

69kV SUBSTATION EXPANSION PROJECT 2022
GPL-PD-048-2022
ADDENDUM No.4

Pursuant to ADDENDUM No. 4, the scope of works for Canefield Substation has been adjusted to include the addition of a 60MVA Transformer and Transformer Bay.

The Technical Specifications for the 60MVA Transformer and Transformer Bay are as follows:

Technical Specifications for 60 MVA ONAN Rated 3-Phase Power Transformer

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1. SCOPE

This specification covers the design, manufacture, shop testing, pre-delivery inspection, packing at manufacturer's works, transit insurance, delivery to GPL as per request of 60 MVA, ONAN rated, 69kV/13.8kV, copper wound, power transformers, complete with all accessories/fittings with first filling of new transformer oil in vacuum conditions and 10% extra transformer oil as specified herein and suitable for outdoor installation.

2. APPLICABLE STANDARDS

Except where modified by this specification, the transformer shall be designed, manufactured and tested in accordance with the latest edition(s) of the standards shown in Table 1. The Proponent may propose alternative standards, but shall demonstrate that the alternatives give a degree of quality and performance equivalent to or better than the referenced standards herein.

Acceptability of an alternative standard is at the discretion of the Purchaser in writing.

The Proponent shall furnish a copy of the alternative standard(s) along with the bid. If the alternative standard is not written in the English Language, a certified English Language translated version of the original standard shall be submitted with the bid.

Table 1: Applicable Standards

Item No.	ANSI/IEC/IEEE/ISO Standards	Title
1	IEEE C57.12.00	Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2	ANSI/IEEE C57.106	Guide for Acceptance and Maintenance of Insulating Oil in Equipment
3	ANSI/IEEE C57.92	Guide for Loading Mineral-Oil-Immersed Power Transformers up to and Including 100 MVA with 55 Degrees C or 65 Degrees C Average Winding Rise
4	NEMA TR1	Transformers, Regulators and Reactors
5	IEC 60076	Power transformers

Item No.	ANSI/IEC/IEEE/ISO Standards	Title
6	IEEE C57.12.90	Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers Corrigendum 1: Editorial and Technical Corrections
7	ANSI C57.12.20	Overhead-Type Distribution Transformers 500 kVA and Smaller; High Voltage, 34 500 V and Below; Low Voltage, 7970/13 800Y V and Below
8	IEEE Std 519	Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
9	IEC 600137	Insulated bushings for alternating voltages above 1 000 V
10	IEEE C57.12.70	Standard for Standard Terminal Markings and Connections for Distribution and Power Transformers
11	IEEE C57.156	Guide for Tank Rupture Mitigation of Liquid-Immersed Power Transformers and Reactors
12	IEEE C57.12.31	Standard for Pole-Mounted Equipment-Enclosure Integrity
13	IEC 61099	Insulating liquids - Specifications for unused synthetic organic esters for electrical purposes
14	IEC 60836	Specifications for unused silicone insulating liquids for electrotechnical purposes
15	IEC 62535	Insulating liquids - Test method for detection of potentially corrosive sulphur in used and unused insulating oil
16	IEEE C57.12.91	Standard Test Code for Dry-Type Distribution and Power Transformers
17	ISO 9001	Quality management systems - Requirements
18	ISO 9002	Quality management systems. Guidelines for the application of ISO 9001:2015
19	ISO 9000	Quality Management Systems - Fundamentals and Vocabulary

In case of conflict(s) with applicable standard(s), the order of precedence shall be:

- This Technical Specification for Power Transformer; then
- Other Applicable and Recognised Standards for Power Transformers.

3. INSTALLATION/SERVICE CONDITIONS

The installation conditions of the transformer shall be as follows:

- Maximum altitude above mean sea level < 1,000 m above sea-level
- Maximum ambient air temperature 40°C
- Maximum daily average ambient air temperature 35°C
- Minimum ambient temperature 15°C
- Maximum relative humidity 100%
- Wind Speed at typical transformer height 3 m/s
- Isokeraunic level 120
- Average Number of days with rain 206 days per year (> 0.1 mm)
- Average annual rainfall 188.4 mm

All outdoor materials, components and equipment shall be designed and protected for use in exposed, heavily polluted and salty, corrosive and humid tropical coastal atmospheric conditions.

Maximum temperature rise over ambient temperature:	
• In oil by thermometer	65 °C
• In winding by resistance measurement	65 °C
• Limit for hot spot temperature for which the transformer is designed	<80 °C
• Temperature gradient between windings and oil	20 °C
• Type and details of winding hot spot temperature detector	Resistance temperature detector
• Type of maximum winding temperature indicator	analog/ digital
Average Winding Temperature Rise	65 °C
Maximum Winding Temperature Rise	105 °C

4. ELECTRICAL SYSTEM CONDITIONS

The transformer shall be suitable for installation as a Generator Step-up Unit (GSU) or as a Substation Step-down Power transformer within GPL's Power System, which has the following characteristics (see Table 2).

Table 2: Characteristics of GPL's Power System

Nominal System Voltage, Frequency and Phase	High Voltage (HV) Side	69 kV, 60 Hz, 3ϕ-3-wire, Wye
	Medium Voltage (MV) Side	13.8 kV, 60 Hz, 3ϕ-3 wire, Delta
Voltage Class – High Voltage Side	75 kV	
Voltage Class – Medium Voltage Side	15 kV	
Short circuit withstand Capability	As per IEEE C57.12.00, section 7.1.4	
Insulation Level		
Basic Insulation Level (BIL)	110 kV for 13.8 kV side (Medium Voltage Level)	
	350 kV for 69 kV side (High Voltage Level)	
Power Frequency withstand level – Dry 1 Minute	36 kV for 13.8 kV side (Medium Voltage Level)	
	160 kV for 69 kV side (High Voltage Level)	
Power Frequency withstand level – Wet 10 Seconds	30 kV for 13.8 kV side (Medium Voltage Level)	
	140 kV for 69 kV side (High Voltage Level)	
Creepage Distance (minimum)	25 mm/kV for line-to-line and 44 mm/kV for line-to-ground for both 69 kV side (High Voltage Level) and 13.8 kV side (Medium Voltage Level).	
System Grounding		
Neutral Grounding	High Voltage Side	Wye - Solidly Grounded.
	Medium Voltage Side	13.8 kV busses are grounded via a zig-zag transformer with a resistor in neutral connection to earth.

5. AUXILIARY POWER SUPPLIES

The following power supplies shall be available at site:

- AC 3-phase, 480 volts, 60Hz, Earthed;

- AC 1-phase, 240/120 volts, 60Hz. Earthed; and
- 125 volts DC for essential alarms, indication and circuit breaker tripping.

6. TYPE OF TRANSFORMER

The transformer shall be double wound, sealed type, oil immersed with natural oil cooling (ONAN), three phase (3 ϕ) with ratings as specified herein. Additionally, the power transformer shall be completed with all accessories/fittings/ancillaries with first filling of new transformer oil in vacuum condition(s) and 10% extra transformer oil as specified herein and suitable for outdoor installation, all as per ANSI/IEEE C57.106.

The vector ground of the transformer shall confirm to YNd11 and is required to be equipped with four (4) HV and three (3) MV bushing terminations.

The design of the tank, fittings, bushings, etc., shall be of such that it will not be necessary to keep the transformer energised to prevent deterioration as the transformer may be held in reserve and outdoors conditions for many years.

7. RATINGS

The rating of the power transformer shall be 60 MVA, all units at ONAN rating.

The transformer, inclusive of tap changer and other load current carrying components, shall accept emergency overloading as per ANSI/IEEE C57.92, section 4.

8. TAPS AND VOLTAGE REGULATION

The transformer shall have the following voltage transformation ratio and tapping range:

- the nominal high-side voltage for the transformer shall be 69 kV and the medium-side voltage shall be 13.8 kV and conform to the vector group YNd11.
- tolerance on the voltage ratio shall be in accordance with IEEE C57.12.00, section 9.1;
- taps shall be provided in the high voltage winding (69 kV side), with steps of 1.25%, where there shall be four (4) steps above and eight (8) steps below the nominal primary voltage rating of 69 kV; and

- bidder shall state in the technical schedule, the percentage voltage regulation at full load, at power factor of 1.0 and at full load at power factor of 0.8 lagging. The primary and secondary voltage variation shall be based on a winding temperature rise of 65°C.

9. IMPEDANCE

The guaranteed value of impedance, measured at 65°C and on the nominal tap position and at the rated voltage of the transformer, shall be 13.3% to 14.22% for the 60 MVA transformer.

Tolerance for transformers' impedances shall be in accordance with IEEE C57.12.00, section 9.2, for impedance larger than 2.5%.

It should be noted that multiple similarly rated transformers should be capable of operating in parallel and having the above impedances.

10. SHORT CIRCUIT RATINGS

Bidders must submit all short circuit test results for compliance with IEEE C57.12.00, section 7.1.4.

11. LOSSES AND CAPITALISATION OF LOSSES

The Bidder shall state the guaranteed losses. However, no positive tolerance is allowable on the guaranteed values. If the transformer for the mobile substation is supplied with losses exceeding the guaranteed values, the purchaser reserves the right to reject the transformer(s). The mobile transformer load losses (copper loss) shall not exceed 6% at 65°C and no-load losses less than 10% (core loss).

The capitalization of guaranteed losses of the transformer shall be calculated and considered while evaluating the bids as the final bid price. The guaranteed values of no-load losses and load losses shall be stated in the bid, which should match the corresponding loss figures mentioned in the short circuit type test report submitted along with the offer by the bidder. Liquidated damages will be applied to successful bidder for not achieving the quoted guaranteed figures.

The Total Ownership Cost (TOC) formula is as follow:

$$\text{TOC} = \text{Bid Price} + [(A \times \text{NLL}) + (B \times \text{LL})]$$

Where:

1. **TOC** is the Total Owning Cost in US\$
2. **Bid Price** in US\$
3. **A** is the No Load-Loss Factor = 14.82 US\$/W
4. **B** is the Load-Loss Factor = 3.63 US\$/W
5. **NLL** is the No-Load Loss in W
6. **LL** is the Load Loss in W

12. FLUX DENSITY

The flux density at any point of the magnetic circuit, core, and winding, when the transformer is connected on the centre tap and operating at normal voltage and frequency, shall be stated in the bid and shall not exceed 1.5 Tesla (operating flux density). The transformer must be capable of operating at 20% overvoltage at 95% of rated frequency without resulting in magnetic saturation of the transformer's core or the flux density exceeding 1.5 Tesla.

