	

	Item	Units	Required	Tendered
12.	Transformer terminals for line and neutral			
	(i) HV line		Bushings	
	(ii) Neutral		Bushings	
	(iii) MV line		Bushings	
	(attach all technical data of all types of bushings & ducts)			
13.	Accommodation for current transformers in bushings at			
	(i) HV line			
	(ii) Neutral			
	(iii) MV line			
14.	Accommodation of tank for outdoor weatherproof HV neutral current transformers		Yes	
15.	Pollution category of bushings High-25mm/kV based on system highest voltage			
(c)	**Cooling**			
1.	Minimum number of radiators per transformer			
2.	Maximum rating of each radiator as percentage of total loss at CMR			
(d)	**General**			
1.	Type of oil preservation system		Silica Gel	
2.	Whether wheels, skid or flat bottom base required		Wheels	
3.	Whether anti-vibration pads required		No	
4.	Transformer noise acceptance level	dB	83	

	Item	Units	Required	Tendered
(e)	**Details Of Construction**			
1.	Types of winding -			
	(A) HV			
	(B) MV			
	(C) TW			
2.	Material of Insulation			
	(A) HV windings.			
	(B) MV windings			
	(C) TW winding			
3.	Insulation of tapping connections			
4.	Insulation of -			
	(A) Yoke bolts.			
	(B) Side plates.			
5.	Winding connections brazed or crimped Specify material (winding material and the joint material)			
6.	Is facility provided for adjustment of axial pressure on windings.	Yes/No		
7.	Thickness of transformer tank			
	(A) Sides	mm		
	(B) Bottom	mm		
8.	Material used for gaskets for oil tight joints.			
9.	Cover flange:-			
	Level: Low/High			
	Joint: WELDED/GASKETTED			

	Item	Units	Required	Tendered
(f)	**Radiators Valves and Fans**			
1.	Thickness of radiator plates and/or cooling tubes.	mm		
2.	Valve type/material:			
	75mm and below			
	above 75mm			
3.	Equipment for ONAN cooling state (A) or (B) -			
	(A) Radiator on main tank			
	(B) Separate cooler bank			
4.	Number of cooling air blowers per transformer			
5.	Speed of air blowers and air flow	rpm /m^3 per min		
6.	Rating of each air blower motor	kW		
7.	Starting current of each blower motor,	A		
(g)	**Oil Volumes and Weights**			
1.	Total oil required including cooler system	liters		
2.	Volume of oil to fill transformer to above the top yoke.	liters		
3.	Total volume of conservator	liters		
4.	Volume of oil in conservator between highest and lowest visible	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		

	Item	Units	Required	Tendered
7.	Total weights of complete transformers, including attached coolers, voltage regulating equipment, all fittings and oil	tons		
8.	Weight of transformer arranged for transport	tons		
(h)	**Transformer Oil**			
1.	Manufacture, type and class of oil to IEC 60296			
(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 (If Applicable)**			
1.	Manufacturer			
2.	Insulator material (solid/oil-paper)			
3.	Manufacturer's type reference and rated voltage			
4.	Rated current			
5.	Manufacturer of porcelain			
6.	Length of insulator (overall).	mm		
7.	Weight of insulator.	kg		
8.	Electrostatic capacity of complete bushings.	pF		
9.	Dry lightning impulse voltage withstand. (1.2/50 wave)	kV		
10.	50Hz dry voltage withstand voltage without arching horns	kV		

	Item	Units	Required	Tendered
11.	50Hz wet withstand voltage without arcing horns	kV		
12.	Total creepage distance of shed (specified minimum 25mm/kV based on maximum system voltage)	mm		
13	Negative pressure tank can withstand			
14	Type test Certificate for similar category transformer	To be annexed	yes	
15	Proof of manufacturing experience of 12 years for power transformers	To be annexed	yes	
16	Customer reference list for similar category Transformers	To be annexed	yes	
17	Tests carried out at the manufacture's work as per IEC 60076-1:2011	To be annexed	yes	
k	**Transformer tank Fittings**			
1	Draining and filter valves		yes	
2	Valves for tank oil sampling		yes	
3	Radiator isolation valves		yes	
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	

	Item	Units	Required	Tendered
l	**Transformer accessories**			
1	Oil preservation system with or without rubber bag		Yes	
2	Dehydrating breather (maintenance free Type)		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	
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		Yes	
12	On-line monitoring system		Yes	
13	Fire protection system		Yes	
m	**Quality Assurance**			
1	Manufacturer quality assurance acc. to ISO 9001		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	

	Item	Units	Required	Tendered
n	**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).		Yes	
6	Tests on on-load tap-changers (11.7).		Yes	
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 between each winding to earth and between windings.		Yes	
14	Measurement of dissipation factor (tan δ) of the insulation system capacitances.		Yes	
	Item	**Units**	**Required**	**Tendered**

16	Measurement of no-load loss and current at 90 % and 110 % of rated voltage(11.5).		Yes	
o	**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	
p	**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	
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).		Yes	
8	Measurement of d.c. 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	
	Item	**Units**	**Required**	**Tendered**
12	Measurement of frequency		Yes	

	response (Frequency Response Analysis or FRA). The test procedure shall be agreed between manufacturer and purchaser.			
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 on-load current		Yes	
18	Insulation test of oil and Measurement of dielectric strength of oil		Yes	
q	**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	Insulation resistance measurement		Yes	
7	Check of protective earthing connections		Yes	
8	Current transformer polarity check		Yes	
9	Control equipment circuit check		Yes	
10	Oil tests		Yes	
11	Operation test of supervisory equipment		Yes	
12	Operation test of cooling equipment		Yes	

	Item	**Units**	**Required**	**Tendered**
13	Operation test of on load tap changer		Yes	
14	Visual Inspections and adjustments as per clause 10.24 of technical specifications		Yes	
15	fingerprint tests (Um>72 kV)		Yes	

2.15.2 45 MVA, 132/33 kV Transformer (110 V dc Voltage) – (Not Applicable)

	Item	Units	Required	Tendered
(a)	**Rating and Performance**			
1.	Manufacturer's Name & Address			
2.	Continuous maximum rating (ONAN/ONAF)	MVA	33/45	
3.	Number of phases		3	
4.	Rated Frequency	Hz	50	
5.	Number of windings		2	
6.	Applicable standards		IEC 60076:2011	
7.	System maximum voltage for both windings Um	HV	145kV	
		MV	36kV	
8.	Insulation type	HV	Graded	
		MV	Uniform	
9.	Highest Voltage for equipment	HV	145kV	
		MV	36kV	
10.	Winding insulation level.	HV	LI: 650kV, AC: 275 kV	
		MV	LI:170kV, AC:70kV	
11.	Transformer Nominal Ratio		132kV / 33 kV	
12.	Phase connections :			
	HV winding		Star	
	LV winding		Delta	
	Vector Group		YNd1	

	Item	Units	Required	Tendered
13.	Short circuit withstand fault level at terminals of			
	145kV busbars	kA	40	
	36kV busbars	kA	25	
	Short Circuit withstand current	sec	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	^{0}C	32	
	Average in one year	^{0}C	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 (+ & -)		+7 to -10 (18 tap positions)	
	(E) Step size	%	1.5	
	(F) 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)		
	(G) Type test certificate reference			
	Tap position Indication	2nos BCD		

