REPUBLIC OF THE PHILIPPINES

NATIONAL POWER CORPORATION

(Pambansang Korporasyon sa Elektrisidad)

BID DOCUMENTS

Name of Project : **SUPPLY, DELIVERY, CONSTRUCTION, INSTALLATION, TESTING AND COMMISSIONING OF 10MVA MASBATE (MALINTA) SUBSTATION**

Project Location : **Malinta, Masbate**

Specs No. : **LuzP23Z1636Sce**

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A.2.0 POWER CIRCUIT BREAKER

A.2.1 Technical Characteristics and Requirements

		Contractor's Data
a.	Manufacturer	
b.	Type and Designation	
c.	Country of Origin	

A.2.2 Circuit Breaker Electrical Characteristics

		NPC Requirement	Contractor's Data
a.	Rated Maximum Voltage, kV	72.5	
b.	Rated System Voltage, kV	69	
c.	Rated Insulation Level		
	1. Short-duration Power Frequency Withstand Voltage, kV rms	140	
	2. Lightning Impulse Withstand Voltage, kV, (peak value)	325	
d.	Rated continuous current at System Frequency, A rms	600	
e.	Rated Short Time Withstand Current, kA rms	20	
f.	Rated duration of short circuit current, sec.	3	
g.	Rated Interrupting Time, cycles	5	
h.	Maximum Symmetrical Interrupting Capability, kA rms	23	
i.	Rated peak withstand current, kA rms	37	
j.	Reclosing Duty Cycle	O-0.3s CO-3min CO	
k.	Minimum reclosing time, cycles	20	

A.2.3 Circuit Breaker Physical Characteristics

a.	Medium of Interrupting	SF6	
b.	Interrupting Module	Live Tank	

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A.3.0 METALCLAD SWITCHGEAR

A.3.1 Technical Characteristics and Requirements

		Contractor's Data
a.	Manufacturer	
b.	Country of Origin	

A.3.2 General Technical Data and Requirements for the Switchgear

		NPC Requirements	Contractor's Data
a.	Rated service voltage, kV	13.8	
b.	Rated voltage, kV	15	
c.	Number of phases	3	
d.	Current rating		
	1. Continuous, A	600	
	2. Short – time withstand current, kA rms,	18 both main and earthing circuit	
	3. Peak Withstand Current. kA peak	23 both main and earthing circuit	
	4. Short time current duration, sec.	3 for both main and earthing circuit	
e.	Rated Insulation Level		
	1. Power Frequency Withstand, kV rms	45	
	2. Lighting Impulse withstand voltage, kV peak	110	
f.	Rated Power Frequency, Hz	60	
g.	Material		
	1. Main Bus	Copper	
	2. Vertical Bus	Copper	
h.	Type of Main Bus Connections	Bolted	
i.	Vertical to Main bus connection method	Bolted	
j.	No. of circuit breakers per vertical section	one	

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A.3.3 Metalclad Switchgear Physical Characteristics

		NPC Requirement	Contractor's Data
a.	Type (Outdoor, Indoor) If outdoor, specify "walk-in" or "non walk-in"	Outdoor Non-Walk-in	
b.	Doors	Gasketed	
c.	Protection class applied	IP 55	
d.	Cable and/or Bus Duct Entrance		
	1. Power Supply	Bottom	
	2. Power Feeder	Bottom	
	3. Control cables	Bottom	
e.	Rodent proofing	To be provided	

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A.4.0 LINE PROTECTION SYSTEM

A.4.1 Technical Characteristics and Requirements

	Contractor's Data
a. Country of Origin	
1. Main Relay	
2. Back – up Relay	
b. Manufacturers	
1. Main Relay	
2. Back – up Relay	
3. DEF Protection	
4. Auto-reclosing Relay	
5. Synchro/Voltage Check Relay	
6. Stub Protection	
7. Transmission Line Overvoltage Protection	
8. Remote Back-up Protection	
9. Fault Locator	

A.4.2 Line Parameters

	NPC Requirement	Contractor's Data
a. Voltage rating, kV	69	
b. System grounding	Solidly grounded	

A.4.3 Instrument Transformer Requirements

a. VT Ratio	350/600:1	
b. VT Secondary Voltage	115/66.4V_{L-G} with System Voltage 69kV_{L-L}	
c. Current Transformer Secondary Rating, A	1 A	
d. Current Transformer Ratio	600 : 1A	
e. Frequency	60 Hz	

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A.4.4 Protective Line Relay Technical Features and Characteristics

	NPC Requirement	Contractor's Data
a. Construction	Microprocessor based and/ or Numerical	
b. Required no. of protection relay sets per line	Two sets per line	
c. Type		
1. Main	Distance Relay (21)	
2. Back-Up	Directional/ Directional Ground Over Current Relay (67/67G)	
d. For Main distance relay used:		
1. Required no. of measuring zones for protection	At least three forward directional time-stepped zones designated Z1, Z2, and Z3 with Z3 being able to be set in reverse direction	

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A.5.0 SUBSTATION PROTECTION SYSTEM

A.5.1 Technical Characteristics and Requirements

		Contractor's Data
a.	Country of Origin	
	1. Transformer Protective Relay	
	2. Breaker Failure Relay	
	3. Bus Protective Relay	
	4. Feeder Protective Relay	
b.	Manufacturers	
	1. Transformer Protective Relay	
	2. Breaker Failure Relay	
	3. Bus Protective Relay	
	4. Feeder Protective Relay	
c.	Model No.	
	1. Transformer Protective Relay	
	2. Breaker Failure Relay	
	3. Bus Protective Relay	
	4. Feeder Protective Relay	
d.	Power Requirements, DC supply	
	1. Transformer Protective Relay	
	2. Breaker Failure Relay	
	3. Bus Protective Relay	
	4. Feeder Protective Relay	
e.	Heat Dissipation, BTU	
	1. Transformer Protective Relay	
	2. Breaker Failure Relay	
	3. Bus Protective Relay	
	4. Feeder Protective Relay	

A.5.2 Instrument Transformer Data

		NPC Requirement	Contractor's Data
a.	VT/CCVT Ratio	350/600:1	
b.	VT/CCVT Secondary Voltage	115/66.4 V_{L-G} with 69 kV_{L-L} system voltage	
c.	Current Transformer Secondary Rating	1A	
d.	Current Transformer Ratio	600/500/400/300/ 200/100:1A	

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A.5.3 Bus Protection Technical Features and Characteristics (69 kV Busbars) (If required)

	NPC Requirement	Contractor's Data
a. Construction	Micro-processor based design (numerical/digital)	
b. Operating Parameters		
1. Bus differential relay		
a. Function Time	≤ 13 ms	
b. Setting Range	10 – 200V	
2. Lock-out relay		
a. Type	Manual reset	
b. Operating time, ms	≤ 9ms	
c. No. of contacts required	to be coordinated with no. of associated relays	
d. Trip coil voltage operating range	70-145 VDC	
e. Contact ratings		
1. Continuous	20A	
2. 1 min.	40A	

A.5.4 Over Current Relays Operating Parameters and Technical Features (If applicable)

a. Construction	Micro-processor based design (numerical/digital)	

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SECTION VI

PART II – ANNEX B

TECHNICAL DATA SHEETS

(TO BE SUBMITTED DURING THE POSTQUALIFICATION)

ELECTRICAL WORKS

ANNEX B (TO BE SUBMITTED DURING THE POST-QUALIFICATION)

B.1.0 GENERAL TECHNICAL REQUIREMENTS

B.1.1 Project Requirements

All standard accessories, including those not indicated in this Specification, shall be furnished.

The detailed work to be performed by NPC or Contractor for the Project shall be as follows:

	NPC	Contractor
Design & Engineering		X
Fabrication & Manufacture of Substation Equipment and its accessories per specification		X
Factory Tests (Design & Routine)	X [1]	X
Packing and Delivery to Port of Loading		X
Delivery from Port of Loading (FOB) to Port of Entry (CIF Port of Entry)		X
Loading/Unloading		X
Delivery from Port of Entry to Site		X
Unloading at Site or NPC Stockyard		X
Storage, Moving and Care of Goods		X
Checking All Parts (at Delivery Port or Site)		X
Unpacking (at Site)		X
Foundations		X
Foundation Piers		X
Interconnecting Shipping Sections		X
Tools for Installation and Testing		X
Installation		X
Tools for Maintenance		X
Spare Parts		X
Cable and Wire Connections		X
Cable Schedule		X
Oil Filling and Treatment of Oil (for transformers, reactors)		X
Field Testing (Pre-Commissioning) [2]	X [2]	X

[1] *NPC representative(s) to witness Factory Routine Tests, if required in the Technical Data Sheets of every equipment.*

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	NPC	Contractor
Calibration of Instrument & Controls		X
Quality Assurance Control	X	X
Touch-up Paint		X
Commissioning [2]	X [2]	X

The services of a competent field service engineer or technician is required under this contract (is, is not)

B.1.2 Site Conditions and Environment

The expected environmental and meteorological conditions for the location of the equipment installation are as follows:

Description	NPC Requirements
a. Elevation above sea level	Not higher than 1000m
b. Equipment location (indoor, outdoor)	Outdoor
c. Ambient conditions at equipment location	
1. Temperature range °C	0 – 40
2. Relative humidity %	75 –95 non-condensing
d. Maximum outdoor daily average temperature, °C	32
e. Outdoor air conditions:	
1. Tropical (Yes, No)	Yes
2 Dust or Salt Laden (Yes, No)	Yes
f. Degree of Contamination (specify light, medium, heavy, or very heavy per IEC Std.)	Very Heavy
g. Maximum design wind velocity, kph	260kph
h. Required creepage distance, mm/kV (Based on max. phase to phase voltage)	31
i. Flood level above equipment pedestal, mm	300
j. Other outdoor abnormal conditions: (Yes, No)	
1. hurricane (typhoon)	Yes
Design for seismic load (Yes, No): If Yes, refer to Section EW-1.10 of the Technical Specifications	
a. Acceleration Factor (horizontal)	Yes
1. Seismic zone factor, Z	0.4G
Equipment shall be shipped, prepared and protected for outdoor storage for period of: year	One (1)

[2] *NPC representative to approve procedures prepared by Contractor and witness every field testing and commissioning to be conducted for each of the substation equipment.*

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B.1.3 Other General Requirements

Description	NPC Requirements
a. Latest Edition of **ANSI Standards** in original book bound form to be provided for the following equipment: [3]	
1. Power Transformer (if required)	Refer to **Codes and Standard** under Technical Specifications.
2. Power Circuit Breaker	--- ditto ---
3. Disconnect Switch	--- ditto ---
4. Surge Arrester	--- ditto ---
5. Instrument Transformers	--- ditto ---
6. Metal Clad Switchgear	--- ditto ---
7. Protective Relays	--- ditto ---
8. Grounding System	--- ditto ---
b. Hardware and Software to be provided as a complement for the submission of Final/As-Built Drawings	If applicable
1. Type	PC compatible Laptop
2. Processor	Intel Core i9 or Latest available on time of award
3. Clock Frequency	Fastest available
4. RAM capacity, GB	16 GB min.
5. Hard disk capacity, TB	2 TB min. (7200 RPM)
6. Sound card	64-bit Stereo
7. Video card capacity	Largest available
8. Monitor	14" LED SVGA / color monitor
Software:	
1. Operating System	Latest Windows 11 OS with Hardcopy and CD
2. Microsoft Office	Yes, Professional Edition Latest Version to be provided with hardcopy and CD

[3] *The cost of ANSI Standards to be supplied shall be included in the cost of each equipment.*

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Description	NPC Requirements
3. Autocad Software	Yes, two (2) sets of latest version to be provided-with Hardcopy and CD
Peripheral Connectivity:	
1. Communication Interface	RS 232-C and USB 3.0 Ports
2. Network Interface	Yes, 10/100/1000 MBps (built in)
3. DVD ROM / WRITE	Yes, latest version
4. DVD ROM Drive provided	Yes, latest speed
5. Portable mouse provided	Yes
6. Built-in i.Link (IEEE 1394) port	Yes
7. 10/100/1000 Mbps RJ-45 PCI based with Wake-on LAN, DMI Capable	Yes
Power Supply:	
1. Voltage	100-240 VAC, 1-Φ, 60 Hz
2. UPS for the computer to be provided	No
Units to be provided:	
1. Laptop	N/A

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B-2.0: POWER TRANSFORMER INSTALLATION

A. Project Requirements

A.1 All materials, tools and instruments needed for installation work, including those not indicated in this Data Sheets, shall be furnished by the Contractor.

A.2 Generally, work to be performed by NPC or Contractor, shall be as follows:

	NPC	Contractor
Checking of Power Transformer and accessories (at NPC Mobo S/S) *	X	X
Dismantling and Loading of Power Transformer and accessories for Hauling (at NPC Mobo S/S)		X
Hauling from NPC Mobo S/S to Project Site (Masbate Substation)		X
Unloading of Power Transformer and accessories at Project Site		X
Checking Power Transformer and accessories (at Project Site) *	X	X
Installation of Transformer**		X
Assembling Parts and Accessories of Transformer		X
Connection to grounding system of arresters, neutral bushing and transformer tank		X

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	NPC	Contractor
Connection of instrumentation, control and power cables to terminal blocks of transformer control cubicle including conduit installation within transformer		X
External Wiring & Connection from transformer control cubicle to main control switchboard and/or transformer operation control and protection system panel (including conduit installation, if any).		X
Repair, De-rusting and Repainting		X
Oil Testing, Filling and Filter Pressing		X
Inspection and Field Testing*	X	X
Calibration of Instrument & Controls (if any)		X
Quality Assurance Control*	X	X
Commissioning*	X	X

* *To be undertaken by both NPC and Contractor or their representatives.*

** *To include transformer setting on transformer foundation, leveling and correct alignment.*

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B. Technical Data

NOTE: THE CONTRACTOR IS REQUIRED TO FAMILIARIZE HIMSELF WITH ALL THE INFORMATION PROVIDED UNDER THE COLUMN "NPC'S DATA".

		NPC Data
B.1	Technical Assistance	
B.1.1	The assistance in testing and commissioning of a competent field service engineer or technician by the manufacturer is provided. (Yes/No)	No
B.2	Power Transformer(s) Installation Details	
B.2.1	Number of power transformer(s) required to be installed under this contract is/are; unit(s)[1]	One (1)
B.2.2	Oil Filling	
B.2.2.1	Oil filling operation to be performed under this contract, (partial, complete)	Complete
B.2.2.2	Oil filter press operation to be performed under this contract, (partial, complete)	Complete
B.2.3	Grounding	
B.2.3.1	Number of transformer tank grounding pad connection to grounding mat to be performed under this contract,	Two
B.2.3.2	Number of neutral bushing connection to grounding mat to be performed under this contract,	One
B.2.3.3	Number of arresters connection to ground mat to be performed under this contract,	As required
B.3	Field Tests and Commissioning	
B.3.1	Inspection and field tests to be performed on transformer under this contract,	Refer to Paragraph D.1

[1] To include all accessories and appurtenances.

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		NPC Data
B.3.2	Commissioning work to be performed under this contract,	Refer to Paragraph A.2
B.4	Documentation	
B.4.1	Reports on inspection and field tests performed under this contract,	Complete
B.4.2	As-built drawings on work performed and other documentation under this contract,	Complete
B.5	Transformer Description	
B.5.1	Transformer Technical Data	
	a. Number of phase	3
	b. Insulation (mineral oil, synthetic oil, gas)	Mineral Oil
	c. Application	Substation Transformer
	d. Class (outdoor, indoor)	Outdoor
	e. Continuous rated output at 65°C temp. rise (80°C hot spot), MVA, per phase	10MVA
	f. Number of cooling stages (one, two, three)	Two (2)
	g. Type of cooling, (OA, FA, FOA)	OA/FA
	h. Type (3-winding, 2-winding, auto-transformer)	3-winding
B.5.2	Cooling System	
	a. Cooling medium will be (air, water, oil)	air and oil

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		NPC Data
	b. Conduit connections to the weatherproof control cabinets shall be: (from bottom, from top, other)	from bottom
	c. Type of cooling	OA/FA
	d. Cooler arrangement (separately mounted or transformer mounted)	transformer mounted
	e. Coolers (specify radiator, cooler tubes)	Radiator
	f. Steps of cooling (one, two)	one
B.5.3	Surge Arresters Mounted on Transformer	
B.5.3.1	Surge arrester technical description are as follows	
	a. Voltage Rating	15 kV, 12 kV
	b. Type	metal oxide
	c. Discharge counter (with, without)	Without
	d. Leakage current monitor (with, without)	Without
	e. Mounting provisions (with, without)	With
B. 6	Facilities for Handling the Transformer	
	a. Standard skid base of heavy steel with wheels	N/A
	b. Wheels shall be removable type	N/A
	c. Wheels shall run on rails	N/A

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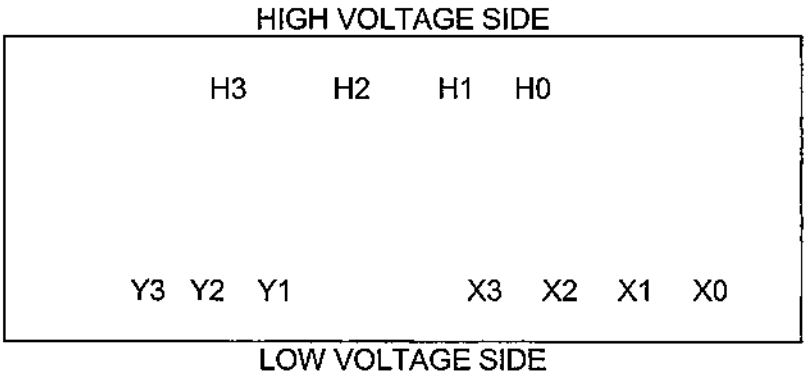
B.7 Location of Transformer Bushings:

B.7.1 The location of the bushings of the transformer shall be as shown below:

Right hand Left hand



* Location of the tertiary and the neutral terminal shall depend on the Manufacturer's arrangement.

B.8 Other Technical Requirements for the Power Transformer

The Power Transformer was delivered partially filled with insulating oil. Considering that it has been preserved for a long time, the Contractor shall check and test the condition of oil. The Contractor shall supply the mineral oil in accordance with ASTM D3487 (Specification of Mineral Insulating Oil Used in Electrical Apparatus) fully tested and shall fill the transformer up to its normal oil level.

