

7.1a TECHNICAL SPECIFICATIONS FOR 11 KV GIS SUBSTATION SWITCHGEAR

7.1a.1 Scope

This clause describe the General Technical Requirements for the new 11KV indoor gas insulated Switchgear and general switchyard equipment, and shall be read in conjunction with the Tender Requirements, Schedules and Drawings in the specification.

The Supplier shall demonstrate that the switchgear has been designed, built and installed in accordance with the relevant international standards and the specification. It shall also operate and perform on a site in accordance with the requirements of the specification and in the environment defined herein.

The design shall be proven by the submission at the time of Tender of test certificates covering all specified tests deemed to be pertinent to the plant and to the conditions in which it will operate or, if such test certificates cannot be supplied or are deemed unacceptable by the Engineer, type tests which will be subject to the conditions of this Contract shall be carried out at no extra cost to the Employer.

The requirement for switchgear spares, tools and appliances, including test, maintenance and handling equipment shall be as stated in the Bid document. All devices necessary for operation and earthing shall be provided within the Contract Price.

7.1a.2 References

7.1a.2.1 British Standards

BS 159	Specifications for HV bus bars and bus bar connections
BS 1977	Specifications for high conductivity copper tubes for electrical
BS 2898	Specifications for wrought aluminium for electrical purposes. Strip with
BS 3938	drawn or rolled edges.
BS 5253	Specifications for AC disconnectors and earthing switches.
BS 6651	Lightning Protection
BS 7354	Code of practice for design of HV open terminal stations.

7.1a.2.2 IEC Standards

1.	IEC 62271	HV Switchgear and Controlgear.
2.	IEC 60376	Specification and acceptance of new sulphur hexafluoride
3.	IEC 60480	Guide to checking of sulphur hexafluoride taken from electrical equipment.
4.	IEC 60060	High Voltage test techniques.
5.	IEC 60071	Insulation Co-ordination
6.	IEC 60099-5	Surge arresters Part 5: Selection and application recommendation
7.	IEC 60129	AC disconnectors (isolators) and earthing switches
8.	IEC 60044-1	Current transformers.
9.	IEC 60044-2	Voltage transformers.
10.	IEC 60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.

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| 11. | IEC 61850 | Communication network and system in substation |
| 12. | IEC 60529 | Degrees of protection provided by Enclosure (IP code) |
| 13. | IEC 60255 | Electrical relays |
| 14. | IEC 62271-1 | High voltage switchgear and control gear: common specification |
| 15. | IEC 62271-100 | High voltage switchgear and control gear: Part 100: Alternating current circuit breakers |
| 16. | IEC 62271-102 | High voltage switchgear and control gear: Part 102: Alternating current disconnectors and earthing switches |

1) 7.1a.3 11 KV GIS INDOOR METAL CLAD SWITCHGEAR

7.1a.3.1 General

The 11 kV switchgear shall consist of a single bus-bar, metal clad, indoor type, floor mounted, single tier integrated unit, incorporating enclosures for the circuit breaker units, bus-bars, current transformers and auxiliary wiring. The switchgear shall be made according to IEC62271-200.

Each 11 kV CB shall be provided with a combined relay & control panel forming an integral part of the circuit breaker equipment.

The panels shall be equipped with the necessary protection control devices, indicating instruments and alarming devices, separate MCBs for power supply of protection device, measuring devices and others, etc.

The switchgear shall be of robust construction designed for maximum reliability of service in the tropical climate specified.

Cable boxes shall be supplied complete with glands and terminal lugs. Cable termination shall be totally insulated. Facility with necessary accessories for plug-socket connection of at least two cables per phase shall be provided. Sealing/cap for unused cable termination shall also to be provided.

7.1a.3.1.1

1.	Installation	Indoor
2.	Bus-bar Scheme	Single bus bar
3.	Construction	The structure of the cell is made of special sheet clad with convenient treatment which in all respect resists the effect of indoor humid tropicalized climate.
4.	System	3-Phase, 3-Wire with earthed Neutral
5.	Nominal System Voltage	11 kV Phase to Phase
6.	System Highest Voltage	12 kV Phase to Phase
7.	Rated short duration power frequency	28 kV (rms)

	withstand voltage	
8.	Rated Lightning Impulse withstand voltage	75 kV (peak)
9.	Frequency	50 Hz
10.	Rated normal current:	
11.	a) for 20/26 & 16/20 MVA power transformer 11kV Incoming & Bus Coupler	2500A
	b) for 11KV outgoing feeder with 2500A bus bars	630A
	Temperature rise of any part of the switchgear & control gear	Shall be as per the latest revision of relevant IEC standards.
12.	Rated Short-time withstand Current (Rated short circuit breaking current)	25 KA for 3 Sec.
13.	Rated Peak withstand Current (Rated short circuit making current)	62.5 KA
14.	Opening Time	≤ 0.05 Sec.
15.	Breaking Time	≤ 5 Cycle
16.	Closing Time	≤ 5 Cycle
17.	Rated supply voltage of closing & opening and auxiliary circuits (heating, lighting, motor).	110 V DC & 240/415 V AC (respectively).
18.	Rated Operating Sequence	0-0.3sec-CO-3Min-CO
19.	Degrees of Protection by enclosures (IP)	IP4X as defined in IEC 60529
20.	All Current Carrying Parts of Switchgear	Shall be made of copper
21.	Dimensions of all 11kV Cubicles (including bus bar height and size)	Shall be matched in all respect.
22.	Three position disconnecter Switch (Motorized & Manual)	Rated Voltage 12 kV, Rated current 2500A for Incomer & Bus Coupler and 630A for Outgoing feeder, Rated short time curren 25 kA, Short time current rated duration 3sec, Switch Position close, open, earth. Electrical and Mechanical interlock as per IEC 62271-200.
23.	Standard	Design, Manufacture, Testing and Performance shall be in accordance to the IEC-62271-200 and other related IEC standards.

7.1a.4.1.2 11KV TRANSFORMER INCOMING CUBICLES, EACH PANEL COMPRISING:

1.	Type of Bus Bar	HDHC copper 2500A.
2.	Bus Bar Scheme	Single Bus Bar

3.	Number of Phases	3 (Three)
4.	Operating Mechanism	For Circuit Breaker operation, spring-operated and stored-energy mechanisms shall be available. With manual Power/Manual, Trip Free, Electrically Spring operated by 240 Vac motor and shunt trip by 110 Vdc from storage battery, there shall be 2 Nos. Trip coils. The operating sequence OPEN-CLOSE-OPEN is stored in the springs.
5.	Rupturing Capacity.	500 MVA, Symmetrical.
6.	Breaking Time.	5 Cycle Maximum
7.	Continuous Current Rating.	2500 A
8.	All Current Carrying Parts of Switchgear.	Shall be made of Copper
9.	AC Control Voltage.	240 ± 10% Volts
10.	DC Control Voltage.	110 ± 10% Volts
11.	Cable and Boxes for Incoming.	Suitable for size 2x1Cx630 mm ² XLPE 11kV cables per phase with copper conductors.
12.	Single Phase Current Transformer with Ratio 900-1800/5-5-5A of accuracy class & burden 0.2, 15 VA for measuring core (1st core) and 5P20, 15 VA for protection core (2nd & 3rd core). (Characteristics: Epoxy resins insulated and double windings, butyl rubber type. The epoxy resin should be ultraviolet stabilized, fungus resistant & high tracking resistance, short time current ratings 25KA for 3 second & extended current ratings 120% of the rated value, secondary double winding, installation shall be in the panel).	3 Nos. (A Phase, B Phase & C Phase Shall have Individual CT)

13.	Numerical, programmable Over Current and Earth fault Protection relay and separate Standby Earth fault and all other necessary features for transformer incoming feeder protection. The current setting range of the O/C & E/F relay shall be from 0.1*I_n to 30*I_n for both overcurrent and earth fault element. All O/C & E/F relays (3 O/C element + 1 E/F element) shall have both IDMT, DT (51) and Instantaneous (50) function along with IEC NI, VI, EI, LTI etc. curve setting capability. O/C & E/F relays for 11 kV Transformer Incoming Cubicles shall have directional (67P, 67N) features as well. The numerical programmable relay shall have IEC 61850 communication protocol suitable for SAS implementation	1 set				
14.	Master Trip & Trip Circuit Supervision (for each trip coil) relays.	1 Set				
15.	All necessary Auxiliary & Signaling relays.	As required by BPDB.				
16.	Numerical Programmable 3 phase, 4 wire, 3 element solid state, indoor type, multi tariff programmable KWH Meter of accuracy class 0.2s with the features for measuring the parameters viz. phase voltages, phase currents, per phase & total KW with maximum demand, KVar, Power factor etc.	1 No.				
17.	Indicating analogue ampere meter flush mounting type with dual scales option (0-900A/1800A) for connecting to the current transformer ratio 900-1800/5-5-5A.	3 Nos.				
18.	70W, 240V AC, Single Phase space heater with thermostat and a visible light indicator which indicate the "ON"- "OFF" position of the heater	1 set				
19.	All necessary AC DC MCB, TNC Switch, Selector Switch, Limit Switch, Control Switch, Toggle Switch, Link/ Base, Push Button, Indicating/ Illumination Lamp, AC Plug Socket, Wiring, Fuses, Hooter etc. i.e. complete in all respect. Mimic diagram with LED based Semaphore Indicator for Isolator/Breaker/Earth switch position.	As required.				
20.	11 kV bus incomer Switchgear panel (16 window Annunciator)					
		<table border="1"> <tr> <td>Main DC Fail</td> <td>AC Fail</td> <td>Main Relay Faulty</td> <td>PT Failure</td> </tr> </table>	Main DC Fail	AC Fail	Main Relay Faulty	PT Failure
Main DC Fail	AC Fail	Main Relay Faulty	PT Failure			