The transformer shall be designed to have an operating overvoltage capability of 112.5% of rated voltage (continuous).

13. NOISE LEVEL

The acceptable audible sound levels for all transformers shall comply with NEMA TR1, Table 0-3. Bidders shall confirm procedure for noise level measurement according to IEC 60076-10 or IEEE C57.12.90 and submit audible sound levels test results with the bid document.

14. RADIO INFLUENCE VOLTAGE

Radio influence voltage of all transformers, contained herein, shall comply with NEMA TRI, section 0.03.1.

15. TAP CHANGING CHARACTERISTICS

The tap changer shall be designed to operate as an automatic on-load tap changer. The design shall also provide for manual override of the automatic on-load tap changer in the event of an emergency.

At minimum, the unit must display the mode of operation, the current tap position, indication of action (up or down) and time elapsed during change action. The unit shall be IEC 61850 compliant to connect to SCADA system using protocol 101, must have clearly marked operation buttons and work with a power supply of 125VDC.

The OLTC shall have provisions to perform at least the following functions from local or remote control thru the substation SCADA system:

1. Selection to operate under automatic voltage regulator mode or manual mode.
2. Settings of the reference voltage for the automatic voltage regulator mode.
3. Setting of the dead band for automatic voltage control.
4. Manual operation to increase or lower the taps.

The tap changer position shall be provided locally and remotely thru the SCADA system.

Tap positions shall be numbered as shown in Table 3 unless an acceptable alternative number of taps is provided.

The operating handle shall have provision for padlocking and shall give a visual indication of the tap position without unlocking.

Each tap-changer position and the tap voltage or percentage associated with voltage shall be identifiable by reference to nameplate information. All positions of the tap changer shall be operative positions.

Tap changer handles shall be fitted with covers having gaskets, so that sealing of the transformer under normal conditions is independent of the switch shaft gland.

Table 3: Transformer onload tap positions.

Taps	HV Side Voltage (V)	Step %
1	72,450	5
2	71,590	3.75
3	70,725	2.5
4	69,865	1.25
5	69,000	0
6	68,140	-1.25
7	67,275	-2.5
8	66,415	-3.75
9	65,550	-5
10	64,690	-6.25
11	63,825	-7.5
12	62,965	-8.75
13	62,100	-10

16. CORE AND WINDINGS

The core and windings shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings will be energized to heat the coils and drive out moisture, and the transformer shall be filled with preheated filtered degassed insulating fluid.

The core and winding shall be capable of withstanding mechanical shocks during transport, installation, and servicing, inclusive of thermal and mechanical stresses caused by any symmetrical and asymmetrical faults on any winding.

The transformer shall be provided with winding temperature indicator and combined alarm and trip relays of approved design, oil temperature indicator of approved design incorporating contacts and relay(s) for initiating alarms and trips, Buchholtz relay and low oil level alarm.

16.1 CORE

The core shall be manufactured from burr-free, grain-oriented silicon steel laminations and shall be precisely stacked to eliminate gaps in the corner joints.

Provision to the design and construction of the transformer shall be made to prevent movement of the core and windings, relative to the tank and any other ancillary device(s)

within the tank, during transport, installation and short-circuits (symmetrical and asymmetrical).

The design of the core shall avoid the presence of pockets, which can prevent complete emptying of the oil in the tank through its drain plug/pipe.

The transformer core assembly shall be boltless type.

16.2 WINDINGS

The winding conductor shall be of electrolytic copper, to give the optimum economic and technical results of the transformers over its operation lifespan.

The windings shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper, and shall be free from any other insulating compounds that are liable to soften, ooze out, shrink or collapse, and non-catalytic and chemically inert in the transformer oil during normal servicing. The windings shall be uniformly insulated, and the neutral point(s) shall be insulated for full line-to-line voltage on both sides of the transformer.

The stacks of windings shall receive adequate shrinkage treatment, and the windings and connections are to be braced to withstand mechanical shocks during transport, switching, short-circuit or other transient conditions.

The transformer shall be equipped with a buried delta winding.

17. SUPPRESSION OF HARMONICS

Each transformer's core shall be designed with attention to the suppression of harmonic voltages and currents, as per IEEE Std 519-2014 in Table 1 for bus voltage between 1 kV and 69 kV and Table 2 for current distortion limits for systems rated 120 V through 69 kV.

Proponents shall submit results for harmonic suppression tests for voltage and current distortions.

18. BUSHINGS AND TERMINATIONS

18.1 Bushings

Bushings shall be of the outdoor type and easily replaceable. Cemented types will not be acceptable. The bushings shall be sufficiently robust (mechanically) to withstand normal transport and erection hazards, as well as mechanical force developed for the short-circuit withstand capability current.

All bushings shall have a minimum creepage distance of 25 mm/kV for maximum phase-to-phase system voltage and shall have a continuous rating of 200 % of the transformer capacity rating.

Bushings should be such that they contain all necessary current transformers for measurement and protection. Polymer bushings can be used to leverage weight savings.

Bushings shall comply with IEC 600137 except where amended this specification. HV bushings shall be mounted on top of the tank, while the MV bushings shall be side wall mounted with full height air terminal. Both HV and MV bushings shall be provided with current transformers for overcurrent and differential protection, and measurement purposes of the transformer.

18.2 Bushing Labels

HV bushings shall be labelled H1, H2, H3, H0.

MV bushings shall be labelled X1 to X3 in accordance with IEEE C57.12.70 standards.

Marking letters shall be at least 80 mm (or 3 inches) high. The means of marking shall conform to the requirements of the section on Labels in this specification.

18.3 EARTHING TERMINALS

The transformer shall be provided with at least two earthing/grounding terminals comprising an isometric bolt and nut, which shall be non-ferrous material but not plastic. It shall include a spring washer and a lock washer.

External connecting strip(s) between earthing/grounding terminal and neutral bushing(s) is/are required.

19. TANK FABRICATION

19.1 GENERAL CONSTRUCTION FEATURES

All material used shall be of the highest quality and of the class most suitable for working under the conditions specified and withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting up of undue stresses which may impair suitability of the various parts for the work which they have to perform. Similar parts, particularly removable ones, shall be interchangeable.

Pipes and pipe fittings, screws, studs, nuts, and bolts used for external connections shall be as per the relevant standards for power transformers. Steel bolts and nuts exposed to atmosphere shall be galvanized. Nuts, bolts, and pins used inside the transformers and tap changer compartments shall be provided with lock washer or locknuts. Exposed parts shall not have pockets where water can be collected settled.

Internal design of transformer shall ensure that air is not trapped in any location. Material in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated. Labels, indelibly marked, shall be provided for all identifiable accessories like Relays, switches current transformers etc. All label plates shall be of in corrodible material. All internal connections and fastenings shall be capable of operating under overloads and over-excitation, allowed as per specified stands without injury.

Transformer and accessories shall be designed to facilitate proper operation, inspection, maintenance, and repairs. No patching, plugging, shimming or other such means of overcoming defects, discrepancies or errors will be accepted.

Schematic Drawing of the wiring, including external cables shall be included on the inside door of the transformer marshalling box and placed in a secured and safe position from the elements.

The tank shall be of sealed construction and fabricated using materials to withstand a minimum of 15 psi internal pressures and to mitigate rupture as per IEEE C57.156 The Proponent shall

state if other than bolted cover construction is used and shall give full details of such construction. The interior of the tank shall be sealed to avoid moisture from getting inside the parts and loss of internal pressure.

The Proponent shall state the top oil temperature that corresponds to the tank's internal pressure of 15 psi and steady load at rated capacity and emergency loading condition while considering an ambient condition stated in this document. Adequate space shall be provided at the bottom of the tank for collection and draining of sediments.

Transformer tanks shall be designed to allow the unit to be lifted and transported with the total weight of the transformer, oil at the required level and any other attached ancillary, without any deformation or oil leakages. Lifting provisions shall consist lifting brackets welded to opposite sides of the tank and cover for separate lifting.

Additionally, for a total mass, equal to or greater than 2,000 kg, jacking pads shall be incorporated into the transformer tank design and construction, capable of withstanding the point load of the total mass of the transformer (tank, core, windings, and oil filled to the required level and all other attached ancillaries).

The tank shall be fabricated of construction steel with a minimum thickness of 11 mm; top and bottom covers of the tank shall have a minimum thickness of 11 mm, while the design shall ensure that skin effect is kept minimum.

Thickness below this value will be considered only in exceptional cases with a written guarantee and/or warranty from the Proponent and must be submitted along with the bid. The transformer tank and the top cover shall be designed to confirm with IEEE C57.12.31.

All sealing washers/gaskets shall be made of oil and heat resistant nitrile rubber or neoprene bonded cork seals suitable for temperatures as stipulated in this specification. Surfaces, where joints have gaskets, shall be of, such that, an even surface is presented to the gasket, thereby eliminating the necessity for the gasket to take up surface irregularities.

A conservator that prevents contact between the oil in the transformer tank and the ambient air shall be provided with the transformer, e.g., either the membrane type or multi-compartment type of split conservator.

The transformers shall be equipped with a Buchholz relay complete with alarm and trip contacts, an air relief valve, flanges, and valves to enable its removal without the need to drain the oil.

Facilities should be provided for measuring the top oil temperature by the installation of a tubular pocket at the top of the tank.

The diverter switch oil compartment shall be connected to a separate conservator or segregated section of the main conservator of the transformer

The finish of internal walls of tank, covers, connecting boxes and cooling systems shall effectively protect against the effects of corrosion and the influence of the oil or synthetic liquid used in the transformer.

All pipes, radiators, stiffeners, or corrugations, which are welded to the tank wall, shall be welded externally, and shall be double welded wherever possible. All welds shall be stress relieved.