Insulating liquid must not contain more than 2PPM of Polychlorinated Biphenyl (PCB), classified as "PCB free".

C. Construction Power Supply

C.1 The Contractor shall provide for his own the necessary installation and construction power needed in the performance and completion of the Contract.

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D. Field Testing and Commissioning

D.1 In accordance with EW-2.3, Technical Specifications, the following tests shall be performed:

		Contractor
a.	Insulation resistance test on each winding to ground and between windings	to be performed
b.	Power factor test on each winding to ground and between windings	N/A
c.	Winding ratio test on each and all taps	N/A
d.	Winding resistance test on all windings	N/A
e.	Operation of oil and hot-spot temperature indicating and control devices shall be verified	to be performed
f.	Dielectric strength, power factor, interfacial tension water content, gas content, neutralization number and condition of the oil shall be checked in accordance with IEEE 64, Section 3 (Table 4).	to be performed
g.	Oxygen and total-combustible-gas content of nitrogen gas cushion shall be checked.	to be performed
h.	Operation of auxiliary equipment such as oil-circulating pumps, fans, and oil or water flow meters shall be verified	to be performed
i.	Operation of load-tap-changer shall be verified for all positions	to be performed
j.	The dielectric strength of the oil shall be tested while still in the tankers or delivery containers in accordance with IEEE 64, Section 3 (Table 2)	to be performed
k.	Oil quality check (DGA, resistivity)	to be performed

D.2 NPC shall not provide the services of a competent field service technician or engineer at the job site to extend assistance in the field testing and commissioning of the transformer.

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E. Loading, Hauling and Unloading

E.1 Crates with sizes and weights indicated below shall be loaded by Contractor from **Mobo Substation** to his hauling **equipment** and then haul **(by land and/or sea)** from **Mobo SS** to **Masbate SS (project site)**. The crates shall be unloaded by Contractor at project site and provide temporary storage before installation.

E.2 Various sizes and weights of crates to be loaded, hauled and unloaded:

	NPC Data			Contractor's Data
	Dimension (cm)	Gross Weight (kgs)	Value of Equipment for Insurance Purposes	
a. 10MVA Transformer	N/A	34,500	₱ 10,000,000	

E.3 Below are information with regards to the Transformer equipment hauling activity to be performed by the Contractor:

	NPC Data
a. Location of NPC Switchyard where equipment is in storage.	Mobo Substation, Masbate
b. Suggested hauling route to be taken by Contractor for hauling work.	Masbate Substation, Masbate
c. Approximate distance between: Mobo to Masbate Substation.	13km approx.

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F. Tools and Appliances

F.1 Where special tools are needed in the installation or assembling specialized parts and accessories of the power transformer, such special tools shall be lent by the NPC to the Contractor. Below are the major tools and appliances to be provided by the Contractor for use in the installation of the power transformer, but are not limited to the following:

	To be Lent by NPC	To be Provided by Contractor
a. Manually operated jacks of ample capacity for lifting the transformer in place or position steel rollers during installation at job site, set		one set of 4-units
b. Set of ordinary tools, wrenches and equipment necessary for assembling the transformer, set		one
c. Set of any special tools, wrenches and equipment necessary for assembling the transformer, set		one
d. Portable set of oil testing equipment for measuring dielectric strength of insulating oil complete with accessories, set		one
e. Vacuum oil purifying equipment to be used during oil filling of the transformer including acc., set		one
f. Set of slings necessary for lifting 105% of the transport weight of transformer, set		one

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G. Submittals

G.1 Contractor shall submit with his proposal, the following documents in addition to those required elsewhere in these Specifications:

	NPC Requirement	Contractor's Data
a. Detailed Installation Time Bar Schedule *	Yes	

* An integrated Installation Time Bar Schedule for all works proposed may be submitted.

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B 3.0 POWER CIRCUIT BREAKER

B.3.1 Application

	NPC Requirement	Contractor's Data
a. Breaker Application	Substation	
b. Frequency of operation, No./Year	75	

B.3.2 Other Circuit Breaker Electrical Characteristics

a. Rated Permissible Tripping Delay, sec	Manufacturer's Std.	
b. Minimum Dead Time to insure that closing time is not too short	By Contractor	

B.3.3 Other Circuit Breaker Physical Characteristics

a. Location (specify indoor, outdoor)	Outdoor	
b. Enclosures (specify single pole tank, three-pole tank)	By Contractor	
c. Number of Interrupting Modules/Pole	By Contractor	
d. Mounting on: (specify individual foundation, common foundation, frame)	By Contractor	
e. Phase Spacing between centerline of single phase tanks, mm	2000	
f. Phase Spacing between tops of bushings (if provided in common enclosures)	By Contractor	

B.3.4 Bushing Characteristics

a. Voltage class, kV	72.5	
b. Creepage length, mm	≥2247.5	
c. Maximum cantilever strength, kg	By Contractor	
d. Must be suitable for live line washing:	Yes	
e. Internal bushing insulation	SF6 gas	

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B.3.5 Operating Mechanism and Auxiliaries

		NPC Requirement	Contractor's Data
a.	Operating mechanism	Motor Spring Charged	
b.	Motor Operating mechanism voltage (AC, DC)	230 Vac, 1Ø, 60Hz	
c.	Closing coil voltage (AC, DC)	125 VDC	
d.	Tripping Mechanism		
	1. Number of trip coils (circuits) per pole	One	
e.	Tripping mechanism Voltage, Vdc	125 VDC	
f.	Number of additional convertible auxiliary contacts above those normally required for circuit breaker operation	10A, 10B all prewired to terminal block	
g.	For compressed gas or air blast circuit breakers, on decrease of gas pressure below minimum value of the circuit breaker		
	1. If closed, shall be PT - Prevented from Tripping TA - Trip Automatically	PT	
	2. If open, shall be PC - Prevented from Closing CA - Close Automatically	PC	

B.3.6 Miscellaneous Accessories

a.	Breaker Position Indicator (both mechanical & light)	Yes	
b.	Manual Closing Device	Yes	
c.	Operations Counter	Yes	
d.	Cable duct from the control cubicle down to cable trench	To be provided	
e.	Type and size of Ground terminal connectors to be furnished by the Contractor for the circuit breaker shall be suitable for (specify size of conductor)	$\geq$ 100 mm^2 insulated tin-annealed stranded Cu conductor PVC insulated	

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	NPC Requirement	Contractor's Data
f. Required no. of ground terminal connectors on the structure of the breaker:		
1. If mounted on individual structure	1	
2. If mounted on common structure	2	
B.3.7 Alarm Devices		
All alarm indicating devices shall have electrically independent contacts to be used on (volts dc) control system to open or close 0.1 amperes inductive circuit	DPDT	
	125 VDC	
B.3.8 Service and Maintenance		
a. Minimum permissible number of interruptions before any contact check or mechanical check with opening of gas compartment is necessary:		
1. at 100% short circuit rated current	20 for all types of breakers	
2. at rated continuous current	6000 for all types of breakers	
3. mechanically	3000 for all types of breakers	
b. Leakage rate of SF6 per year, %	< 1 for all types of breakers	
B.3.9 Test and Experience Requirements		
B.3.9.1 Test Requirements		
a. Is breaker design new or of previous design with substantial changes in design and/or rating (Yes, No)	By Contractor	
Note: If yes, certified design tests and reports are required	Yes	

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	NPC Requirement	Contractor's Data
b. Design test and reports required (Yes, No) [1]	Yes	
c. Certified test design reports of prototype or duplicate production type are acceptable (Yes, No) [7]	Yes	
d. Additional tests are required (Yes, No) If yes, see B.3.9.2	Yes	
e. Test reports of licenser instead of his own (Contractor) is (not acceptable, acceptable)	not acceptable	
f. Test frequency requirements	60 Hz	
g. Factory Acceptance (Routine) Tests to be performed on each type and voltage rating of the equipment	Yes	
h. Factory Routine Tests to be witnessed by NPC Representative	Yes	
i. Required no. of NPC personnel to witness Factory Acceptance Test (FAT).	3	

B.3.9.2 Additional Tests

If additional tests are required (see B.3.9.1.d), they shall be as follows:

Manufacturer's tests standards not within the specified tests of ANSI or IEC Standards.

B.3.9.3 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing the equipment of the same voltage rating or greater for not less than: years	10	
b. The manufacturer must have overseas (outside country of origin) supply record of Power Circuit Breakers of the same voltage rating or greater of not less than:	20 sets	

[1] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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	NPC Requirement	Contractor's Data
c. The reference power circuit breakers being offered (at least from three (3) different power utilities) should have been in the actual service and operating satisfactorily for not less than: years	3	

Note: Experience less than what is required will be ground for rejection of bid. Proof of satisfactory performance from at least three (3) different power utilities shall be submitted as compliance with the requirements and for NPC reference. Non-submission of the requirement shall also be considered as a disqualification of the bid being offered.

B.3.10 Auxiliary Power Supply

The items listed below shall be designed to receive the following auxiliary voltage source.

a. Space heaters for the control cubicle	230 VAC, 1-ϕ, 60 Hz	
b. Internal lights and convenience outlets	230 VAC, 1-ϕ, 60 Hz	
c. Motors	230 VAC, 1-ϕ, 60 Hz	
d. Controls	125 VDC, +10%, -15%	
e. Indicating lights for position indicator of operating mechanism	125 VDC, +10%, -15%	

B.3.11 Contractor's Field Service Representative

Contractor ___shall___ provide the services of a testing engineer at the job site.

B.3.12 Spares and Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for **Masbate Substation.**

a. Insulator stack or bushing insulator assembly for one breaker pole	1	
b. Set(s) of trip coils for the circuit breaker	2	

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	NPC Requirement	Contractor's Data
c. Set(s) of anti-condensation heaters for each breaker type	1	
d. Set(s) of motor for the operating mechanism of the breaker	1	

All spare parts shall be interchangeable with and identical in all respect to the original parts.

All breakers of the same rating and type and all its components shall be fully interchangeable.

B.3.13 Tools

In addition to those tools and devices recommended by the Contractor for the circuit breaker, the following tools and devices shall be supplied for **Masbate Substation.**

a. Set(s) of SF6 handling equipment composing of but not limited to the following: 1. SF6 gas filling device 2. SF6 gas recovery & drying device 3. SF6 testing set for leakage, humidity, O2 content and SO2 gas analysis 4. SF6 gas temp. measuring device 5. SF6 measuring device for SF6 density	1 set	

B.3.14 Other Technical Data to be Filled-in by Contractor

The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

	Contractor's Data
a. Control Circuit	
1. Closing voltage range, V	
2. Maximum closing current, A	
3. Tripping voltage range, V	
4. Maximum tripping current, A	

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	Contractor's Data
b. Breaker Operating Time (in ms) for Rated Control Voltage and Pressure	
1. Opening time from energization of trip coil to contact parting	
2. Arcing time	
3. Break time	
4. Close open time	
5. Closing time	
c. Gas Pressures	
1. Pressure at 20°C of interrupting medium	
2. Pressure at 20°C of insulating medium	
d. Gas System	
1. SF6 Gas shipment method in breaker or separate: (Yes, No)	
2. If Yes, no. of containers, each	
3. Weight per container, kg	
4. Gas per container, kg	
5. Total quantity of SF6 gas to be supplied with the original equipment, kg	
6. Total quantity of SF6 gas required per breaker, kg	
7. Guaranteed maximum SF6 gas leakage rate in kg/yr	
8. No. of gas monitoring systems included with the equipment	
9. In-service life of gaskets, years	
10. Storage shelf life of gaskets, years	
e. Maximum Foundation Loading during Operation	
1. For horizontal breakers, N	
2. For vertical breakers, N	
f. Motor Capacity	
1. Type	
2. Horsepower, hp	
3. Current, start/run	

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B.4.0 DISCONNECT/EARTHING SWITCH

B.4.1 Technical Characteristics and Requirements

	Contractor's Data
a. Manufacturers	
b. Type and Designation	
1. Disconnect Switch	
2. Earthing Switch	
c. Country of Origin	

B.4.2 Technical Features and Requirements

	NPC Requirement	Contractor's Data
a. Type	Outdoor	
b. Mounting height above top of foundation to terminal pad center line, mm	≥3750	
c. Phase spacing (centerline-to-centerline), mm	2000	
d. Frequency, Hz	60	

B.4.3 Disconnect/Earthing Switch Ratings

a. Nominal System Voltage, kV	69	
b. Rated voltage, kV	72.5	
c. Rated Insulation Level		
1. Power Frequency Withstand Voltage, kV rms	140	
2. Lightning Impulse Withstand Voltage, kV crest	325	
d. Rated continuous current at System Frequency, A rms	600	
e. Rated Short Time Withstand Current Capability, kA rms	20	
f. Rated duration of short circuit current, sec	3	
g. Rated Peak withstand current, kA	37	

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B.4.4 Disconnect/ Earthing Switch Physical Characteristics

	NPC Requirement	Contractor's Data
a. Pole construction	Three	
b. Type	Horizontal Double Column Break	
c. Earthing Switch		
1. Type	Vertical single break	
2. Current rating		
a) Rated short circuit current, kA	20	
b) Rated peak withstand current, kA	37	

B.4.5 Support Insulator Characteristics

a. Rated Maximum Voltage, kV	72.5	
b. Creepage length, mm	≥2247.5	
c. Type	Porcelain	

B.4.6 Operating Mechanism and Auxiliaries

a. Main Switch		
1. Type	Manual	
2. Mode of operation	Local & Manual	
3. Operating mechanism control voltage	125 VDC +10%, -15%	
b. Earthing Switch	Manual	
c. Number of additional convertible auxiliary switches above those normally required for disconnect/ earthing operation	8A, 8B	
d. Construction of operating control mechanism box	Stainless steel	

B.4.7 Miscellaneous Accessories

a. Key Interlocks	To be provided	
b. Position Indicator (both mechanical and light)	To be provided	
c. Manual Closing Device provided	To be provided	
d. Damping Device	To be provided	

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	NPC Requirement	Contractor's Data
e. Ground terminal connectors of disconnect switches to be provided shall be suitable for: (specify size/ ampacity/ no. of conductors to be used)	≥ 100 mm² tin-annealed stranded copper conductor, PVC insulated	

B.4.8 Tests and Experience Requirements

B.4.8.1 Test Requirements

a. Is disconnect/earthing switch design new or of previous design with substantial changes in design and/or rating (Yes, No)	By Contractor	
Note: If yes, certified design tests and reports are required	To be provided	
b. Design test and reports required [1]	Yes	
c. Certified test design reports of prototype or duplicate production type are acceptable [8]	Yes	
d. Test reports of licenser instead of his own (Contractor) is: (not acceptable, acceptable)	not acceptable	
e. Test frequency requirements	60 Hz	
f. Factory Routine Tests to be performed on each type and voltage rating of the equipment (Yes, No)	Yes	

B.4.8.2 Additional Tests

If additional tests are required, they shall be as follows:

Manufacturer's tests standards not within the specified tests of either ANSI or IEC standards

B.4.8.3 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing Disconnect/ Earthing Switches of the same voltage rating for not less than: years	10	

[1] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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	NPC Requirement	Contractor's Data
b. The reference disconnect switch being offered at least from three (3) different power utilities at tropical countries or countries having the same climatic conditions as that of the Phils. should have been in the actual service and operating satisfactorily for not less than: years	3	

Note: Experience less than what is required will be ground for rejection of equipment being offered. Non submission of the requirement shall also be considered as a ground for rejection of the equipment being offered.

B.4.9 Auxiliary Power Supply

The items listed below shall be designed to receive the following auxiliary power supply.

a.	Indicating lights	125 VDC, +10%, -15%	
b.	Space heaters	230 VAC, 1-ϕ, 60 Hz	
c.	Internal lights and convenience outlets	230 VAC, 1-ϕ, 60 Hz	

B.4.10 Spares and Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for disconnect/earthing switches for **Masbate Substation.**

a.	Units of insulator post column used for the disconnect switch proposed.	2	
b.	Each of the lamp fixtures and lamps used (green and red) for indication of the disconnect/ earthing switch	2 fixtures each and 10 lamps	
c.	Sets of main contact and blade for each type of disconnect switch proposed	1	

All spare parts shall be interchangeable with and identical in all respect to the original parts.

All disconnect/earthing switches of the same rating and type and its components shall be fully interchangeable.

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B.4.11 Other Technical Data to be Filled-in by Contractor

The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

	Contractor's Data
a. Making Current of auxiliary contacts, A	
1. Disconnect Switch	_____
2. Earthing Switch	_____
b. Breaking current of auxiliary contacts, A	_____
1. Disconnect Switch	_____
2. Earthing Switch	_____
c. Power consumption of operating valves, Watt	_____
1. Disconnect Switch	_____
2. Earthing Switch	_____
d. Power consumption of interlock valves or magnets	_____
1. Disconnect Switch	_____
2. Earthing Switch	_____
e. Making current of motor protective circuit breaker for disconnector	_____
f. Breaking current or motor protective circuit breaker for disconnector	_____

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B.5.0 MAIN CONTROL SWITCHBOARD

B.5.1 Technical Data for Switchboard

	Contractor's Data
Name of Manufacturers/Country of Origin:	
a. Main Control Switchboard	
b. Protective Relays	
c. Annunciation System	
d. Meters	
e. Terminal Blocks	
f. Space Heaters	

B.5.2 Technical Characteristics and Requirements

	NPC Requirement	Contractor's Data
a. Switchboard type	Dual	
b. Panel type	Mosaic	
c. Doors	Gasketed	
d. Protection class applied	IP 50	
e. Provided with the following associated accessories:		
1. Metering equip., i.e. watt-hour meters and recording meters		
a) Integrated in the main control board	Yes	
b) Cable Entrance		
1) DC control supplies	Bottom	
2) AC control supplies	Bottom	
3) External cables	Bottom	
4) Interconnection to communication equipment	Yes	
5) Interconnection to sequence-of-events recorder or data logging system	Yes	
6) Interconnection to supervisory system	Yes	

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	NPC Requirement	Contractor's Data
g. Instrument transformers characteristics for indicating and energy meters		
1. Secondary voltage if voltage transformers (with nominal system voltage /V3 and specified ratio), V	115/66.4 V_{L-G} with 69 kV $_{L-L}$ system voltage	
2. Secondary Current	1 A	

B.5.3 Test and Experience Requirements

B.5.3.1 Normal Tests

a. Design Test and Certified Test Reports of Control Switchboard components required *(Yes, No)* [1]	Yes	
b. Test reports of licenser instead of his own (Contractor's manufacturer) is : *(acceptable, not acceptable)*	not acceptable	
c. Additional tests are required *(Yes, No)*	Yes	
d. Test frequency requirements	60 Hz	
e. Factory routine tests to be performed on the main control switchboard (Yes, No)	Yes	
f. Factory Acceptance Tests (Routine) to be witnessed by NPC (Yes, No)	No	

B.5.3.2 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing the equipment of not more less than: Years	10	
b. The equipment offered should have been in the actual service for not less than: Years	3	

[1] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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B.5.4 Auxiliary Power Supply

The item listed below shall be designed to receive the following auxiliary voltage source.