	Item	Units	Required	Tendered
18.	Size of tapping step with position nos.		18 taps/1.5% step voltage	
19.	Approximate ONAN rating	MVA	33	
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) b) Long time emergency loadings(IEC 60076-7) c) Short time emergency loading(IEC 60076-7)	 ^{0}C ^{0}C ^{0}C	 120 140 160	
24.	Flux density in iron at normal voltage and frequency and at normal ratio - (no load).			
	(A) Core	Tesla		
	(B) Yokes	Tesla		
25.	Magnetising current (approx) at nominal ratio and			
	at 0.9 x nominal voltage	%		
	at 1.0 x nominal voltage	%		
	at 1.1 x nominal voltage	%		
	at 1.2 x nominal voltage	%		

	Item	Units	Required	Tendered
26.	Guaranteed Losses at nominal ratio			
	(A) No Load losses (at rated voltage and frequency)	kW	Max. 25	
	(B) Copper losses at CMR corrected to 75^0C	kW	Max. 150	
	(C) Auxiliary losses at CMR corrected to 75^0C	kW		
27.	Regulation at 75^0C and normal ratio			
	(A) At unity power factor	%		
	(B) At 0.8 lagging power factor	%		
28.	Impedance voltage at 75 ^{0}C and CMR. Between			
	HV and LV Windings at Tap			
	Maximum	%		
	Nominal	%	11.0	
	Minimum	%		
29.	Equivalent circuit zero sequence impedance between HV and LV windings	ohms		
30.	Maximum current density in windings at C.M.R.			
	(A) HV Winding	A/mm^2		
	(B) LV Winding	A/mm^2		

	Item	Units	Required	Tendered
(b)	**Control Circuits**			
1.	Type of controls for on load tap changer and cooler controls		Automatic	
2.	Whether automatic control required and the		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	
6.	DC supply (control voltage) :			
	Nominal	V	110 V DC	
	Maximum float voltage	V		
7.	AC supply voltage for tap changer operating motor 3 phase.		400V AC 50Hz	
8.	Whether provision for supervisory control required, including AVR setting		No	
9.	Whether marshalling kiosk required			
10.	Whether provision for supervisory control required, including AVR setting			
11.	Number of transformers for which automatic control is to be provided		All	

	Item	Units	Required	Tendered
12.	Transformer terminals for line and neutral			
	(i) HV line		Cable Terminal Chamber	
	(ii) Neutral		Single contact elbow bushing	
	(iii) MV line		Multi contact elbow Bushings	
	(attach all technical data of all types of bushings & ducts)			
13.	Accommodation for current transformers in bushings at			
	(i) HV line			
	(ii) Neutral			
	(iii) MV line			
14.	Accommodation of tank for outdoor weatherproof HV neutral current transformers		Yes	
15.	Pollution category of bushings High-43.3mm/kV 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			
(d)	**General**			
1.	Type of oil preservation system		Silica Gel	
2.	Whether wheels, skid or flat bottom base required		Wheels	
3.	Whether anti-vibration pads required		No	
4.	Transformer noise acceptance level	dB	83	

	Item	Units	Required	Tendered
(e)	**Details Of Construction**			
1.	Types of winding -			
	(A) HV			
	(B) MV			
2.	Material of Insulation			
	(A) HV windings.			
	(B) LV windings			
3.	Insulation of tapping connections			
4.	Insulation of -			
	(A) Yoke bolts.			
	(B) Side plates.			
5.	Winding connections brazed or crimped Specify material (winding material and the joint material)			
6.	Is facility provided for adjustment of axial pressure on windings.	Yes/No		
7.	Thickness of transformer tank			
	(A) Sides	mm		
	(B) Bottom	mm		
8.	Material used for gaskets for oil tight joints.			
9.	Cover flange:-			
	Level: Low/High			
	Joint: WELDED/GASKETTED			

	Item	Units	Required	Tendered
(f)	**Radiators Valves and Fans**			
1.	Thickness of radiator plates and/or cooling tubes.	mm		
2.	Valve type/material:			
	75mm and below			
	above 75mm			
3.	Equipment for ONAN cooling state (A) or (B) -			
	(A) Radiator on main tank			
	(B) Separate cooler bank			
4.	Number of cooling air blowers per transformer			
5.	Speed of air blowers and air flow	rpm /m^3 per min		
6.	Rating of each air blower motor	kW		
7.	Starting current of each blower motor,	A		
(g)	**Oil Volumes and Weights**			
1.	Total oil required including cooler system	liters		
2.	Volume of oil to fill transformer to above the top yoke.	liters		
3.	Total volume of conservator	liters		
4.	Volume of oil in conservator between highest and lowest visible	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		

	Item	Units	Required	Tendered		
7.	Total weights of complete transformers, including attached coolers, voltage regulating equipment, all fittings and oil	tons				
8.	Weight of transformer arranged for transport	tons				
(h)	**Transformer Oil**					
1.	Manufacture, type and class of oil to IEC 60296					
(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**			HV	HV-N	MV
1.	Manufacturer					
2.	Insulator material (solid/oil-paper)					
3.	Manufacturer's type reference and rated voltage					
4.	Rated current					
5.	Manufacturer of porcelain					
6.	Length of insulator (overall).	mm				
7.	Weight of insulator.	kg				
8.	Electrostatic capacity of complete bushings.	pF				
9.	Dry lightning impulse voltage withstand. (1.2/50 wave)	kV				
10.	50Hz dry voltage withstand voltage without arching horns	kV				

	Item	Units	Required	Tendered		
11.	50Hz wet withstand voltage without arcing horns	kV				
12.	Total creepage distance of shed (specified minimum 25mm/kV based on maximum system voltage)	mm				
k	**Other Information**					
1.	Negative pressure tank can withstand					
2.	Type test Certificate for similar category transformer	To be annexed	yes			
3.	Proof of manufacturing experience of 12 years for power transformers	To be annexed	yes			
4.	Customer reference list for similar category Transformers	To be annexed	yes			
5.	Tests carried out at the manufacture's work as per IEC 60076-1:2011	To be annexed	yes			
l	**Transformer tank Fittings**					
1	Draining and filter valves		yes			
2	Valves for tank oil sampling		yes			
3	Radiator isolation valves		yes			
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	Wheels adjustable in two directions		yes			

	Item	Units	Required	Tendered
m	**Transformer accessories**			
1	Oil preservation system with or without rubber bag		Yes	
2	Dehydrating breather (maintenance free Type)		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	
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		Yes	
12	On-line monitoring system		Yes	
13	Fire protection system		Yes	
n	**Quality Assurance**			
1	Manufacturer quality assurance acc. to ISO 9001		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	

	Item	Units	Required	Tendered
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).		Yes	
6	Tests on on-load tap-changers (11.7).		Yes	
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 between each winding to earth and between windings.		Yes	

	Item	Units	Required	Tendered
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	
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).		Yes (At an independent test lab such as KEMA or CESI)	
8	Measurement of d.c. insulation resistance each winding to earth and		Yes	