	TCS-1 Unhealthy	TCS-2 Unhealthy	O/C Trip	E/F Trip
	67 Trip	67N Trip	Standby E/F	33 kV Inter trip
	Trip relay operated	Gas fault	Spring Charge Fail	SCADA/ Remote Trip
21.	11kV PT: For All the 11kV (Each) Bus Section (1 set-Bus VT) (Can be installed in any Feeder panel or in separate Panel): 11 KV $\sqrt{3}$: 110V $\sqrt{3}$, 110V $\sqrt{3}$ for each phase with accuracy class & Burden- 0.2, 20VA for measuring core and 3P, 20VA for protection core (A Phase, B Phase & C Phase Shall have Individual PT)		1 set	
22.	Indicating analogue voltmeter with six position selector switch flush mounting with scales 0-15 kV for connection to potential transformer ratio $(11/\sqrt{3})/(0.11/\sqrt{3})/(0.11/\sqrt{3})$ kV, (50 Hz).		1 set	
23.	Capacitive Voltage Divider (CVD) based Live Line Indicator (LLI) system.		1 set	

7.1a.4.1.3 BUS COUPLER WITH BUS RISER CUBICLES EACH COMPRISING:

1.	Type of Bus Bar	HDHC copper 2500A.
2.	Bus Bar Scheme	Single Bus Bar
3.	Number of Phases	3 (Three)
4.	Operating Mechanism	For Circuit Breaker operation, both spring-operated and stored-energy mechanisms shall be available. With manual Power/Manual, Trip Free, Electrically Spring wound operated by 240 Vac and shunt trip by 110 Vdc from storage battery, there shall be 2 Nos. Trip coils. The operating sequence OPEN-CLOSE-OPEN is stored in the springs.
5.	Rupturing Capacity	500 MVA, Symmetrical
6.	Breaking Time	5 Cycle Maximum
7.	Continuous Current Rating	2500 A
8.	All Current Carrying Parts of VCB	Shall be made of Copper
9.	AC Control Voltage	240 \pm 10% Volts
10.	DC Control Voltage	110 \pm 10% Volts

11.	Single Phase Current Transformer with Ratio 900-1800/5-5A of accuracy class & burden 0.2, 15 VA for measuring core (1st core) and 5P20, 15 VA for protection core (2nd core) (Characteristics: Epoxy resins insulated and double windings, butyl rubber type. The epoxy resin should be ultraviolet stabilized, fungus resistant & high tracking resistance, short time current ratings 25KA for 3 sec. & extended current ratings 120% of the rated value, secondary double winding, installation shall be in the panel).	3 Nos. (A Phase, B Phase & C Phase Shall have Individual CT)
12.	Numerical programmable Over Current and Earth fault protection relay with all necessary features for Bus Coupler protection. The current setting range of the O/C & E/F relay shall be from $0.1 \cdot I_n$ to $30 \cdot I_n$ (where I_n is relay nominal current) for both overcurrent and earth fault element. All O/C & E/F relays (3 O/C element + 1 E/F element) shall have both IDMT, DT (51) and Instantaneous (50) function along with IEC NI, VI, EI, LTI etc. curve setting capability. The numerical programmable relay shall have IEC 61850 communication protocol suitable for SAS implementation. The numerical shall have inbuilt synchronization check (25) function.	1 set
13.	Indicating analogue ampere meter flush mounting type with dual scales option (0-900A/1800A) for connecting to the current transformer ratio 900-1800/5-5A.	3 nos.
14.	Master Trip & Trip Circuit Supervision (for each trip coil) relays.	1 Set
15.	All necessary Auxiliary & Signaling relays.	As required by BPDB.
16.	100W, 230V AC, Single Phase heater with thermostat and a visible light indicator which indicate the "ON"- "OFF" position of the heater	1 set
17.	All necessary AC DC MCB, TNC Switch, Selector Switch, Limit Switch, Control Switch, Toggle Switch, Link/ Base, Push Button, Indicating/ Illumination Lamp, AC Plug Socket, Wiring, Fuses, Hooter etc. i.e. complete in all respect. Mimic diagram with LED based Semaphore Indicator for Isolator/Breaker/Earth switch position.	As required by BPDB.

18.	11 kV bus coupler Switchgear panel (12 window Annunciator)			
19.				
	Main DC Fail	AC Fail	Main Relay Faulty	PT Failure
	TCS-1 Unhealthy	TCS-2 Unhealthy	O/C Trip	E/F Trip
	Trip relay operated	Gas fault	Spring Charge Fail	SCADA/ Remote Trip
20.	Indicating analogue voltmeter with seven position selector switch flush mounting with scales 0-15 kV for connection to potential transformer ratio $(11/\sqrt{3})/(0.11/\sqrt{3})/(0.11/\sqrt{3})$ kV, (50 Hz). There shall be two voltmeters, one for Bus-1 and the other for Bus-2 respectively.		1 set	
21.	Capacitive Voltage Divider (CVD) based Live Line Indicator (LLI) system.		1 set	

7.1a.4.1.4 OUT-GOING CUBICLES, EACH COMPRISING:

1.	Type of Bus Bar	HDHC Copper 2500A
2.	Bus Bar Scheme	Single Bus Bar
3.	Number of Phases	3 (Three)
4.	Operating Mechanism	For Circuit Breaker operation, both spring-operated and stored-energy mechanisms shall be available. With manual Power/ Manual, Trip Free, Electrically Spring wound operated by 240 Vac and shunt trip by 110 Vdc from storage battery, there shall be 2 Nos. Trip coils. The operating sequence OPEN-CLOSE-OPEN is stored in the springs.
5.	Rupturing Capacity	500 MVA, Symmetrical.
6.	Breaking Time	5 Cycle Maximum
7.	Continuous Current Rating	630 Amps
8.	Cable and Boxes for Incoming Cable	Suitable for size 1x3Cx185 mm ² or 500 mm ² 11 KV XLPE cable with copper conductors.
9.	AC Control Voltage	240 ± 10% Volts
10.	DC Control Voltage	110 ± 10% Volts
11.	All Current Carrying Parts of VCB	Shall be made of Copper

12.	Single Phase Current Transformer of Ratio 200-400/5-5A of burden & accuracy class-5P20, 15 VA for protection core 0.2, 15 VA for measuring core & 0.2 (for measurement) and 20VA & 5P20 (for protection). (Characteristics: Epoxy resins insulated and double windings, butyl rubber type. The epoxy resin should be ultraviolet stabilized, fungus resistant & high tracking resistance, short time current ratings 25KA for 3 sec. & extended current ratings 120% of the rated value, secondary double winding, installation shall be in the panel)	3 Nos. (A Phase, B Phase & C Phase Shall have Individual CT)			
13.	Numerical programmable Over Current and Earth fault protection relay with all necessary features for 11KV Outgoing feeder protection. The current setting range of the O/C & E/F relay shall be from $0.1 \cdot I_n$ to $30 \cdot I_n$ (where I_n is relay nominal current) for both overcurrent and earth fault element. All O/C & E/F relays (3 O/C element + 1 E/F element) shall have both IDMT, DT (51) and Instantaneous (50) function along with IEC NI, VI, EI, LTI etc. curve setting capability. The numerical programmable relay shall have IEC 61850 communication protocol suitable for SAS implementation	1 set			
14.	Master Trip & Trip Circuit Supervision (for each trip coil) relays.	1 Set			
15.	All necessary Auxiliary & Signaling relays.	As required by BPDB.			
16.	Numerical Programmable 3 phase, 4 wire, 3 element solid state, indoor type, multi tariff programmable KWH Meter of accuracy class 0.2s with the features for measuring the parameters viz. phase voltages, phase currents, per phase & total KW with maximum demand, KVar, Power factor etc.	1 No.			
17.	Indicating analogue ampere meter flush mounting type with dual scales option (0-200A/400A) for connecting to the current transformer ratio 200-400/5-5A.	3 Nos.			
18.	70W, 230V AC, Single Phase heater with thermostat and a visible light indicator which indicate the "ON"- "OFF" position of the heater	1 set			
19.	All necessary AC DC MCB, TNC Switch, Selector Switch, Limit Switch, Control Switch, Toggle Switch, Link/Base, Push Button, Indicating/ Illumination Lamp, AC Plug Socket, Wiring, Fuses, Hooter etc. i.e. complete in all respect. Mimic diagram with LED based Semaphore Indicator for Isolator/Breaker/Earth switch position.	As required by BPDB.			
20.	11 kV outgoing feeder panel (12 window Annunciator)				
		Main DC Fail	AC Fail	Main Relay Faulty	PT Failure