		NPC Requirement	Contractor's Data
a.	Control and instrument switches, Vdc	125 VDC +10%, -15%	
b.	Annunciator system, Vdc	125 VDC +10%, -15%	
c.	Internal lights and convenience outlets, Vac	230 VAC, 1-ϕ, 60 Hz for lights 15 A, 230 V, 1-ϕ, 60 Hz for CO	
d.	Heaters, Vac	230 VAC, 1-ϕ, 60 Hz	
e.	Recorders	230 VAC, 1-ϕ, 60 Hz	
f.	Transducers (if required)	125 VDC, +10%, -10%	

B.5.5 Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for the main control switchboard for **Masbate Substation**

a.	Unit(s) of each type of control switch, breakers and knife switch of each type used	1	
b.	Unit(s) of each relay of each type used	2	
c.	Unit(s) of each type of digital panel meters used except KWH and KVARH meters	1	
d.	Pieces of annunciator module complete with the required lamps and flashers	1 set	
e.	Unit(s) of synchro-voltage check relay used	1	
f.	Pieces of mosaic tile used	20	

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B.5.6 Tools

In addition to those tools and devices recommended by the Contractor for the main control switchboard, the following tools and devices shall be supplied:

	NPC Requirement	Contractor's Data
a. Terminal press tool and screw drivers kit with tool box containing the following:		
1. Press tool for 2 mm^2 - 38 mm^2 conductors, manual operation type	1	
2. Stripper, remover of vinyl insulation of 1.5 mm^2 - 8 mm^2 conductors, spring return type	1	
3. Cable sheath remover, for cutting cable sheath in the sectional axial direction for cable *(PVC & XLPE)*, 3.5 mm^2 x 2C - 22 mm^2 x 2C	1	
4. Set of screw drivers of various sizes *(12 different)* suited for control board wiring terminals	1	
b. Home kit with tool box with the following content:		
1. Drill Chuck	1	
2. Set of pliers of various sizes	1	
3. Wool bonnet	2	
4. Electric drill capable of accepting 3.5 mm - 10 mm size of drill diameter, 1-ϕ, 220 Vac	1	
5. Spare drill		
a. 3.5 mm diameter	5 pcs.	
b. 5.0 mm diameter	5 pcs.	
c. 7.0 mm diameter	5 pcs.	
d. 10.0 mm diameter	5 pcs.	
6. Spare carbon brushes	10 pcs.	

Note: These items are included in the cost of the main control switchboard as mentioned in Section EW-5.3.7 of the Technical Specifications

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B.6.0 METALCLAD SWITCHGEAR

B.6.1 Other General Technical Data and Requirements for the Switchgear

	NPC Requirements	Contractor's Data
a. Control System		
1. Operation and indication of equipment	Remote / Local	
b. Connection of metalclad switchgear:		
1. Between power transformer and metalclad switchgear	Medium voltage cable	
2. Between station service transformer and metalclad switchgear	Medium Voltage cable	
c. Provided with the following associated equipment in the panel		
1. Fault annunciator system	Yes	
2. Metering equipment	Yes, as per one line diagram	
3. Protective relays	Yes, as per one line diagram	

B.6.2 Metalclad Switchgear Accessories *(Number required)*

a. Handle for manual charge on the spring powered stored energy mechanism	1 unit	
b. Removable crank or manual device to move the breaker from the "test" to the "service" position or vice-versa	1 unit	
c. Tests plugs for relay testing	1 set	
d. Control cable with plug type terminals for testing breakers in the test position	1 set	
e. Removable ground and test device for grounding and testing feeders	required	

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B.6.3 Circuit Breaker Technical Features and Ratings

		NPC Requirements	Contractor's Data
a.	Rated current, continuous, A	600 for main breakers, 600 for feeder breakers	
b.	Max. interrupting time, cycles	5	
c.	Max. closing time, sec	Manufacturer's Data	
d.	Type of Breaker	Vacuum Circuit Breaker (VCB)	
e.	Operating mechanism		
	1. Type	spring-charged motor operated	
	2. Mechanism voltage	125VDC	
f.	Closing and tripping circuits		
	1 No. of trip coil	1	
	2. Trip circuit voltage	125 VDC	
	3. Closing circuit voltage	125 VDC	
	4. Tripping circuit voltage range	90-140 VDC	
	5. Closing circuit voltage range	90-140 VDC	
g.	Inspection after:		
	1. No. of years	10 (min.)	
	2. No. of switching/operation	3000	
	3. No. of breaking operation	20	

B.6.4 Voltage Transformers Technical Features and Ratings

a.	Nominal voltage of VT, kV	13.8	
b.	Highest continuous operating voltage of VTs, kV	15	
c.	Rated voltage factor, continuous	1.2	
d.	Rated secondary voltage	$115\sqrt{3}$	
e.	Burden/Accuracy Class		
	1. Measuring	0.5	
	2. Protection	6P	
f.	Rated Output at 0.8 pf lagging	50VA	
g.	Accuracy class to be fully kept within the range:	80-120% of rated primary voltage	
h.	Type	cast resin	

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B.6.5 Current Transformers Technical Features and Ratings

		NPC Requirements	Contractor's Data
a.	Secondary rated current for all windings, A	1	
b.	No. of cores		
	1. Core No. 1	Metering	
	2. Core No. 2	Relaying	
	3. Core No. 3	Relaying	
c.	Maximum continuous service current factor	1.2	
d.	Burden/Accuracy class [1]		
	1. Metering	0.3 BO.9	
	2. Relaying	C200	
e.	CT Ratio	to be based on protection requirement	
f.	Type	cast resin	

B.6.6 Surge Arresters Technical Features and Ratings

a.	Type	Station	
b.	Nominal voltage of system, nominal, kV	13.8kV	
c.	Duty cycle voltage, kV rms	12	
d.	Arrester class	Station	
e.	Pressure relief class	Class 1	
f.	Max. continuous operating voltage *(MCOV)*, kV rms	10.2	
g.	Max. discharge voltage at indicated impulse current for 8/20 μs waveshape, kV crest	39.1	
h.	Front-of-wave protective level, kV crest	44	
i.	Rated discharge current, kA	10	
j.	Discharge Counter with Leakage current monitor	To be provided	

[1] *Accuracy class/Burden of Instrument Transformers are indicative/for bidding purposes only, required design rating shall be determined by the Contractor subject to NPC's approval.*

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B.6.7 Tests and Experience Requirements

B.6.7.1 Test Requirements

		NPC Requirements	Contractor's Data
a.	Is circuit breaker for the switchgear new or previous design with substantial changes in design and/or rating *(Yes, No)*	By Contractor	
b.	If Yes, Design Test and Certified Test Reports required *(Yes, No)* [2]	Yes	
c.	Certified test design reports of prototype or duplicate production type are acceptable *(Yes, No)*	Yes	
d.	Additional tests are required *(Yes, No)* If yes, see B.6.7.2	Yes	
e.	Test reports of licensee or instead of his own *(Contractor)* is:	not acceptable	
f.	Test frequency requirements	60 Hz	
g.	Factory Acceptance Tests *(Routine)* to be performed on the Metalclad Switchgear	Yes	
h.	Factory Acceptance Tests *(Routine)* to be witnessed by NPC	Yes	
i.	Required No. of NPC representative to witness Factory Acceptance Test	Three (3)	

B.6.7.2 Additional Tests

If additional tests are required (see B.6.7.1.d), they shall be as follows:

The additional Routine Tests mentioned in Clause 7, IEC 62271 -200 First Edition 2003-11 shall be performed for the metalclad switchgear.

B.6.7.3 Equipment and Manufacturer's Experience

a.	The manufacturer's should have been in the business of manufacturing the equipment of not more less than: Years	10	

[2] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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	NPC Requirements	Contractor's Data
b. The equipment offered should have been in the actual service for not less than: Years	3	
c. The manufacturer must have an overseas (outside country of origin) supply record of metalclad switchgear with same voltage rating or greater of not less than: units	20	

Note: Experience less than what is required will be ground for rejection of equipment being offered. Non submission of the requirement shall also be considered as a ground for rejection of the equipment being offered.

B.6.8 Auxiliary Power Supply

The items listed below shall be designed to receive the following auxiliary voltage source.

a.	Breaker Control and Alarm, VDC	125 VDC, +10%, -15%	
b.	Indicating lights for position indicator of operating mechanism of breaker	125 VDC, +10%, -15%	
c.	Motors	N/A	
d.	Internal Lights and Power Outlets, VAC	230VAC, 1-ϕ, 60 Hz	
e.	Switchgear Space Heaters, VAC	230VAC, 1-ϕ, 60 Hz	

B.6.9 Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for the Metalclad Switchgear for **Masbate Substation.**

a.	Set of each type and voltage rating of VT supplied complete with accessories	1 unit	
b.	Set of each type and voltage rating of CT supplied complete with accessories	1 unit	
c.	Surge arresters, 12 kV	1 unit	
d.	Set of contact assemblies for the pole of the circuit breakers	1	
e.	Pieces of trip coils used for the circuit breaker	1	

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	NPC Requirements	Contractor's Data
f. Pieces of closing coils used for the circuit breaker	1	
g. Unit(s) of each type of space heaters and thermostat equipment supplied complete with accessories	1	

All spare parts shall be interchangeable with and identical in all respect to the original parts.

All parts of the same rating and type and all its components shall be fully interchangeable.

B.6.10 Tools

No particular tools would be required for the supply of metalclad switchgear for NPC used. The Contractor shall be responsible for the metalclad switchgear to be properly installed and commissioned.

B.6.11 Other Technical Data to be Filled-in by Contractor

The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by Purchaser are the sole responsibility of the Contractor.

	Contractor's Data
a. Main Bus	
1. Size	
b. Vertical Bus	
1. Size	
c. Bus Supports: Describe	
d. Control Circuits Requirement for Circuit Breaker	
1. Max. trip current, A	
2. Max. close current, A	
3. Max. close inrush current, A	
4. Min. close voltage, VDC	
5 Min. trip voltage, VDC	
e. Operating Mechanism	
1. Max. spring charging time, sec.	

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Contractor's Data

f. Other Technical Data for the Switchgear
   1. Name of Manufacturer and Country of Origin
      a) Circuit Breaker _____
      b) Current Transformer _____
      c) Potential Transformer _____
      d) Surge Arrester _____
      e) Earthing Switch _____
      f) Isolator _____
      g) Medium Voltage Power Cable _____
      h) Protective Relays _____
      i) Terminal Blocks _____
      j) Space Heaters _____

g. Motor Capacity (for Circuit Breaker)
   1. Type _____
   2. Horsepower, Hp _____
   3. Current _____
   4. Voltage and phase _____

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B.7.0 SURGE ARRESTER

B.7.1 Technical Characteristics and Requirements

		Contractor's Data
a.	Manufacturer	
b.	Type and Designation	
c.	Country of Origin	

B.7.2 Technical Features and Requirements

		NPC Requirement	Contractor's Data
a.	Classification	Station	
b.	Type	Metal oxide gapless	
c.	Construction	either hollow or caged design	
d.	If hollow insulator, pressure relief device is required/included:	To be provided	
e.	Material of Insulator	Porcelain	
f.	Nominal system voltage, kV	69	
g.	Duty Cycle Voltage (Rating), kV rms	60	
h.	Maximum Continuous Operating Voltage (MCOV), for the arresters having the following duty cycle voltage, kV rms	48	
i.	Rated Frequency, Hz	60	
j.	Maximum Discharge Voltages for the following duty cycle voltage rating:		
	1. Residual voltage at lightning impulse current (8/20 μs waveshape), kV crest	Manufacturer's std.	
	2. Front-of wave Protective Level, *(1/2μs wave shape)*, kV crest	Manufacturer's std.	
k.	System Ground [Earth] (Solid, other)	Solid	
l.	Nominal discharge current, kA	10	
m.	Line Discharge Class	3	

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B.7.3 Surge Arrester Physical Characteristics

	NPC Requirement	Contractor's Data
a. Class	Outdoor	
b. Mounting	Pedestal [1]	
c. Supporting Structure	To be provided	

B.7.4 Post Insulator Characteristics

a. Max. Services (Line Voltage), kV rms	72.5	
b. Dielectric strength of insulator housing		
1. Power frequency withstand voltage, kV	140	
2. Lightning impulse withstand, kV	325	
c. Creepage Length, mm	≥2247.5	
d. Type of Insulator Housing	Porcelain	

B.7.5 Accessories

a. Leakage Current Monitor and Discharge Counter	To be provided	
b. Remote indication of discharge counter registers	To be provided	
c. No. of grounding pads and terminal connector(s) required for arrester supporting structure	Two	
d. Ground terminal connectors of arresters shall be suitable for:	≥ 100 mm^2 tin-annealed PVC insulated copper conductor	
e. Interconnecting insulated ground cable from the arrester to the discharge counter/ leakage current monitor down to the earth terminal	To be provided	
f. Interconnecting cable from the arrester to the discharge counter to the remote discharge counter monitors (approx. 300m)	To be provided	
g. Conduits from the discharge counter down to the cable trench	To be provided	

[1] *Except arresters which are components/accessories of the Power Transformer according to Section EW-2.3.5.2 of the Technical Specifications*

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B.7.6 Tests and Experience Requirements

B.7.6.1 Tests Requirements

	NPC Requirement	Contractor's Data
a. Is surge arrester design new or of previous design with substantial changes in design and/or rating *(Yes, No)*	By Contractor	
Note: If yes, certified design tests and reports are required	To be provided	
b. Design test and reports required *(Yes, No)* [2]	To be provided	
c. Certified test design reports of prototype or duplicate production type are acceptable *(Yes, No)* [13]	To be provided	
d. Additional tests are required *(Yes, No)*	To be provided	
e. Test frequency requirements	60Hz	
f. Factory Routine Tests	To be performed	

B.7.6.2 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing surge arresters of the same voltage rating for not less than: years	10	
b. The reference surge arresters being offered (at least from three (3) different power utilities) should have been in the actual service and operating satisfactorily for not less than: years	3	

B.7.7 Auxiliary Power Supply

a. Remote indication of discharge counter registers	125VDC	

[2] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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B.7.8 Spare and Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for the surge arrester of **Masbate Substation.**

	NPC Requirement	Contractor's Data
a. Unit(s) of arrester w/o the supporting structures	1 unit	
b. Unit(s) of discharge counter with leakage current monitor	2 units	
c. Remote indicator assembly for the discharge counter	N/A	

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B.8.0 INSTRUMENT TRANSFORMERS

B.8.1 Current Transformers (Protection and Revenue Meter)

B.8.1.1 Technical Characteristics and Requirements

		Contractor's Data
a.	Manufacturer	
b.	Type and Designation	
c.	Country of Origin	

B.8.1.2 Technical Features and Requirements

		NPC Requirements	Contractor's Data
a.	Application	Outdoor	
b.	Insulating Medium	Oil	
c.	Construction	Free standing	
d.	If free standing, specify type	By Contractor	

B.8.1.3.A Current Transformer Ratings (Protection)

a.	Nominal System Voltage, kV	69	
b.	Rated maximum voltage, kV rms	72.5	
c.	Rated frequency, Hz	60	
d.	Insulation level		
	1. Lightning Impulse Withstand Level, kV	325	
	2. Power frequency withstand voltage, one minute, primary winding, kV rms	140	
	3. Power frequency withstand voltage, one minute, secondary winding, kV rms	2	
e.	Rated primary current, A	600	
f.	Rated secondary current, A	1 A	
g.	No. of cores per free standing CT	4	
h.	Current ratio: Multi-Ratio (with secondary taps)		
	1. Core No. 1	600/500/400/300/ 200/100: 1A	

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		NPC Requirements	Contractor's Data
2.	Core No. 2	600/500/400/300/ 200/100: 1A	
3.	Core No. 3	600/500/400/300/ 200/100: 1A	
4.	Core No. 4	600/500/400/300/ 200/100: 1A	
i.	Core assignment		
1.	Core No. 1	Metering	
2.	Core No. 2	Relaying	
3.	Core No. 3	Relaying	
4.	Core No. 4	Relaying	
j.	Burden/Accuracy class (per ANSI Standard) [1]		
1.	Metering Core	0.3B2.0	
2.	Relaying Core	C400	
k.	Continuous Thermal Current Rating Factor	1.2	
l.	Short time current rating (per IEC)		
1.	Thermal, Ith, kA	22	
2.	Dynamic, Idyn, kA	55	

B.8.1.3.B Current Transformer Ratings (Revenue Meter)

a.	Nominal System Voltage, kV	69	
b.	Rated maximum voltage, kV rms	72.5	
c.	Rated frequency, Hz	60	
d.	Insulation level		
1.	Lightning Impulse Withstand Level, kV	325	
2.	Power frequency withstand voltage, one-minute, primary winding, kV rms	140	
3.	Power frequency withstand voltage, one-minute, secondary winding, kV rms	2	
e.	Rated primary current, A	600	
f.	Rated secondary current, A	1 A	
g.	No. of cores per free standing CT	2	
h.	Current ratio: Multi-Ratio (with secondary taps)		
1.	Core No. 1	600/500/400/300/ 200/100: 1A	

[1] *To be determined by the Contractor subject to NPC approval.*

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	NPC Requirements	Contractor's Data
2. Core No. 2	600/500/400/300/ 200/100: 1A	
i. Core assignment		
1. Core No. 1	Metering	
2. Core No. 2	Metering (Spare)	
j. Burden/Accuracy class (per ANSI Standard) [2]		
1. Metering Core	0.3B2.0	
k. Continuous Thermal Current Rating Factor	1.2	
l. Short time current rating (per IEC)		
1. Thermal, Ith, kA	22	
2. Dynamic, Idyn, kA	55	

B.8.1.4 Current Transformer Other Requirements

a. Standards used	By Contractor	
b. Mounting (if not BCT)	Pedestal	
c. Supporting structure	To be provided	
d. Height of terminal pad above top of foundation (including supporting structure), mm	3750 (min.)	