	Item	Units	Required	Tendered
	between windings.			
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.		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	
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	Insulation resistance measurement		Yes	

	Item	Units	Required	Tendered
7	Check of protective earthing connections		Yes	
8	Current transformer polarity check		Yes	
9	Control equipment circuit check		Yes	
10	Oil tests		Yes	
11	Operation test of supervisory equipment		Yes	
12	Operation test of cooling equipment		Yes	
13	Operation test of on load tap changer		Yes	
14	Visual Inspections and adjustments as per clause 10.24 of technical specifications		Yes	
15	Fingerprint tests (Um>72 kV)		Yes	
s	**Type test reports submitted with the bid**			
	Temperature-rise type test (IEC60076-2).		Yes	
	Dielectric type tests (IEC60076-3).		Yes	
	Determination of sound level (IEC60076-10) for each method of cooling		Yes	
	Measurement of the power taken by the fan and liquid pump motors.		Yes	
	Measurement of no-load loss and current at 90% and 110% of rated voltage		Yes	
t	**Special Test reports to be submitted with the bid**		Short circuit withstand test on similar transformer as per IEC 60076-5 tested at internationally recognised test lab such as KEMA or CESI	

2.15.3 31.5 MVA, 132/33 kV Transformer (110 V dc Voltage)

The Guaranteed Technical Particulars shall be completed without any alterations to its format. All blank spaces shall be filled with the information required. The provided particulars under this form shall be taken as the **particulars guaranteed by the bidder/manufacturer for the offered item/s under this contract,** and shall prevail over catalogues or any other document submitted with the bid.

132/33 KV, 23/31.5 MVA (ONAN/ONAF) THREE PHASE TRANSFORMER WITH ON LOAD TAP CHANGERS AT 132 KV WINDINGS

	Items	Units	Required	Tendered
(A)	**Rating and Performance**			
1.	Manufacturer's name and address			
2.	Continuous maximum rating (ONAN/ONAF)	MVA	23/31.5	
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 - MV	 kV kV	 145 36	
8.	Winding Insulation - HV - MV		 Graded Uniform	
9.	Highest voltage for equipment - HV - MV	 kV kV	 145 36	
10.	Winding insulation levels - HV - MV		 LI: 650, AC: 275 LI: 170, AC: 70	
	Items	**Units**	**Required**	**Tendered**
11.	Transformer nominal ratio		132 kV/ 33 kV	
12.	Phase connections - HV winding - MV winding		 Star Delta	

	- Vector group		YNd1	
13.	Short circuit withstand fault level at terminals of - 145 kV Busbars - 36 kV Busbars	 kA kA	 31.5 25	
14.	Type of cooling		ONAN/ONAF	
15.	External cooling medium		Air	
16.	Service conditions • Altitude not exceeding • Air temperature not exceeding • Average air temperature in any one year not exceeding - In any one day - Average in one year	 m ˚C ˚C ˚C	 1000 40 32 30	
17.	On load tap changer (a) Type (b) Category of voltage control (c) HV or LV winding (d) Range (+ & -)		 M.R. Germany CFVV HV +7 to -10	
	(e) Step size (f) 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	1.5	
	Items	**Units**	**Required**	**Tendered**
	(g) Type test certificate reference (h) Tap position indication	 2nos BCD		
18.	Size of tapping step with position nos.		18 taps 1.5% step voltage	
19.	Approximate ONAN rating	MVA	23	
20.	Winding temperature rise at CMR	˚C	55	
21.	Top oil temperature rise (a) CMR (b) ONAN rating	 ˚C ˚C	 50	

22.	Maximum hot spot temperature at CMR	˚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	Shall be less than 160 ^{0}C when increase the load current from 1.0 time to 1.8 times the rated current, and operated for 30 mins.	
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	
	Items	**Units**	**Required**	**Tendered**
25.	Magnetizing current (approx.) as a percentage of rated current at nominal ratio and;			
	- At 0.9 x nominal voltage	%		
	- At 1.0 x nominal voltage (I_0)	%	≤ 0.15	
	- At 1.1 x normal voltage	%	≤ 2.5 I_0	
	- 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 22.5	
	- 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	kW	Maximum 120	

	ONAF base - Load loss at minimum tap position at ONAF base - Auxiliary losses at CMR corrected to 75^{0}C - Total losses at nominal tap position at ONAN base - Total losses at nominal tap position at ONAF base	kW kW kW kW	Maximum 3	
	Items	**Units**	**Required**	**Tendered**
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	 % % % % % % % %		
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	 % %	 10.0	

	Items	Units	Required	Tendered
	(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	%	9.5	
	(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	%	11.0	
30.	Equivalent zero sequence impedance between HV and LV windings			
31.	Maximum current density in windings at CMR			
	(a) HV winding	A/mm^2	≤ 3.5	
	(b) MV winding	A/mm^2	≤ 3.5	
32	Transformer warranty period	Years	02	
(B)	**Control Circuits**			
1.	Type of controls for on load tap changer and cooler controls		Automatic	
2.	Whether automatic control required		Yes	
2.1	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		NA	
5.	Estimated distance between remote control point and transformer	m	<110	
6.	DC Supply (Control voltage)			
	- Nominal	V DC	220 or 110	
	- Maximum float voltage	V DC		
	Items	**Units**	**Required**	**Tendered**
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 (b) MV line (c) Neutral (Attach all technical data of all types of bushings & ducts)		Bushings Bushings Bushings	
11.	Accommodation for current transformers bushings at (a) HV line (b) MV line (c) Neutral		 Yes Yes Yes	
12.	Accommodation of tank for outdoor weatherproof HV neutral current transformers		No	
13.	Pollution category of bushings Creepage distance based on system highest voltage		D-High 31 mm/kV	
(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	
	Items	**Units**	**Required**	**Tendered**
(D)	**General**			
1.	Type of oil preservation system		Below type Conservator with silica gel breather	
2.	Whether wheels, skid or flat base required		Wheels	
3.	Whether anti-vibration pads required		No	
4.	Transformer noise acceptance level	dB	83	
(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 (b) Bottom (c) Cover	 mm mm mm		
	Items	**Units**	**Required**	**Tendered**
8.	Material used for gaskets for oil tight joints			
9.	Cover Flange - Level - Joint	 Low/high Bolted		
10.	Maximum vacuum pressure safely withstand by tank	Pa		
(F)	**Radiators Valves and Fans**			
1.	Thickness of radiator plates and/ or cooling tubes	mm		
2.	Valve type/ material - 75 mm and below - Above 75 mm			
3.	Equipment for ONAN cooling state (a) or (b) (a) Radiator on main tank (b) Separate cooler bank			
4.	Number of cooling air blowers per transformer			
5.	Speed of air blowers and air flow	rpm/m^3 per min		
6.	Rating of each air blower motor	kW		

7.	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		
	Items	**Units**	**Required**	**Tendered**
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 - Depth - Width	 mm mm mm		
10.	Shipping dimensions - Height - Depth - Width	 mm mm mm		
11.	Minimum space required for transformer bay - Depth - Width	 mm mm		
(H)	**Transformer oil**			
1.	Manufacturer			
2.	Type		Non- inhibited	
3.	Class		1	
4.	Standard		IEC60296	
	Items	**Units**	**Required**	**Tendered**