		TCS-1 Unhealthy	TCS-2 Unhealthy	O/C Trip	E/F Trip
		Trip relay operated	Gas fault	Spring Charge Fail	SCADA/ Remote Trip
21.	Capacitive Voltage Divider (CVD) based Live Line Indicator (LLI) system.				1 set

***** Marking and data to be shown on the Nameplate will be as per approval.**

7.1a.4.1 BUS VOLTAGE MEASURING, EACH COMPRISING (VTs can also be incorporated in any of the GIS panel):

- a) 3 nos. (for each phase) epoxy resin-insulated single phase potential transformer having a ratio of $(11/\sqrt{3})/0.11/\sqrt{3})/0.11/\sqrt{3}$ kV (50 Hz), accuracy class 0.2 for measurement and 3P for protection, rated burden of 20VA connected to the bus through fuses & isolator. The epoxy resin should be ultraviolet stabilized, fungus resistant and should have high tracking resistance.
- b) 2 no. Indicating voltmeter, flush mounted with scale 0 to 15 KV for connection to the potential transformer.
- c) 2 no. voltmeters selector switch with 7 (Seven) positions flush mounted, rated voltage 500 Volts (50 Hz) rated current 15 Amps, front plate with inscription AB-BC-AC-AN-BN-CN.
- d) 1 set, necessary supporting insulators and other accessories, wiring, fuses, heater etc.
- e) Selected P.T. secondary supply for metering and indicating instruments of each panel shall be fed through 4 pole MCB in each phase and link in neutral in each panel of 11KV system voltage.
- f) Selected P.T. secondary supply to the protective relays of each panel shall be fed through 4 poles - MCB and link in neutral in each panel of 11KV system voltage.
- g) Synchrocheck (25) function of the 11kV Bus Coupler Feeder shall be done by adjacent 2 Bus's Bus VT

7.1a.4.2 Clearances

Maximum insulator lengths and clearances in air shall be not less than those specified for 11 kV switchgear having 75 KVp Basic Impulse Level.

7.1a.4.3 Current Ratings

All parts of the switchgear, including current transformers, shall be capable of withstanding, without thermal or mechanical damage, the instantaneous peak and the three second short time current corresponding to the rated making and breaking capacity of the circuit breakers. All normal current specified are the minimum continuous values required under the service conditions appertaining to Bangladesh.

7.1a.4.4 Circuit Breaker making and Breaking capacities

Each circuit breaker shall be capable of making and breaking short circuit faults in accordance with the requirements of IEC 62271 - Circuit Breaker, at 3 phase symmetrical circuit ratings at 11 kV service voltages as stated in the Schedules.

The Contractor shall submit for approval, certified test certificates of making and breaking test carried out by approved independent testing authorities in accordance with IEC 62271.

7.1a.4.5 Circuit Breakers

7.1a.4.5.1 Type

The 11 kV circuit breakers shall be vacuum type in accordance with IEC 62271 as appropriate.

7.1a.4.5.2 Interchangeability of Circuit Breakers

Circuit breaker of the same type and current rating shall be interchangeable, both electrically and mechanically, but it must be impossible to interchange equipment of different current ratings.

7.1a.4.5.3 Circuit Breaker Operation Mechanism

Circuit breaker closing mechanisms shall be AC motor operated preferably spring operated type such that the closing speed is independent of the operator. 11kV switchgear tripping shall be effected by means of 02 nos. of 110 volt d.c. shunt trip coil. Each equipment shall be provided with a visual, mechanized, indicating device, which shall be positively driven in both directions to show whether the circuit breaker is "Open" or "Closed". Lamp indication in place of a mechanical indicator will not be accepted. Operation counters shall be provided on each mechanism.

Means shall be provided for local manual mechanical tripping of circuit breakers, preferably by push buttons, shrouded to prevent inadvertent operation.

Locking facilities shall be provided so that with the circuit breaker in any location it can be prevented from being closed when it is open and from being mechanically tripped when it is closed. This requirement shall be met by the fitting of a single padlock and shall not entail the fitting of any loose components prior to the insertion of the padlock.

It shall not be possible, without the use of tools, to gain access to the tripping toggle or any part of the mechanism which would permit defeat of the locking of the mechanical tripping feature.

It shall not be possible to render the electrical tripping feature inoperative by any mechanical locking device.

7.1a.4.5.4 Circuit Breaker Isolating Features

Irrespective of the operating type of unit the following shall apply.

Each circuit breaker shall be connected to the busbars and feeder circuit through plug and socket type motorized isolating devices (three position disconnect) with manual provision. The devices shall be of the "Off Load Type" but shall be suitable for operation whilst the busbars and/or feeder circuits are alive.

Isolating devices shall be interlocked with their respective circuit breakers to prevent their making or breaking load, but arrangements whereby attempted isolation of a closed circuit breaker trips the circuit breaker are not permitted.

The main circuit isolating devices and also all secondary circuit isolating contacts shall be of the self-aligning type, mounted in accessible positions to permit maintenance.

The number of auxiliary circuit isolating switches shall be sufficient to meet the facilities.

7.1a.4.5.5 Interlocks

All mechanical interlocks shall be of the preventive type and shall be arranged to prevent mal operation as close as possible to the point at which mechanical force is applied, in order to

prevent defeat of the interlocks by distortion of linkages Electrical interlocks shall also function so as to prevent the closing of the circuit breaker.

Interlocking between the Circuit breaker and three position switch should meet the following conditions:

- a) to prevent the disconnect from switching under load, they may only be actuated with the circuit-breaker open
- b) the three-position switch must be prevented from switching through from the closed state in to the “ready-to-earth” position.
- c) the three-position switch can only be brought into the earthing position if the circuit breaker is open.
- d) closing of the circuit-breaker must be blocked for as long as the three position switch has not reached a definite switching position.
- e) for earthing of the feeder, reliable “interrogation interlocking” must be provided. Only the three-position switch is switched into the “ready-to-earth” position, feeder can be earthed and short-circuited by closing the circuit-breaker.
- f) Earth switch operation shall be blocked when there is voltage in intended Line/ Bus/ Equipment.

In addition electrical interlocks may be utilized to ensure safe operation of the plant; i.e. on 11 kV transformer incoming circuits the circuit earth position shall not be operative unless the 33 kV circuit is de-energized and isolated etc.

7.1a.4.5.6 Safety Shutter Devices

A set metal shutters shall be provided to cover each 3 phase group of stationary isolating contacts.

The shutters shall open automatically by a positive drive initiated by the movement of the circuit breaker. The closing operation shall also be automatic by positive drive

When padlocked closed, the shutters shall completely shroud the stationary contacts and it shall not be possible to force the shutters or part of the shutters to gain access to the stationary contacts.

To facilitate testing, means other than locking shall be provided for securing the shutters in the open position. However, such means shall be automatically cancelled when the automatic operation of the shutters restored upon reconnection of the circuit breaker.

Bus-bar shutters shall be painted signal red, colour 537 in BS 381 C or equivalent RAL standard, and shall be clearly and indelibly labeled “BUSBARS” in large white letter in English. The contractor may offer works which comply with different standards or codes only if, when requested by the Engineer Circuit shutters shall be painted yellow, colour 355 in BS381 C or equivalent RAL standard, but shall not be lettered, except that on incoming feeders the circuit shutters shall be clearly and indelibly labeled “DANGER LIVE CABLES” in large red letters.

Voltage transformer spout shutters shall be painted yellow, colour 355 in BS 381 C or equivalent RAL standard. Durable phase colour identification shall be provided in a prominent position. Provision or access shall be made for lubricating the mechanical linkages.

All shutters shall be effectively earthed

Shutters shall not operate towards the fixed isolating contacts.

7.1a.4.5.7 Busbars and Connections

The equipment shall be of single busbar type. Busbars and connection shall comply with applicable clauses of IEC 62271 and shall be fully insulated.

The equipment shall be of single busbar type. The busbar assemblies shall be of a type which shall not rely only on air for insulation purpose.

Any earthed screen applied to the exterior of the insulation shall be securely earthed in each busbar compartments.

The insulation of the busbars and their connections shall be capable of withstanding, without damage, the thermal and mechanical effect of a through fault current equivalent to the short-time rating of the switchgear.

Access to busbars and the connections directly thereto shall be gained only by the removal of covers secured by bolts or screws. Such covers shall be marked clearly and indelibly "BUSBARS"

Busbars shall extensible at both ends; such extension shall entail the minimum possible disturbance to the busbar chambers. Compound filled busbar chambers are not acceptable.

7.1a.4.5.8 Earthing of Metal Parts of Switchgear

All metal parts, other than those forming part of an electrical circuit, shall be connected to a hard-drawn, high conductivity, copper earth conductor on each unit, of adequate sectional area.

Interlocking (both mechanical & electrical) must be provided to avoid accidental earthing circuit breaker in "service position".