B.8.1.5 Post Insulator Characteristics

a. Max. Services (Line Voltage), kV rms	72.5	
b. Creepage length, mm	≥2247.5	

[2] *To be determined by the Contractor subject to NPC approval.*

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B.8.1.6 Current Transformer Auxiliaries and Miscellaneous Accessories

	NPC Requirements	Contractor's Data
a. Secondary terminal junction box with space heater	To be provided	
b. Interconnecting conduits and cables from each CT secondary terminal box to secondary terminal junction box	To be provided	
c. Mechanical Stresses: Primary terminal shall withstand the following static forces:		
- Horizontal and vertical force in most unfavorable condition, N	4000	
- Greatest static and dynamic forces, allowable, N	By Contractor	
d. Line terminal connector	To be provided	
e. Ground terminal connectors of current transformer shall be suitable for: (specify size of conductor)	≥100 mm^2 tin-annealed copper stranded conductor	
f. Required no. of earth terminals of structure if free standing type of CT's:	1	

B.8.1.7 Test and Test Report(s) Requirements

B.8.1.7.1 Test Requirements

a. Is current transformer design new or of previous design with substantial changes in design and/or rating *Note: If yes, certified design tests and reports are required*	By Contractor	
b. Design test and reports required (Yes, No) [3]	Yes	
c. Certified test design reports of prototype or duplicate production type are acceptable (Yes, No) [15]	Yes	

[3] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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	NPC Requirements	Contractor's Data
d. Test frequency requirements	60Hz	
e. Factory Acceptance Tests (Routine) to be witnessed by NPC	No	

B.8.1.7.12 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing current transformers of the same voltage rating or greater for not less than: years	10	
b. The reference current transformers being offered at least from three (3) different power utilities at tropical countries or countries having the same climatic conditions as that of the Phils. should have been in the actual service and operating satisfactorily for not less than: years	3	

Note: Experience less than what is required will be ground for rejection of equipment being offered.

B.8.1.8 Auxiliary Power Supply

a. Service voltage for space heaters on the common junction box and secondary terminal box, VAC	230 VAC, 1-ϕ, 2-wire, 60 Hz	

B.8.1.9 Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for the current transformer for **Masbate Substation.**

a. Unit(s) of 69 kV CT w/o the supporting structure	1	
b. Unit(s) of each type of secondary terminal junction box used	1	
c. Piece(s) of each type of terminal blocks used	2	
d. Piece(s) of each type of short-circuiting elements for terminals used	1	

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B.8.0 INSTRUMENT TRANSFORMERS

B.8.2 Voltage Transformers

B.8.2.1 Technical Characteristics and Requirements

		Contractor's Data
a.	Manufacturer	
b.	Type and Designation	
c.	Country of Origin	

B.8.2.2 Technical Features and Requirements

		NPC Requirements	Contractor's Data
a.	Application	Outdoor	
b.	Insulating Medium	Oil	
c.	Type	Inductive	
d.	Connection	phase to ground	

B.8.2.3 Voltage Transformer Ratings (Protection)

a.	Nominal Operating Voltage, kV	69	
b.	Rated maximum voltage, kV rms	72.5	
c.	Rated frequency, Hz	60	
d.	Rated Insulation Level		
	1. Power Frequency Withstand Voltage, kV rms	140	
	2. Impulse Lightning Withstand, kV crest	325	
e.	Accuracy Class [4]		
	1. Measuring (ANSI)	Class 0.3	
	2. Protection	3P	
f.	No. of secondary windings	2	
g.	Rated Secondary voltage	115/66.4 V L-G with 69kV L-L system voltage	
h.	Rated output at 0.8 pf lagging [16]	100 VA for all voltage level	
i.	Carrier Drain Coil		
	1. BIL	15 kV	

[4] *To be determined by the Contractor subject for NPC approval.*

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	NPC Requirements	Contractor's Data
2. Frequency insertion loss [damping] (specify frequency range), kHz	50 - 500	
3. Max. insertion loss	<1dB	
4. VT Transient Response	Less than 10% of crest residual voltage in 1 cycle	

B.8.2.3 Voltage Transformer Ratings (Revenue Meter)

a. Nominal Operating Voltage, kV	69	
b. Rated maximum voltage, kV rms	72.5	
c. Rated frequency, Hz	60	
d. Rated Insulation Level		
1. Power Frequency Withstand Voltage, kV rms	140	
2. Impulse Lightning Withstand, kV crest	325	
e. Accuracy Class [5]		
1. Measuring (ANSI)	Class 0.3	
f. No. of secondary windings	2	
g. Rated Secondary voltage	115/66.4 V L-G with 69kV L-L system voltage	
h. Rated output at 0.8 pf lagging [16]	100 VA for all voltage level	
i. Carrier Drain Coil		
1. BIL	15 kV	
2. Frequency insertion loss [damping] (specify frequency range), kHz	50 - 500	
3. Max. insertion loss	<1dB	
4. CVT Transient Response	Less than 10% of crest residual voltage in 1 cycle	

B.8.2.4 Voltage Transformer Other Requirements

a. Mounting	Pedestal	
b. Supporting structure	To be provided	
c. Height of terminal pad above top of pedestal, mm	3750 (min.)	
d. Line Terminal Connectors for the equipment	To be provided	
e. Ground Terminal Connectors	To be provided	

[5] *To be determined by the Contractor subject for NPC approval.*

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B.8.2.5 Support Insulator Characteristics

		NPC Requirements	Contractor's Data
a.	Max. services (Line Voltage), kV rms	72.5	
b.	Creepage length, mm	≥2247.5	
c.	Type of support insulator	Porcelain	

B.8.2.6 Voltage Transformer Auxiliaries and Miscellaneous Accessories

a.	Secondary terminal junction box	To be provided	
b.	Make (Material)	Stainless Steel	
c.	Interconnecting conduits and cables between terminal box of each VT and the secondary terminal junction box	To be provided	
d.	Power supply for auxiliaries (heater) requirement	230 VAC, 1-∅	
e.	Ground terminal connectors of voltage transformer shall be suitable for: *(specify size of conductor)*	≥ 100 mm² tin-annealed copper stranded insulated conductor	
f.	Conduits from secondary terminal junction box down to the cable trench	To be provided	
g.	Required no. of earth terminal of structure:	1	

B.8.2.6 Test and Experience Requirements

B.8.2.6.1 Normal Tests

a.	Is voltage transformer design new or of previous design with substantial changes in design and/or rating *(Yes, No)*	By Contractor	
	Note: If yes, certified design tests and reports are required	Yes	
b.	Design test and reports required [6]	Yes	
c.	Certified test design reports of prototype or duplicate production type are acceptable [17]	Yes	
d.	Test reports of licenser instead of his own (Contractor) is : *(not acceptable, acceptable)*	not acceptable	

[6] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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f.	Test frequency requirements	60 Hz	
g.	Factory Acceptance Routine Tests to be performed for the Voltage transformer	Yes	

B.8.2.6.2 Additional Tests

If additional tests are required they shall be as follows:

The tests mentioned in Clause 7.3 of IEC 60044-2 shall be performed for the voltage transformers.

B.8.2.6.3 Equipment and Manufacturer's Experience

		NPC Requirements	Contractor's Data
a.	The manufacturer should have been in the business of manufacturing voltage transformers of the same voltage rating or greater for not less than: years	10	
b.	The reference voltage transformers being offered at least from three (3) different power utilities at tropical countries or countries having the same climatic conditions as that of the Phils. should have been in the actual service and operating satisfactorily for not less than: years	3	

Note: Experience less than what is required will be ground for rejection of equipment being offered.

B.8.2.7 Auxiliary Power Supply

The item listed below shall be designed to receive the auxiliary voltage source indicated in the NPC requirement.

a.	Space heaters for the secondary terminal box, VAC	230 VAC, 1-ϕ, 2 wire, 60 Hz	

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B.8.2.8 Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for the voltage transformer for **Masbate Substation**.

a.	Unit(s) of 69 kV VT w/o supporting structures	1 unit	
b.	Unit(s) of each type of secondary terminal junction box used.	1 unit	
c.	Pieces of each type of terminal block used.	2 pcs.	
d.	Pieces of each type of miniature circuit breaker used for secondary terminal voltage	3 pcs.	

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B.9.0 POWER/CONTROL/INSTRUMENTATION CABLES

B.9.1 Technical Characteristics and Requirements

	Contractor's Data
a. Manufacturer	
1. 15 kV XLPE cable	
2. Power, Control and Instrumentation Cable	
b. Country of Origin	
1. 15 kV XLPE Cable	
2. Power, Control and Instrumentation Cable	

B.9.2 15 kV Power Cable

	NPC Requirements	Contractor's Data
a. No. of Conductors/Cable and Size [1]	By Contractor	
b. Conductor material	Annealed copper stranded wire	
c. Conductor shape	Circular	
d. Conductor cross-section, (mm^2) [2]	Manufacturer's data	
e. Maximum outside diameter, (mm) [19]	Manufacturer's data	
f. Maximum operating temperature, °C	90	
g. Provided with filler and binder tape	Yes	
h. Conductor screen		
1. Material	Strippable extruded	
2. Nominal thickness, (mm) [19]	Manufacturer's data	
3. Min. thickness, (mm) [19]	Manufacturer's data	
i. Insulation		
1. Material	Cross-linked polyethylene, XLPE	

[1] *Contractor to give full description of various number of conductor/cable, sizes and ampacities.*
[2] *Contractor to fill-up the required data.*

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	NPC Requirements	Contractor's Data
2. Nominal thickness, (mm) [3]	Manufacturer's data	
3. Min. thickness at any point, (mm) [20]	Manufacturer's data	
j. Insulation screen		
1. Material	Strippable extruded	
2. Nominal thickness, (mm) [20]	Manufacturer's data	
3. Min. thickness, (mm) [20]	Manufacturer's data	
k. Screen bedding		
1. Type and material	Extruded layer of black PVC compound	
2. Thickness, (mm) [20]	Manufacturer's standard	
l. Metallic screen		
1. Material	Annealed copper wires	
2. Total screen area, (mm^2) [20]	Manufacturer's data	
3. Numbers of wires/cables, pcs. [20]	Manufacturer's data	
m. Outer covering/jacket		
1. Material	Extruded black PE	
2. Density, (kg/dm^3)	0.92 – 0.93	
3. Nominal thickness, (mm) [20]	Manufacturer's data	
4. Min. thickness at any point, (mm) [20]	Manufacturer's data	
5. Termite protection required -Type/material of termite protection [20]	Yes Manufacturer's standard	
n. Duration at which cable can be sustained at maximum conductor temperature under emergency situation, (hours)	≥2	

[3] *Contractor to fill-up the required data.*

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B.9.3 600V Power Cable

		NPC Requirements	Contractor's Data
a.	No. of Conductors/Cable and Size [4]	By Contractor	
b.	Conductor material	Tin Annealed copper stranded wire	
c.	Conductor shape	Circular	
d.	Conductor cross-section, (mm^2) [5]	Manufacturer's data	
e.	Maximum outside diameter, (mm) [22]	Manufacturer's data	
f.	Type of insulation	PVC	
g.	Thickness of insulation [22]	Manufacturer's standard	
h.	Type of jacket (cable sheath)	PVC jacketed for all cables	
i.	Thickness of jacket (cable sheath) [22]	Manufacturer's standard	
j.	Maximum operating temperature, °C	90	

B.9.4 600V Control and Instrumentation Cable

a.	No. of Conductors/Cable and Size [21]	By Contractor	
b.	Conductor material	Tin Annealed copper stranded wire	
c.	Conductor shape	Circular	
d.	Conductor cross-section, (mm^2) [22]	Manufacturer's data	
e.	Maximum outside diameter, (mm) [22]	Manufacturer's data	
f.	Type of insulation	PVC	
g.	Thickness of insulation, not less than, (mm^2) [22]	Manufacturer's standard	
h.	Type of jacket	PVC jacketed for all cables	
i.	Thickness of jacket/outer sheath, not less than, (mm)	1.8 for all cables	
j.	Provided with filler and binder tape	Yes for all cables	

[4] *Contractor to give full description of various number of conductor/cable, sizes and ampacities.*
[5] *Contractor to fill-up the required data.*

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		NPC Requirements	Contractor's Data
k.	Maximum outside diameter, (mm^2) [24]	Manufacturer's data	
l.	Overall shield required	Yes	
m.	Type of shielding	Annealed copper tape with min. thickness of 0.5mm applied helically over the binder tape	
n.	Maximum operating temperature, °C	90	

B.9.5 600V Analog/Measuring (CT/PT) Cables

a.	No. of Conductors/Cable and Size [6]	4c x 6.0mm^2 for 5A 4c x 4.0mm^2 for 1A	
b.	Conductor material	Annealed copper stranded wire	
c.	Conductor shape	Circular (for all conductors)	
d.	Conductor cross-section, (mm^2) [7]	Manufacturer's data	
e.	Maximum outside diameter, (mm) [24]	Manufacturer's data	
f.	Type of insulation	PVC	
g.	Thickness of insulation, not less than, (mm^2) [24]	Manufacturer's standard	
h.	Type of jacket	PVC jacketed for all cables	
i.	Thickness of jacket/outer sheath, not less than, (mm)	1.8 for all cables	
j.	Provided with filler and binder tape	Yes for all cables	
k.	Maximum outside diameter, (mm^2) [24]	Manufacturer's data	
l.	Overall shield required	Yes	

[6] *Contractor to give full description of various number of conductor/cable, sizes and ampacities.*
[7] *Contractor to fill-up the required data.*

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	NPC Requirements	Contractor's Data
m. Type of shielding	Annealed copper tape with min. thickness of 0.5mm applied helically over the binder tape	
n. Maximum operating temperature, °C	90	

B.9.6 Test and Experience Requirements

B.9.6.1 Test Requirements

a. Design test in accordance with applicable standards and reports required *(Yes, No)*	Yes	
b. Certified Design Test Reports of previous tests conducted for same cables are acceptable: *(Yes, No)*	Yes	
c. Test frequency requirements	60 Hz	
d. Factory Acceptance Tests (Routine) to be witnessed by NPC	No	

B.9.6.2 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing power and control cables of not less than : Years	10	

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B.10.0 SUBSTATION STEEL STRUCTURES

B.10.1 Technical Characteristics and Requirements

	Contractor's Data
a. Manufacturer	
b. Country of Origin	

B.10.2 Technical Features and Requirements

	NPC Requirement	Contractor's Data
a. Structural grade of steel used for structural members *(grade ASTM A36, ASTM A572 high strength steel)*	By Contractor	
b. Design according to the design loads and conditions given by NPC *(Yes, No)*	Yes	
c. Provided with the following accessories:		
1. Conductor attachment	Yes	
2. Shield wire attachment	Yes	
3. Step Bolts	Yes	
4. Phase Indication Plates (both for incoming and outgoing lines and the outermost beam structure for both Bus A and Bus B)	Yes	
5. Lightning Rods complete with accessories and attachments	Yes	
6. Earthing points with ground terminal Connectors	Yes	
suitable for:	≥100 mm² insulated Stranded Copper Conductor	
7. Warning and Danger Signs (1-pc per tower structure)	Yes	
d. Wind loads		
1. On the vertical projection of the structural members and other flat surfaces, kg/m²		
a. Transverse	444	
b. 45° wind	314	

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	NPC Requirement	Contractor's Data
2. On vertical round surfaces *(conductors, ground wires, insulators, etc.)*, kg/m^2		
a. Transverse	167	
b. 45° wind	84	
e. Stub angle setting templates, 4 pieces per type per voltage rating	To be provided	

B.10.3 Tests and Experience Requirements

B.10.3.1 Test Requirements

a. Mechanical Test on the material used, required *(Yes, No)*	Yes, if mill certificates are not available	
b. Is mill certificate required	Yes, in lieu of mechanical test	
c. Galvanizing test, if other than ASTM	Yes	
d. Embrittlement tests required	Yes	

B.10.3.2 Materials and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing substation steel structures for not less than: years	10	

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B.11.0 INSTALLATION MATERIALS

B.11.1 Bus Conductors and Hardwares

B.11.1.1 Technical Characteristics and Requirements

	Contractor's Data
a. Manufacturers	
1. Conductors	_____
2. Conductor Hardwares and Materials	_____
3. Tubular Conductor	_____
b. Type and Designation [1]	
1. Conductors	_____
2. Conductor Hardwares and Materials	_____
3. Tubular Conductor	_____
c. Country of Origin	
1. Conductors	_____
2. Conductor Hardwares and Materials	_____
3. Tubular Conductor	_____

B.11.1.2 Stranded Conductor Requirements

	NPC Requirement	Contractor's Data
a. Type designation		
1. Bus section	Tubular Aluminum Alloy	
2. Bay section	Hard Aluminum alloy (HAL) or equivalent	
b. Code word		
1. Bus section	Manufacturer's standard	
2. Bay section	Manufacturer's standard	
c. Ampacity		
1. Bus section	1200	
2. Bay section	600	

[1] *Contractor to give description of each item used.*

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B.11.1.3 Tubular Bus Conductor

	NPC Requirement	Contractor's Data
a. Type designation	Manufacturer's standard	
b. Code word	Manufacturer's standard	
c. Alloy type	Aluminum Alloy type	
d. Pipe schedule	Manufacturer's standard	
e. Ampacity	1200	
f. Pipe diameter	Corresponding to 1200 A ampacity	

B.11.1.4 Conductor Hardwares

a. Bus Support Clamps type	bolted	
1. Expansion bus support clamps	To be provided	
b. Connectors:		
1. Type	Bolted for tubular connection, wedge pressure clamp for stranded conductor connection	
2. Angle and T-connectors type	Bolted for tubular connection, wedge pressure clamp for stranded conductor connection	
c. Couplers, specify type	Stud to cable	
d. Dead-end assembly	Compression dead end	

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B.11.1.5 Tests and Experience Requirements

B.11.1.5.1 Test Requirements

	NPC Requirement	Contractor's Data
a. Type test and/or design test reports required for the bus conductors and materials to be supplied *(Specify Yes or No)* [2]	Yes	

B.11.1.5.2 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing power conductors and hardwares for not less than: Years	10	

[2] *Supplier shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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B.11.0: INSTALLATION MATERIALS