19.2 Pressure Relief Device

Pressure relief devices shall be fitted to the liquid immersed transformer. Pressure relief devices shall be, and not limited to the following:

- provided with a trip contact;
- resetting, rapid acting, relief valve type that has a mechanical operation indicator; and
- provided with facility for directing emissions of liquid from the relief device in the direction specified.

Proponents shall submit all test results of the pressure relief device with the bid document.

19.3 Oil Level Indication

The oil level marker shall be externally visible to the transformer's tank and in compliance with applicable ANSI/IEEE or IEC standards.

19.4 Marshalling Box

A metal enclosed, weather, vermin and dust proof marshalling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch etc. shall be provided with the transformer to accommodate temperature indicators, terminal blocks etc. It shall have degree of protection of IP 55 or superior.

20. FITTINGS

The following minimum standard fittings shall be provided:

- rating, diagrams and terminal marking plate;
- tank grounding terminal;
- lifting lugs;
- oil level indicator;
- manual pressure relief device; and
- drain/sampling valve with plug.

The fittings and accessories listed above are only indicative and any other fittings and accessories according to the applicable standards herein shall be equipped with the transformer.

21. TRANSFORMER OIL

The transformers shall be supplied filled with class 1 mineral oil conforming to ASTM D3487. The complete first filling shall be of new oil free from inhibitors and additives. The dielectric strength of the oil shall not be less than 72.5kV. If an antioxidant inhibitor is recommended, its use shall be subject to the Purchaser's approval. The transformer oil shall be non-corrosive on the basis of tests in accordance with IEC 62535.

22. PROTECTION DEVICES

22.1 Pressure Relief Device or Explosion Vent

The transformer tanks shall be fitted with a pressure relief device or explosion vent. It shall be built on the covers to protect against high pressures inside the oil tanks. It shall be provided with

closed cover used as diaphragm which ruptures at a gauge pressure of 7.98 to 10.15 psi (0.55 to 0.7 bar) (preferably, the sealing of the explosion vent may be accomplished by a spring closed cover, having the same pressure gauge as before).

22.2 Buchholz Relays

The transformers shall be equipped with a Buchholz relay of earthquake proof design. These relays shall be mounted in the pipe connecting the conservator to the transformer tank.

The Buchholz relays shall be of the double float type with two sets of independent mercury contacts (one float actuated by a build-up of gas and the other by a sudden oil surge giving respectively signalization and tripping).

Adequate isolating valves shall permit the removal of the Buchholz relays, the conservator being still connected to the tank by a pipe shunting the relay.

The relays shall be provided with a window having a scale for reading the gas level. It shall be designed to allow taking a gas sample at any time from the device through a vent screw. The Buchholz relay design shall allow testing of the relay when the transformers are in service.

23. TEMPERATURE DETECTORS AND TEMPERATURE INDICATORS

The transformers shall be equipped with:

1. Resistance temperature detectors
2. Resistance temperature detectors of the Pt 100 type (100 ohms at 32°F (0°C)) shall be installed in an appropriate and approved manner in the following places:
3. Two (2) in the hottest spots of the core for remote temperature indication
4. Two (2) at the location of the hottest oil for remote temperature indication, provided the manufacturer would prefer to have this device combined with the temperature indicator as given in paragraph hereafter.

Temperature analogue output signals (i.e., 4 to 20 mA) shall be provide for remote indication in the plant control system.

For measuring the temperature of hot oil locally, each transformer will be provided with a dial thermometer complete with two electrical alarm contacts. The mercury bulb will be placed in an

oil-filled pocket screwed into the transformer cover. The thermometer housing shall be of hose-proof, metal clad ventilated design. Contacts must be available for starting the pumps.

The indicating instrument shall be of stainless steel. The casing must be spring-suspended on the tank at eye-level. The dial will be scaled from -4°F to 302°F (-20°C to 150°C). A maximum pointer shall be provided which may be reset at any time by means of a push button.

Two or more additional pockets for the insertion of thermometers to check oil temperature shall be provided on the cover of the transformer.

Thermal image

The transformer shall be provided each with one thermal image. It will give the hottest spot temperature of the corresponding winding. The hottest spot temperature will be indicated on a dial thermometer placed on the tank (the scale of the dial thermometer will be at least up to 302°F (150°C)).

Contacts shall be available for alarm, tripping and for continuously starting the cooling pumps.

24. UNIT TRANSFORMER MONITORING SYSTEM

For permanent condition monitoring and early fault detection of each transformer, an online monitoring system shall be provided consisting of a dissolved gas-in-oil analysis-supervision (DGA) and collection of general operating data comprising at least the following measurements:

1. Foreign substances in the oil,
2. Temperatures, oil levels,
3. Voltage, current, power, losses on the transformer,
4. Operating condition of cooling and
5. Overload conditions.

The data shall be analysed, trends shall be displayed, and lifetime shall be estimated.

DGA analysis device shall provide information for estimated winding hot spot temperature, moisture level in paper, moisture bubbling temperature, insulation aging, overload capacity and cooling efficiency.

Following measurements shall be applied:

1. Gas Sensor: Fuel cell type sensor behind a gas permeable membrane in contact with mineral transformer insulating oil through a flooded manifold, measurement range 0-2000 ppm (volume/volume, H₂ equivalent), sufficient measurement accuracy and sensitivity for H₂, CO, C₂H₂, C₂H₄ concentration,
2. Moisture Sensor: thin film capacitive type sensor immersed in mineral insulating oil through a flooded manifold, measured range 0-100% RH with sufficient accuracy

Each DGA shall have a display with Keypad, digital communications for local and remote system, gas and moisture level and trend data output, local alarm for gas and moisture, service in different configurations. Remote connection for monitoring thru the SCADA system shall be provided for each transformer.

Control and Terminal Cabinets, Wiring

This cabinet shall be accessible from ground level and be provided with a door for front access, handles locking facilities (key locks), heaters, internal lighting and electrical outlet on separate conduits.

All secondary wiring used on each transformer shall be carried out in suitably supported galvanized steel conduits or metal protective channels (bows and branches must be open) and brought to an adequately dimensioned terminal cabinet with sealed cover or equivalent design.

All cabling or wiring shall terminate in terminal blocks located in the cabinets described above. Two rows of terminal blocks shall be available arranged opposite each other, one for the external cables and one for the transformer cables. The wiring and terminal blocks shall be neatly grouped and arranged to permit connection with minimum number of external cables.

25. RATING AND CONNECTION PLATE

Each transformer shall be provided with anodized aluminium laser engraved nameplate, in accordance with IEEE C57.12 - Nameplate A and C as necessary.

The following plates, or an approved combined plate, shall be fixed to each transformer tank at an average height of 1500 mm above the ground level:

1. A rating plate bearing the data specified in IEC 60076 Part 1. This plate shall also include the short circuit current rating, measured no load current and no-load losses at rated voltage and frequency, measured load losses at 75° C (normal tap only) and D.C resistance of each winding at 75° C.
2. A diagram plate showing in an approved manner, the internal connections, and the voltage vector relationship of the several windings, in accordance with IEC 60076 Part 1 with the transformer voltage ratio for each tap and, in addition, a plan view of the transformer giving the correct physical relationship of the terminals.
3. A plate showing the location and function of all valves and air release cocks or plugs. This plate shall also, if necessary, warn operators to refer to the Maintenance Instructions before applying vacuum.
4. Plates are to be of stainless steel or other approved material capable of withstanding the rigours of continuous outdoor service at site.

Additionally, Bidders shall ensure that the following attributes are indicated on the aforementioned nameplate and conform to the requirements of the section on Labels in this specification:

- standard to which it is manufactured and tested;
- identification of internal short-circuit and overload protection devices;
- type of cooling (ONAN);
- rated currents in A;
- chopped wave (short time) impulse voltage withstand level in kV;
- power frequency withstand voltage in kV;

- percentage impedance at 65°C;
- load loss in kW at rated current;
- no-load loss in kW at rated voltage and frequency;
- continuous ambient temperature at which ratings apply in °C (40);
- top oil and winding temperature rise at rated load in °C;
- winding connection diagram;
- total mass (core, windings, and oil) in kg;
- mass of core and windings in kg;
- volume of oil in litres;
- oil with less than 2ppm of PCB. The manufacturer shall test the oil to confirm that the oil contains less than 2ppm of PCBs and provide the test results to the Owner; and
- name of the purchaser (Property of Guyana Power & Light Inc.).

26. SURFACE TREATMENT

The transformer tank and all accessories shall be treated in accordance with IEEE C57.12. 29 to ensure enclosure and equipment integrity.

27. TESTS

All transformers shall be subjected to routine tests, as required in IEEE C57.12.00, as per section 8 and Table 18, including oil leakage tests, according to the relevant approved specifications at manufacturer's works. The transformers shall be subjected to pressure equal to the normal pressure plus 35 kN/m². This pressure shall be maintained for a period of not less than 48 hours during which no leakage whatsoever shall occur.

Tests shall also be conducted in accordance with the provisions of IEEE C57.12.91 and shall include, as a minimum, the following tests:

1. Ratio
2. Polarity
3. Phase Rotation
4. No-Load Loss
5. Excitation Current
6. Impedance Voltage
7. Load Loss
8. Applied Potential
9. Induced Potential
10. Impulse Test (typical data from previous unit is acceptable)
11. Temperature Test (typical data from previous unit is acceptable)
12. Sound Test (typical data from previous unit is acceptable)

The following routine measurements and tests shall be carried out and results shall be submitted to the Purchaser upon delivery:

- a) Measurement of winding resistance at the nominal and extreme tap positions for each transformer provided;
- b) Measurement of impedance;
- c) Measurement of no-load loss and no-load currents at full, 90% and 110% voltages;
- d) Induced overvoltage withstand test;
- e) Separate source voltage withstand tests on HV and MV windings;
- f) Magnetic balance test;

- g) Polarization Index Test. The index shall be not less than 1.5;
- h) Oil leakage test: The criterion of leakage shall be discolouration by oil of whitewash applied externally to suspected parts at an oil temperature of 90°C or other method approved by the Purchaser;
- i) Bushings and oil shall be subject to the following routine tests.
 - I. bushing routine tests
 - II. oil dielectric and moisture content test.