7.1a.4.5.9 Earthing of Insulations

Earthing of the switchgear and ancillary panels and auxiliary equipment shall be carried out in accordance with IEC 62271 Standard where applicable.

7.1a.4.5.10 Insulators

Porcelain insulators shall be best quality electrical porcelain. The clamping surfaces of all porcelain insulators shall be accurately ground and shall be free of glaze.

Insulators of moulded or resin bonded material shall have a durable, non-hygroscopic surface finish having a high anti-tracking index.

7.1a.4.5.11 Auxiliary switch

Each circuit breaker shall be provided with adequate nos. auxiliary switches to interrupt the supply to the closing mechanism and to complete the trip circuit, when the circuit breaker is in the "Closed" position and to cover all the necessary indication, interlocking and control facilities with spare contacts.

Each circuit breaker shall be provided with clean auxiliary contacts for the purpose of providing remote switch and alarm indication at the remote grid supervisory centre. In addition each circuit breaker shall be provided with the necessary 50 volt d.c. Interposing relays required to achieve remote control of the circuit breaker via a future remote grid supervisory system. All auxiliary switches shall be wired down whether in use or not to the appropriate marshaling kiosk.

7.1a.4.6 Special Tools

One complete set, of all special tools that are necessary for the overhauling maintenance and adjustment of the whole equipment shall be provided with each switchboard. The tools provided shall be in a new condition and shall not be used for the erection of the equipment on Site.

7.1a.4.7 Indoor Breaker Specification

The 11 kV switchgear unit indoor vacuum CB along with CT, 11 kV bus, 11 kV PT (3 × single phase unit – draw out/ plug in type). The C.B shall have spring operating mechanism suitable for charging by motor (universal type) with provision of hand charging. Sufficient auxiliary contacts shall be provided for position indication, interlocks and other purposes. Two sets of independently operative trip coils shall be there. Provision for signaling of low gas pressure and ultimate lock out for very low pressure shall be provided.

Technical Particulars of 11 kV Circuit Breakers:

Phase	3-phase Service
Voltage/Maximum system Voltage	11kV/12 kV
Continuous rating current of Bus-bar	2500 Amps.
Continuous rating current	2500 A for Incomer 2500 A-for Bus Coupler, 630A for 11KV Outgoing feeder
Breaking Capacity	25 KA (3 Sec).
Basic Impulse Level (BIL)	70 kV,
Power frequency withstand voltage	28 kV.
Bus Shall be 3 phase, 50Hz 2500 A, air insulated capable of withstanding 25kA for 3sec.	

2)

3) 7.1A.4.8 PROTECTIVE RELAYS

All Protective relays shall be numerical programmable type and shall comply relevant IEC or equivalent international standard. All the relays shall be IEC 61850 protocol type for automation network of the 33/11kV Sub-station.

All the protective relays shall be supplied from any of following manufacturers:-

- a) ABB (Switzerland/Sweden/Finland).
- b) Siemens (Germany).
- c) ALSTOM (UK/France)
- d) Schneider Electric (UK/France)
- e) NR, China
- f) SEL, USA

****** 11 kV Bus Coupler Feeder panels Numerical Relay should have synchronization (25) function.**

Note: Supply of Related software with required license keys & accessories is within the scope of supply.

7.1A.4.9 ENERGY METERS

KWH meter shall 3-phase 4-wire, Numerical Programmable Multifunction KWH Meter of accuracy class 0.2s with the features for measuring the parameters viz. phase voltages, phase currents, system frequency, per phase & total KW with maximum demand, KVAR, Power factor etc.

It has to be ensured that the meter complies IEC61850 for SAS operation. If required, internal/external module as protocol converter can be used for the compatibility with IEC61850. However, the detail specification of the meter shall be same as that for 33 kV PCM panel meter described in **clause 7.1.3.24**.

All the energy meter shall be supplied from any of the following manufacturers:-

- a) Siemens, Germany/Switzerland.
- b) AEG, Germany.
- c) ABB, Switzerland/Finland
- d) Itron, USA
- e) Elster, USA./Romania
- f) Landis+ Gyr, Switzerland
- g) Toshiba (Japan)
- h) Honeywell (USA)
- i) CEWE, UK

Note: Manufacturer's authorization for Protective Relays & Energy Meters (KWh) shall furnish with the offer. Necessary software & accessories is within the scope of supply.

7.1a.4.10 Current Transformers (CTs).

The current transformer rated current ratio shall match the connected load circuit and secondary circuit requirements.

Current transformers shall be capable of withstanding without damage the full load, peak and rated short time currents of their associated equipment.

Where space within a current transformer chamber permits dedicated current transformers shall be used for protection, instrumentation and metering.

Current transformers used for energizing indicating instruments and metering shall be of Class 0.2 accuracy in accordance with IEC 60044.1. Current transformers for protective and protective/indication purposes shall be designed to suit the particular requirements of the

associated protection, which in general shall be in accordance with the recommendations given in BS 3938 or equivalent IEC standard.

Class 5P current transformers shall be used for inverse time over-current and/or earth fault protection. The rated accuracy limit current shall be equivalent to the maximum symmetrical three phase fault current or earth fault current of the protected circuit or equivalent to the switchgear breaking capacity unless otherwise approved by the Engineer. The current transformers shall be capable of meeting the 5P error classification at rated accuracy limit current over the full range of relay settings, unless otherwise approved by the Engineer.

Current transformers used for indication/metering purposes shall be designed to saturate at a value of primary current sufficiently low to protect the secondary circuit from damage at all possible values of primary fault current up to the associated primary short time thermal rating.

The rated volt-amp output of each current transformer shall not be less than 110% of the connected burden as installed in service, the burden of cable connections being taken into account

The secondary windings of each set of current transformers shall be earthed at one point only via an accessible bolted disconnecting link, preferably located within the relay cubicle.

Where double-ratio secondary windings are specified provided a label shall be provided at the secondary terminals of the current transformer indicating clearly the connections required for either tap. The connections and the ratio in use shall be indicated on all connection diagrams.

Design magnetization curves and d.c resistance values shall be submitted before manufacture for each current transformer used for protective purposes and shall be subsequently verified by works routine tests and also by site commissioning tests.

Where current transformers have to operate or be mounted on apparatus provided under other contracts, the Contractor shall be responsible for ensuring design and installation compatibility with other Contractors and for keeping the Engineer informed.

Metal clad switchgear current transformers shall be located on the non-bus-bar side of the circuit breaker except where current transformers are provided on both sides of the circuit breaker for protection zone overlap. The primary conductors shall be accessible for primary current injection testing on site.

7.1a.4.11 Voltage Transformers (VTs)

Voltage transformers shall comply with the requirements of IEC 60044-2 with amendments and supplements and shall be of:-

- Class 3P accuracy for protection/indicating instruments
- Class 0.2 accuracy for tariff metering or acceptance efficiency testing.

For tariff metering voltage transformers the Contractor shall check the total installed secondary burden and if necessary shall install dummy burdens to achieve the calibrated accuracy.

Voltage transformer secondary circuit shall be earthed at one point only and metal cases shall be separately earthed. The transformers core, where accessible, shall also be separately earthed. All voltage transformers in the system at a given voltage level shall be earthed in the same manner.

Where it is required to earth the primary neutral of a metal clad three- phase voltage transformer, the neutral earthing connection shall be insulated and brought out separately from the tank earthing connection. Means shall be provided to maintain the tank earthing connection while the voltage transformer is being withdrawn.

Where three single-phase voltage transformers are supplied for protection purposes, star connected secondary windings shall have the star point formed by insulated connections and shall be earthed at a common point.

Where possible primary windings shall be connected through fuses with current limiting features. All the 11kV Bus VTs shall be draw out/plug-in type installation with manual isolating switch.

Secondary MCB's shall be provided as close as possible to each voltage transformer and labeled to show their function and phase colour. The secondary circuits shall be monitored individually to detect and alarm individual fuse failure or MCB trip and to block protection operation if required.

Voltage transformers shall be designed that saturation of their cores does not occur when 1.732 times normal voltage is applied to each winding. Magnetization curves shall be submitted for approval for each type of voltage transformer.

The standard secondary voltage between phases shall be 110 volts unless special circumstances dictate otherwise, and are approved by the Engineer.

Secondary circuits from different voltage transformers, or separate windings of the same transformer, shall not be connected in parallel.

Voltage transformers shall be connected on the non-busbar side of circuit breakers unless otherwise approved by the Engineer.

7.1a.4.12 FEATURES & ACCESSORIES

- a) VCB should be restrike free.
- b) VCB should be trip free.
- c) Vacuum Interrupter shall be capable of short circuit current switching ≥ 50 .
- d) Breaker trucks of different current ratings shall not be interchangeable. The breaker truck shall be wheel mounted and rail supported.
- e) All current carrying parts shall be made of copper.
- f) Hand closing and tripping shall be done through manual levers.
- g) Manually operating devices for slow closing for inspection and maintenance. It shall not be possible to slow close a breaker when in normal services.