B.11.2 Station Insulators

B.11.2.1 Technical Characteristics and Requirements

	Contractor's Data
a. Manufacturers	
1. Suspension Insulators	
2. Post type Insulators	
b. Type and Description	
1. Suspension Insulators	
2. Post type Insulators	
c. Country of Origin	
1. Suspension Insulators	
2. Post type Insulators	

B.11.2.2 Insulator Characteristics/Unit

	NPC Requirements	Contractor's Data
a. Material of shell		
1. Suspension	Porcelain	
2. Tension	Porcelain	
b. Class (specify ANSI or IEC class)		
1. Bay Section	ANSI Class 52-3	
c. Type (specify standard or fog type)	Standard	
d. Class of hardware (specify ball & socket or tongue and clevis)	ANSI ball & socket coupling, Type B	
e. Diameter of shell, mm	254	
f. Unit spacing, mm (tolerance)	146	
g. Leakage distance total/shielded, mm	292	
h. Flashover voltages per unit, kV		
1. Impulse critical 1.2 x 50 microsecond wave		
a. Positive, max	125 for all types & class of insulators	
b. Negative, max	130 for all types & class of insulators	

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	NPC Requirements	Contractor's Data
2. Low frequency 60 cycles		
a. Dry, rms	80	
b. Wet, rms	50	
i. Radio influence voltage		
1. Test voltage to ground, kV	10	
2. Max. RIV at 1000 kHz (standard atmospheric condition), microvolt	50	
j. Low frequency puncture voltage (if applicable), kV	110	
k. Strength ratings		
1. Combined M & E strength, lbs.	18,000	
2. Impact strength, lbs.-in	90	
3. Tension proof load, lbs.	9,000	
4. Time loading test, lbs.	12,000	
l. Protection against electrolytic corrosion	To be provided	

B.11.2.3 Design and Operating Conditions of Complete Insulator String for 69 kV System

a. Frequency, Hz	60	
b. Max. Services (Line Voltage), kV rms	72.5	
c. Rated Lightning impulse withstand level (BIL), kV	325	
d. Low Frequency Average Flashover		
1. Dry, kV rms		
a. Tension	485	
b. Suspension	435	
2. Wet, kV rms		
a. Tension	335	
b. Suspension	335	
e. Critical Lightning Impulse Flashover		
1. Positive / kV		
a. Tension	780	
b. Suspension	695	
2. Negative / kV		
a. Tension	760	
b. Suspension	670	

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	NPC Requirements	Contractor's Data
f. Number of units in string [3]		
1. Suspension	7	
2. Tension	8	
g. Number of Insulator String		
1. V – configuration	By Contractor	
2. Parallel configuration	By Contractor	
h. Use of grading shields	Yes	

B.11.2.4 Characteristics, Design and Operating Conditions of Complete Station Post Insulator Stacks

a. Frequency, Hz	60	
b. Max. Services (Line Voltage), kV rms	72.5	
c. Rated Lightning impulse withstand level (BIL), kV	350	
d. Low Frequency Wet Withstand, kV	145	
e. Critical Impulse Flashover, positive, kV	390	
f. RIV, Test voltage to ground, kV	44	
g. Max. RIV to 1000 kHz, microvolts	200	
h. Mechanical Properties		
1. Cantilever Strength, lb	3000	
2. Tensile Strength, lb	26,000	
3. Compression Strength, lb	60,000	
4. Torsional Strength, lb	40,000	
i. Leakage Distance Total shielded, mm	2247.5	
j. Max. Line to Ground Fault Current/Duration, kA/cycles	10/30	
k. Material	Porcelain	

B.11.2.5 Tests and Equipment's Experience Requirements

B.11.2.5.1 Normal Tests

a. Type test or design test reports required for the station insulators and materials to be supplied [5]	Yes	

[3] *Necessary counterweights shall be provided for all suspension/jumper insulator strings.*

[5] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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	NPC Requirement	Contractor's Data
b. Certified design test reports on the insulator identical to the specified insulator are acceptable	Yes	
c. Test Reports of licenser instead of his own (Manufacturer) is (acceptable, not acceptable)	Not acceptable	
d. Test frequency requirements	60 Hz	

B.11.2.5.2 Equipment and Manufacturer's Experience

a. The manufacturer's should have been in the business of manufacturing insulators for not less than: Years		
1. Porcelain Insulators	20	
b. The type of insulators being offered should have been in the actual service for not less than: Years		
1. Porcelain Insulators	20	

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B.12.0 GROUNDING SYSTEM

B.12.1 Technical Characteristics and Requirements

	Contractor's Data
a. Country of Origin	
1. Overhead ground wire	
2. Copper ground conductor	
3. Ground rods	
4. Shield wire accessories:	
a. Tension clamp	
b. Suspension clamp	
c. Parallel groove	
d. Lightning rods	
5. Grounding materials and accessories for Various type of connections	
b. Manufacturers	
1. Overhead ground wire	
2. Copper ground conductor	
3. Ground rods	
4. Shield wire accessories:	
a. Tension clamp	
b. Suspension clamp	
c. Parallel groove	
d. Lightning rods	
5. Grounding materials and accessories for Various type of connections	

B.12.2 Grounding Design Criteria

	NPC Requirement	Contractor's Data
a. Fault duration, sec	3	
b. Total fault level *(line to ground)*, kA	19	
c. Grounding connection *(Specify exothermic, compression, etc.)*	Exothermic for underground; Compression for exposed	
d. Grid conductor *(Specify size and type)*	≥100 mm^2 tin-annealed copper stranded conductor (bare)	

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		NPC Requirement	Contractor's Data
e.	Bonding Conductor (riser)	≥100mm² tin-annealed copper stranded conductor with 3.3 kV PVC insulation	
f.	Burial depth of grid conductor below finished grade, m.	0.60 (min.)	
h.	Ground mat design resistance	0.5 ohms max.	
i.	Permissible temperature rise of grid copper conductor, °C	300	
j.	Ground rod		
	1. Type	Copperclad	
	2. Diameter, mm	Not less than 19	
	3. Length/Section, mm	3000	
k.	Resistivity of crushed rock, (wet) Ohmmeter	3000	
l.	Soil resistivity (for calculation), ohmmeter	By Contractor [1]	

B.12.3 Overhead Ground Wire

a.	Type	7 No. 8 AWG aluminum clad steel wire	
b.	Ultimate strength, not less than, kg	7,277	
c.	Outside diameter, mm	Manufacturer's Standard	
e.	Weight of aluminum coating for aluminum-clad steel wire, if specified in item a., not less than, g/m²	963	
f.	No. of Wires	7	
g.	Nominal diameter of wire, mm	3.264	
h.	Cross-sectional area, mm	58.561	
i.	Approx. weight, kg/m	0.323	
j.	Modulus of elasticity in kg/m²	16,169 (final)	
k.	Coefficient of linear expansion, $x10^{-6}/^{0}C$	12.96	
l.	Elongation in 610 mm, not less than, %	By Contractor	
m.	Resistance at 20°C, max.	1.46267 Ω	

[1] *Design of grounding system is responsibility of Contractor including measurement of actual soil resistivity.*

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	NPC Requirement	Contractor's Data
n. Recommended length per reel, if specified, m	1,500	

B.12.4 Grounding Cable for Ground Mat

a. Nominal sectional area, mm^2	≥ 100 mm^2	
b. Construction of stranded conductor (no./dia. in mm)	19/2.68	
c. Outside diameter of cable, mm	13.4	
d. DC Resistance at 20°C ohms/km	0.1641	

B.12.5 Bonding Conductor (Riser)

a. Size, mm^2	≥ 100 mm^2	
b. Conductor, metal	≥ 100mm^2 tin-annealed copper stranded conductor with 3.3 kV PVC insulation	
c. Type of insulation	PVC	

B.12.6 Accessories for Overhead Ground Wire

B.12.6.1 Suspension Ground Wire Materials

a. Type	Wedge	
b. Applied conductor *(Specify type of conductor used)*	Aluminum-clad steel wire, 7 No. 8 AWG	
c. Ultimate breaking strength, kg	7,500	
d. Slip Strength, kg	not less than 2,500	

B.12.6.2 Tension Wire Ground Materials

A. Tension Clamp

a. Type of Clamp	Wedge Pressure Clamp	
b. Applied conductor *(Specify type of conductor used)*	Aluminum-clad steel wire, 7 No. 8 AWG	

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	NPC Requirement	Contractor's Data
c. Ultimate breaking strength, kg	Not less than 95% UTS of OHGW	
d. Slip Strength, kg	Not less than 90% UTS of OHGW	
B. Jumper Clamp		
a. Ultimate breaking strength, kg	1,500	
b. Slip Strength, kg	700	
c. Type	Wedge Pressure Clamp	

B.12.7 Test and Test Report(s) Requirements

a. Type test and/or design test reports required for the grounding conductor and materials to be supplied (Specify Yes or No) [2]	Yes	
b. Measurement of ground grid resistance after completion of grounding system to be measured before and after connection of the external ground wires of the transmission line to the substation ground system. *(Specify Yes or No)*	Yes	
c. Additional tests are required other than those specified in Section EW-12.5 of the Technical Specifications *(Yes, No)*	Yes	

[2] *Contractor shall place in the filled-in-data "submitted" or "will submit" as appropriate.*

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B.12.8 Tools

In addition to those tools and devices recommended by the Contractor for the grounding system the following tools and devices shall be supplied for **Masbate Substation**.

	NPC Requirement	Contractor's Data
a. Earthing Stick, separable type, with vinyl tube stick with 5 m length insulated copper conductor of 38 mm^2 bolt clamping type clamp, hung type head	2 pcs.	

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B.13.0 AC AND DC STATION AUXILIARY SWITCHBOARD

B.13.1 Technical Characteristics and Requirements

	Contractor's Data
Name of Manufacturers / Country of Origin	
a. 230VAC Station Auxiliary Switchboard	
b. 125VDC Station Auxiliary Switchboard	

B.13.2 Station Auxiliary Switchboard Panel Technical Features

	NPC Requirement	Contractor's Data
a. With gasketed doors		
1. Main Distribution board	required	
2. Outdoor Sub-distribution board	required	
b. Degree and Protective class applied		
1. Indoor	IP 50 (minimum)	
2. Outdoor	IP 55 (minimum)	
c. Cable entrance	bottom, both indoor & outdoor	
d. Access for maintenance and testing		
1. Main Distribution Board	front access only	
2. Sub-distribution Board	front access only	

B.13.3 230VAC Main and Sub-Distribution Board Technical Features

a. Rated voltage	230VAC, 3ϕ, 3-wire	
b. Construction:		
1. Main breaker	Compact circuit breaker withdrawable units	
2. Branch breaker	compact circuit breaker, modularized plug-in units	
3. Feeder breaker	compact circuit breaker, modularized fixed units	

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	NPC Requirement	Contractor's Data
c. Type		
1. Main breaker	compact with solid state trip unit and remote-control functions	
2. Branch breakers	compact with thermal-magnetic trip unit	
3. Feeder breakers	compact with thermal-magnetic trip unit	
d. Current Rating of Breakers		
1. Short circuit current *(rated ultimate breaking capacity)*, kA		
a) Main Breaker	By Contractor [1]	
b) Branch Breaker	By Contractor	
c) Feeder Breaker	By Contractor	
2. Time duration, sec.	1	
e. Voltage Rating of Breakers		
1. Rated Voltage, V	230 VAC	
2. Rated insulation voltage, V	600	
3. Impulse withstand voltage, kV	10	
f. Frequency, Hz	60	
g. Bus Rating		
1. Short circuit current, kA		
a) Main bus	10	
b) Sub-distribution bus	10	
h. Bus Material		
1. Main bus	copper	
2. Sub-distribution bus	copper	
i. Type of Bus connection		
1. Main bus	bolted	
2. Sub-distribution bus	bolted	
j. Automatic and/or Manual Source change over		
1. For main breaker	To be provided	

[1] *Contractor to provide design computation for NPC's review and approval.*

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	NPC Requirement	Contractor's Data
k. Transient Voltage Surge Suppression to be provided		
1. For main feeder	To be provided, only for the main breaker	
2. For branch feeder	Refer to One line Diagram for AC & DC system	
l. Other Features		
1. Remote opening and closing of the breakers	To be provided, only for the main breakers	
2. Remote indication for alarm and trip		
a) Main breaker	To be provided	
3. Provided with the following		
a) Fault indication		
1) Main breaker	Yes	
b) Load Monitoring and control	To be provided, for the main breaker	
c) Front face LED indicators	To be provided, only for main breaker	
4. Contacts (Alarm and Trip) for Sequence of Events Recorder		
a) Main Breaker	To be provided	
b) Branch Breaker	To be provided	

B.13.4 125 VDC Main and Sub-Distribution Board Technical Features

a. Rated Voltage, V	125 VDC, 2P	
b. Construction		
1. Main distribution board breakers	Compact circuit breaker withdrawable unit	
2. Sub-distribution board breakers	Compact circuit breaker plug-in unit	

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	NPC Requirement	Contractor's Data
c. Type		
1. Main distribution board breaker	compact with thermal-magnetic trip unit	
2. Sub-distribution board breakers	compact with thermal-magnetic trip unit	
d. Current rating of breakers		
1. Short circuit current rating, kA		
a) Main distribution board breakers	7.5	
b) Sub-distribution board breakers	7.5	
c) Time duration, s	1	
e. Voltage Rating of Breakers		
1. Rated voltage, V	125	
2. Rated insulation voltage, V	250	
3. Impulse withstand voltage, kV	1.2	
f. Bus Rating		
1. Short circuit current, kA		
a) Main distribution bus	7.5	
b) Sub-distribution bus	7.5	
g. Bus Material		
1. Main bus	copper	
2. Sub-distribution bus	copper	
h. Type of bus connection		
1. Main bus	bolted	
2. Sub-distribution bus	bolted	
i. Other Features		
1. Remote indication for Alarm and Trip		
a) For Main Distribution Board breakers	To be provided, only for Main Distribution Board Breakers	
2. Provided with the following options *(Yes, No)*		
a) Fault Indication	To be provided, only for main distribution board breakers	

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B.13.5 Transient Voltage Surge Suppressors Technical Features

		NPC Requirement	Contractor's Data
a.	Application		
	1. 230 VAC System	3-ϕ delta, 120/ 240 Vrms 3-wire + ground	
	2. 125 VDC System	125VDC, +10%, -15% 2-pole, 2-wire + ground	
b.	Maximum Operating Voltage		
	1. 230 VAC System	250 Vrms	
	2. 125 VDC System	250 VDC	
c.	Input Frequency, Hz	60	
d.	Peak Surge Current (8 x 20 us waveform, single impulse)		
	1. 230 VAC System	By Contractor	
	2. 125 VDC System	By Contractor	
e.	Energy, Joules		
	1. 230 VAC System	By Contractor	
	2. 125 VDC System	By Contractor	
f.	Response Time	≤ 1 nanosecond for all voltage system	
g.	Connection	Parallel connected suppressor	

B.13.6 Under/Over Voltage Relays Technical Characteristics

a.	Time delay setting	0 – 75 sec in step of 0.1s	
b.	Voltage setting	adjustable from 0.02 to 1.98 x rated voltage	
c.	Continuous voltage rating		
	1. 230 VAC System	2 x V rated voltage	
	2. 125 VDC System	2 x V rated voltage	

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	NPC Requirement	Contractor's Data
d. Current rating		
1. Tripping current		
a) Continuous	10 A	
b) Making	30 A	
2. Signalling contact		
a) Continuous	2 A	
b) Making	5 A	

B.13.6 Test and Experience Requirements

B.13.6.1 Test Requirements

a. Design and Routine Test and Certified Test Reports of Station Auxiliary Switchboard components required [2]	Yes	
b. Test reports of licenser instead of his own (Contractor's manufacturer) is:	not acceptable	
c. Test frequency requirements	60 Hz	
d. Factory Routine Test to be performed on the Auxiliary Switchboards	Yes	

B.13.6.2 Equipment and Manufacturer's Experience

a. The manufacturers should have been in the business of manufacturing the equipment of not more less than: Years	10	

Note: Experience less than what is required will be ground for rejection of equipment being offered.