Routine test certificates shall include in addition to the test results, the Purchaser's order number, the transformers' serial numbers, outline drawing number and transformer kVA rating.

Upon acceptance of Tender, the Manufacturer/Proponent shall provide results of standard design type tests required in Table 18 of IEEE C57.12.00.

28.COMPLIANCE WITH SPECIFICATION

The transformer shall comply in all respects with the requirements of this specification. However, any minor departure from the provisions of the specification shall be disclosed at the time of tendering in the Non-Compliance Schedule in this document (see page 37).

29.COMPLIANCE WITH REGULATIONS

All the transformers/equipment shall comply in all respects with the Laws of Guyana Governing the Importation of Commercial Items and/or Goods.

The equipment and connections shall be designed and arranged to minimize the risk of fire and any damage that might be caused in the event of a fire.

30.QUALITY ASSURANCE, INSPECTION AND TESTING

30.1 General

To ensure that the supply and services are in accordance with the Specification herein, with the regulations of Guyana and with relevant authorized international standards, the Proponent shall

have in place suitable Quality Assurance Programmes and Procedures to ensure that all activities are being controlled and documented, as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002, as deemed appropriate by the Purchaser and the Proponent.

The systems and procedures that the Proponent will use to ensure that the supply complies with the specified requirements, shall be defined in the Proponent's Quality Plan.

The Proponent shall operate systems that implement the following:

Hold Point "A stage in the material procurement or workmanship process beyond which work shall not proceed without the documented approval of designated individuals or organisations."

The Purchaser's written approval is required to authorise work to progress beyond the Hold Points indicated in approved Quality Plans.

Notification Point "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness."

If the Purchaser's representative does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice, then work may proceed.

30.2 Quality Assurance System

Unless the Proponent's Quality Assurance System has been audited and approved by the Purchaser, a Quality Assurance System shall be submitted to the Purchaser for approval within a minimum of One (1) month from the placement of order, or such other period as shall be agreed with the Purchaser. The Quality Assurance System shall provide a description of the Quality Control System for the supply and shall, unless advised otherwise, shall include, but not limited to the following details:

1. The structure of the organisation;
2. The duties and responsibilities assigned to staff to ensure quality of work;

3. The system for purchasing, taking delivery and verification of the specifications of raw materials;
4. The system for ensuring the quality of workmanship
5. The system for control of documentation;
6. The system for the retention of records; and
7. The arrangement for the Proponent's internal auditing.

30.3 Quality Plans

The Quality Plans shall set out the activities in a logical sequence and, unless advised otherwise, shall include, but limited to the following:

1. An outline of the proposed programme sequence;
2. The duties and responsibilities assigned to staff ensuring the quality of work;
3. Hold and notification points;
4. Submission of engineering documents required by the specification;
5. The inspection of materials and components on receipt;
6. Reference to the Supplier's procedures appropriate to each activity;
7. Inspection during fabrication and assembly; and
8. Final inspection and test.

30.4 Inspection and Testing

The Purchaser shall have free entry at all times, while work on the order is being performed, to all parts of the manufacturer's working area which are in relation to the processing of the transformers ordered. The Manufacturer/Proponent shall afford the Purchaser without charge, all

reasonable facilities to assure that the transformers being furnished are in accordance with the specifications herein.

The equipment shall have successfully passed all tests as described in Section 24 (see page 232).

The Purchaser reserves the right to reject an item of the transformer if the test results do not comply with the values specified herein.

Tests, including any retests required, shall be carried out by the Supplier at no extra charge, at the manufacturer's works.

Full details of the proposed methods of testing, including connection diagrams, shall be submitted to the Purchaser by the Supplier for approval, at least one month before testing.

All costs in connection with the testing, including any necessary re-testing, shall be borne by the Manufacturer/Proponent.

Any cost incurred by the Purchaser in connection with inspection and re-testing as a result of the failure of the transformer or any of its components under test or damage during transport or offloading shall be to the account of the Proponent.

The Proponent shall submit to the Purchaser three signed copies of the test certificates, giving the results of the tests as required. No materials shall be dispatched until the test certificates have been received by the Purchaser and the Proponent has been informed that they are acceptable.

The test certificates must show the actual values obtained from the tests, in the units used in this specification, and **not** merely confirm that the requirements have been met.

No inspection or lack of inspection or approval by the Purchaser's Representative of equipment or materials whether supplied by the Proponent or a Sub-Proponent, shall relieve the Proponent from his/her liability to complete the contracted works in accordance with the contract would exonerate him/her from any of his/her guarantees.

30.5 Guarantee

The Proponent shall guarantee the following:

- Quality and strength of materials used;
- Satisfactory operation during the guarantee period of one (1) year from the date of commissioning, or 18 months from the date of acceptance of the equipment by the Purchaser following delivery, whichever is the earlier. The Purchaser shall advise the Proponent of the date of commissioning;
- Performance figures as supplied by the Proponent in the Technical Data Schedule, the guaranteed copper and iron losses and other particulars;
- The offered surface treatment shall protect the treated metal from corrosion for a period of not less than ten (10) years from the date of delivery.

31. SPARE PARTS AND SPECIAL TOOLS

The Proponent shall provide a list of recommended spare parts and their individual prices and shall include HV and MV bushings. This list shall identify all essential spares and consumable items for any recommended maintenance for a period of five (5) years after commissioning.

The Purchaser may order all or any of the spares parts listed at the time of placement of order.

A spare parts catalogue with price list shall be provided and this shall form part of the drawings and literature to be supplied with the bid.

The Proponent shall give an assurance that spare parts and consumables will continue to be available through the life span of the equipment/transformers, which shall be 25 years minimum. However, the Proponent shall give a minimum of 12 months' notice to the Purchaser, in the event that the Proponent or any Sub-supplier, plan to discontinue manufacturing of any component used in the transformers.

Any spare apparatus, parts or tools shall be subjected to the same specification herein, tests and conditions as similar main material supplied. They shall be strictly interchangeable and

suitable for use in place of the corresponding parts supplied with the mobile substation and must be suitably marked and numbered for identification.

Spare parts shall be delivered suitably packaged and treated for long periods in storage. Each package shall be clearly and indelibly marked with its contents, including a designation number corresponding to the spare parts lists in the operation and maintenance instructions.

32. PACKING, SHIPPING AND DELIVERY

32.1 Delivery

The Supplier shall ensure safe transit from the Manufacturer's works to designated Warehouse and shall be responsible for all associated costs and expenses, including off-loading, delivery, and insurance.

Customs Clearance and Delivery from such Designated Warehouse to Site shall be carried out by GPL at their expense.

32.2 Delivery Documentation

Delivery Documentation shall include the following, at a minimum:

- a clearly defined delivery docket number
- supplier's name;
- contract number / order no.
- quantity of material, description, and GPL Item No.
- packing list

A packing list in a sealed waterproof envelope shall accompany each case/drum or other delivery configuration.

Two copies of each packing list shall be sent to the Purchaser prior to dispatching the equipment/material.

32.3 Marking of Items

Each item/package shall be indelibly marked, on two sides - with the following:

- individual serial number;
- purchaser's name;
- contract number / order no.
- supplier's name;
- manufacturer's name;
- country of origin;
- description of contents; or
- conductor/cable details and length on drum
- case/drum measurements;
- gross and net weights; and
- all necessary slinging and stacking instructions.

32.4 Delivery Schedule

Bidders shall state and guarantee a delivery time from the date of receipt of an official order for the transformer and spares.

33. LABELS

All apparatus shall be clearly labelled indicating, where necessary, its purpose and service positions.

The material of all labels and plates, their dimensions, legend, and the method of printing shall be subject to the approval of the Purchaser.

Colours shall be permanent and free from fading. All labels and plates for outdoor use shall be of non-corrosive material.

They shall be engraved in English. Nameplates shall carry all the applicable information specified in the applicable items of the Standards and other details as required in this specification. No scratching, corrections or changes will be allowed on nameplates.

Wherever possible the equipment shall carry the markings "**THIS EQUIPMENT IS PROPERTY OF GPL Inc.**".

34. DECALS

"Danger Do Not Open" decal on exterior transformer doors

"Danger Do Not Touch" decal on interior transformer doors

Typical decals shown in Appendix A.

35. GUARANTEE

The Supplier shall provide a guarantee which shall include the following:

- Satisfactory operation during the guarantee period of 24 months from the date of commissioning or 30 months from the date of shipment;
- Performance figures as supplied in the Technical Schedule; and
- No need for maintenance renewal of Corrosion Protection for at least five years from the date of delivery.

36. SUBMITTALS REQUIRED WITH THE BID

The following shall be required in duplicate of three (3) copies:

1. completed technical data schedule for each type and rating of the transformer;
2. descriptive literature giving full technical details of equipment offered;
3. Outline dimension drawings for each major component, general arrangement drawing showing component layout and general schematic diagrams;

4. type test certificates, where available, and sample routine test reports for each type and rating of the transformer;
5. summary reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating;
6. details of manufacturer's quality assurance standards and programme and ISO 9000 series or equivalent national certification;
7. deviations from this specification. Only deviations approved in writing before placement of order shall be accepted; and
8. list of recommended spare parts and consumable items for five years of operation with prices and spare parts catalogue with price list for future requirements.

36.1 DRAWINGS/DOCUMENTS:

The following particulars shall be submitted with the Bid

1. General outline drawing showing shipping dimensions and overall dimensions, net weights and shipping weights, quality of insulating oil, location of coolers, marshalling box and tap changers etc.;
2. Assembly drawings of core, windings etc. and weights of main components/parts;
3. Height of centre line on HV and LV connectors of transformers from the rail top level;
4. Dimensions of the largest part to be transported;
5. GA drawings/details of various types of bushing;
6. Tap changing and Name Plate diagram;
7. Type test certificates of similar transformers;
8. Illustrative & descriptive literature of the Transformer and
9. Maintenance and Operating Instructions.