(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		Oil - Paper (OIP)	
	- 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 (Specified minimum 43.3 mm/kV based on maximum system voltage)	mm		
	- Capacitive voltage tap available for testing purposes		Yes	
2.	33 kV Bushings			
	- Manufacturer			
	Items	**Units**	**Required**	**Tendered**
	- 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 (Specified minimum 43.3 mm/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		
	Items	**Units**	**Required**	**Tendered**
	- 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 (Specified minimum 43.3 mm/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		Yes	

	(a) Type (a) Material for 75 mm and below (b) Material for above 75 mm		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	
	Items	**Units**	**Required**	**Tendered**
(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	
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		Not required	
(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	
	Items	**Units**	**Required**	**Tendered**
(N)	**Factory Acceptance Tests (IEC 60076-1:2011)**			
	Routine tests			
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).		Yes	
6	Tests on on-load tap-changers (11.7).		Yes	
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 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	

	Items	**Units**	**Required**	**Tendered**
	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	
	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	
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	
	Items	**Units**	**Required**	**Tendered**
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		Yes	

	shall be agreed between manufacturer and purchaser.			
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	
18	Insulation test of oil and Measurement of dielectric strength of oil		Yes	
(O)	**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	
	Items	**Units**	**Required**	**Tendered**
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	
(P)	**Type test reports submitted with the bid** (for a transformer of similar or higher Voltage and Power rating with ONAN/ONAF cooling method)			
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	
	Items	**Units**	**Required**	**Tendered**
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 test reports submitted with the bid**			
1	Short circuit withstand test on similar transformer as per IEC 60076-5 at an internationally		Yes	

	recognized test laboratory such as KEMA or CESI			
(R)	**Other Information to be provided**			
1.	Customer reference list for the manufactured & supplied Transformers according to Clause 1.5 (I) of General Specification.	To be annexed	Yes	
2.	Minimum 2 certificates issued by end users **or** manufacturer's guarantee for continues operation of his transformer for 10 years with relevant purchase order number and contact details according to Clause 1.5 (II) of General Specification.	To be annexed	Yes	
3.	License agreement with the parent manufacturer according to 1.5 (III) of General Specification. (only if applicable)	To be annexed	Yes	
4.	Manufacturer's guarantee for having failure investigation and R & D Reports, and List of R & D reports published during the last two years according to 1.5 (IV) of General Specification	To be annexed	Yes	
5.	Brief description of the software tool	To be annexed	Yes	
	Items	**Units**	**Required**	**Tendered**
6.	List of test equipment at the factory for Routine, Dielectric and special tests, and name and address of the nearest short circuit test facility.	To be annexed	Yes	
8.	Calculations to demonstrate the thermal ability to withstand the short circuit and ability to withstand the dynamic effect of short circuit.	To be annexed	Yes	
9.	Outline drawings of the transformer and NCT.	To be annexed	Yes	
10.	Magnetization curve of the offered transformer core	To be annexed	Yes	
7.	Duly completed Schedule 01: form EXP-1.5.	To be annexed	Yes	

2.15.4 Earthing Transformers

	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		

	Item	Units	Required	Tendered
(c)	**Service Conditions**			
1.	- Maximum ambient temperature	^{0}C		
2.	- Maximum service altitude	m		
3.	Temperature rise limit- oil / windings	K		
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:			

	Item	Units	Required	Tendered
(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		
4.	Un-tanking mass	kg		
5.	Mass of insulating liquid	kg		
6.	Minimum space requirements for transformer bay			
	- width	m		
	- depth	m		

2.15.5 Auxiliary Transformers

	Item	Units	Required	Tendered
	AUXILIARY TRANSFORMERS 200 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		
2.	Rated symmetrical short circuit current	kA		
3.	Rated voltages (no load)			
	- primary	kV		
	- secondary	kV		
4.	Vector group symbol		Dyn 11	
5.	Rated frequency	Hz		

	Item	Units	Required	Tendered
(c)	**Service Conditions**			
	- Maximum ambient temperature	^{0}C		
	- 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			
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)		

	Item	Units	Required	Tendered
(f)	**Construction Details**			
1.	Bottom base type			
2.	Terminations:			
	- HV		Cable Box	
	- LV		Cable Box	
	- Neutral		Cable Box	
(g)	**Masses, Measures and Drawings**			
1.	Overall dimensions including bushings			
	- height	mm		
	- depth	mm		
	- width	mm		
	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		

2.15.6 Diesel Generator

	Item	Units	Required	Tendered
	DIESEL GENERATOR			
1.	Manufacturer's Name & Address			
2.	Type			
3.	Rating	kVA	See Scope of Works	

2.16 ENERGY METERS

	Item	Units	Required	Tendered
(a)	**Meters**			
1.	Manufacturers name & address			
2.	Manufactures Type designation and model number.			
3.	Dimensions			
	width	mm		
	height	mm		
	depth	mm		
4.	Type		Digital Technology, Term "Interval Meters" - Accumulate pulse over a definite time interval.	
5.	Analog Inputs			
	Current AC	A	1-5A	
	Voltage AC	V	110/220V	
6.	Accuracy Class		0.20%	
	Tolerance for all acceptance tests at unity power factor expressed in percent	%	0.20%	
	Tolerance for all acceptance tests at 50% power factor expressed in percent	%	0.30%	
7.	Pulse Resolution of the Energy transferred within		+ or - 0.05% of the Energy measured	

	Item	Units	Required	Tendered
8.	Measure Produce and Store Import Wh	Yes/No	Yes	
	Measure Produce and Store Export Wh	Yes/No	Yes	
	Measure Produce and Store Leading VArh.	Yes/No	Yes	
	Measure Produce and Store Lagging VArh.	Yes/No	Yes	
	Measure Produce and StroeV^2H per Phase	Yes/No	Yes	
	Measure Produce and Store I^2H per Phase	Yes/No	Yes	
	Date and Time	Yes/No	Yes	
9.	Capability of Storing 15 min time stamped interval data for 3 months period	Yes/No	Yes	
10.	Number of Events readable and maintain in the event logger	Nos	100	
11.	Remote interrogation over a Varity of communication media		Yes	
12.	Internal or external modem speed	bit/sec	9600	
13.	Availability of RS - 485 communication port	Yes/No	Yes	
	Availability of RS - 232 communication port	Yes/No	Yes	
	Support Public telecommunication system	Yes/No	Yes	
	Support Itron C&I Network	Yes/No	Yes	
	Support TCP/IP	Yes/No	Yes	
	Support ARDIS	Yes/No	Yes	