[2] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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B.13.7 Auxiliary Power Supply

The items listed below shall be designed to receive the following auxiliary voltage source.

a.	Control and instrument switches, VDC	125 VDC +10%,-15%	
b.	Annunciator system, VDC	125 VDC +10%,-15%	
c.	Internal lights and convenience outlets, VAC	230 V, 10 A, 1-Φ, 60 Hz for lights; 230 V, 15 A, 1-Φ , 60 Hz for CO	
d.	Heaters, VAC	230 V, 1-Φ , 60 Hz	

B.13.8 Spare Parts

The following spares and spare parts aside from those Contractor's recommended spare parts shall be furnished for the AC & DC Auxiliary Switchboard for **Masbate Substation.**

a.	Unit(s) of each type of plug-in control module used	1	
b.	Unit(s) of each compact circuit breaker of each type used	2 each	
c.	Unit(s) of TVSS of each type used	2 each	

B.13.9 Tools

In addition to those tools and devices recommended by the Contractor for the circuit breaker, the following tools and devices shall be supplied for **Masbate Substation**

a.	Calibration test kit, with features and characteristics used to check operating points for the various protection functions provided with carrying case, test leads and probes including operating instruction book	N/A	
b.	Mini battery unit simplified test kit with carrying case, test leads and probes including operating instruction book	N/A	

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B.14.0 STORAGE BATTERIES

B.14.1 Technical Requirements

		Contractor's Data
a.	Manufacturer 1. 125VDC	
b.	Country of Origin 1. 125VDC	

B.14.2 Technical Features and Requirements

		NPC Requirements	Contractor's Data
a.	Nominal Voltage Rating of Battery System	125VDC	
b.	Number of cells per battery 1. 125 VDC	60	
c.	Cell Type	Lead Antimony	
d.	Plate type	pasted plate	
e.	Technology *(Vented, Sealed)*	Vented	
f.	End of duty cycle voltage or minimum voltage during duty cycle (volts per cell -VPC) 1. 125 VDC	105	
g.	Max. allowable voltage or equalizing voltage 1. 125 VDC	140	
h.	Equalizing charge voltage (VPC)	2.33	
i.	Max. float voltage, VPC	2.23 for Antimony alloy 2.25 for Calcium alloy	
j.	Normal float voltage, VPC	2.17 for Calcium alloy 2.15 for Antimony alloy	
k.	Open Circuit Voltage (Fully charged), VPC	2.05 for all types of lead-acid batteries	

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	NPC Requirements	Contractor's Data
l. Ampere Hour Capacity at 10-hour discharge rate to 1.75 volts per cell [1]		
1. 125 VDC	200AH	
m. Electrolyte specific gravity at 25°C	1.210	
n. Battery Room Parameters:		
1. Coldest temperature in battery room	20°C	
2. Hottest temperature in battery room	40°C	
3. Battery room design temperature	25°C	
4. Battery room relative humidity	95% non-condensing	
o. Insulated Cable Connections and Insulated Terminal Lugs	To be provided	
1. Connecting power cable: a) Size	By Contractor	
b) Number of cables per positive or negative pole	By Contractor	
2. Terminal lugs for power cable, to be provided (*Yes, No*)	To be provided	
3. Ground cable size for battery rack:	100 mm^2 insulated copper stranded conductor	
p. Battery to be used in a grounded dc system (*Yes, No*)	No	
q. No. of battery bank 1. 125 VDC	1	
r. External Vent Plug recombinator (Gas recombinator) 1. 125VDC	Required for each cell	

[1] *Contractor to submit design calculations.*

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B.14.3 Tests and Experience Requirements

B.14.3.1 Normal Tests

	NPC Requirements	Contractor's Data
a. Capacity tests shall be performed on the batteries in accordance with this specification *(Yes, No)*	Yes	
b. Test reports of Licenser instead of his own (manufacturer) is: *(not acceptable, acceptable)*	not acceptable	

B.14.3.2 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing the equipment for not less than: years	10	

B.14.4 Spares and Spare Parts

The following spares and spare parts shall be furnished for the batteries for **Masbate Substation.**

a. Complete battery cell	2 of each type	
b. Extra cable terminals	3 each for 125 VDC	
c. Extra inter cell connectors and cable	3 each for 125 VDC	
d. Pre-mixed spare electrolyte	N/A	
e. Extra distilled water, in 20 liters container	N/A	
f. A quantity of protective no-oxide grease for connections, in cans	1-can in liter size	

B.14.5 Tools

In addition to those tools and devices mentioned in Section EW-14.3.4 of the Technical Specifications, the following shall be provided for **Masbate Substation.**

a. Connector bolt wrenches	1	
b. Plastic funnels	N/A	

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		NPC Requirements	Contractor's Data
c.	Cell lifting device	2	
d.	Rod thermometer	N/A	
e.	Digital Voltmeter Tester	1	
f.	Maintenance Tool Box	1 set	
g.	Battery Conductance Tester	1 set	

B.14.6 Other Technical Data to be Filled-in by Contractor

The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

	Contractor's Data
a. Battery Type	
1. 125 VDC	
a) Lead Calcium (LC), Lead Antimony (LA), other	
b) Positive plate construction (plante, pasted plate, etc.)	
c) Number of positive plates per cell	
b. Recommended battery charger data:	
1. Floating voltage range	
a) 125 VDC	
2. Equalizing voltage range	
a) 125 VDC	
3. Current rating	
a) 125 VDC	
c. Heat released in BTU/hour during:	
1. discharge duty cycle	
a) 125 VDC	
2. float charge	
a) 125 VDC	
3. equalizing charge	
a) 125 VDC	

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	Contractor's Data
d. Max. amount of hydrogen gas that will be evolved per hour during battery equalizing charge at max. battery temperature (cubic feet H2/ cell x hour)	
1. 125 VDC	
e. H_2 evolution at float ft^3 H_2/cell x hour	
f. Service life multiplier	
g. Battery rack	
1. Rack outline or Catalog no.	
2. Quantity of racks for the battery	
3. Description (seismic or other)	
h. Intercell connectors:	
1. Type	
a) 125 VDC	
2. Material	
a) 125 VDC	
i. Terminal lugs for NPC power cable:	
1. Manufacturer	
2. Type no.	
j. Terminal lugs for NPC's ground cable:	
1. Manufacturer	
2. Type no.	
k. Performance Data	
1. Float voltage (volts per cell-VPC) without equalizing	
a) 125 VDC	
2. Voltage (volts per cell-VPC) with equalizing	
a) 125 VDC	
3. Float voltage (volts per cell-VPC) with equalizing	
a) 125 VDC	
4. Recommended frequency of equalizing charge	
a) 125 VDC	
5. Recommended duration of equalizing charge	
a) 125 VDC	

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	Contractor's Data
6. Short-circuit current at short circuited (bolted) battery terminals at floating voltage:	
a) At 77°F	
1) 125 VDC	_____
b) At hottest battery room temperature	
1) 125 VDC	_____
7. Battery discharge characteristics (Contractor's reference curve number) [2]	_____
8. Guaranteed capacity to specified final voltage	
a) One minute, Ampere	_____
b) 30 minutes, Ampere	_____
c) 60 minutes, Ampere	_____
d) 120 mins., Amp-hour	_____
e) 4 hours, Amp-hour	_____
f) 5 hours, Amp-hour	_____
9. Specific gravity of electrolyte at 77°C	_____

[2] *Contractor to provide brief description.*

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B.15.0 BATTERY CHARGER

B.15.1 Technical Requirements

		Contractor's Data
a.	Manufacturer(s)	
b.	Type and Designation	
c.	Country of Origin	

B.15.2 Technical Features and Requirements

		NPC Requirement	Contractor's Data
a.	Construction	Industrial Type	
b.	Primary input power supply		
	1. Voltage	230 V	
	2. Frequency	60 Hz	
	3. Phase/Wire	3-phase/4 wire	
	4. System Grounding *(solid, high resistance, ungrounded)*	Solid	
	5. Available short-circuit current *(amperes rms sym.)* at rated voltage [1]	Manufacturer's Data	
	6. Steady state voltage variation	±10%	
	7. Frequency variation	±5%	
c.	Battery Charger Output Data		
	1. The Contractor shall be responsible for the detailed design of the battery charging system and for the determination of the battery charger ratings	Yes	
	2. Nominal Output Voltage		
	a) 125 VDC	125	
	3. Output Voltage Adjustment Range (minimum)		
	a) Float Voltage		
	1) 125 VDC	120-130	
	b) Equalizing Voltage		
	1) 125 VDC	130-140	

[1] *To be coordinated with AC and DC Station Auxiliary Switchboard.*

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	NPC Requirement	Contractor's Data
4. Float Voltage Regulation for 0-100%, ±10% line voltage variation and ±5% frequency variation	1% maximum	
5. Rated continuous current output at max. ambient temperature and site elevation		
a) at max. dc voltage		
1) 125 VDC	By Contractor	
b) at min. dc voltage		
1) 125 VDC	By Contractor	
c) at nominal dc voltage		
1) 125 VDC	By Contractor	
6. Battery Recharge Current	By Contractor	
7. Charger current limit, % of continuous output	150 to 250	
8. RMS Ripple, mV		
a) Without battery connected	per ANSI/IEC Std.	
b) With battery connected	100 mV (max.)	
9. Time required to completely recharge full discharged battery plus supply station loads, hrs.	10	
10. Min. efficiency by 50% load	80%	
11. Min. efficiency by 50-100% load	85%	
d. Battery Data		
1. Nominal battery voltage	125 VDC	
2. Number of cells		
a) 125 VDC	60	
3. Float Voltage (Volts/Cell), max.	2.23 for Antimony alloy and 2.25 for calcium alloy	
4. Charging Voltage (Volts/Cell)	2.30	
5. Boost Charging	2.65	
6. Equalize voltage (volts/cell)	2.33 max.	
7. Minimum Voltage (Volts/Cell)	1.75	
8. Cell Type	By Contractor	
9. Battery short-circuit current	By Contractor	
e. Maximum sound level, dB (A)	50	

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B.15.3 Other Technical Features

		NPC Requirement	Contractor's Data
a.	Equalizing Timer	To be provided	
b.	Equalizing Timer	Automatic with manual provision	
c.	Filtered output	To be provided	
d.	DC output operation	Ungrounded	
e.	With transient voltage surge suppression on the input side of the charger	To be provided [2]	
f.	Boost charge, charge failure, loss of AV input and ground fault indication shall be provided at the charger panel (except for 48Vdc)	Yes	
g.	Monitoring of Equipment parameters for Current, Voltage, Frequency, Power (Input, Output, Battery, etc...) through digital monitor on the front panel of the equipment	Yes	
h.	Monitoring of equipment through Active Mimic Display on the front panel of equipment	Yes	
i.	Provision with automatic recharging/charging facilities	Yes	
j.	Provision of temperature DC voltage compensation and Battery discharge test	Yes	
k.	Cable entry		
	1. AC Power input	Bottom	
	2. DC output	Bottom	
l.	Cable sizes, mm^2		
	1. AC supply		
	a) 125 VDC	By Contractor	
	2. DC output		
	a) 125 VDC	By Contractor	
m.	Size of grounding cable for connection to ground bus of charger	$\geq$100 mm^2 copper stranded conductor	

[2] *Refer to 125VDC System Requirements (One Line Diagram).*

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B.15.4 Tests and Experience Requirements

B.15.4.1 Normal Tests

	NPC Requirement	Contractor's Data
a. Is battery charger design new or of previous design with substantial changes in design and/or rating	By Contractor	
1. If new, design test and routine and reports required	Yes	
2. If previous design of same rating and voltage level, certified design reports of prototype or duplicate production type are acceptable	Yes	
b. Routine Tests to be performed on all chargers whether new or previous design	Yes	
c. Certified Routine Tests Reports to be submitted (Yes, No)	Yes	
d. Test reports of Licenser instead of his own (manufacturer) is:	not acceptable	
e. Test frequency requirement	60 Hz	

B.15.4.2 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing the equipment for not less than: years	10	
b. The type of equipment being offered should have been in the actual service for not less than: years	3	

B.15.5 Auxiliary Power Supply

The following auxiliary power shall be provided for the Battery Charger.

a. Power Supply, input	230 V, 3-Φ, 60 Hz	
b. Annunciator system, VDC	125 VDC	
c. Heaters, (if required)	230 V, 1-Φ, 60 Hz	

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B.15.6 Spares and Spare Parts

The following spares and spare parts aside from those Contractor's recommended spare parts shall be furnished for the battery charger for **Masbate Substation**:

		NPC Requirement	Contractor's Data
a.	Plug-in control module of each type used, sets	1 each for the 125VDC	
b.	Set of thyristors and silicon rectifiers of each type used	1 each for the 125VDC	
c.	Fans used, (if required), pcs.	N/A	

B.15.7 Other Technical Data to be Filled-in by Contractor

The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

	Contractor's Data
a. Battery Charger Input Data	
1. Input ac voltage, max/min, V	
2. Input ac current at rated output	
a) rated voltage, A	
b) at min. ac voltage, A	

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B.16.0 STATION SERVICE TRANSFORMER

B.16.1 Technical Characteristics and Requirements

		Contractor's Data
a.	Manufacturer	
b.	Type and Designation	
c.	Country of Origin	

B.16.2 Transformer Description

		NPC Requirement	Contractor's Data
a.	Number of phase	Three (3)	
b.	Insulation	Epoxy Cast Resin	
c.	Application	Station Service Transformer	
d.	Class (outdoor, indoor)	Outdoor	
e.	Percent overload, %	20	
f.	Continuous rated output at 65°C temp. rise, kVA	75	
g.	Type of overload capability (specify planned, long time, or short time emergency loading)	Short time	
h.	Required no. of hours for overload capacity, hrs	4	
i.	Type (specify 3-winding, 2-winding, auto-transformer	Two (2) winding	
j.	Winding connection:		
	1. H-winding	Delta	
	2. X-winding	Wye w/ neutral grounding	
k.	Insulation level:		
	1. Nominal system voltage, kVrms		
	a) H-winding	13.8	
	b) X-winding	0.23	
	c) Neutral winding	X_0, 0.23	

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	NPC Requirement	Contractor's Data
2. Maximum system voltage, kVrms		
a) H-winding	15	
b) X-winding	1.2	
c) Neutral winding	1.2	
3. Short-duration power frequency withstand voltage, kVrms		
a) H-winding	38	
b) X-winding	10	
c) Neutral winding	10	
4. Lightning impulse withstand voltage, kVcrest		
a) H-winding	95	
b) X-winding	30	
c) Neutral winding	30	

B.16.3 Winding Material

a. H-winding	copper	
b. X-winding	copper	

B.16.4 Capacity Ratings

The maximum simultaneous continuous loadings in windings without exceeding the temperature rise limitations, under each cooling condition, shall be as follows:

a. Winding	H & X	
b. kV		
1. H-winding	13.8	
2. X-winding	0.23	
c. kVA rating		
1. H-winding	75	
2. X-winding	75	
d. PF (leading, lagging)	0.8 lag.	
e. Type of cooling	AN	
f. Temperature rise, °C		
1. Winding	≥65	

B.16.5 Impedance

a. Short Circuit Impedance, %	4-6	

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B.16.6 Audible Sound Level

	NPC Requirement	Contractor's Data
a. The average audible sound level, dB (A) shall not be more than:	50	
b. With a load of: kVA	100%	

B.16.7 Ground Terminal Connection

a. Ground Terminal connectors of transformer shall be suitable for:	≥100 mm^2 tin annealed copper conductor	

B.16.8 Tolerances

a. Losses		
1. Total losses	Not more than 6% of manufacturer's specified value	
2. No-load or load losses	Not more than 10% of manufacturer's specified value	
b. Impedance (full capacity taps at rated current)	±10% of manufacturer's specified value	
c. No-load current	+30% of the obligatory no-load current	
d. Sound pressure level	without tolerance	

B.16.9 Tests and Experience Requirements

B.16.9.1 Test Requirements

a. Design and Routine tests reports required (Yes, No) [1]	Yes	
b. Certified test design reports of previous duplicate production type not older than three (3) years old are acceptable (Yes, No)	Yes	

Note: If Yes, no need to perform design test for item a.

[1] *Contractor shall place in the filled-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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	NPC Requirement	Contractor's Data
c. Test reports of licenser instead of his own (Contractor) is:	not acceptable	
d. Test frequency requirements	60 Hz	
e. Factory Routine Tests to be performed (Yes, No)	Yes	

B.16.9.2 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing the equipment of the same voltage rating for not less than: years	10	
b. The type of equipment being offered should have been in the actual service for not less than: years	3	

B.16.10 Other Technical Data to be Filled-in by Contractor

The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

	Contractor's Data
a. Transformer Guaranteed Losses	
1. No-load losses, kW	
2. Load losses, kW	
3. Total losses, kW	
b. Winding Construction	(layer, disc, etc.)
c. Core Construction	(core, shell)
d. Estimated Natural resonant freq. of the transformer, Hz	

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B.17.0 CONDUITS & CABLE TRAY SYSTEMS

B.17.1 Technical Requirements

		Contractor's Data
a.	Name of Manufacturer	
b.	Country of Origin	

B.17.2 Technical Characteristics and Requirements

		NPC Requirements	Contractor's Data
a.	Provided with the following accessories:		
	1. Cable Tray		
	a) Supports with anchor bolts	Yes	
	b) Ground terminal & connector	Yes	
	c) Cable tray markings	Yes	
	2. Conduits		
	a) Junction boxes	Yes	
	b) Pull boxes, if required	Yes	
	c) Couplings, fittings, etc.	Yes	
	d) Conduits, tags & markings	Yes	
b.	Material		
	1. Cable Tray	Galvanized Steel	
	2. Conduits	uPVC/RSC	

B.17.3 Test and Experience Requirements

B.17.3.1 Test Requirements

a.	Mechanical Test on the material used required	Yes, if mill certificates are not available	
b.	Mill Certificate required	Yes, in lieu of mechanical test	
c.	Galvanizing test, if other than ASTM	Yes	
d.	Embrittlement test required	Yes	

B.17.3.2 Equipment and Manufacturer's Experience

a.	The manufacturer should have been in the business of manufacturing the conduits and cable trays for not less than: Years	5	

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B.18.0 LIGHTING SYSTEM

B.18.1 Technical Features and Requirements

	Contractor's Data
a. Name of Manufacturer	
b. Country of Origin	

B.18.2 Technical Characteristics and Requirements

	NPC Requirements	Contractor's Data
a. Contamination and Aging Factor		
1. Indoor	1.25	
2. Outdoor	1.67	
b. Illumination Level Requirement, lux		
1. Control Room	400	
2. Relay Room	300	
3. AC/DC Room	200	
4. Battery Room	200	
5. Hallway, Corridor, Foyer	50	
6. Pump House	100	
7. Roads	50	
8. Transformer, Reactor Area	30	
9. Substation Yard	30	
10. Guardhouse	100	
11. Office	500	
12. Toilet/Utility Rooms	100	

B.18.3 Lamp Characteristics & Requirement for Various Rooms/Areas

a. Indoor (Control Building)		
1. Control Room	Combination of low energy LED luminaries on a louver type of fixtures and pin light with compact low energy fluorescent luminaire. Fixtures are recessed type with mirror finished aluminum reflector.	