37. SUBMITTALS AFTER CONTRACT AWARD

A. Technical Folders – Hard Copy

The Purchaser shall nominate items of equipment for which the Supplier shall provide two bound Folders of Technical Particulars. Information in respect of each nominated item shall include the following, insofar as applicable:

1. Descriptive literature giving full technical details;
2. Detailed dimensioned drawing;
3. Installation, Commissioning and Operation and Maintenance Instructions;
4. Manufacturers Recommendations regarding spares:
 - a. Commissioning spares
 - b. O&M parts.
 - c. Special tools and equipment required for erection, commissioning, and maintenance.
5. A Schedule of all special tools and equipment required for erection, commissioning, and maintenance of the equipment.
6. Calculations validating the Design (If requested by the Purchaser)
7. Technical data schedule, with approved revisions
8. Inspection and test reports carried out in the manufacturer's works;

Such folders shall be subject to approval by the Purchaser, who shall reserve the right to call for additional information/data, if in his/her opinion such is required.

B. Technical Folders – Electronic Version

Suppliers shall provide an Electronic Version of the Technical Folders in addition to the hard copy.

C. Drawings and Documentation

1. Schedule for the Production of Drawings

Within 10 days of placement of order, the Supplier shall submit for approval by the Purchaser, a schedule of the drawings to be produced. The schedule shall also provide a program of drawing submittals.

2. Drawings and Document Formats

All detail drawings submitted for approval shall be to scale not less than 1:20. All the important dimensions shall be given and the material of which each part is to be constructed shall be indicated on the drawings. All documents and drawings shall become the property of the Purchaser.

All drawings and calculations, submitted to the Purchaser, shall be on international standard size paper, A0, A1, A2, A3 or A4. All such drawings and calculations shall be provided with a contract title block, which shall include the name of the Purchaser and shall be assigned a unique drawing number.

Lettering sizes and thickness of lettering and lines be selected so that if reduced by two stages to one quarter of their size, the alphanumeric characters and lines are still perfectly legible so as to enable them to be microfilmed.

For presentation of design drawings and circuit documents, IEC Publication 60617 or equivalent standards for graphical symbols are to be followed.

3. Approval Procedures

The Supplier shall submit all drawings, documents, and type test reports for approval in sufficient time to permit modifications to be made if such are deemed necessary and re-submit them for approval without delaying the initial deliveries or completion of the supply. The Purchaser shall endeavor to return them within a period of two weeks from the date of receipt.

Three copies of all drawings shall be submitted for approval and three copies for any subsequent revision. The Purchaser reserves the right to request any further additional information/data that may be considered necessary in order to fully review the drawings. If the Purchaser is satisfied with the drawing, one copy will be returned to the Supplier marked with "Approved" stamp. If the Purchaser is not totally satisfied with the drawing, then "Approved Subject to Comment" status will be given to it and a comment sheet will be sent to the Supplier.

If the drawing submitted does not comply with the requirements of the specification, then it will be given “Not Approved” status and a comment sheet will be sent to the Supplier. In both these cases the Supplier will have to modify the drawing, update the revision column and resubmit for final approval. Following approval, ten copies of the final drawings will be required by the Purchaser.

Any drawing or document submitted for information only should be indicated as such by the Supplier. Drawings and documents submitted for information only will not be returned to the Supplier unless the Purchaser considers that such drawing needs to be approved, in which case they will be returned suitably stamped with comments.

The Supplier shall be responsible for any discrepancies or errors in or omissions from the drawings, whether such drawings have been approved or not by the Purchaser. Approval given by the Purchaser to any drawing shall not relieve the Supplier from his liability to complete the supply in accordance with this specification and the conditions of contract nor exonerate him from any of his guarantees.

4. Electronic Versions of the Drawings & Documentation

Electronic versions of drawings and documentation shall be provided.

14. COMPLETENESS OF SUPPLY

All accessories or fittings not specifically mentioned in the Specification, but which are necessary or usual for similar equipment and for its efficient performance shall be included in the Bid along with full details and price. The attention of the Purchaser should be drawn to it.

38. NON-COMPLIANCE SCHEDULE

On this schedule, the Proponent shall provide a list of non-compliance with this specification, documenting the effects that such non-compliance is likely to have on the transformer/equipment/component life span and operating characteristics. Each non-compliance shall be referred to the relevant specification clause.

Clause No.	Non-Compliance
------------	----------------

39. TEST CERTIFICATE SCHEDULE

On this schedule, a list of the test certificates shall be included with the bid. This list shall include the certificates for the type tests and sample routine test reports. Each certificate listed shall be referred to the relevant specification clause.

Clause No.	Type Test Certificate or Routine Test Report
-------------------	---

40. TECHNICAL DATA SCHEDULE FOR 60 MVA, 13.8/69KV THREE PHASE POWER TRANSFORMER

For submission(s) to be evaluated, Proponent **MUST** complete the form below.

Item No.	Description	Unit	GPL	Bidder
1	Rated Power (kVAn - ONAN Rated)	kVA	60,000	Bidder to state.
2	Rated Frequency	Hz	60	Bidder to state.
3	Rated Primary Voltage	kV	69	Bidder to state.
4	Rated Secondary Voltage	V	13,800	Bidder to state.
5	Number of Phases		3	Bidder to state.
6	Transformer Type		Oil Immersed	Bidder to state.
7	HV – LV Vector Group		YNd11	Bidder to state.
8	Cooling Type		ONAN	Bidder to state.
9	No. of Tap Positions/Steps	No.	13	Bidder to state.
10	Max Tap Position (above nominal)	%	5	Bidder to state.
11	Min Tap Position (below nominal)	%	-10	Bidder to state.
12	Tap Steps	%	1.25	Bidder to state.
13	Magnetic Flux Density (one minute at normal tap) (20% overvoltage at 95% of rated frequency)	Tesla	1.5	Bidder to state.
14	No Load Current	A	(1% to 2%) x In	Bidder shall provide specific value.
15	No-load Loss at Nominal Tap Position and Rated Primary Voltage	kW	(0.08% to 0.1%) x kVAn x 0.8	Bidder shall provide specific value.
16	Load Loss at Nominal Tap Position and Rated Load Current	kW	(0.38% to 0.48%) x kVAn x 0.8	Bidder shall provide specific value.
17	Voltage Regulation at Full Load and Power Factor of 1	%	≤1	Bidder shall provide specific value.
18	Voltage Regulation at Full Load and Power Factor of 80%	%	<1.25	Bidder shall provide specific value.
19	Rated Short-circuit withstand Current (HV side/ MV side)	kA	40/65	Bidder to state.
20	Rated Short-circuit Current withstand duration (both sides)	s	10	Bidder to state.
21	Impedance measured at 65 °C and nominal tap position	%	13.3 to 14.22	Bidder shall provide specific value.

Item No.	Description	Unit	GPL	Bidder
22	X/R Ratio	%	18.6	Bidder shall provide specific value.
23	Type of Winding material on HV Side (Copper is the preferred material type)	...	Copper	Bidder to state.
24	Type of Winding material on LV Side (Copper is the preferred material type)	...	Copper	Bidder to state.
25	Connections - HV windings		Wye with neutral	Bidder to state.
26	Connections - MV windings		Delta	Bidder to state.
Transformer Oil				
27	Oil type		Class 1 mineral oil conforming to ASTM D3487	Bidder to state.
28	Dielectric strength of the oil	kV	>40	Bidder shall provide specific value.
Overloading				
29	Duration of 25% Overload at Service Conditions	minutes	180	Bidder to state.
30	Duration of 50% Overload at Service Conditions	minutes	90	Bidder to state.
Temperature Rise				Bidder to state.
31	Design maximum outdoor temperature	°C	40	Bidder to state.
32	Design continuous ambient temperature	°C	35	Bidder to state.
33	Minimum ambient temperature	°C	15	Bidder to state.
34	Maximum temperature rise over ambient temperature:			Bidder to state.
	a) In oil by thermometer	°C	65	Bidder to state.
	b) In winding by resistance measurement	°C	65	Bidder to state.
	c) Limit for hot spot temperature for which the transformer is designed	°C	<80	Bidder shall provide specific value.
	d) Temperature gradient between windings and oil	°C	20	Bidder to state.
	e) Type and details of winding hot spot temperature detector		Resistance temperature detector	Bidder to state.
	f) Type of maximum winding temperature indicator		analog/ digital	Bidder to state.
35	Average Winding Temperature Rise	°C	65	Bidder to state.
36	Maximum Winding Temperature Rise	°C	105	Bidder to state.
General Transformer Data				
37	Manufacturer	...		Bidder to state.

Item No.	Description	Unit	GPL	Bidder
38	Type		double wound, sealed type, oil immersed with natural oil cooling	Bidder to state.
39	Operating flux density	Tesla	1.5	Bidder to state.
40	Manufacturer's data sheet supplied	YES/NO	YES	Bidder to state.
	Windings/Coils			
41	Conductor for HV Winding - Manufacturer/Supplier			Bidder to state.
42	Conductor Material for HV Winding		Copper	Bidder to state.
43	Conductor for MV Winding - Manufacturer/Supplier			Bidder to state.
44	Conductor Material for MV Winding		Copper	Bidder to state.
	Bushings & Terminals			
45	Type of bushing insulator - HV		porcelain	Bidder to state.
46	Type of bushing insulator - MV		porcelain	Bidder to state.
47	Type of bushing insulator - Neutral		porcelain	Bidder to state.
48	Voltage rating HV Bushing	kV	72.5	Bidder to state.
49	Voltage rating MV Bushing	kV	15	Bidder to state.
50	Current rating HV Bushing	A	2 x In of transformer	Bidder shall provide specific value.
51	Current rating MV Bushing	A	2 x In of transformer	Bidder shall provide specific value.
52	HV Bushing BIL	kV	350	Bidder to state.
53	HV Busing Power Frequency withstand Voltage - Dry	kV	160	Bidder to state.
54	HV Busing Power Frequency withstand Voltage - Wet	kV	140	Bidder to state.
55	Type and Metal used in HV Terminal			Bidder to state.
56	MV Busing Power Frequency withstand Voltage - Dry	kV	36	Bidder to state.
57	MV Busing Power Frequency withstand Voltage - Wet	kV	30	Bidder to state.
58	Type and Metal used in MV Terminal			Bidder to state.
59	Type and Metal used in Earth Terminal			Bidder to state.
60	Busing Type		outdoor type and easily replaceable	Bidder to state.
61	Creepage Distance (minimum) line to line	mm/kV	25	Bidder to state.
62	Creepage Distance (minimum) line to ground	mm/kV	44	Bidder to state.