	Item	Units	Required	Tendered
	Front Panel Optical port	Yes/No	Yes	
	Digital or Analog Cellular	Yes/No	Yes	
14.	Password protection in two levels for meter data collection	Yes/No	Yes	
	Read only access to interval data, event log, and metrological quantities	Yes/No	Yes	
.	Full access to set the time function	Yes/No	Yes	
15.	Built in Battery backup capability to store and maintain interval data, event log & clock time	days	35	
16.	Clock time drift	minutes	<1	
17.	Condition monitoring with recording in event log for failure in measuring and pulse over run	Yes/No	Yes	
18.	Possibility of up load and detect faulty equipment conditions.	Yes/No	Yes	
19.	Sealability of Meters to prevent from:			
	access to adjustment or calibration devices on meter.	Yes/No	Yes	
	access to terminals of incoming current or potential wiring.	Yes/No	Yes	
20.	External Display showing the registers of total kWH and kVAR	Yes/No	Yes	

2.17 SOLAR PHOTO VOLTAIC SYSTEM

2.17.1 Solar PV Module

	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	W_p	> 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)	

	Item	Units	Required	Tendered
21.	Panel Voltage (Nominal)	V		
22.	Module Power Tolerance			
23.	Maximum Power Voltage of a Module (V_{mpp})			
24.	Maximum Power Current of a Module (I_{mmp})			
25.	Open Circuit Voltage (V_{oc})			
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	^{0}C	-40 - 85	
30.	Nominal Operating Cell Temperature (NOCT)	^{0}C	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			

2.17.2 Inverter and Other Parts

	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			

	Item	Units	Required	Tendered
24.	Ground-Fault Isolation Detection			
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			

2.17.3 Supporting Structures and Cabling

	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			

2.17.4 Other facilities

	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			

2.17.5 Metal Enclosed Capacitor Bank

No	**Item**	**Unit**	**Required**	**Offered**
1	Manufactures Name			
2	Country of Origin			
3	Place of Testing			
4	Applicable Standards	IEC		
5	Manufactures Type Designation /model number			
6	Rated Voltage	kV		
7	Rated frequency	Hz		
8	Type of Bank	Inrush/Filter	Filter	
9	Power at rated voltage	Mvar	Scope of works	
10	Step Size	Mvar	4	
11	Insulation level			
	Maximum system Voltage	kV		
	Power frequency Voltage	kV		
	Impulse Voltage	kV		
13	Capacitor Connection		Double star	
14	Short Circuit Capacity	kA/sec		
15	Internal Arc Classification			
16	Auxiliary Voltage	VDC/VAC		
	Frame/Enclosure			
17	Location	Indoor/Outdoor	Indoor	
18	IP class		IP41	
19	Material/Painting			
	Switching device			
20	Type/Breaker		breaker, contactor/vacuum	
21	Rated current	A		
22	Rated capacitive switching current	A		
23	Rated short circuit breaking current	kA		
24	Electrical endurance at rated current			
25	Mechanical endurance			
26	Operating mechanism			
	Capacitors			
27	Average loss factor at 20^0C	W/kvar		
28	Nominal reactive power per capacitor	kvar		
29	Capacitor voltage	V		
30	Tolerance on capacitance value			
31	Relative capacitance variation	ΔC/C per ^{0}C		
32	Internal fuses	Yes/No	Yes	
33	Pressure switch			
34	Discharge resistor	Yes/No	Yes	
	Residual voltage/duration	V/minutes		
34	Capacitor hosing material			

No	Item	Unit	Required	Offered
35	Reactor type			
	core/technology	iron core/resin impregnated, encapsulated		
36	Earth switch	Yes/No		
37	Isolator	Yes/No		
38	Fuses (HRC)	Yes/No		
39	Surge arrester	Yes/No		
40	Unbalance CT	Yes/No		
	Protection			
41	Overcurrent/Earth Fault Protection	Yes/No	Yes	
42	Capacitor bank unbalance	Yes/No	Yes	
43	Unbalance/Over Load Protection	Yes/No	Yes	
44	Under voltage/over voltage	Yes/No	Yes	
45	Dimension (3Mvar x 4 Units)			
	Length	m		
	Width	m		
	Height	m		
	Weight	kg		
46	Control and Monitoring mounted on	on door / separate		

2 TECHNICAL PARTICULARS AND GURANTEES

B - CIVIL WORKS

TABLE OF CONTENTS

2.1 AIR CONDITIONING & VENTILATING INSTALLATIONS

2.1.1 Air Conditioning Units

	Item	Units	Required	Tendered
(a)	**Split type Air Conditioning Unit**			
	Manufacturer's name & address			
	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)			

	Item	Units	Required	Tendered
(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		
	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		

2.1.2 Ventilation Works

	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			

2.2 CCTV SYSTEM

	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			

2.3 FIRE SAFETY EQUIPMENT

	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			

	Item	Units	Required	Tendered
(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			

2.4 LIGHTING & SMALL POWER

	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			

	Item	Units	Required	Tendered
(f)	**Cable Termination's**			
	Manufacturer's name and address			
	Type			
	Material			
(g)	**Switches**			
	Manufacturer's name and address			
	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		

	Item	Units	Required	Tendered
(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			
	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		

2.5 PREFABRICATED HOUSING

No	Item	Unit	Required	Offered
1	Manufactures Name			
2	Country of Origin			
3	Manufactures Type Designation /model number			
4	Type Tested / Standard	Yes/No	Yes / IEC or others	
5	Applicable Standards, IEC/others		IEC 62271-202 / other relevant Std	
6	**Housing Properties**			
	1. Dimensions (WxDxH)	m		
	2. Material		steel	
	3. Gross weight of housing	kg		
	4. Thermal insulation of each wall	W/m^2K		
	5. Thickness of wall (steel/insulation/others)	mm		
7	**Painting of Housing**			
	1. Standard		ISO12944	
	2. Atmospheric Corrosivity Category		C5M	
	3. Duration for maintenance		>15 years	
8	**Enclosure Protection**			
	1. Class of Enclosure Protection (IP rating of the housing)			
	2. IAC classification of housing			
9	Lightning protection for housing	Yes/No	Yes	
10	Fire extinguishes	Yes/No	Yes	
11	Emergency Lighting	Yes/No	Yes	
12	Distribution board for LVAC/DC	Yes/No	Yes	
13	Air-conditioning of housing	Yes/No	Yes	

3 TIMES FOR DELIVERY & COMPLETION AND CONTRACT COMPLETION TIMES

3.1 TIMES FOR DELIVERY AND COMPLETION

The individual dates are all contractually binding.

The times given include all necessary control, relay, metering, auxiliary power and ancillary equipment to enable the respective circuit or item of plant to be completely commissioned and put into commercial operation, together with such other associated equipment, e.g. busbar, etc. as well ensure that subsequent shut-downs are unnecessary or at least only of a temporary or short time nature.

The dates assume and order is placed by Week No. 1.

Key to dates be provided as follows.

E - Target completion dates planned by CEB

D - Construction (delivery, erection and commissioning) date guaranteed by contractor.

C - Shipping completion dates guaranteed by contractor.

B - Date of arrival of first shipment guaranteed by contractor.

A - Earliest date by which access is required by the contractor.

Site	A Earliest Access Permitted Week No.	B Week No.	C Week No.	D Week No.	E Week No.
Sub A					
Sub B					
Sub I					
Sub L (L1 and L2)					

Site	A Earliest Access Permitted Week No.	B Week No.	C Week No.	D Week No.	E Week No.
Sub M					
Sub N					
Thulhiriya GSS					

3.2 CONTRACT COMPLETION TIMES

The times entered below shall be those used to calculate the completion dates for the various sections of the Contract together with the overall Time for completion as referred to in Clauses and of the Conditions of Contract.