- h) Each cubicle shall have ON-OFF indicator and provision for manual operation and necessary mechanical & electrical interlocking.
- i) Protective relay shall be sufficient for over current and earth fault protection and shall be of numerical programmable type. Accessories/Software required if any, Control & Protection Scheme drawings and Operation & Maintenance manual is within the scope of supply for each panel. All the relays shall be IEC 61850 protocol type for automation network of the 33/11kV Sub-station. In addition, numerical relay shall have sufficient contacts and shall be configured for SAS operation. Intermediate auxiliary relay with sufficient spare contacts shall be used for controlling CB or any other switching devices through numerical relay in case of SAS operation.
- j) All indicating meters will be semi flush type with full view 240" scale range with intimate dial, black marketing and pointer with moving element with zero adjuster.
- k) The painting shall be gray (RAL 7032) outside and glazed white inside.
- l) All equipment and accessories shall be fully tropicalized.
- m) Necessary foundation bolts, spare heaters (installed and wire), manual handle for the breakers, test jumpers, portable lamp, set of test plug for test terminals and draw-out type relay shall be supplied.
- n) The complete panel and its accessories shall be made to the latest relevant IEC standards.
- p) Rating plate and diagram plate having all information as per relevant IEC standard shall be made of stainless steel and have engraved letters filled with black enamel paint.
- q) At least three sets relay & meter testing plug shall be supplied.
- r) Each VCB cubicles shall be complete according to the specification, features and bill of materials but not limited to these items; the VCB cubicles should be complete in all respects, to make it fully operational.
- s) Tripping from protection to circuit breakers shall be through fast acting (<10 msec) Trip relays.
- t) CT terminal block shall have isolation, shorting & jacking facility while PT terminal block shall have isolation & jacking facility.
- u) Sufficient spare terminals (at least 10%) in each terminal block.
- v) Provision to hang danger/ caution board.
- w) The Switchgear panel shall be SCADA/SAS compatible and hence all intelligent devices, digital energy meters etc. shall comply IEC61850. All physical connections for control, measurement and status indication shall be made SAS ready.
- x) 70W, 230V AC, 1-phase heater with thermostat and control switch and a visible light indicator which indicate the "ON" & "OFF" position of the heater.
- y) Electrical push button/TNC switch for Circuit breaker & Three position switch (Disconnecter-Earth switch) Open-Close operation in the panel's front side for easy access. Circuit breaker's emergency mechanical OFF push button shall be free from any mechanical & electrical interlocks except permanent feeder earthed & locked scheme.

- z) Circuit Breaker shall have 2 trip coils, Both trip coils shall be energized by separate contacts of master trip relay for protection tripping. However, for manual tripping, only one trip coil can be engaged only.
- aa) Indicating/Signaling Yellow Lamps shall be of LED type for Heater on indication.
- ab) Mimic diagram shall contain LED based Semaphore Indicator instead of moving Semaphore indicator.
- ac) Ferrule marking and color coding for all type of wiring shall be as follows:
 - 1. Ferrule marking:** Ferrule marking shall be done by white flexible rubber/ PVC tube with permanent black ink printing on top, fitted with cable, double point addressing (source-destination)
 - i. "A"- for differential protection circuit
 - ii. "C"- for O/C & E/F protection circuit
 - iii. "D"- for metering circuit
 - iv. "E"- for PT circuit
 - v. "L"- for Alarm & Indication circuit
 - vi. "S"- for fault recorder
 - 2. Color coding:**
 - i. "Black"- for phases of AC supply
 - ii. "White"- for neutral of AC supply
 - iii. "Grey"- for control circuit
 - iv. "Brown & Grey"- for (+) and (-) DC supply respectively
 - v. "Red, Yellow, Blue, Black"- for CT and PT circuit
 - vi. "Yellow with green strip"- for earthing
- ad) A copy of Control circuit scheme shall be laminated and fixed to the inner side of the door of the cubicle
- ae) Operation Counter for the circuit breaker.
- af) Anti pumping feature shall be provided/ included.
- ag) Bidder shall supply related software (1copy) and manuals describing trouble shooting procedure(3copies).
- ah) Bidder shall supply the operation manuals of relay and meters describing the trouble shooting and configuration procedure (3copies).

ai) Inter tripping arrangement for 11 kV incomer Cubicle (from 33 kV transformer feeder tripping) and for 33 kV transformer feeder (from directional tripping of 11 kV incomer or Stand by E/F tripping) shall be provided.. Necessary SAS signaling shall be integrated.

aj) Separate MCBs shall be provided for DC supply to Power, Control and Alarm & Indication circuits.

ak) All type of tripping shall be done through Master Trip relay.

al) Alarm signal for CB operating spring charge fail shall be given using settable time delay relay (time needed for charging the spring) and this alarm signal shall be incorporated in the annunciator & SAS.

am) The annunciator shall have provision for operating on both 110VDC & 240VAC, single supply at a time (auto supply changeover), mainly 110VDC operated and should generate alarm for any of the supply fail. Also Annunciator shall have built-in mute & acknowledge option accessible via SAS command along with other necessary features (built in buzzer/hooter with accept, reset, mute & test push buttons).

7.1A.4.13 TRIP RELAYS

Following shall be the main features of a high speed tripping relays:

All tripping relays shall be of the heavy duty and self-reset type suitable for panel mounting and shall have operating coils which are rated sufficiently to operate in conjunction with series flag relays. If necessary, normally closed contacts in series with the relay operating coil, shall be delayed for a period which will allow series flag relays to operate satisfactorily. All other tripping contacts should be instantaneous i.e. no intentional time delay. The operating time shall not exceed 10 milliseconds at rated voltage. The operating range of the relay shall be from 70% to 120% of rated voltage.

Trip Relay shall be of following types:

- a. Self-reset type (for over current & earth fault protection numerical relay)
- b. Operating Coil Voltage: 110 V DC (No series resistor allowed.)
- c. Shall have in built freewheeling diode.

Wherever the tripping relay contacts need to break the D.C., sufficiently rated magnetic blow out contacts or such approved means shall be used.

4) 7.1A.4.14 INDICATING AMMETERS

Each 11kV PCM Cubicle will be provided with 3 Ammeters, analogue type/Digital Multifunction Meter (1 for each phase).

5)

6) 7.1A.4.15 INDICATING VOLTMETERS

1 (one) voltmeter with selector switch, analogue type /Digital Multifunction Meter with a multi-selector switch (phase to phase, phase to neutral, off) shall be installed.

7.1A.4.16 EARTHING SYSTEM

Earthing of metallic parts or metallic bodies of the equipment on the Panel shall be done with soft drawn single conductor bare Copper Tail connections shall have minimum area of 16 sq, mm. and

the main earthing connection 60 sq.mm. These wires shall be connected by suitable terminals and clamps junction. Soldered connections shall not be employed.

All metal parts other than those forming part of any electrical circuit shall be earthed to the earthing system. Any necessary terminals on any part of the equipment required for this purpose shall be provided by the Manufacturer. Earthing conductor cross section shall be in accordance with the manufacturer standards which shall be proved with necessary type test reports. However, for 33kV switchgear minimum 300 mm² cross section copper bar shall be employed for earthing. The copper earth bar shall run along the full length of the switchboard and earthing studs shall be provided at not less than two points. The frame of the draw-out circuit breaker earthing truck shall be automatically connected to the switchgears bar through substantial plug type contact when the circuit breaker is in disconnection, service and test position.

7.1A.4.17 SUPERVISION RELAYS

7.1A.4.17.1 Trip Circuit and Protection Supply Supervision

The trip circuit supervision function shall be a separate relay and independent of control and protection unit provided in the switchgear. Trip circuit supervision relays shall be provided to monitor each of the trip circuits of all 11kV circuit breakers and each relay shall have sufficient contacts for visual/audible alarm and indication purposes. The trip circuit supervision scheme shall provide continuous supervision of the trip circuits of the circuit breaker in either the open or closed position and independent of local or remote selection at the local operating position. Relay elements shall be delayed on drop-off to prevent false alarms during faults on dc wiring on adjacent circuits, or due to operation of a trip relay contact. Series resistances shall be provided in trip supervision circuits to prevent mal tripping a circuit breaker if a relay element is short circuited. Relay alarm elements shall be equipped with hand resetting flag indicators.

Trip circuit supervision relay (TCSR) shall supervise not only the trip coil but also the whole trip circuit during both breaker open and close position (pre-close & post-close). Both trip circuits shall be supervised by separate TCS relay. TCS function of main relay shall be avoided for supervision.

All the TCS relay shall have at least 3NO+3NC contact for Indication, Annunciation & SAS Integration. 2 NO contact shall be used for CB closing circuit interlock & closing readiness indication (if used) and 2 NC contact shall be used for TCS faulty Annunciation & SAS integration.

7.1A.4.17.2 D.C. Supply Supervision

All the DC Supply MCB (Main supply, Control supply, Device supply, Indication supply, Annunciation supply etc.) shall have at least 2NO+2NC contact for & there shall be 1 (one) 110V D.C. operated no-volt auxiliary relay (self-reset type) installed across panel's main DC supply entry point at terminal block with inscription "Main D.C. Supply Supervision relay" and shall have at least 2NO+2NC contact for Indication, Annunciation & SAS integration. These supervision relays are to be independent of alarms from the trip circuit supervision scheme so that the operator can clearly differentiate via the available alarms between loss of supply due to a blown fuse / tripped MCB and failure of a trip circuit's supervision /faulty supervision wiring. 1 NO contact of the Main DC supply supervision relay & DC supply MCBs shall be used for DC supply healthy indication (if used) and 2 NC contact shall be used for DC supply faulty Annunciation & SAS integration.