Item No.	Description	Unit	GPL	Bidder
Bushing Clearance				
63	Minimum phase to phase clearance HV	mm	700	Bidder to state.
64	Minimum earth to phase clearance	mm	700	Bidder to state.
65	Minimum phase to phase clearance MV	mm	200	Bidder to state.
66	Spring and lock washer included	YES/NO	YES	Bidder to state.
Tap Changer				
67	Tap Changer Catalogue Details Attached	YES/NO	YES	Bidder to state.
68	Can the Tap Changer switch be Locked	YES/NO	YES	Bidder to state.
Details of CT in the Bushing to be provided :				
69	MV CT		2000:5 0.5/5P20 20VA/20VA	Bidder to state.
70	HV CT		600:5 0.5/5P20 20VA/20VA	Bidder to state.
71	HV - Neutral CT		200:5 0.5/5P20 20VA/20VA	Bidder to state.
Tank				
72	Tank material		construction steel	
73	Thickness of the metal sheet	mm	≥11	Bidder shall provide specific value.
74	Painting method details attached	YES/NO	YES	Bidder to state.
Tank (for information purposes only)				
75	Tank Width	mm		Bidder to state.
76	Tank Height	mm		Bidder to state.
77	Tank Dept (length)	mm		Bidder to state.
78	Weight of Core and Windings	kg		Bidder to state.
79	Weight of Tank	kg		Bidder to state.
80	Weight of Oil at 20 °C	kg		Bidder to state.
81	Total weight of Transformer without oil	kg		Bidder to state.
82	Shipping weight of Transformer	kg		Bidder to state.

Name:.....

Affix Company
Seal Below

Signature:.....

Date:.....

APPENDIX A (Decals)

Danger, Do Not Open



End of Technical Specification



Technical Specifications for Indoor 69kV/13.8kV Transformer Circuit Breaker Protection & Control Panel

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1. SCOPE

This specification covers the design, engineering, manufacture, testing, supply and performance requirements of the indoor 69 kV Transformer Circuit Breaker protection and control panels for use in substations within the Guyana Power & Light Inc. (GPL).

2. APPLICABLE STANDARDS

Except where modified by this specification, the indoor transformer circuit breaker control panels shall be designed, manufactured and tested in accordance with the latest editions of the following standards in Table 1. The bidder may propose alternative standards, but shall demonstrate that they give a degree of quality and performance equivalent to or better than the referenced standards herein.

Acceptability of an alternative standard is at the discretion of the Purchaser.

The Bidder shall furnish a copy of the alternative standard proposed along with the bid. If the alternative standard is not written in the English Language, a certified English Language translated version of the original standard shall be submitted with the bid.

Table 4: Applicable Standards

Item No.	ANSI/IEC Standards	Title
1	IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
2	IEC 60332	Tests on electric and optical fibre cables under fire conditions
3	IEEE 37.113	Guide for Protective Relay Applications to Transmission Transformers
4	IEEE C37.119	Guide for Breaker Failure Protection of Power Circuit Breakers
5	IEEE C37.104	Guide for Automatic Reclosing of Circuit Breakers for AC Distribution and Transmission Transformers
6	IEC 60228	Conductors of Insulated Cables
7	IEC 60255	Measuring relays and protection equipment
8	IEC 61850	Communication Protocols for Intelligent Electronic Devices at Electrical Substations

In case of conflict, the order of precedence shall be:

- This Technical Specification



- IEEE or IEC Standards



3. INSTALLATION/SERVICE CONDITIONS

The installation conditions of the indoor transformer control panels shall be as follows:

- Maximum altitude above mean sea level < 1,000 m;
- Maximum ambient air temperature 40°C;
- Maximum daily average ambient air temperature 34°C;
- Minimum ambient temperature 18°C; and
- Maximum relative humidity 99.9%.

All materials, components and equipment shall be designed and protected for use in heavily polluted and salty, corrosive, and humid tropical coastal, saline atmospheric conditions.

4. ELECTRICAL SYSTEM CONDITIONS

The indoor transformer control panels shall be suitable for installation within GPL's Power System that has the following characteristics as shown in Table 2.

Table 5: Characteristics of GPL's Power System

Nominal System Voltage, Frequency and Phase	Three Phase Low Voltage Supply (LV)	0.48 kV, 60 Hz, 3φ-4-wire, Wye
	Single Phase Low Voltage Supply	220 VAC, 60Hz, single phase 2-wire
	Special Purpose Supply	Regulated and filtered 125 VDC
Voltage Class – Low Voltage Side	1 kVac	

5. TYPE OF CIRCUIT BREAKER PANELS

The circuit breaker protection and control panels shall be indoor type, coated and folded mild steel panels.

6. OPERATION AND DESIGN LIFE

The protection and control panel shall be designed for a minimum lifespan of 25 years. The equipment contained within the panel shall be suitable for a minimum lifespan of 15 years with normal continuous operation and without the need for maintenance at full load for 24 hours per day, 365 days per year under the climatic conditions detailed in this specification. All equipment shall be designed to perform this duty safely, effectively and reliability.

7. CABLING, WIRING AND EQUIPMENT GENERAL ARRANGEMENT



Equipment/Components in the control panel shall be arranged to allow adequate space for the installation and termination of all internal and external wiring. There shall be a suitable amount of space between the internal components to allow easy access for maintenance on the equipment, including the removal of failed equipment/component without the need to disassemble adjacent equipment.

All cabling and wiring shall be accessible. All wiring shall be one continuous length from terminal to terminal. Splicing, jointing, or teeing shall not be permitted.

Electronic protection equipment requiring connections to AC supply, current transformers, voltage transformers, and the like, shall, wherever possible, be directly connected to such equipment.

A minimum of 75 mm shall be maintained between each terminal row and any cable ducts to provide sufficient clearance for fanning of conductors for termination and for affixing ferrules for wire identification.

Equipment shall be mounted on a gear tray and not directly to the external metalwork of the enclosure in such a manner so that all equipment can be removed without unbolting the gear tray. Self-tapping screws for fixing equipment to gear trays is not accepted.

All terminal types shall be mounted on DIN rails that are attached to a gear tray, with the open side of the terminals facing upwards. DIN rails shall be single, continuous lengths extending the full length between wiring ducts.

Where practical, all field cables shall be terminated on the same side of the terminal blocks within an enclosure. Terminal strips shall be mounted vertically to facilitate ease of cable termination and identification of terminals. Terminals for the connection of field cables shall be located as close as practical to the point of entry of the cable into the enclosure.

8. CABLING AND WIRING CONFINEMENT

All cabling and wiring within the enclosures shall be neat, firmly secured and enclosed within PVC cable ducts. Wiring looms or spiral wraps shall not be permitted except for wiring connections to hinged equipment (doors etc) and braided conductor for grounding. Ensure minimum clearance of 100 mm is maintained between cable ducting and gland plates.

The use of terminations as the only means of wiring support is not permitted. Self-adhesive wiring supports shall not be used. Cable ducts shall be side slotted PVC and shall have positive continuous (or clamping) edges on both the wiring channel and the cover. PVC ducts shall be sized such that their cross-sectional area utilisation factor does not exceed



60%. All wiring within a cable duct shall be well insulated for the highest voltage within the cable duct.

9. CABLE AND WIRE DETAIL

1. All wiring and cabling shall be low smoke emission, halogen free, stranded flexible tinned copper conductor and be flame retardant in accordance with the requirements of IEC60332;
2. All panel wires shall be multi-stranded single core copper 0.6/1 kV PVC insulated with a minimum cross-sectional area of 1.0 mm² for instrumentation, 1.5 mm² for control and minimum of 2.5mm² for power wiring;
3. CT wiring shall be sized against the related CT burden and shall have a minimum cross-sectional area of 4.0 mm²;
4. Multi-pair cables with multi-strand 0.5 mm² conductors shall be permitted for wiring to control system high density I/O modules within enclosures;
5. For telecommunications applications, wiring shall be minimum of 0.4mm² (or 22 AWG); and
6. Plugs and cables supplied with standard equipment items shall not be modified and shall be installed in the protection and control panel as per the manufacture's recommendation.

10. WIRE INSULATION COLOUR CODING

Table 2: Wire Insulation Colour

Description		Required Colour
AC 3 Phase Power	A Phase	Red
	B Phase	Yellow
	C Phase	Blue
	Neutral	Black
AC CT&PT	A Phase	Red
	B Phase	Yellow
	C Phase	Blue
	Neutral	Black
Earth		Green & Yellow Stripes

11. WIRE NUMBERING

1. Panel wiring shall be numbered at each end with the wire numbers as detailed on the schematic and wiring diagrams;



2. All alpha-numeric characters used for wire numbering shall be in English;
3. Wires shall be marked using indelibly printed ferrules in transparent plastic push-on ferrule holders and shall be clearly read without moving the ferrule holder;
4. Wires connected directly in series or parallel shall have the same ferrule number, all wires shall be uniquely numbered. Ferrules shall be arranged to read from left to right and from bottom to top;
5. Ferrules and holders shall be unaffected by moisture;
6. Ferrules shall require disconnection of the wire to remove the ferrule;
7. Ferrule holders shall be sized to suit the wire and shall not rotate freely around the wire;
8. Wire numbers shall not change across terminals for wiring within the control panel; and
9. When wiring numbers change (i.e., at connections between equipment) a clear system of coding is to be used at the change point and details shall be clearly marked on the drawings.

12.DOOR WIRING

1. Flexible wiring shall be provided to equipment mounted on doors or similar hinged moving equipment;
2. The wiring loom shall be clamped to keep the loom in position and to prevent any strain or rubbing of the wiring for the full travel of the door; and
3. Spiral wrap, split tubing or similar shall be installed to provide mechanical protection for door wiring looms.