	Completion Time in Calender months calculated from the date of Commencement
Completion Time For The Contract	- …….. Months.
Completion Time For Works At Sub A	- ……Months
Completion Time For Works At Sub I	- ……Months
Completion Time For Works At Sub L (L1 and L2)	- ……Months
Completion Time For Works At Sub B	- ……Months
Completion Time For Works At Sub M	- ……Months
Completion Time For Works At Sub N	- ……Months
Completion Time For Works At Thulhiriya GSS	- ……Months

4 DEPARTURES FROM SPECIFICATION

(To be completed by the Bidder).

Any details that will lead to deductions of final Bid price shall not be inserted.

The bidder shall list below all deviations of his bid to the commercial and technical bidding conditions / specifications of these bidding documents.

It shall not be necessary for the employer to examine the standard literature and documents of the manufacturer to determine the existence and extent of any exceptions or deviations from this specification.

No other deviation stated elsewhere in the bid would be considered as valid deviations during the contract period.

.

Volume	Clause No.	Proposed Deviations

5 MANUFACTURES' AND SUBCONTRACTORS' STATEMENT OF EXPERIENCE

5.1 Tenderer's Statement of Previous Experience

Tenderers are to complete this schedule giving details of substation contract of the same type of construction as this contract and which they have completed or which are in the course of completion by them. Failure to complete this schedule with full satisfactory details and documentary proof will render the offer liable to rejection.

Name of the Project					
Contract No.					
Country					
System Voltage kV					
Type of Construction					
Purchaser					
Consultant					
No. of Bays & Cap. of GSS MVA					
Contract Award Date					
Contractual Completion Date					
Actual Completion Date					
Contract Value					

5.2 Key Personnel

Designation	Name of (i) Nominee (ii) Alternate	Summary of Qualification Experience and Present Occupation	Year of Birth
Headquarters Project Director Project Manager Engineering Design Staff Other Key Staff (Give Designation) Site Office Project Manager Site Manager Deputy Site Manager Supervising Engineers Construction Supervisors Other Key Staff			

The Tenderer shall list in this Schedule the key personnel (including first nominee and the second choice alternate) he will employ from headquarters and from site office to direct and execute the works.

5.3 Contractor's Site Personnel

Erection Staff

The contractor shall give below the status and numbers of staff required for erection of the plant and the estimated period for which they will be retained on site.

Supervisory and expatriate staff : -	
(a) Bachelor status	
(b) Married status	

Position	Months
Headquarters Project Director Project Manager Other Key Staff (Give Designation) Project Office in Sri Lanka Project Manager Site Office Site Manager Deputy Site Manager Supervising Engineers Construction Supervisors Other Key Staff	

5.4 Sub-Contractors

Item	Element of work	Approximate value	Name and address of Sub Contractor	Statement of Similar Works executed

The tenderer shall enter in this schedule a list of the sections and appropriate value of the work for which the purposes to use sub-contractors, together with the names and addresses of the proposed sub-contractors. The tenderer shall also enter a statement of similar works

Previously executed by the proposed sub-contractors, including description, location and value of works, year completed, and name and addresses of the Employer Notwithstanding such information the tenderer, if awarded the contract, shall remain entirely and solely responsible for the satisfactory completion of the Works.

6 DOCUMENTS, DRAWINGS AND INFORMATION TO BE SUBMITTED WITH THE TECHNICAL BID

The following documents & drawings shall be submitted with the Technical BID.

6.1 Duly signed Part A – Scope of Works in Section VI – Employer's Requirement in Part 2 – Employer's Requirements in Volume 4 of 8.

6.2 Duly signed Part B – Technical Specification in Section VI – Employer's Requirement in Part 2 – Employer's Requirements in Volume 5 of 8.

6.3 Duly signed Part C – Drawings in Section VI – Employer's Requirement in Part 2 – Employer's Requirements in Volume 6 of 8.

6.4 Duly completed and signed Supplementary Information,

1. Manufacturers and place of manufacture and testing.
2. Technical particulars and guarantees.
3. Times for delivery and completion and contract completion.
4. Departures from the Specification.
5. Manufacturers' and subcontractors' statement of experience.
6. Documents, drawings and information to be submitted.
7. Confirmation of Adherence to the Environmental Acts, Regulation and/or Guidelines.

6.5 Duly signed Section VII - General Conditions in Part 3 – Conditions of Contract and Contract Forms in Volume 8 of 8.

6.6 Duly signed Section VIII - Particular Conditions in Part 3 – Conditions of Contract and Contract Forms in Volume 8 of 8.

6.7 Duly signed Section IX –Contract Forms in Part 3 – Conditions of Contract and Contract Forms in Volume 8 of 8.

6.8 Not Applicable

6.9 Not Applicable

6.10 Verifiable evidence of service experience of equipment offered under this bid to meet the criteria stated in Item 1.5 of Chapter 1 of Volume 5 of 8.

6.11 - Not Applicable -

6.12 Certificates issued by an independent international organization to ensure compliance with the ISO 9001:2000 standards by the Bidder and Manufacturers of all main equipment listed below,

1. Circuit Breakers
2. Disconnectors
3. Surge Arrestors
4. Current Transformers
5. Voltage Transformers
6. Power Transformers
7. Earthing Transformers
8. 36kV Indoor Switchgear
9. All control, protection and metering equipment
10. All HV cables and accessories
11. Communication equipment
12. All outdoor post insulators and bushings for current and voltage transformers
13. Energy meters.
14. Capacitor Banks

6.13 Authorization letters shall be provided with the bid in respect of following items not manufactured by the bidder,

1. Circuit Breakers
2. Disconnectors
3. Surge Arrestors
4. Current Transformers
5. Voltage Transformers
6. Power Transformers
7. Earthing Transformers
8. 36kV Indoor Switchgear
9. All control, protection and metering equipment
10. All HV/MV cables and accessories
11. Communication equipment
12. All outdoor post insulators and bushings for current and voltage transformers

13. Energy meters.
14. Capacitor Banks

6.14 The manufacturer's guarantee that they have an established department that will serve the Ceylon Electricity Board in supply of spares for at least 10 years for all equipment listed in 6.13 above.

6.15 The manufacturer's guarantee that they have an established department that will serve the Ceylon Electricity Board to provide advisory service with regard to maintenance and overhauling at least for 10 years for all equipment listed in 6.13 above.

6.16 Type Test certificates in accordance with standards specified in relevant Chapters in Volume 5 of 8, issued by an independent laboratory or Type Tests witnessed by CEB for,

1. Circuit Breakers
2. Disconnectors
3. Earthing Switches
4. Surge Arrestors
5. Current Transformers
6. Voltage Transformers
7. Similar Power Transformers
8. Earthing Transformers
9. 36kV Indoor Switchgear
10. All control, protection and metering equipment
11. All HV cables and accessories
12. Communication equipment
13. Energy meters.
14. Capacitor Banks

6.17 Parent company guarantee in case of joint ventures and subsidiaries.

6.18 Descriptive information for equipment being offered including;

1. List of recommended spare parts with prices.
2. List of special tools or fixtures required for installation, testing, maintaining and operating the equipment.
3. List of cost of special tools, lifting devices required for installation, operation and maintenance.