DC supply supervision of the annunciation circuit shall be performed by the built in AC/DC fail relay of the Annunciator. Hence, the Annunciator shall be powered by dual source (with internal/external AC/DC changeover switch).

7.1A.4.17.3 PT Supply Supervision

Each PT supply secondary circuit shall be supervised by individual 110V A.C. operated no-volt auxiliary relay (self-reset type) installed across panel’s main PT supply entry point at terminal block with inscription “Measuring/Protection P.T. Supply Supervision relay” with at least 2NO+2NC contact for Indication, Annunciation & SAS integration. As per section 7.1a.4.1, 1 NO contact of the PT supply supervision relay & PT supply MCBs shall be used for PT supply healthy indication (if used) and 2 NC contact shall be used for PT supply faulty Annunciation & SAS integration.

7.1A.4.17.4 A.C. Supply Supervision

There shall be 1 (one) 240V A.C. operated no-volt auxiliary relay (self-reset type) installed across panel’s main AC supply entry point at terminal block with inscription “Main A.C. Supply Supervision relay” and shall have at least 2NO+2NC contact for Indication, Annunciation & SAS integration.

All the AC Supply MCBs (Main supply, Spring charge motor supply, TPS motor supply, lighting & heating supply etc.) shall have at least 2NO+2NC contact for Indication, Annunciation & SAS integration. 1 NO contact of the Main AC supply supervision relay & AC supply MCBs shall be used for AC supply healthy indication (if used) and 2 NC contact shall be used for AC supply faulty Annunciation & SAS integration.

7.1A.4.18 MIMIC BUS

Mimic bus material shall be brass, bronze or copper with enamel finished or anodized aluminum or plastic. The mimic bus and included symbols shall be shaped, colored and located as international standard. Light indicator showing position (opening/closing) of circuit breaker, DS, ES shall be installed.

The mimic bus shall be attached to the panel by mechanical devices, not with adhesive. Attachment shall be closely spaced to hold all parts of the mimic bus firmly to the panel face.

Mimic bus shall be provided with the following dimensions and color code:-

<u>Voltage</u>	<u>Bus Color</u>	<u>Thick</u>	<u>Dimension (mm)</u>
11 KV	Black	3	12

LED based Semaphore Indicator showing the position (open/close) of Circuit Breaker and Earth Switch shall be inserted within the mimic bus.

7.1a.4.19 Auxiliary Relays

Each 11 kV Switchgear Cubicle shall be provided with 1 (one) set separate Auxiliary and signaling relay and wiring with fuses. This relay shall be used for control & monitoring of CB and ES through numerical relay/BCU in case of SAS operation.

7.1a.4.20 Live Line Indicator

Each 11 kV Switchgear Cubicle shall be equipped with CVD based Live Line Indicator (LLI) system.

7.1a.4.21 Information Required

The Bidder/ Manufacturer as per tender requirements shall provide all information. Besides

these, the following information has to be submitted:

- a) Manufacturer's Printed Catalogue describing specification and technical data for crucial components (i.e. breakers, vacuum interrupter, relays, energy meters, annunciator, etc.) of offered type equipment.
- b) Outline and General Arrangement drawings.
- c) The Bidder/ Manufacturer shall submit the list of available testing/ measuring equipment, meters, etc., along with valid Calibration Certificate(s) from competent authority used in manufacturer's laboratory for performing Routine Test as per IEC standard.
- d) Manufacturer's ISO 9001 Certificate.

7.1a.4.22 APPROVAL OF DRAWINGS

The successful bidder/tenderer shall submit the following drawings in AutoCAD format and in hard copy for the approval to the Engineer, Director, Design & Inspection-II, BPDB within within 15 days from the date of signing Contract.

1. Technical Specification and Guaranteed Technical
2. Detailed dimensional drawings of 11KV Switchgear including foundation drawing. with cable slots showing all equipment mounted on them along with complete panel wise list of equipment and list of Name Plates. Weight of these panels with all the equipment mounted on these shall also be furnished in the Drawing.
3. Outlined drawings of internal wiring diagram of the instrument, relays, meters, annunciator and other equipment showing external terminal connections with the equipment terminal number.
4. Complete AC and DC Schematic diagram of 11 KV Switchgear Panels to indicate the followings:
 - i) Annunciator circuit
 - ii) Protection and control circuit
 - iii) Indication and Supervision circuit
 - iv) Other circuits as necessaryThese drawings shall show AC power connection and Secondary connections for relays, meters, terminal blocks with their number etc. interconnection diagram between PCM and circuit breaker, Power and Instrument Transformer and other equipment as necessary
5. Cabling and wiring diagram of the cubicles and inter-connections between them. Ferrule numbers, device number and grouping for cable take off shall be distinctly shown. No work shall be performed in connection with the fabrication and manufacture of the testing equipment until the technical data and drawings have been approved.
6. Manufacturer's printed catalogue describing the type/model of offered 11KV Switchgear, Protective relays, Energy Meters
7. The Bidder shall have to submit 3 (three) sets of the same for Approval. The bidder shall also submit one set reproducible tracing of the above drawings in soft format.
8. List of switchgears electrical & mechanical interlock, BCPU/Relay's BI, BO, LED, Annunciators window and related drawings shall be submitted with detail switchgear drawing during approval stage.

No work shall be performed in connection with the fabrication and manufacture of the Testing Equipment until the technical data and drawings have been approved. The manufacturing of

the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. The cost of supplying drawings and specifications shall be borne by the supplier.

At the time of delivery of Equipment, the supplier shall supply three (3) sets of all approved technical data and drawings in bound book form along with manufacturer's original catalogue of the Equipment to the office of Director, Design & Inspection-II, BPDB, 9/B, Motijheel C/A, Dhaka, Bangladesh, Telephone # 88-02-9550404

7.1A.5 SPECIFICATION OF 110V, 3 x 5(6) A, 3-PHASE, 4-WIRE, 3-ELEMENT, INDOOR TYPE MULTI-TARIFF PROGRAMMABLE METER WITH ASSOCIATED INSTRUMENT TRANSFORMERS ENCLOSED IN METERING PANEL.

7.1A.5A GENERAL

The meters are required for the purpose of energy metering of medium/high/extra-high voltage consumer metering at 132 kV or 33 kV or 11kV level . KWh is the unit for the purpose.

System voltage	Nominal service voltage 110V (PT Secondary), 3 phase 4wire, solidly grounded neutral at source, maximum system voltage 120V line to line.
System frequency	50 Hz

7.1a.5.B SPECIFICATION OF 110V 3 x 5(6)A, 3-PHASE, 4-WIRE 3-ELEMENT, INDOOR TYPE MULTI TARIFF PROGRAMMABLE DIGITAL ENERGY METER

The consumer meters are required for the purpose of energy metering of low voltage consumer who purchases power at 11 kV/33 kV line through PT & CT. kWh is the unit for revenue purpose.

System voltage	: Nominal service voltage 110V, 3 phase 4 wire, solidly grounded neutral at source, maximum system voltage 120V line to line.
System frequency	: 50 Hz
Standard	: The Energy Meter should be designed, manufactured and tested in accordance with IEC 62052-11, 62053-22 and 62053-23 or ANSI C 12.16, 12.10 (latest publication) or specified in this specification
Installation Type	: Indoor Type : Solid state.
Application	: Registration of KWh (Peak & off-peak), Total KVarh(Q1+Q4), KW on 3- phase, 4-wire supply for balanced & unbalanced load (unidirectional). Peak 17.00-23.00. hrs and off peak 23.00-17.00 hrs (programmable) Bangladesh standard time. The software for Time of Use (TOU) shall be so developed to accommodate future tariff and can be customized, if the purchaser changes the tariff. The software shall be compatible with Windows operating system.
Connection	: 3-phase 4-wire, solidly grounded neutral.
Nos. of element	: 3 (Three)
Rated current	: Basic current 5 amps and maximum current ≥ 6 amps.

- Multiplication factor : The following shall be inscribe on the mater. Dial reading X CT ratio X PT ratio = Actual reading in KWh.
- Register : Solid state LCD display type register. The display shall be programmable, automatic and include:
- Meter ID
 - Time & date
 - Cumulative KWh (Peak & off-peak)
 - Cumulative Total KVarh (Q1+Q4)
 - Maximum demand (KW) with time & date
 - Cumulative Maximum demand (kW) for billing month.

Maximum demand (MD) in kW shall be registered using the technique of cumulating on integration period controlled by built-in process and the MD shall be continuously recorded and the highest shall be indicated. The highest MD shall be added to the cumulative store, which shall be automatically initiated after an interval of one month / one billing period by means of built-in timing device.

- Integration period: 30 (thirty) minutes.
- Number of MD reset (Automatic& manually).
- Average PF for billing period.