13.LABELLING AND IDENTIFICATION

All equipment within the control panel enclosure shall be clearly labelled for positive identification with the design documentation.

Every exterior and interior device, including terminals, terminal strips, fuses, switches, test blocks, indication lamps, relays, and other equipment, shall be identified by a label fixed near the device and oriented so that it is readable from the appropriate access door. The label shall include a unique alphanumeric identification code. Equipment labels shall be fixed in such manner that they are not obstructed from view by panel wiring.

Label colouring shall be:

- Internal labels: White/Black engraved ABS PLASTIC to the label schedule.



- Warning labels: Red/Yellow engraved ABS PLASTIC to the label schedule.
- Emergency Stop pushbutton labels: shall have yellow ring with black lettering.

14.EARTHING

1. All parts of the control panel which must be earthed shall be effectively connected to the control panel earth bar. All earth conductor connections to the earth bar shall be secured with two screws. Screw holes shall be drilled and tapped. The earth bar shall be provided with suitable termination facilities for the connection of the earth conductors on all incoming and outgoing cables and shall be provided in each terminating zone;
2. The earth bar shall be colour-coded with green/yellow bands at maximum 300 mm intervals. The earth bar shall be tapped and fitted with bolts, washers, and spring washers to accommodate the earth connections for all incoming and outgoing cables;
3. All metal parts of the control panel shall be bonded to the control panel earth bar;
4. All doors fitted with control and/or indicating equipment shall have an independent flexible earth strap with mounting bolt and nut, or stud welded to the door;
5. All secondaries of current transformers shall have one lead earthed; and
6. All metal cases of instruments, relays, selector switches, etc. shall be connected by an unbroken insulated earth wire of minimum size 2.5 mm² to the earth bar. The earthing connections shall be arranged so that removal of one component shall not affect continuity of the earthing conductor associated with any other component. Earth conductor insulation shall be coloured green/yellow.

15.ENCLOSURE

Indoor control panels shall be minimum IP54 or in accordance with IEC 60529 and completely self-supporting fully welded rigid structure, constructed from formed zinc annealed mild sheet steel, of minimum thickness 2.0 mm, free from rust, dents, and any surface defects.

16.ENCLOSURE DIMENSIONS

The enclosure shall have the following dimensions:

Width: 800 mm; Depth: 600 mm; Height: 2200 mm

17.DOORS

Doors shall be constructed from formed zinc annealed mild sheet steel, of minimum thickness 1.6 mm, free from rust, dents, and any surface defects. Door sealing shall be



achieved by 120 degree return on case, sealing against neoprene gasket glued to the inside of the door.

Stiffeners shall be fitted to all doors as needed. Doors shall open a minimum of 100 degrees for full equipment access and shall be fitted with door stays.

All doors shall be fitted with chrome plated pintle hinges.

18. VENTILATION

All panels shall be equipped with natural ventilation. The maximum temperature inside the panel shall not exceed the maximum temperature rating specified by the component manufacturers.

Air intake and exhaust outlets shall be provided with mesh screens and air filters to prevent vermin ingress with screens and filters removable for cleaning. Screens and vents must be removable from inside the enclosure without need to unbolt the gear tray or remove equipment from the gear tray to gain access. External metal hoods shall be provided to vents and air intakes to maintain IP rating of the enclosure.

19. GLAND PLATES

Gland plates shall be single piece, 5 mm aluminium. Gland plates shall be sized for 50% spare cable access in future.

The gland plate shall be effectively earthed to the control panel earth bar.

20. EQUIPMENT MOUNTING

No items of equipment which is to be operated or viewed by an operator (pushbuttons, switches, and meters) shall be mounted more than 1900 mm or less than 400 mm above floor level. It shall not be necessary to open any door or remove any cover to operate or reset equipment that is required for normal operation.

No piece of equipment shall be mounted behind other equipment or in any manner denying free access for removal or maintenance.

Items of equipment or terminals shall be no closer than 300 mm measured vertically from outgoing gland plates.

21. TERMINATION OF CT AND VT CABLING

Test terminals and short circuiting disconnect links shall be provided in all on protection secondary circuits to facilitate secondary injection testing for CT circuits. These terminals shall be readily accessible and suitably protected with a removable clear shroud.



CT circuit wiring connected to circuits external to the enclosure shall be provided with captive-type shorting links at the outgoing terminal.

Test terminals shall be provided for VT circuits.

22. INDICATING LAMPS

1. Indicating lamps shall be flush mounted and designed so as not to rotate even if the retaining nut is not fully tightened. The fitting shall be secured to the panel independently of any bezel which needs to be removed for lamp changing;
2. The status of indication lamps shall be visible from a wide viewing angle;
3. Lamp holders and lenses shall be designed to dissipate the heat produced;
4. Lamps shall protrude from the front of the fitting far enough to be readily gripped with the fingers for change-out;
5. Lamp nominal voltages shall be at least 110% of their supply voltage. LV circuit lamps are not permitted;
6. Lamps shall be cluster LED type with internal voltage drop resistor; and
7. Colours for indicating lamps shall be:
 - Green: CB Open; and
 - Red: CB Closed.

23. PROTECTION RELAYS AND BAY CONTROL UNIT

The circuit breaker control panel shall contain transformer circuit breaker multifunction protective relaying in accordance with IEEE C37.113. Microprocessor-based three-phase relays shall be UL-Listed or UL-Recognized. All protection relays shall be mounted on the panel doors.

The relays and other bay control and supervisory units/devices shall be equipped for digital communications for local and remote system, gas and moisture level and trend data output, local alarm for gas and moisture, service in different configurations. Remote connection for monitoring thru the SCADA system shall be provided for the transformer.

Further, the bay control unit shall have provisions to perform at least the following functions from local or remote control thru the substation SCADA system:

1. Selection to operate under automatic voltage regulator mode or manual mode.
2. Settings of the reference voltage for the automatic voltage regulator mode.
3. Setting of the dead band for automatic voltage control.



4. Manual operation to increase or lower the taps.

The tap changer position shall be provided locally and remotely thru the SCADA system.

The 69 kV transformer circuit breaker protection relays shall at minimum have the following features:

The relays shall be Numerical Type Relay and shall provide, but not limited to the following protection functions:

1. Phase differential (87P);
2. Unrestrained differential (87U);
3. Negative sequence differential (87Q);
4. Ground differential (87N);
5. Ground differential (87) protection;
6. Under (27) and Over (59) Voltage;
7. Phase over current (50, 51) – with directional capability;
8. Ground over current (50 G/N, 51 G/N) – with directional capability;
9. Lockout auxiliary (86);
10. Over (81O) and Under (81U) frequency;
11. Three-phase non-directional overcurrent protection, high and low stage (50P and 51P);
12. Three-phase non-directional overcurrent protection, instantaneous stage (50P/51P);
13. Three-phase directional overcurrent protection, high and low stage (67/50P and 67/51P);
14. Non-directional earth-fault protection, low stage (51N-1);
15. Non-directional earth-fault protection, high stage (50G);
16. Non-directional earth-fault protection, instantaneous stage (50N/51N);
17. Directional earth-fault protection, low stage (67/51N);
18. Directional earth-fault protection, high stage (67/50N);
19. Admittance based earth-fault protection (21YN);
20. Wattmetric based earth-fault protection (32N);
21. Transient/intermittent earth-fault protection (67NIEF);
22. Harmonics based earth-fault protection (51NHA);



23. Non-directional (cross-country) earth fault protection, using calculated I_0 (51N-2);
24. Negative-sequence overcurrent protection (46);
25. Phase discontinuity protection (46PD);
26. Residual overvoltage protection (59/59N);
27. Three-phase undervoltage protection (27);
28. Three-phase overvoltage protection (59);
29. Positive sequence undervoltage protection (47U+);
30. Negative-sequence overvoltage protection (47);
31. Frequency protection (81);
32. Three-phase thermal protection (49F);
33. Binary signal transfer (BST);
34. Three-phase inrush detector (INR);
35. Switch onto fault (SOTF);
36. Master trip (86/94);
37. Multi-purpose protection (MAP);
38. Fault locator (21FL);
39. Transformer differential protection within zone power transformer (87L);
40. High impedance fault detection;
41. Current total demand distortion;
42. Voltage total harmonic distortion;
43. Voltage variation;
44. Voltage unbalance;
45. Circuit-breaker control (52);
46. Disconnecter control (29DS);
47. Earthing switch control (29GS);
48. Earthing switch indication (29GS);
49. Auto-reclosing (79) as per IEEE C37.104;
50. Synchronism and energizing check (25);



51. Breaker Failure (50BF) as per IEEE C37.119;
52. Annunciator Relay (30);
53. Rate-of-Change Frequency (81R);
54. Ac Directional Overcurrent Relay (67);
55. Synchronizing or Synchronism-Check Device (25);
56. Distance Relay (21);
57. Differential Protective Relay (87);
58. Arc protection;
59. The relays shall be IEC 61850 compliant. The relays shall be able to support either RJ 45, RS-485 or fibre-optic communications; and
60. Relays shall be capable of displaying an active mimic diagram.

The bay control unit shall have the following basic features:

1. Shall be IEC 61850 compliant. The bay control unit shall be able to support either RJ 45, RS-485 or fibre-optic communications.
2. Shall be capable of displaying an active mimic diagram.
3. Shall have Digital Inputs: For example, status input (important signal may be input by double point information), alarm signal, sequence of events record (SOE), pulse counter input, which are provided with the function of debounce.
4. Shall have remote control function: For normal operation, the equipment may accept the remote-control command from the master and perform as follows: control breakers and the switches around the circuit breaker; reset the transceiver and the operating instrument.
5. Shall have AC inputs for three phase voltage, three phase current.

24. RATING AND CONNECTION PLATE

Each transformer control panel shall be provided with anodized aluminium laser engraved nameplate. Additionally, bidders shall ensure that the following attributes are indicated on the aforementioned nameplate:

- Serial number;
- Standard to which it is manufactured and tested



- Year manufactured;
- Name of the purchaser (**Property of Guyana Power & Light Inc.**); and
- Any other relevant technical details.