6.19 Details/drawings of indoor 36kV switchgears.

6.20 Typical arrangement drawings of control, metering and relay panels similar to the panels offered.

6.21 Protection block diagrams and typical diagrams of unit protective equipment and bus bar zone protection similar to the system offered.

6.22 Typical diagrams of architecture of substation automation system and associated system similar to the architecture offered.

6.23 Not Applicable

6.24 Any other material required to be completed and submitted by bidders in accordance with the instruction to bidders.

7. ADHERENCE TO THE ENVIRONMENTAL ACTS, REGULATIONS AND / OR GUIDELINES

The Bidders shall submit with their Technical Bid, written confirmation certifying that they will comply with Environmental Safeguard Documents prepared under National Environmental Act (NEA) found under "Our performances" tab in http://www.ceb.lk/environment/.

Section 6 - Employer's Requirements

Part E - Bank Guaranties and Certificates, Variations and Adjustments Orders

Table of Content

1 Certificates

Form of Completion Certificate

Contract: [. . . . *insert name of contract and contract identification details*. . . . .]

Date: .....

Certificate No.: .....

To: [. . . . *insert name and address of contractor*. . . . .]

Dear Ladies and/or Gentlemen,

Pursuant to GCC Clause 24 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Employer dated [. . . . *insert date*. . . . .], relating to the [. . . *brief description of the Facilities* . . . .], we hereby notify you that the following part(s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below.

1. Description of the Facilities or part thereof: [. . . *description* . . . .]

2. Date of Completion: [. . . *date* . . . .]

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defect Liability Period.

Very truly yours,

[. . . *Signature* . . . .]

Project Manager

Form of Operational Acceptance Certificate

Contract: [. . . . .*insert name of contract and contract identification details*. . . . .]

Date: .....

Certificate No.: .....

To: [. . . . .*insert name and address of contractor*. . . . .]

Pursuant to GCC Subclause 25.3 (Operational Acceptance) of the General Conditions of the Contract entered into between yourselves and the Employer dated [. . .*date*. . .], relating to the [. . .*brief description of the facilities*. . .], we hereby notify you that the Functional Guarantees of the following part(s) of the Facilities were satisfactorily attained on the date specified below.

1. Description of the Facilities or part thereof: [. . . *description* . . .]

2. Date of Operational Acceptance: [. . . *date* . . .]

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defect Liability Period.

Very truly yours,

[. . . .*Signature* . . . .]

Project Manager

2 Change Orders

2.1 Change Order Procedure

2.1.1 General
2.1.2 Change Order Log
2.1.3 References for Changes

2.2 Change Order Forms

2.2.1 Request for Change Proposal
2.2.2 Estimate for Change Proposal
2.2.3 Acceptance of Estimate
2.2.4 Change Proposal
2.2.5 Change Order
2.2.6 Pending Agreement Change Order
2.2.7 Application for Change Proposal

2.1. Change Order Procedure

2.1.1 General

This section provides samples of procedures and forms for implementing changes in the Facilities during the performance of the Contract in accordance with GCC Clause 39 (Change in the Facilities) of the General Conditions.

2.1.2 Change Order Log

The Contractor shall keep an up-to-date Change Order Log to show the current status of Requests for Change and Changes authorized or pending. Entries of the Changes in the Change Order Log shall be made to ensure that the log is up-to-date. The Contractor shall attach a copy of the current Change Order Log in the monthly progress report to be submitted to the Employer.

2.1.3 References for Changes

(1) Request for Change as referred to in GCC Clause 39 shall be serially numbered CR-X-nnn.

(2) Estimate for Change Proposal as referred to in GCC Clause 39 shall be serially numbered CN-X-nnn.

(3) Acceptance of Estimate as referred to in GCC Clause 39 shall be serially numbered CA-X-nnn.

(4) Change Proposal as referred to in GCC Clause 39 shall be serially numbered CP-X-nnn.

(5) Change Order as referred to in GCC Clause 39 shall be serially numbered CO-X-nnn.

Note:

(a) Requests for Change issued from the Employer's Home Office and the Site representatives of the Employer shall have the following respective references:

Home Office	CR-H-nnn
Site	CR-S-nnn

(b) The above number "nnn" is the same for Request for Change, Estimate for Change Proposal, Acceptance of Estimate, Change Proposal and Change Order.

2.2 Change Order Forms

2.2.1 Request for Change Proposal Form

[*Employer's letterhead*]

To: [*Contractor's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]
Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

With reference to the captioned Contract, you are requested to prepare and submit a Change Proposal for the Change noted below in accordance with the following instructions within [*number*] days of the date of this letter [or on or before (*date*)].

1. Title of Change: [*Title*]
2. Change Request No./Rev.: [*Number*]
3. Originator of Change:
   Employer: [Name]
   Contractor (by Application for Change Proposal No. [Number Refer to Annex 6.2.7])
4. Brief Description of Change: [*Description*]
5. Facilities and/or Item No. of equipment related to the requested Change: [*Description*]
6. Reference drawings and/or technical documents for the request of Change:
   Drawing No./Document No. *Description*
7. Detailed conditions or special requirements on the requested Change: [*Description*]
8. General Terms and Conditions:
   (a) Please submit your estimate showing what effect the requested Change will have on the Contract Price.
   (b) Your estimate shall include your claim for the additional time, if any, for completing the requested Change.
   (c) If you have any opinion that is critical to the adoption of the requested Change in connection with the conformability to the other provisions of the Contract or the safety of the Plant or Facilities, please inform us in your proposal of revised provisions.
   (d) Any increase or decrease in the work of the Contractor relating to the services of its personnel shall be calculated.
   (e) You shall not proceed with the execution of the work for the requested Change until we have accepted and confirmed the amount and nature in writing.

[*Employer's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

2.2.2 Estimate for Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]
Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

With reference to your Request for Change Proposal, we are pleased to notify you of the approximate cost to prepare the below-referenced Change Proposal in accordance with GCC Subclause 39.2.1 of the General Conditions. We acknowledge that your agreement to the cost of preparing the Change Proposal, in accordance with GCC Subclause 39.2.2, is required before estimating the cost for change work.

1. Title of Change: [*Title*]
2. Change Request No./Rev.: [*Number*]
3. Brief Description of Change: [*Description*]
4. Scheduled Impact of Change: [*Description*]
5. Cost for Preparation of Change Proposal: [*insert costs, which shall be in the currencies of the contract*]

(a)	Engineering		(Amount)
	(i) Engineer	_____ hours (hrs) x _ rate/hr =	_____
	(ii) Draftsperson	_____ hrs x _____ rate/hr =	_____
	Sub-total	_____ hrs	_____
	Total Engineering Cost		_____
(b)	Other Cost		_____
	Total Cost (a) + (b)		_____

[*Contractor's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

2.2.3 Acceptance of Estimate Form

[*Employer's letterhead*]

To: [*Contractor's name and address*] Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*
Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

We hereby accept your Estimate for Change Proposal and agree that you should proceed with the preparation of the Change Proposal.