Instantaneous:

- Phase voltage with indication
- Phase amps with direction.
- Power factor (average).
- Demand (KW)
- Voltage phase angel (each phase) |or P.F. Angle(each phase)
- Current phase angle(each phase)
- Tampering indication in the register.

- Memory storage : The meter shall have sufficient capacity (minimum 400 KB) to store the following readings and data in non-volatile memory even in case of power failure.
- Equipment identification codes, security codes and access codes.
 - Number of power interruption with date & time (minimum 100 events).
 - Latest power failure time & date
 - Date & time of meter tempering. (Voltage & Current missing, demand reset , time change).
 - Event logs
 - Current & Previous registered in month KWh (Peak & off-peak), Total KVarh (Q1+Q4)
 - Current & Previous month registered with maximum KW demand since last MD reset with time and date of its occurrence.

The meter must have sufficient capacity to store data at 30 (thirty) minutes interval for at least 90 (ninety) days.

- Load Profile data [kWh, KVarh (Q1+Q4)]
- Phase voltage or Vh
- Phase amps or Ah

Accuracy class	: Accuracy class is 0.2s (point two s)
Number of digit	Minimum 5 (Five) integer with 1 (One) decimal (Total 6 digit).
Type of Display	Solid-state LCD display.
Time switch	: The time switch shall be built-in type and shall be designed to perform a present cycle of operation. Time switch shall reset MDI at the end of every month (billing period) automatically. In the event of failure of power supply and battery, at the same time set memory shall not be lost i.e. the set program shall be recorded in non-volatile memory. The maximum error shall be kept within ± 1 (one) second per day. Time error adjustment facility shall be provided.
Battery reserve	: Each time switch must be provided with lithium battery which allow the switch to function for a period of not less than 10 (ten) years. The guaranteed life of the battery should not be less than 10 (ten) years and shall have provision for easy replacement. The shelf life of the battery should be minimum 15(fifteen) years or more.
Construction	: The meter shall be completely self-contain round socket or enclosure type. The meter cover shall be made of polycarbonate/acrylic /phenolic /resin and socket cover shall be made of metal polycarbonate/ acrylic /phenolic /resin. The meter cover and socket /enclosure shall be provided with security sealing provisions to prevent unauthorized access to the internal meter works and socket /enclosure sealing shall be designed to accommodate both padlock and wire type seal.

IEC meters shall be minimum IP51. The ANSI Standard meter shall be effectively sealed to prevent entrance of rain and dust into its internal parts. The meter shall pass Rain test described in underwriter's laboratory standard UL-50 (USA) for type 3 enclosures. A general purpose finish of class 1 as specified in section 7 of ANSI C12.10 shall be provided for the meter and it shall meet the requirement of weather simulation test (Sec. 7.2.1 of ANSI C12.10) and salt spray test (ASTM B117). It shall be designed to operate continuously for the normal life of the meter in unsheltered outdoor tropical location exposed to the elements without corrosion or other damage to parts to adversely affect meter accuracy or reliability.

Enclosure for IEC Standard Meter	The meter shall be surface mounted in an outdoor pole mounted metering enclosure box with necessary wiring. The enclosure box
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should be made either of high quality flame retardant ABS Resin of minimum 3 mm thickness or of galvanized sheet steel of minimum 1.22 mm (18 SWG) thickness or of auto extinguishable, shockproof and UV resistant, hot molded glass reinforced polyester of minimum 3 mm thickness. The box shall have hinged front door with one toughened glass window or transparent UV resistant Polly carbonate to enable easy reading of meter. The metering box shall be weather proof, dust proof, rodent and insect proof in accordance with enclosure classification IP54. Service cable entry and exit will be sides of the box and 40 (forty) mm diameter hole with black PVC conic cable gland shall be provided for side entry & exit for this purpose. All material parts shall have anti-corrosive protection.

All materials shall be designed, manufactured and tested as per IEC or equivalent International standards except as mentioned. The front door shall be removable and provision must be made for sealing in the closed position.

- Socket : Meter sockets shall be suitable for installation of offered type meter. Meter sockets shall be 3-phase, 4-wire wye, 600 volt class, made from 16 gauge sheet metal. Meter sockets shall be similar except as described below. Meter sockets shall approximately 14" (35.6 cm) H×9"(22.9cm) W×4" (10.2 cm) D and rectangular in shape. Sockets shall be the same size as 1-phase sockets and terminal blocks shall be interchangeable. Sockets shall be ring less type, sealing latch to be stainless steel and have adequate means for socket grounding. Meter socket shall have a 2"(5 cm) Diameter top opening complete with a 1- ¼" (3.2 cm) hub. Meter socket shall have 4 knockouts with a range up to 2"(5 cm) Diameter, one on the back, one in the bottom and one in each side. Meter socket shall comply with ANSI C 12.6, 12.10
The Socket shall have written permanently (not in paper printed) "connection diagram" distinctly marked in addition to all standard data.
- Terminal : Socket connected type/ Non-symmetrical, bottom entry, front connection, and connection type with extended terminal cover: Minimum 10 Terminals to accommodate up to 06 sq. mm size of cable. The terminal cover for the offered energy meter shall be extended type, and which can be sealed independently. There shall be free space between bottom of the terminal and the bottom of the terminal cover.
- Connection : 3-phase, 4-wire solidly grounded neutral.
- Service life of meter : Shall be minimum 15 (fifteen) years.
- Visual indication of operation : Pulse indicator on the front of meter as per meter constant.

- Special condition : a) The factory calibration conforms to relevant IEC or equivalent international standard. LCD display shall be shown consecutively and continuously one after another. The display shall be automated i.e. no external means shall be required to see the display. Each display shall last for at least 5 (five) sec.
- b) Meter Electronic Circuit biasing voltage shall have to be ensured from each phase to phase and each phase to neutral and minimum basing voltage 40V.
- Meter Sealing : The Energy meter body will be hermetically sealed or ultrasonically welded to avoid unauthorized opening of meter cover. Otherwise the bid will be rejected.
- Communication port : The meter must be provided with a suitable communication port to allow down loading of desired information stored in the meter to a PC via hand held data logger as per IEC 1107 or equivalent standard.
- Remote Communication : The meter shall be equipped with external GSM-GPRS Modem, which will be able to interface with RS232, RS485 for data communication with the central server from meters, having all accessories like power supply adapter, necessary connecting cables, antenna with minimum 2.5 meter extension cable, connectors, enclosure box with fixing materials etc. The modem shall be compatible with existing AMR system of BPDB.

7.1a.5.C. TAMPER AND FRAUD PROTECTION FEATURE:

The meter shall have the following features to prevent/detect tamper and fraud:

- **Phase Sequence Reversal:** The meter should work accurately irrespective of phase sequence of supply.
- **Missing Potentials:** The meter shall be capable of detection occurrence of missing potential of one phase or two phase(s), which can happen due to intentional/accidental disconnection of potential link(s).
- **Terminal cover** must have micro-switch provision to monitor unauthorized opening. Opening of terminal cover shall trigger an event to be recorded in the event log memory.
- **Software Access:** Software access for configuration and setting of the meters.

7.1a.5.D TECHNICAL FEATURE

- The body cover and socket / enclosure shall be provided security sealing provisions to prevent unauthorized access to the internal meter works.
- The meter shall be provided with connection diagram.
- The data access should be protected by minimum 3(three) steps software password in meter.
- The meter shall have provision of phase to phase and each phase to neutral biasing.
- The meter shall have minimum biasing voltage of 40V otherwise the bid will be rejected.

- The meter and socket/enclosure shall have provision of earthing.
- Meter must operate and accurately register demand and energy when service voltage is applied across any two of the three input terminals or when service voltage is applied from any input terminal to neutral. Meter will continue to operate even the neutral is missing.
- The meter and socket/ enclosure must be the same country of origin other wise the bid will be rejected.
- The registration of KWh (Peak & off-peak) on 3-phase, 4-wire supply for balanced & unbalanced load will be unidirectional. i.e. if one, two or three phase supply is/are reversed, it will take the absolute (kWh-del) + absolute (kWh-rev) and will add them together as total 3-phase KWh.
- The meter shall be equipped with remote GSM & PSTN communication option.
- It has to be ensured that the meter complies IEC61850 for SAS operation. If required, internal/external module as protocol converter can be used for the compatibility with IEC61850
- The meter shall have permanently print nameplate distinctly marked with the following in addition to all standard data:
 1. The word “BPDB” and insignia of BPDB.
 2. Voltage and current rating.
 3. Frequency.
 4. Number of element, number of wire and multiplication factor.
 5. Accuracy class.
 6. Year of manufacture.
 7. Serial number.
 8. Name of manufacturer.
 9. Meter constant.

7.1a.5.E. Display of measured values/ Meter Display

- The Sequence of LCD display should be user programmable.
- The contrast setting of LCD display should be visible in different lighting environment and distinctly visible in broad daylight.
- The meter should be of displaying time and date, the direction of energy i.e. as import/export or +/-, active tariff and internal fault indicators.
- There should be up to three groups of display to priorities the display. Each showing a programmable function group.