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	NPC Requirements	Contractor's Data
2. Station Auxiliary Room	Indoor lighting fixture recessed type with mirror finished aluminum reflector and decorative opal or prismatic panel suitable for LED luminaire	
3. Relay Room	Recessed ceiling mounted lighting fixture complete with LED luminaire, mirror finished aluminum reflector with silver square louvres of metallized styrene finished	
4. Service Balcony, Foyer, Lobby, Porch, Toilets, Utility Room and Hallway	Decorative down light or pin light particularly in Foyer and Lobby made of cold roll galvanized steel housing with aluminized highly specular polycarbonate reflector with perfectly integrated white bezel ring	
5. Battery Room, Cable Gallery, Electrical Room	Explosion proof lighting fixture w/ acid resistant casing suitable for 36" LED fixture.	
6. Façade Lighting	By Contractor	
b. Maintenance Bay/Warehouse	Highbay lighting fixture, heavy duty die-cast aluminum ballast housing with electrocoat gray paint finish suitable for metal halide lamps	

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	NPC Requirements	Contractor's Data
c. Administrative Building		
1. Engineering/Technical Room, Administrative Room, Mgr. Office, Disbursing Office	General purpose luminaire made of white-coated, stove enameled sheet steel, recessed type complete with LED luminaire, mirror finished aluminum reflector with prismatic diffuser made of quality polymerized material	
2. Hallway, Eaves, Utility Room, Toilets	Decorative down light or pin light particularly in Foyer and Lobby made of cold roll galvanized steel housing with aluminized highly specular polycarbonate reflector with perfectly integrated white bezel ring	
3. Façade Lighting	By Contractor	
d. Outdoor		
1. Perimeter lighting	LED lamp	
2. Street lighting fixture	LED lamp	
3. Substation Yard lighting	LED lamp	
4. Flood lighting (Transformer/Reactor Area, Open Stockyard)	LED lamp	
5. Decorative landscape lighting fixtures	Contractor's Data	

B.18.4 Lighting Fixtures Auxiliaries and Miscellaneous Accessories

a. Interconnecting conduits and cables between fixtures and panel boards	To be provided [1]	
b. Junction boxes and pull boxes	To be provided	
c. Lighting poles	To be provided	
d. Ground terminal and connector	To be provided	

[1] *Contractor to provide detailed calculation of sizes of conduits and cables.*

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B.18.5 Other Requirements

	NPC Requirements	Contractor's Data
a. Power Outlets		
1. For outdoor area		
a) Type	Weather proof, corrosion proof with stainless steel metal cover	
b) Requirement [2]	1 per bay 1 per X'former bank	
c) Voltage rating	230V, 1Φ, 60 Hz	
d) Interconnecting conduits and cables between outlets and distribution board	To be provided	

B.18.6 Test Requirements

a. Functional tests of all components of lighting system	Yes	
b. Wiring continuity tests	Yes	
c. Galvanizing tests on the lighting poles	Yes	

B.18.7 Spares and Spare Parts

One (1) lighting luminaire (lamp) of each type installed shall be supplied as spare for every five (5) units of each type of lighting luminaires/lamps furnished and installed at **Masbate Substation.**

[2] *There shall be one (1) 230 Vac power outlet per location.*

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B.19.0 LINE PROTECTION SYSTEM

B.19.1 Other Line Parameters

	NPC Requirement	Contractor's Data
a. Line distances, km		
1. Masbate S/S – Mobo S/S	≈13 km	
2. Masbate S/S – San Juan S/S	≈33 km	
3. Masbate S/S – Aroroy S/S	≈34 km	
b. Type of circuit		
1. Masbate S/S – Mobo S/S	Single Circuit Steel Pole	
2. Masbate S/S – San Juan S/S	Single Circuit Steel Pole	
3. Masbate S/S – Aroroy S/S	Single Circuit Steel Pole	
c. Phase conductors		
1. Conductor Type	336.4 MCM	
2. Code Name	Linnet	
3. Material	Aluminum	
4. Calculated total area, mm^2	263.31	
5. Conductor outer diameter, mm	19	
6. Core Material	Aluminum Clad Steel	
7. Conductor outer diameter, mm	By Contractor	
d. Shield conductor		
1. Conductor specification	7/6 AWG	
2. Material	Aluminum Clad Steel Wire	
3. Size, nominal mm	12.34	
4. DC Resistance per km, ohms	0.9197	

B.19.2 Cubicle Details of Line Protective Relay

a. Cubicle type *(specify dual, duplex, Enclosed swinging rack, open, etc.)*	enclosed swinging rack	
b. Panel type *(specify mosaic, sheet steel)*	sheet steel	
c. Doors	Gasketed	
d. Degree and protective class applied	Yes, IP 50 (min.)	
e. Cable entrance	Bottom	
f. Access for maintenance and testing	Front access	

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B.19.3 Other Protective Line Relay Technical Features and Characteristics

	NPC Requirement	Contractor's Data
a. Mounting	19" rack with panel enclosure	
b. Application		
1. Main 1 and Back-Up shall have		
a) Different operating principle	Yes	
c. Make		
1. Main and Back-Up with different operating principles and measuring technique	Yes	
d. Main and Back-Up systems output alarms and indications shall have provisions for connection to:		
1. Sequence-of-events recorder	Yes	
2. Microprocessor Based Substation Control (MBSC)	Yes	
e. Main and Back-Up to be provided with serial communication port [1]	Yes	
f. Configuration Editor and Maintenance Software for Main and Back-Up relays to be provided	Yes	
g. Operating frequency range, Hz	60 Hz	
h. Power supply, VDC	125; +10%,-15%	
i. For Main distance relay used:		
1. Provided with the following associated relays and functions *(Yes, No)*		
a) Directional earth fault	Yes	
b) Synchronism check/voltage check relays	Yes	
c) Overcurrent relay	Yes	
d) Line terminal under/overvoltage protection	Yes	
e) CT column short-zone fault protection	Yes	
f) Fault locator	Yes	
g) Event recording	Yes	
h) Disturbance recorder	Yes	

[1] *This will be used for communicating either locally or remotely with a PC for data retrieval, reconfiguration of settings and maintenance of relay. A separate port shall be provided for connection to future MBSC.*

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	NPC Requirement	Contractor's Data
i) Broken conductor check	Yes	
j) Lock-out relay	Yes	
j. For Directional Over Current Relays:		
1. Provided with the following associated relays:		
a) Overcurrent relay	Yes	
b) Directional Earth Fault relay	Yes	
c) Line Terminal Under/Overvoltage Protection	Yes	
d) Fault Locator	Yes	
e) Event Recording	Yes	
f) Disturbance Recorder	Yes	
g) Distance Protection Function	Yes	
h) Metering function	Yes	

B.19.4 Basic Requirements and Operating Parameters for Distance Relay

a. Distance Relay Reactive reach for all types of faults, ohms/phase		
1. Zone 1	0.2-10	
2. Zone 2 (Pilot)	0.4-20	
3. Zone 3 (Reverse)	1.0- 50	
b. Distance schemes of measuring zones *(specify non-switched, switched)*		
1. Zone 1, Phase and Ground	non-switched	
2. Zone 2, Phase and Ground	non-switched	
3. Zone 3, Phase and Ground	non-switched	
c. Timer setting of measuring zones		
1. Zone 1	Instantaneous	
2. Zone 2 (Pilot) & 3 (Reverse)	shall preferably have time delayed tripping with timer settings of 0.1-5.0 s	

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	NPC Requirement	Contractor's Data
d. Ratio of Zone 1G/Zone 1 Ph can be set differently from that of Zone 2G/ Zone 2Ph and Zone 3G/ Zone 3Ph *(Yes, No)*	Yes (preferred)	
e. Operating Time including tripping relay contact, ms		
1. Typical		
Ph-G fault	<30	
Multi-phase fault	<25	
2. Maximum at 80% set reach with severe CVT transients and SIR=10		
Ph-G fault	<50	
Multi-phase fault	<40	
f. Reset Time, ms		
1. Without breaker trip	<30	
2. With breaker trip	<50	
g. Residual compensation and zero sequence compensation factor setting		
1. KN range, steps	0-2 in steps of 0.1 or less	
2. K0 range, steps	0-7 in steps of 0.2 or less	
h. Line impedance angle setting ranges	30° - 80° in steps of 0.1°	
i. Resistive reach or R/X ratio when blinders used	1-20 ohms/phase	
j. Measurement accuracy, %	±5	
k. Dynamic overreach, %	<5	
l. Reset ratio, %	105% of setting for all zones	

B.19.5 Other Features of the Distance Relay

a. Teleprotection Scheme		
1. PUTT	Yes	
2. POTT	Yes	
b. Other Required Features *(Yes, No)*		
1. Self-checking and monitoring features		
a) Self-test of components and measuring elements	Yes	

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	NPC Requirement	Contractor's Data
b) Continuous monitoring of abnormal conditions of measuring elements and other vital components	Yes	
c) VT circuit monitoring	Yes	
d) CT circuit monitoring	Yes	
e) Trip circuit supervision	Yes	
f) DC supply monitoring	Yes	
2. Current reversal blocking	Yes	
3. Power swing blocking	Yes	
4. Phase selector logic	Yes	
5. Single-pole and three-pole tripping	Yes	
6. Parallel line compensation	Yes	
c. Other Information		
1. Polarizing methods used	voltage memory ckts./ cross polarization	
2. Characteristics description		
a) Ground measurements	polygonal or variable mho	
b) Phase measurements	Polygonal or mho	

B.19.6 Basic Requirements and Operating Parameters for Directional Over Current Relay

a. Dual differential slope characteristic, low level & high level *(Yes, No)*	Yes	
b. Current setting range		
1. Low level	0.2 to 10 In in 0.05 steps	
2. High level	1 to 30 In in 0.05 steps	
c. Operating Time		
1. Minimum	25ms	
2. Maximum	35ms	

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B.19.7 Basic Requirements for the Associated Relays

B.19.7.1 Directional Earth fault Protection (DEF)

		NPC Requirement	Contractor's Data
a.	Part of Main or Back Up	Yes, both Distance and Directional Over Current I Relay	
b.	Method of Polarizing (directional decision)	• Negative sequence - preferred • Zero sequence voltage - optional	
c.	Teleprotection scheme mode of operation	Permissive Overreach Transfer Trip	
d.	Current reversal blocking	To be provided	
e.	Teleprotection signal of DEF, separate or common from distance relay	Separate	
f.	Sensitivity V and I		
	1. Forward element	I: 5%-20% x I_n V: 0.5% -5% x V_o	
	2. Reverse element	50% of the setting for forward element	
g.	Maximum sensitivity angle	Approx. 75°	
h.	Tripping time delay, adjustable, ms	50-150	
i.	Blocking input included *(Yes, No)*	Yes	
j.	Stabilized against magnetizing inrush *(Yes, No)*	Yes	
k.	Residual overcurrent relay operating parameters		
	1. Current relay setting ranges		
	a) Instantaneous (optional)	2 – 20 x In	
	b) Time delayed	0.1 - 2 x In	
	2. Reset ratio	95% or better	

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	NPC Requirement	Contractor's Data
l. Provided with the following features and logic functions *(Yes, No)*		
1. Self-checking and continuous monitoring features	Yes	
2. Switch-onto-fault	Yes	
3. Current reversal	Yes	
4. Weak end infeed echo	Yes	
B.19.7.2 Switch – onto – Fault Protection		
a. Part of Main or Back-up	Main	
b. Starting Method Used *(Yes, No)*		
1. CB close contact	Yes	
2. Line voltage and current	Yes	
B.19.7.3 Synchro and Voltage Check Relay		
a. No. of breakers controlled per module	One	
b. Possible selection of synchro-check function only or voltage check function only or both.	both	
c. Synchro-check settings		
1. Live conditions	>45°of Un	
2. Difference in voltage magnitudes	20% of Ur in step of 5%	
3. Difference in phase angles	5° - 75° in step of 5p	
4. Difference in frequency	<200mHz	
d. Voltage-check function		
1. Live-bus/dead-line check	Yes	
2. Live-line/dead-bus check	Yes	
3. Dead condition	Yes	
4. Live condition	Yes	
B.19.7.4 Fault Locator		
a. Construction	Built-in function of the relay	
b. Visual information to be provided by means of		
1. LCD *(Yes, No)*	Yes	
2. Print-out on a built-in printer *(Yes, No)*	Yes	

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		NPC Requirement	Contractor's Data
c.	Accuracy	± 2% of line length	
d.	Fault locator setting range, ohms	0 – 1500 Ω/phase for In = 1 A	
e.	With parallel line compensation	Yes	
f.	With load currents compensation	Yes	

B.19.8 Test and Experience Requirements

B.19.8.1 Normal Tests

a.	Design Test and Reports Required for each of the Relay component [2]	Yes	
b.	Certified test design reports of previous or duplicate production type are acceptable [42]	Yes	
c.	Additional tests are required, If yes, see B.19.8.2	Yes	
d.	Test frequency requirements	60 Hz	
e	Factory Routine/Acceptance Tests to be performed on the relays	Yes	
f.	Factory acceptance tests to be witnessed by NPC at relay manufacturer's country	Yes	
g.	Required no. of personnel to witness Factory Acceptance Tests	Three (3)	

B.19.8.2 Additional Tests

If additional tests are required (see B.19.8.1.c), they shall be as follows:

Manufacturer's tests standards not within the specified tests of either ANSI or IEC standards.

B.19.8.3 Equipment and Manufacturer's Experience

a.	The manufacturer should have been in the business of manufacturing protective relays of not less than: Years	10	

[2] *Contractor shall place in the fill-in data "submitted" or "will submit", "will perform" or had been performed" as appropriate.*

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	NPC Requirement	Contractor's Data
b. The type of equipment offered should have been operating satisfactorily in the actual service for not less than: Years	3	
c. The minimum quantity of equipment of similar characteristics in actual service as stipulated in item b.	4	

Note: Experience less than what is required will be ground for rejection of equipment being offered.

B.19.9 Auxiliary Power Supply

The items listed below shall be designed to receive auxiliary power supply mentioned in the NPC requirement.

a. Power Supply	125 VDC +10%, -15%	
b. Annunciator system, VDC	125 VDC +10%, -15%	
c. Internal lights and convenience outlets, VAC	230 V, 10 A, 1-ϕ, 60 Hz for lights; 230 V, 15 A, 1-ϕ, 60 Hz for CO	
d. Heaters, VAC (if required)	230 V, 1-ϕ, 60 Hz	

B.19.10 Spares and Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for the Line Protective Relay Equipment.

a. Unit(s) of complete Main Protective Relay and complete associated relays without panel enclosure	1	
b. Unit(s) of complete Back -up Protective Relay and complete associated relays without panel enclosure	1	

All spare parts shall be hermetically sealed and shall be specifically packed for storage for an extended period of time and shall come complete with storage instructions.

All spare parts shall be interchangeable with and identified in all respect to the original parts.

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B.19.11 Tools

A portable PC is required for maintenance, testing, re-configuration and data access of the Line Protective Relay equipment, it shall be connected via a service interface RS232-C port at 9600 baud. Provision therefore for this interface port shall be provided for the Protective Relay terminal equipment. The servicing PC to be supplied must have the following minimum technical requirements:

		NPC Requirement	Contractor's Data
a.	Type	PC Compatible notebook/laptop computer	
b.	Hardware		
1.	Processor	Intel Core i9 or Latest Model Available	
2.	Clock Frequency, GHz	Fastest speed available	
3.	Memory, GB	16 GB (min.)	
4.	Hard disk capacity	2TB SSD & 4TB HDD	
5.	Video Card	Largest available	
6.	CD-ROM drive/ DVD ROM drive	latest speed (built-in)	
7.	Display	14" 720p(min.) Active TFT Color Matrix Display LCD color	
8.	Audio system	64-bit stereo audio system w/ crystal sound dual speaker	
9.	Network Interface	10/100/1000 MBps (built-in)	

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	NPC Requirement	Contractor's Data
c. Software		
1. Operating system	Licensed Windows 10 Professional 64-bit, pre-installed with back-up DISC and reference manuals; Licensed Microsoft Office 2016 Professional Plus	
2. Communication stack	OSI-TCP / IP	
3. Configuration tools *(specify provided, not provided)*	Provided with Back-up copy	
4. Maintenance tools *(specify provided, not provided)*	Provided with back up copy	
d. Peripheral connectivity		
1. Communication interface (I/O)	1x9-pin RS232 Serial & 1x25-pin ECP/EPP parallel ports, 3xUSB3.0, VGA port, 4-in-1 SD Card reader, Phone Line in, 3.5mm Microphone in ports, DC jack for power adapter,	
e. Keyboard	84/85 key w/ embedded numeric key pad	
f. Mouse	Optical Sensor type with scroll wheel	
g. Power Adaptor	100 – 240V full range 50 – 60 Hz	
h. Battery	Li-Ion battery pack 6-8 hrs. rundown battery life w/ APM	
i. No. of units to be provided	Two (2)	

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B.19.12 Other Technical Requirements

a. The protection panel shall accommodate the desired relay components shown in the bid drawing's single line diagrams.

	NPC Requirement	Contractor's Data
b. Is the Line Protective Relay equipment to be supplied already existing in the Grid where it will be installed? (Yes, No)	By Contractor	
1. If Yes:		
a) Was training at the manufacturer's place conducted for the NPC engineers	Yes	
b) Was local training also conducted by the Contractor for the NPC engineers	Yes	
c) Training overseas required? (Yes, No)	Yes	
d) Local training required? (Yes, No) Refer to Section GW-2.12.2 of the Technical Specifications	Yes	
2. If No:		
a) Training overseas required? (Yes, No) Refer to Section GW-2.12.2 of the Technical Specifications	Yes	
b) Local training required? (Yes, No) Refer to Section GW-2.12.2 of the Technical Specifications	Yes	

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B.19.13 Other Technical Data to be Filled-in by Contractor

The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

	Contractor's Data
a. Model No.	
1. Main Relay	_____
2. Back – up Relay	_____
3. DEF Protection	_____
4. Auto-reclosing Relay	_____
5. Synchro/Voltage Check Relay	_____
6. Stub Protection	_____
7. Transmission Line Overvoltage Protection	_____
8. Remote Back-up Protection	_____
9. Fault Locator	_____
b. Power Requirements, DC supply	
1. Main, watts	_____
2. Back – up, watts	_____
c. Heat Dissipation, BTU	
1. Main	_____
2. Back – up	_____

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B.20.0 SUBSTATION PROTECTION SYSTEM

B.20.1 Cubicle Details of Protective Relay

		NPC Requirement	Contractor's Data
a.	Cubicle type (specify dual, duplex, enclosed swinging rack, open, etc.)	enclosed swinging rack	
b.	Panel type (specify mosaic, sheet steel)	sheet steel	
c.	Doors	Gasketed	
d.	Degree and protective class applied	Yes, IP 50	
e.	Cable entrance	Bottom	
f.	Access for maintenance and testing	front access	

B.20.2 Transformer Protection Technical Features and Characteristics

B.20.2.1 Transformer Technical Data

a.	Capacity	10MVA	
b.	Voltage rating, kV		
	1. High voltage	69	
	2. Low voltage	13.8	
c.	Type (specify auto-transformer, 3-winding, 2- winding)	3-winding	
d.	No. of phase	3-phase	
e.	Winding connection		
	1. High voltage winding	Wye w/ neutral	
	2. Low voltage winding	Delta-Wye w/ neutral grounded	
f.	Method of grounding (specify solidly grounded, low resistance, reactance, etc.)	solidly grounded	

B.20.2.2 Relay Composition and Characteristics

a.	Construction (specify micro-processor based, static, etc.)	Digital/ Numerical [1]	
b.	Mounting	19" rack with panel enclosure (See B.20.1)	

[1] *If a numerical protection system is proposed, it shall have an integrated overcurrent (if required), overload and overfluxing (if required) relays as back-up for the differential protection function. These details shall be contained in the protection cubicle.*