1. Title of Change: [*Title*]
2. Change Request No./Rev.: [*Request number/revision*]
3. Estimate for Change Proposal No./Rev.: [*Proposal number/revision*]
4. Acceptance of Estimate No./Rev.: [*Estimate number/revision*]
5. Brief Description of Change: [*Description*]
6. Other Terms and Conditions: In the event that we decide not to order the Change accepted, you shall be entitled to compensation for the cost of preparing the Change Proposal described in your Estimate for Change Proposal mentioned in para. 3 above in accordance with GCC Clause 39 of the General Conditions.

[*Employer's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

2.2.4 Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]
Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

In response to your Request for Change Proposal No. [Number], we hereby submit our proposal as follows:

1. Title of Change: [*Name*]
2. Change Proposal No./Rev.: [*Proposal number / revision*]
3. Originator of Change: Employer: [*Name*] / Contractor: [*Name*]
4. Brief Description of Change: [*Description*]
5. Reasons for Change: [*Reason*]
6. Facilities and/or Item No. of Equipment related to the requested Change: [*Facilities*]
7. Reference drawings and/or technical documents for the requested Change:
   [*Drawing/Document No./Description*]
8. Estimate of increase/decrease to the Contract Price resulting from the Change Proposal:

		Amount [*insert amounts in the currencies of the Contract*]
(a)	Direct material	_____
(b)	Major construction equipment	_____
(c)	Direct field labor (Total hrs)	_____
(d)	Subcontracts	_____
(e)	Indirect material and labor	_____
(f)	Site supervision	_____
(g)	Head office technical staff salaries	
	Process engineer _____ hrs @ _____ rate/hr	_____
	Project engineer _____ hrs @ _____ rate/hr	_____
	Equipment engineer _____ hrs @ _____ rate/hr	_____
	Procurement _____ hrs @ _____ rate/hr	_____
	Draftsperson _____ hrs @ _____ rate/hr	_____
	Total _____ hrs	
(h)	Extraordinary costs (computer, travel, etc.)	_____
(i)	Fee for general administration, % of Items	_____
(j)	Taxes and customs duties	_____
Total lump sum cost of Change Proposal		[*Sum of items (a) to (j)*]
Cost to prepare Estimate for Change Proposal		[*Amount payable if Change is not accepted*]

9. Additional time for Completion required due to Change Proposal
10. Effect on the Functional Guarantees
11. Effect on the other terms and conditions of the Contract
12. Validity of this Proposal: within [Number] days after receipt of this Proposal by the Employer
13. Other terms and conditions of this Change Proposal:
    (a) You are requested to notify us of your acceptance, comments or rejection of this detailed Change Proposal within [Number] days from your receipt of this Proposal.
    (b) The amount of any increase and/or decrease shall be taken into account in the adjustment of the Contract Price.
    (c) Contractor's cost for preparation of this Change Proposal: [. . . .*insert amount. This cost shall be reimbursed by the employer in case of employer's withdrawal or rejection of this Change Proposal without default of the contractor in accordance with GCC Clause 39 of the General Conditions* . . . .]

[*Contractor's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

2.2.5 Change Order Form

[*Employer's letterhead*]

To: *[Contractor's name and address]* Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*
Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

We approve the Change Order for the work specified in the Change Proposal (No. [*number*]), and agree to adjust the Contract Price, Time for Completion, and/or other conditions of the Contract in accordance with GCC Clause 39 of the General Conditions.

1. Title of Change: [*Name*]

2. Change Request No./Rev.: [*Request number / revision*]

3. Change Order No./Rev.: [*Order number / revision*]

4. Originator of Change: Employer: [*Name*] / Contractor: [*Name*]

5. Authorized Price:

   Ref. No.: [*Number*] Date: [*Date*]

   Foreign currency portion [*Amount*] plus Local currency portion [*Amount*]

6. Adjustment of Time for Completion

   None Increase [*Number*] days Decrease [*Number*] days

7. Other effects, if any

Authorized by: _____ Date: _____
Employer

Accepted by: _____ Date: _____
Contractor

2.2.6 Pending Agreement Change Order Form

[*Employer's letterhead*]

To: *[Contractor's name and address]* Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*
Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

We instruct you to carry out the work in the Change Order detailed below in accordance with GCC Clause 39 of the General Conditions.

1. Title of Change: [*Name*]
2. Employer's Request for Change Proposal No./Rev.: [*number/revision*] dated: [*date*]
3. Contractor's Change Proposal No./Rev.: [*number / revision*] dated: [*date*]
4. Brief Description of Change: [*Description*]
5. Facilities and/or Item No. of equipment related to the requested Change: [*Facilities*]
6. Reference Drawings and/or technical documents for the requested Change:
   [*Drawing / Document No. / Description*]
7. Adjustment of Time for Completion:
8. Other change in the Contract terms:
9. Other terms and conditions:

[*Employer's name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

2.2.7 Application for Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]
Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

We hereby propose that the work mentioned below be treated as a Change in the Facilities.

1. Title of Change: [*Name*]
2. Application for Change Proposal No./Rev.: [*Number / revision*]dated: [*Date*]
3. Brief Description of Change: [*Description*]
4. Reasons for Change:
5. Order of Magnitude Estimation (amount in the currencies of the Contract): [*Amount*]
6. Scheduled Impact of Change:
7. Effect on Functional Guarantees, if any:
8. Appendix:

[*Contractor's name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

3. Personnel Requirements

Using Form PER - 1 and PER - 2 in Section 4 (Bidding Forms), the Bidder must demonstrate that it has personnel who meet the following requirements:

No.	*Position*	Number of Persons	Total Work Experience [years]	Experience In Similar Work [years]
1	Project Manager	1	10	5
2	Design Engineers	1	10	5
3	Site Engineers	3	5	5
4	Construction supervisors	7	5	5
5	Safety Officer	1	5	5

Project manager shall be dedicated for this project and shall be available for full time of the project period in Sri Lanka.
The Bidder shall provide details of the proposed personnel and their experience records in the relevant Information Forms included in Section 4 (Bidding Forms).

4.Equipment Requirements

Using Form EQU in Section 4 (Bidding Forms), the Bidder must demonstrate that it has the key equipment listed below:

No.	Equipment Type and Characteristics	Min. Number Required
1	**Equipment for civil construction**	
	Excavators/ Loader	2
	Concrete Mixer	4
	Dump Track	2
	Poker Vibrator	4
	Plate Compactor	4
	Roller Compactor	4
	De Watering Pump	4
	Theodolite/Surveying equipment	2
2	**Equipment for electrical construction**	
	Truck mounted crane	1
	Cable Drum Jack	2
	Cable Pulling Rollers	10
	Crimping Tools	2
3	**Equipment for testing and commissioning**	
	Contact Resistance Tester	1
	Insulation Tester (1kV)	1
	High Voltage Installation Tester	1
	Current Transformer Test	1
	Primary Injection Set (Digital)	1
	Secondary Injection Set-1 Phase (Digital)	1
	Secondary Injection Set-3 Phase (Digital)	1
	High Voltage Test Unit for panel commissioning	1