7.1a.5.F Meter Parameterisation Software

- The parameterisation software must run on Windows operating environment.
- The software must be protected by software keys to control duplication and installation.
- The software should have a customizable printing feature by task list.
- The meter must be able to display or record meter ID, Program, Programmer ID, C. T. ratio, V. T. ratio, Total (KWh, KVarh, KVAh, KW, KVar, KVA, P.F); per phase

(voltage, current, KW, KVar, KVA, P.F, phase voltage angle, phase current angle); Load profile having minimum 8(eight) Channels data stored in different interval for 90 days.

- Tamper feature: The meter must have Errors & Warnings codes, History log and Event log(minimum 400events) to record date & time of all power outages, demand resets, time change.
- In addition, each software key must bear a unique user ID and that is not transferable to another PC that has different user ID.
- The Meter should be able to display the phasor diagram.
- The software for Time of Use (TOU) shall be compatible to accommodate future tariff and can be customized, if the purchaser changes the tariff .The software shall be compatible with Windows operating system.
- The Meter must be provided with meter passwords to secure communication between meter software and meter having minimum 3(three) access levels.
- The AMR Software have to be compatible with BPDB's existing AMR System. The Tenderer have to develop the total AMR System with exiting and supplied AMR Solution. In this case the tenderer have to provide their meter protocols so that all exiting meters and supplied meters data will be downloaded and managed in a single AMR System.

7.1a.5.F2 EXTERNAL MODEM WITH ACCESSORIES

GSM/GPRS modem with RS-232 ports, meter interfaced power supply, connection cables, antenna with minimum 2.5 meters cable, mounting facilities, enclosure (if necessary). The modems will be capable of GSM and GPRS connectivity simultaneously. For GSM configuration the AT command will be available and for GPRS communication the APN, reset time, username, password, port number, etc. are configurable. The modem will have the following specification.

Interruption (< 1 ms), RS-232 (at least 1), GPRS class 10, operating band 900/1800, auto reset capability (with phone call, SMS). The modem will be robust, durable and compatible with the employers existing service condition.

7.1a.5.F3 Manufacturer

All the energy meter shall be supplied from any of the following Country: -

- a) European Country.
- b) North American Country.
- c) Japan
- d) Australia

The tenderer should submit authentic document with the tender against the country and location of the offered Electric Energy Meter Manufacturing plant which will be verified during tender evaluation.

Note: Related software & accessories if required for Energy meters is within the scope of supply.

7.1a.6 Technical Orientation and Quality Test Witness (Acceptance test) for 11kV GIS:

A. FACRORY INSPECTION AND TEST WITNESS:

Witnessing of the manufacturing process and tests of the equipment at manufacturer's premises including transfer of technical know-how shall be required/held as detailed elsewhere in Particular Conditions of Contract (GCC 32.1) of tender document and other than this the following will be as follows:

The BPDB's inspection team proposed by the purchaser or consignee (if consignee is Project Director) and approved by the competent authority shall have the right to inspect, examine and test the workmanship and performance of the goods/materials to confirm the conformity to the specification at all reasonable time before and during manufacture at the manufacturer's premises.

The manufacturer will allow inspection team to inspect the manufacturing process and quality control and progress of the work at any time need by BPDB's inspection team. This team will witness the Factory/Technical orientation & Quality test at the manufacturer's plant. The Manufacturer shall have facilities to carry out all tests at its premises and shall provide free of charge such assistance, labor, materials, electricity, fuel, stores, apparatus and instruments as may be requisite and as may be reasonably demanded to carry out such test efficiently.

The inspection team maximum 2 (two) times may inspect (if required) the goods during the manufacturing process or after manufacture of Goods as required and shall also request to supplier for the purchase/ import/ shipping documents of major/key materials of Goods and shall check in accordance with Guaranteed Technical Particulars (GTP) and guarantees of the contract. All expenses for such tests shall be borne by the supplier.

BPDB's Inspection Team will witness the routine test at the manufacturer's premises. Tests shall be performed in accordance with the relevant IEC/BS/ANSI/ASTM/BDS standards or any other standard mentioned in the contract document which shall be complied with the Guaranteed Technical Particulars (GTP) of the Contract. All expenses for such tests shall be borne by the Contractor.

At the time of Factory Test witness BPDB's Inspection Team will check the calibration seal/certificate of the testing/measuring equipment, meters etc. issued by the competent authority. The contractor shall ensure that the Manufacturer shall complete the calibration of the testing/ measuring equipment, meters etc. before the inspection of BPDB's team.

The Supplier shall, after consulting the consignee, give notice to the consignee in writing of the date and the place where the material or equipment will be ready for testing at least 15 days before schedule of inspection. The consignee shall give the supplier timely notice in writing of his intention to attend the test. As and when the consignee is satisfied that any materials/equipment shall have passed the tests referred to in this clause, consignee shall notify the contractor in writing to that effect.

Should any inspected/ tested goods fail to conform to the specification, the consignee shall have the right to reject any of the items or complete batch if necessary. In that case Supplier has to replace the equipment and to make good of them and the supplier shall conduct similar pre-delivery Inspection and factory tests without any financial involvement to the consignee. In case any of the Equipment/goods found not conforming to the specification at the time of post landing Inspection, the supplier will in no way be relieved from the responsibility of replacing them on making them good at their own cost, despite the Equipment were found good at the time of Factory Acceptance Test in respect of quality and quantity. Nothing in this clause shall in any way release the supplier from any warranty or other obligations under the contract.

If the offered goods are manufactured within the purchaser's country, then the manufacturer/supplier shall have the testing facilities at manufacturer's/supplier's premises in accordance with the relevant IEC/BS/ANSI/ASTM/BDS Standards. The inspector(s) shall sent the sample material (selected by the BPDB's Inspection Team consisting of at least three engineers in each consignment) to CERS,

BPDB/BUET/CUET/KUET/RUET/DUET to carry out any test(s) pending due to lack of testing facilities or any reason at the manufacturer's/supplier's premises. All cost of testing including carrying, loading, unloading etc. will be borne by the supplier and shall be deemed to be included in the offered price. If the sample(s) fails to confirm the specification, the full consignment will be rejected.

No goods shall be packed, prepared for shipment/delivery unless it has been approved and written instructions have been received from the consignee.

On successful completion of Pre-shipment inspection/quality test witness, delivery of goods will be made to the designated stores under contractor's/supplier's responsibility until Post-Landing Inspection is successfully completed without any obligation on part of BPDB. Quality and quantity of the delivered goods will be determined at the time of post-landing inspection at the designated stores in presence of the authorized representative of the contractor/supplier. After approval of the satisfactory Post-Landing Inspection, R&I Report will be issued following the contractual obligations.

B. RANDOM SAMPLE TEST DURING FACTORY INSPECTION AND WITNESS: Required

During Pre-delivery Inspection & Factory Test Witnessing of the goods to be supplied under the Contract, the Inspection Team will witness the routine tests at the manufacturer's premises. The Inspection Team will select goods on random sampling basis. The Tests shall be performed in accordance with the relevant IEC/BS/ANSI/ASTM/BDS standards or any other standard mentioned in the contract document which shall be complied with the Guaranteed Technical Particulars (GTP) of the Contract. All expenses for such tests shall be borne by the Contractor.

C. ACCEPTANCE REPORT OF GOODS FOR DELIVERY:

If the test results of the tested sample(s) during factory test witness by the BPDB's inspection team fail to confirm the specification and the Guaranteed Technical Particulars (GTP), the full consignment will be rejected. A formal delivery order will be issued after satisfactory pre-delivery inspection & test report by BPDB's inspection team.

D. POST-DELIVERY INSPECTION & TESTING:

Post Landing Inspection shall be done after arrival of the goods at **Final destination**

The Supplier shall inform (within 5 (five) working days) the purchaser or consignee (if consignee is Project Director) immediately after arrival of the goods at the designated store of BPDB (as per delivery schedule). An Inspection team of BPDB (may be the previously or newly formed team) shall start to perform the post-landing inspection not beyond 10 (ten) working days in presence of supplier's representative after getting information from supplier about the delivery of goods at designated store. The Supplier shall arrange post-landing inspection as per program in consultation with the consignee. If any defect or damage has been found at post-landing inspection, the defective or damaged materials/ goods shall be replaced by the supplier at his own cost within the stipulated time.

The purchaser's or consignee's (if consignee is Project Director) right to inspect, test (where necessary) and reject the goods after delivery at the designated stores of BPDB shall in no way be limited or waived by reason of the goods having previously been inspected, tested and passed by the purchaser prior to the goods' delivery.

The Inspection team will check the physical conditions and quantity of the goods delivered. The inspection team will select the sample of good(s) on random sampling basis and sent the selected sample goods to CERS, BPDB or BUET/ CUET/ KUET /RUET (as selected by the inspection team) to carry-out the test(s) as per contract to confirm the conformity to the approved Technical Specifications, Guaranteed Technical Particulars (GTP), drawings and relevant standards. If the tested sample(s) fail to confirm the specifications in tests, the full consignment will be rejected. All cost of testing of Materials/ Goods including carrying, loading, un-loading etc. will be borne by the supplier.