Colours shall be permanent and free from fading. All labels and plates shall be of non-corrosive material, capable to withstanding the service conditions mentioned herein.

25. SURFACE TREATMENT

The circuit breaker control panel shall be made of an appropriate material or coated or treated to provide a durable finish which offers good corrosion protection, chemical/solvent resistance, and weathering to withstand the service conditions as indicated in section 3 above. In addition, the finish shall be highly resistant to discoloration and scratches. If paint or other coating is used, the circuit breaker control panel exterior shall be painted in ANSI grey colour and have a uniform appearance.

26. DRAWINGS

The supplier shall submit drawings for approval within 5 working days after notification of contract award.

27. TESTS

Supplier shall test and submit certified test reports in accordance with IEC 60255, IEC60332 and other applicable IEC and IEEE standards.

28. COMPLIANCE WITH SPECIFICATION

The circuit breaker control panel shall comply in all respects with the requirements of this specification. However, any minor departure from the provisions of the specification shall be disclosed at the time of tendering in the Non-Compliance Schedule in this document.

29. COMPLIANCE WITH REGULATIONS

All the equipment shall comply in all respects with the Laws of Guyana Governing the Importation of Commercial Items and/or Goods.

The equipment and connections shall be designed and arranged to minimize the risk of fire and any damage that might be caused in the event of a fire.

30. QUALITY ASSURANCE, INSPECTION AND TESTING

30.1 GENERAL



To ensure that the supply and services are in accordance with the Specification herein, with the regulations of Guyana and with relevant authorized international standards, the Proponent shall have in place suitable Quality Assurance Programmes and Procedures to ensure that all activities are being controlled and documented, as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002, as deemed appropriate by the Purchaser and the Proponent.

The systems and procedures that the Proponent will use to ensure that the supply complies with the specified requirements, shall be defined in the Proponent's Quality Plan.

The Proponent shall operate systems that implement the following:

Hold Point "A stage in the material procurement or workmanship process beyond which work shall not proceed without the documented approval of designated individuals or organisations."

The Purchaser's written approval is required to authorise work to progress beyond the Hold Points indicated in approved Quality Plans.

Notification Point "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness."

If the Purchaser's representative does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice, then work may proceed.

30.2 QUALITY ASSURANCE SYSTEM

Unless the Proponent's Quality Assurance System has been audited and approved by the Purchaser, a Quality Assurance System shall be submitted to the Purchaser for approval within a minimum of One (1) month from the placement of order, or such other period as shall be agreed with the Purchaser. The Quality Assurance System shall provide a description of the Quality Control System for the supply and shall, unless advised otherwise, shall include, but not limited to the following details:

8. The structure of the organisation;
9. The duties and responsibilities assigned to staff to ensure quality of work;
10. The system for purchasing, taking delivery and verification of the specifications of raw materials;
11. The system for ensuring the quality of workmanship
12. The system for control of documentation;



13. The system for the retention of records; and
14. The arrangement for the Proponent's internal auditing.

30.3 QUALITY PLANS

The Quality Plans shall set out the activities in a logical sequence and, unless advised otherwise, shall include, but limited to the following:

1. An outline of the proposed programme sequence;
2. The duties and responsibilities assigned to staff ensuring the quality of work;
3. Hold and notification points;
4. Submission of engineering documents required by the specification;
5. The inspection of materials and components on receipt;
6. Reference to the Supplier's procedures appropriate to each activity;
7. Inspection during fabrication and assembly; and
8. Final inspection and test.

30.4 INSPECTION AND TESTING

The Purchaser reserves the right to reject an item of the equipment if the test results or review of technical documentations provided do not comply with the details specified herein.

Prior to final approval the Manufacturer/Proponent shall afford the Purchaser without charge, all reasonable facilities, inclusive of additional technical documentations, to assure that the equipment being furnished are in accordance with the specifications herein.

Tests, including any retests required, shall be carried out by the Supplier at no extra charge, at the manufacturer's works.

Full details of the proposed methods of testing, including connection diagrams, shall be submitted to the Purchaser by the Supplier for approval, at least one month before testing.

All costs in connection with the testing, including any necessary re-testing, shall be borne by the Manufacturer/Proponent.

Any cost incurred by the Purchaser in connection with inspection and re-testing as a result of the failure of the circuit breaker control panel or any of its components under test or damage during transport or offloading shall be to the account of the Proponent.

The Proponent shall submit to the Purchaser three signed copies of the test certificates, giving the results of the tests as required. No materials shall be dispatched until the test certificates



have been received by the Purchaser and the Proponent has been informed that they are acceptable.

The test certificates must show the actual values obtained from the tests, in the units used in this specification, and **not** merely confirm that the requirements have been met.

No inspection or lack of inspection or approval by the Purchaser's Representative of equipment or materials whether supplied by the Proponent or a Sub-Proponent, shall relieve the Proponent from his/her liability to complete the contracted works in accordance with the contract would exonerate him/her from any of his/her guarantees.



31. NON-COMPLIANCE SCHEDULE

On this schedule, the Proponent shall provide a list of non-compliance with this specification, documenting the effects that such non-compliance is likely to have on the equipment/ component life span and operating characteristics. Each non-compliance shall be referred to the relevant specification clause.

Clause No.

Non-Compliance



32. TECHNICAL DATA SCHEDULE FOR INDOOR 69 kV TRANSFORMER CIRCUIT BREAKER PROTECTION AND CONTROL PANEL

Bidder **shall** complete the form below. Failure to complete the form below will automatically result in disqualification from the evaluation process. Bidder shall complete table below with specific data that is validated.

Item #	Description of Item	Unit	GPL	Bidder
Standard Compliance				
1	Compliance with IEC 60529 (Bidder must submit copy of certificate of compliance)	Yes/No	Yes	
2	Compliance with IEC 60332 (Bidder must submit copy of certificate of compliance)	Yes/No	Yes	
3	Compliance with IEEE 37.113 (Bidder must submit copy of certificate of compliance)	Yes/No	Yes	
4	Compliance with IEEE C37.119 (Bidder must submit copy of certificate of compliance)	Yes/No	Yes	
5	Compliance with IEEE C37.104 (Bidder must submit copy of certificate of compliance)	Yes/No	Yes	
6	Compliance with IEC 60228 (Bidder must submit copy of certificate of compliance)	Yes/No	Yes	
7	Compliance with IEC 60255 (Bidder must submit copy of certificate of compliance)	Yes/No	Yes	
8	Compliance with IEC 61850 (Bidder must submit copy of certificate of compliance)	Yes/No	Yes	
9	Compliance with Protection Relay Functions – Section 23	Yes/No	Yes	
Rating				
10	Voltage Class - low voltage	kV	1	
11	Nominal System Voltage (3 ϕ -4-wire, wye) - low voltage	kV	0.48	
12	Nominal System Voltage (single phase 2-wire) - low voltage	VAC	220	
13	Nominal System Voltage (special purpose supply)	VDC	125	
14	Rated Frequency	Hz	60	
15	Protection and Control Panel Lifespan	years	≥ 20	
Wire Insulation Colour Coding				
16	AC 3 Phase Power - A Phase		Red	
17	AC 3 Phase Power - B Phase		Yellow	
18	AC 3 Phase Power - C Phase		Blue	
19	AC 3 Phase Power - Neutral		Black	
20	AC CT&PT - A Phase		Red	
21	AC CT&PT - B Phase		Yellow	
22	AC CT&PT - C Phase		Blue	
23	AC CT&PT - Neutral		Black	



Item #	Description of Item	Unit	GPL	Bidder
24	Earth		Green & Yellow Stripes	
	Labelling and Identification			
25	Internal labels		White/Black engraved ABS PLASTIC	
26	Warning labels		Red/Yellow engraved ABS PLASTIC	
	Emergency Stop pushbutton labels		Yellow ring with black lettering	
27	Installation/Service Conditions			
	Designed and protected for use in heavily polluted and salty, corrosive, and humid tropical coastal saline atmospheric conditions	Yes/No	Yes	
28	Enclosures			
29	Min. protection degree of indoor control panel		IP54	
30	Thickness	mm	≥ 2	
31	Width	mm	800	
32	Depth	mm	600	
33	Height	mm	2200	
34	Minimum space between each terminal row and any cable duct	mm	75	
35	Equipment mounted on a gear tray	Yes/No	Yes	
36	All field cables terminated on the same side of the terminal blocks	Yes/No	Yes	
37	Self-tapping screws for fixing equipment to gear trays	Yes/No	No	
38	Cabling and wiring within the enclosures neat, firmly secured and enclosed within PVC cable ducts	Yes/No	Yes	
39	Minimum life span of enclosure	Years	25	
40	Minimum life span of equipment/component	Years	15	



33. SHIPPING

The Manufacturer/Proponent shall prepare the transformer control panel for shipping in such a manner as to protect from them from damage or deterioration during shipping and storage, and shall be responsible for, and make good, any and all damage due to improper preparation for loading, shipment, and storage.

The transformer control panel shall be shipped securely banded with a steel strap or approved synthetic strap to a pallet. The pallet shall be constructed to accept two fixed 195 mm forks spaced either 65mm or 320 mm apart. At least 90 mm clearance shall be provided under each pallet and the bottom of the pallet must not be fully covered in order to facilitate the use of pallet jacks.

End of Technical Specification



SCHEDULE 1.1.1 - SEGREGATED PRICES FOR LOT 1 – CANEFIELD SUBSTATION

ITEM NO.	DESCRIPTION	QUANTITY	RATE (USD)	TOTAL (USD)
1	Electrical, Civil and Building works inclusive of all foundations, concrete cable trenches, ducts, cable works and crushed stone layer for additional earthing works.	1		
2.	Supply and installation of New 69 kV switchyard/switchgear incl.of SF6 Circuit Breaker, DS with Earthing Switch, Single Phase PT and associated protection and control panel, metering equipment, UPS, DC systems as required, and accessories necessary for safe, efficient and reliable operation	1		
3.	Installation of a 60 MVA Power Transformer, neutral earthing transformers and associated equipment and all other transformer related works	1		
4	Cost of design, risk, lodging, site technical services, insurance, temporary facilities etc.	1		
	TOTAL			