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	NPC Requirement	Contractor's Data
c. If individual relays are to be supplied, required no. of protection sets for single transformer (specify one, two, etc.) [2] [3]	One	
d. Composition of protection sets, if more than one protection set is required (Yes, No)		
1. Differential relay	Yes	
2. Over-excitation / Overfluxing	Yes	
3. Lock-out relay	Yes	
4. Overvoltage Relay	Yes	
5. Restricted earthfault	Yes	
6. Overcurrent relay	Yes	
7. Neutral overcurrent protection	Yes	

B.20.2.3 Transformer Differential Relay Operating Parameters and Technical Parameters [4] [4]

a. Type		
1. Percentage differential with harmonic restraint (Yes, No)	Yes	
b. If percentage differential with harmonic restraint:		
1. No. of restraint inputs	4	
2. Harmonic restrained operate time, ms	By Contractor	
3. Unrestrained operate time, ms	By Contractor	
4. Harmonic restraint	restraint for 2nd & higher	
5. Sensitivity (Restrained operate value)	Settable to 20-50% of rated current	
6. Unrestrained high speed operate value	Settable to 8-20 times rated current	
7. Restraint percentage	By Contractor	
8. CT ratio matching	By Contractor	

[2] *The technical data stated are taken from the requirements of both ANSI/IEEE C.37.91 and IEC 255. Contractor shall fill-up the applicable data requirements stated above for the relay to be supplied.*

[3] *If a numerical protection system is proposed, it shall have an integrated overcurrent (if required), overload and overfluxing (if required) relays as back-up for the differential protection function. These details shall be contained in the protection cubicle.*

[4] *If a numerical protection system is proposed, it shall have an integrated overcurrent, overvoltage (if required), overload and overfluxing (if required) relays as back-up for the differential protection function. These shall be contained in the protection cubicle.*

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	NPC Requirement	Contractor's Data
c. Common Requirements		
1. Rated current	1A	
2. Rated frequency	60 Hz	
3. Overload capacity		
a) continuous	20 A	
b) 2 sec	200 A	
4. MTBF, year	By Contractor	

B.20.2.4 Overexcitation/Overfluxing Relay Operating Parameters and Technical Features

a. Overexcitation sensing unit	To be provided	
b. Timing unit to provide selectable inverse time and definite minimum time characteristics	To be provided	
c. Rated voltage, V	90-300V	
d. Rated frequency	60 Hz	
e. Flux setting range	1.0 to 1.25 rated flux	
f. Operating range, Hz	1.5-3	
g. Definite time setting range for alarm, s	0.5 - 5	
h. Inverse time operating characteristics for tripping range, sec	By Contractor	
i. MTBF, year	By Contractor	

B.20.2.5 Overcurrent Relays Operating Parameters and Technical Features

a. Application		
1. Phase instantaneous and phase time overcurrent plus ground overcurrent (instantaneous & time overcurrent) on the high voltage side of the transformer to be provided	Yes	
2. Same for item 1 but applies on the low voltage side of the transformer	Yes	

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		NPC Requirement	Contractor's Data
3.	Phase time and ground overcurrent function applied on the tertiary side of the transformer to be provided	Yes	
4.	Overcurrent functions to be directional or non-directional	non-directional	
b.	Technical Features and Operating Parameters of Item B.20.2.5.a.1 & 2:		
1.	Type (Protective Function)	Instantaneous and time delayed elements for each of the three phases and ground	
2.	Rated current	1A	
3.	Rated frequency	60 Hz	
4.	Choice of inverse time curves and time ranges for both phase and ground protection by separate setting switches provided on the relay front board [5]	Yes	
5.	Separate LED indicators provided on individual measuring elements to indicate time delayed and instantaneous operations (for pick-up and tripping functions)	Yes	
6.	Separate output contacts provided for instantaneous phase faults, time delayed phase faults, instantaneous earth fault and time delayed earth fault operations	Yes	
7.	Provision for blocking the operation of the relay by external signals in both phase and ground units	Yes	

[5] *Contractor to indicate the proposed measuring ranges, i.e., instantaneous and time delayed.*

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	NPC Requirement	Contractor's Data
8. Instantaneous function provided with adjustable time delay	Yes, preferred 0-2 sec. In steps of 0.01 sec.	
9. Resetting ratio (Drop-off/ Pick-up Ratio)	≥95%	
10. Time delayed setting range		
a) Phase relays operation	0.1 to 100 sec	
b) Ground relays	0.1 to 100 sec	
11. Current setting range:		
a) Phase relays		
1) Instantaneous	10 - 100 A	
2) Time delayed	4 – 20 A	
b) Ground relay,		
1) Instantaneous	10 – 40 A	
2) Time delayed	0.1 – 5 A	
12. Overload capacity of current circuits		
a) Continuous	3 times rated current for phase & neutral current	
b) 1 sec	100 times the rated current for phase & neutral current	
13. Provided with breaker fail function	Yes	
14. MTBF, year	By Contractor	
c. Technical Features and Operating Parameters of Item B.20.2.5.a.3:		
1. Type (Protective Function)	Instantaneous (optional) and time delayed elements for each of the three phases and ground	
2. Rated current	1A	
3. Rated frequency	60 Hz	

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	NPC Requirement	Contractor's Data
4. Choice of inverse time curves and time ranges for both phase and ground protection by separate setting switches provided on the relay front board	Yes	
5. Separate LED indicators provided on individual measuring elements to indicate time delayed and instantaneous operations	Yes, preferred	
6. Separate output contacts provided for overcurrent and ground relay measuring elements	Yes, preferred	
7. Provision for the instantaneous function of the relay to be blocked or delayed	Yes [6]	
8. Start operation parameters		
a. Current setting range		
1. Phase relays Instantaneous (optional)	0.1 to 20 In in steps of 0.1 In	
2. Time delayed	0.2 to 20 In in steps of 0.1 In	
b. Ground relay		
1. Instantaneous	0.1 to 20 In in steps of 0.1 In	
2. Time delayed	0.2 to 20 In in steps of 0.1 In	
c. Drop-off/ Pick-up Ratio	95%	
9. Time delayed operation parameters		
a. Phase relays	0.1 to 100 sec	
b. Ground relays	0.1 to 100 sec	
10. Instantaneous operation provided with adjustable time delayed (Yes, No)	Yes, preferred	

[6] *Contractor to give full description on the time delayed function.*

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	NPC Requirement	Contractor's Data
11. Overload capacity of current circuits		
a. Continuous	2 times rated current phase & neutral current	
b. 1 sec	75 times rated current, phase & neutral current	
12. MTBF, year	By Contractor	

B.20.2.6 Neutral Current Protection Operating Parameters and Technical Features

a. Setting range, step 1, Instantaneous (optional)		
1. Current, A	0.1 to 20 In in steps of 0.1 In.	
2. Operating time	< 40ms	
b. Setting range, step 2, Time delay		
1. Current, A	0.1 to 20 In in steps of 0.01 In	
2. Time delay, sec	0.02 to 60 s in steps of 0.01 s	
c. Methods of stabilizing for in-rush current [7]	By Contractor	
d. MTBF, year	By Contractor	

B.20.2.7 Restricted Earth Fault Operating Parameters and Technical Features

a. Rated frequency	60 Hz	
b. Type, low or high impedance	By Contractor	
c. Setting range, A or V	By Contractor	
d. With CT ratio compensation	Yes	
e. Operating time, ms	10-20ms	
f. Method of stabilizing for dc component	By Contractor	
g. MTBF, year	By Contractor	

[7] *Contractor to give brief description.*

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B.20.2.8 Lock-out Relay Operating Parameters and Technical Features

	NPC Requirement	Contractor's Data
a. Type (specify manual reset, electrical reset, etc.)	Manual reset	
b. Operating time, ms	≥ 15ms	
c. No. of contacts required	To be coordinated with the no. of associated relays	
d. Trip coil voltage operating range	70-145 Vdc	
e. Contact ratings		
1. Continuous	20 A	
2. 1 min	40 A	

B.20.3 Bus Protection Technical Features and Characteristics (69 kV Busbars)

a. Mounting	19" rack with panel enclosure (See B.20.1)	
b. Required no. of protection sets for the bus (specify one, two, etc.)	One (Main 1) for each bus section with check zone feature	
c. Composition of protection sets, if more than one protection set is required		
1. Main 1		
a) Bus differential relay	To be provided	
b) High speed undervoltage relay for shunt circuit fault detection (for high impedance differential relay)	By Contractor	
c) High speed undervoltage relay for ground fault detection (for high impedance differential relay)	By Contractor	
d) CT secondary circuit supervision	Yes	
e) Lock-out relay	Yes	
d. Operating principle (specify high impedance, moderately high impedance, low impedance, etc.)	Moderately high impedance relay	

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B.20.4 Breaker Fail Protection Operating Parameters and Technical Features (Not Used)

B.20.5 Feeder Protection Technical Features and Characteristics (69 kV feeders)

B.20.5.1 Relay Composition and Characteristics (If required)

	NPC Requirement	Contractor's Data
a. Construction	Microprocessor based or Numerical protection system	
b. Mounting	19" rack with panel enclosure (See B.20.1)	
c. Composition of the protection sets (Yes, No)		
1. Phase and ground time and instantaneous overcurrent relay	Yes	
2. Reclosing relay	Yes	
d. Provided with the following features and characteristics (Yes, No)		
1. Trip circuit monitoring	Yes	
2. Status information (open, close) of circuit breaker and associated disconnect switches.	Yes	
3. remote and local breaker control (trip and close)	Yes	
4. Breaker failure function provided (Yes, No)	Yes	
5. Provided with measurement functions with local display of:		
a) measured phase current	Yes	
b) Active and reactive power	Yes	
Provision for remotely acquisition of the above data.	Yes	
7. Extensive self-test and diagnostic	Yes	
8. Serial communication interface via RS232 port	Yes	
e. Configuration Editor Software to be provided for the relay as part of the supply	Yes	

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B.20.5.2 Over Current Relays Operating Parameters and Technical Features (If required)

	NPC Requirement	Contractor's Data
a. Mounting	19" rack with panel enclosure (See B.20.1)	
b. Will form part of micro-processor-based substation control and protection system (Yes, No)	No	
c. Application		
1. Phase instantaneous and phase time overcurrent plus ground overcurrent (instantaneous & time overcurrent)	Yes	
2. Overcurrent functions to be directional or non-directional	Non-directional	
d. Technical Features and Operating Parameters of Item B.20.2.5.a.1 & 2:		
1. Type (Protective Function)	Instantaneous and time delayed elements for each of the three phases and ground	
2. Rated current	1A	
3. Rated frequency	60 Hz	
4. Choice of inverse time curves and time ranges for both phase and ground protection by separate setting switches provided on the relay front board [8]	Yes	
5. Separate LED indicators provided on Individual measuring elements to indicate time delayed and instantaneous (for pick-up and tripping functions)	Yes	

[8] *Contractor to indicate the proposed measuring ranges, i.e., instantaneous and time delayed.*

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		NPC Requirement	Contractor's Data
6.	Separate output contracts provided for instantaneous phase faults, time delayed phase faults, instantaneous earth fault and time delayed earth fault operations	Yes	
7.	Provision for blocking the operation of the relay by external signals in both phase and ground units.	Yes	
8.	Instantaneous function with adjustable time delay	To be provided, preferred 0-2 sec. In steps of 0.01 sec.	
9.	Resetting ratio (Drop-off/Pick-up Ratio)	95%	
10.	Time delayed setting range		
	a) Phase relays operation	0.5 to 100 sec	
	b) Ground relays	0.5 to 100 sec	
11.	Current setting range		
	a) Phase relays		
	1) Instantaneous	0.1 to 20 In in steps of 0.1	
	2) Time delayed	0.02 to 20 In in steps of 0.01 In	
	b) Ground relay		
	1) Instantaneous	0.02 o 20 In in steps of 0.1	
	2) Time delayed	0.02 to 20 In in steps of 0.01 In	
12.	Overload capacity of current circuits		
	a) Continuous	3 times rated current for phase & neutral current	
	b) 1 sec.	100 times the rated current for phase & neutral current	
13.	Provided with Breaker Fail function	Yes	
14.	MTBF, year	By Contractor	

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B.20.6 Test and Experience Requirements

B.20.6.1 Test Requirements

	NPC Requirement	Contractor's Data
a. Design Test and Reports Required for each of the Relay component [9]	Yes	
b. Certified test design reports of previous or duplicate production type are acceptable [51]	Yes	
c. Additional tests are required, If yes, see B.20.6.2	Yes	
d. Test reports of Contractor instead of manufacturer: (acceptable, not acceptable)	not acceptable	
e. Test frequency requirements	60 Hz	
f. Factory acceptance tests to be witnessed by NPC	Yes	
g. Required no. of personnel to witness Factory Acceptance Tests	Three (3)	

B.20.6.2 Additional Tests

If additional tests are required (see B.20.6.1.c), they shall be as follows:

Manufacturer's tests standards not within the specified tests of either ANSI or IEC standards.

B.20.6.3 Equipment and Manufacturer's Experience

a. The manufacturer should have been in the business of manufacturing protective relays of not less than: Years	10	
b. The type of equipment offered should have been operating satisfactorily in the actual service for not less than: Years	3	
c. The minimum quantity of equipment of similar characteristics in actual service as stipulated in item b.	4	

Note: Experience less than what is required will be ground for rejection of equipment being offered.

[9] *Contractor shall place in the fill-in data "submitted" or "will submit", "will perform" or "had been performed" as appropriate.*

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B.20.7 Auxiliary Power Supply

The items listed below should be designed to receive auxiliary voltage source indicated in the NPC requirement.

		NPC Requirement	Contractor's Data
a.	Power Supply	125 VDC +10%, -15%	
b.	Annunciator system, VDC	125 VDC +10%, -15%	
c.	Internal lights and convenience outlets, VAC	230 V, 1-ϕ, 60 Hz for lights 15 A, 230 V, 1-ϕ, 60 Hz for CO	
d.	Heaters, VAC (if required)	230 V, 1-ϕ, 60 Hz	

B.20.8 Spares and Spare Parts

The following parts aside from those Contractor's recommended spare parts shall be furnished for the Substation Protective Relay Equipment for **Masbate Substation.**

1.	Transformer Differential Relay complete with the required back-up and auxiliary relays w/o panel	---	
2.	Busbar Protection Relay		
	a. Main Differential Relay or central unit w/o panel	---	
	b. Field or Bay Unit with auxiliary relays, w/o panel	---	
	c. Overcurrent Relay with reverse interlocking auxiliary relay w/o panel	---	
3.	Feeder Protection Relay		
	a. Feeder Overcurrent Relay w/o panel	---	
4.	Breaker Failure Relay complete with auxiliaries w/o panel	---	

All spare parts shall be hermetically sealed and shall be specifically packed for storage for an extended period of time and shall come complete with storage instructions.

All spare parts shall be interchangeable with and identical in all respect to the original parts.

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B.20.9 Tools

Refer to B.19.11 of the Technical Data Sheets.

B.20.10 Other Technical Requirements

a. The protection panel shall accommodate the desired relay components shown in the bid drawing's single line diagrams.

	NPC Requirement	Contractor's Data
b. Is the Substation Protective Relay equipment to be supplied already existing in the Grid where it will be installed? (Yes, No)	By Contractor	
1. If Yes:		
a) Was training at the manufacturer's place conducted for the NPC engineers	Yes	
b) Was local training also conducted by the Contractor for the NPC engineers	Yes	
c) Training overseas required? (Yes, No)	Yes	
d) Local training required? (Yes, No) Refer to Section GW-2.12.2 of the Technical Specifications	Yes	
2. If No:		
a) Training overseas required? (Yes, No) Refer to Section GW-2.12.2 of the Technical Specifications	Yes	
b) Local training required? (Yes, No) Refer to Section GW-2.12.2 of the Technical Specifications	Yes	

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B.20.11 Other Technical Data to be Filled-in by Contractor

The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

	Contractor's Data
a. Physical Dimensions and Weights	
1. Dimension, (L x W x H), mm	
a) Transformer Protective Relay	
b) Breaker Failure Relay	
c) Bus Protective Relay	
d) Feeder Protective Relay	
2. Weights w/o crate, kg	
a) Transformer Protective Relay	
b) Breaker Failure Relay	
c) Bus Protective Relay	
d) Feeder Protective Relay	
3. Weights with crate, kg	
a) Transformer Protective Relay	
b) Breaker Failure Relay	
c) Bus Protective Relay	
d) Feeder Protective Relay	

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B.21.0: REVENUE METER

B.21.1 Technical Requirements

	Contractor's Data
a. Manufacturer	
1. 69kV	
2. 13.8kV	
b. Country of Origin	
1. 69kV	
2. 13.8kV	

B.21.2 Technical Features and Requirements

	NPC Requirements	Contractor's Data
a. Accuracy Class	Class 0.3 (ANSI/IEEE) or Class 0.2 (IEC)	
b. Number of Phase	3	
c. Wire	4	
d. Voltage, V	60-240	
e. Current Range	Class 20	
f. Frequency, Hz	60	
g. Register Type	LCD	
h. TOU (Time of Use)	Programmable Ready	
i. Soft Switches	Available	
j. LCD Display	Programmable	
k. Measure and Display (Min.)	kW, kWh, kVAR, kVARh and Comulative Demand	
l. External CT Ratio Setting	X:1A (For 69 kV) X:1A (For 13.8kV)	
m. The Kilowatt-hour meter to be provided is certified and approved by ERC	Yes	
n. Installation	Outdoor with mounting	

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		NPC Requirements	Contractor's Data
o.	Metering Current Transformer (for 13.8kV kWH Revenue Meter)		
1.	Class (indoor, outdoor)	Outdoor	
2.	Insulation type	Full cast epoxy resin	
3.	Secondary rated current for all windings, A	1	
4.	CT ratio	To be based on protection and metering requirements	
5.	Accuracy class	Class 0.3 or better	
6.	Burden	Manufacturer's Data	
7.	BIL, kV	110	
o.	Metering Voltage Transformer (for 13.8kV kwH Demand Meter Only)		
1.	Class (indoor, outdoor)	Outdoor	
2.	Highest continuous operating voltage of VTs, kV	15	
3.	Nominal voltage of VT, kV	13.8	
4.	Rated secondary voltage, V	120	
5.	Insulation type	Full cast epoxy resin	
6.	Accuracy class	Class 0.3 or better	
7.	Burden	Manufacturer's Data	
8.	BIL, kV	110	
p.	Accessories		
1.	10 Pole Test Switch, 600V, 30A	Included	
2.	IP Rating of Enclosure	IP65 or better	

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