Schedule C

Standard Specification

Power Transformer

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2022-03-24	0	Approved for Use	V. Lalonde	S. Fortier	S. Fortier
Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Approved By**
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1. General

1.1.1.1 This document shall be read as part of a complete Specifications package including St. Lucia Electricity Services Ltd. (LUCELEC) documents and other technical appendices:

- *Energy Storage System* Request for Proposal (RFP)
- *Battery Energy Storage System* Specification
- *Power Conversion System* Specification
- Power Transformer Specification
- *Energy Management System* Specifications
- Electrical Balance of Plant and Installation Specifications
- Site Works and Civil Balance of Plant Specifications
- Containerized Building Specification
- Packaging and Shipping Requirements

1.1.1.2 Following definitions will be used for this Specification:

a.) ***Balance of Plant*** or ***BOP*** – electrical and site works for the entire facility, excluding the *ESS* equipment and *PPCS*

b.) ***Battery Energy Storage System*** or ***BESS*** – A lithium-ion electrochemical storage device capable of delivering or absorbing electrical energy at its *DC Bus*

c.) ***Battery Management System*** or ***BMS*** – the control and monitoring system for the *BESS* designed to manage all internal bank functions and internal protection. The *BMS* shall communicate with the *PCS* and *PPCS*

d.) ***Battery Module***- An assembly of rechargeable battery cells with a convenient mechanical arrangement and a degree of protection

e.) ***Battery Rack*** – a free standing assembly of battery modules, integrated as part of an overall *BESS*

f.) ***Calendar Life*** – The expected number of calendar years that the battery is expected to last independent of charge and discharge cycles

g.) ***Contract*** – The agreement resulting from this RFP process

h.) ***Contractor***– the successful *Proponent* with whom the *LUCELEC* may enter into a *Contract*

i.) ***LUCELEC –*** St. Lucia Electricity Services Ltd.

j.) ***LUCELEC's Representative*** – The person appointed by the *LUCELEC* who has responsibility for managing the *Contract* and, unless *Contractor* is expressly advised otherwise, *LUCELEC's Representative* (1) has full authority to act on behalf of and bind the *LUCELEC*, and (2) may, in writing, delegate any or all of his or her authority to any other person

k.) ***Current Transformer*** or ***CT*** - an instrument transformer used to step down a measured current for metering, control or protection purposes

l.) ***DC Bus*** – the direct current connection between the *PCS* and *BESS* capable of carrying rated system power

m.) ***Depth of Discharge*** or ***DOD*** – the ratio of the amount of energy discharged from the *BESS* to the maximum dischargeable energy capacity of the *BESS*

n.) ***End of Life*** or ***EOL*** – the defined remaining *BESS* capacity as a percentage of the amount of initial *BESS* capacity at which the *BESS* system becomes not functional as initially designed

o.) ***Energy Storage System*** or *ESS* – - consists of a *Battery Energy Storage System (BESS)* and a *Power Conversion System (PCS)*

p.) ***Factory Acceptance Testing*** or *FAT* – performance testing of all equipment at the factory to ensure it meets the specifications and requirements prior to shipment to site

q.) ***Factory Integration Testing*** or ***FIT*** - performance testing at the factory of an integrated system, consisting of the *ESS, PCS* and *PPCS* to ensure interface between components is functional prior to shipment to site

r.) ***Input/Output*** or ***I/O –*** refers to the input or output signals associated with a control system or component of the control system such as a programmable logic controller.

s.) ***Inspection and Test Plan*** or ***ITP*** – the plan for managing the quality control and assurance of a particular the construction work providing information on the requirements, overview of the method(s) to be used, responsibilities of relevant parties, and documentary evidence to be provided to verify compliance

t.) ***Human Machine Interface*** or ***HMI*** – A user interface that serves as the main point of interaction between an operator of the battery plant and the settings, functions and commands associated with the plant

u.) ***Low Voltage Bus*** – the alternating current connection between the *PCS* inverter and the step-up transformer

v.) ***Power Conversion System*** or *PCS* – The Battery *PCS* is the power interface from the battery system to the AC electrical grid

w.) ***Proponent*** or ***Tenderer***– Each company receiving this *Request for Proposal*

x.) ***Proposal*** – Documents submitted by *Proponents* in response to this *RFP*

y.) ***Potential Transformer*** or ***PT*** - also known as a Voltage Transformer, an instrument transformer used to step down the main connection voltage for metering, control or protection purposes

z.) ***Programmable Logic Controller*** or ***PLC*** – A ruggedized industrial computer on which the core logic of the control system resides

aa.) ***Power Plant Control System*** or *PPCS* – the *Contractor* supplied power plant control system that communicates to the *PCS*

bb.) ***Primary Frequency Response*** or ***PFR –*** The first stage of frequency control in response to a disturbance on the power system frequency. Traditionally provided by fast acting governor systems.

cc.) ***Request for Proposal*** or ***RFP –*** This Request for Proposal including all attached and referenced documents and subsequent addenda

dd.) ***Remote terminal unit*** or ***RTU -*** A controller that interfaces with a physical system or sub-system of the plant and transmits information to the SCADA network.

ee.) ***Supervisory Control and Data Acquisition System*** or ***SCADA*** – the plant Supervisory Control and Data Acquisition system supplied by *LUCELEC*

ff.) ***SCADA Network*** – the communications network that facilitates the communication between *PLCs* and other networked components within the *BESS*

gg.) ***Site Acceptance Testing*** or ***SAT*** – performance testing of all installed equipment at site to ensure it meets the specifications and requirements and that there was no damage during shipment or installation

hh.) ***State of Charge*** or *SOC* – the ratio of present dischargeable energy storage capacity to maximum dischargeable energy storage capacity expressed either in percentage or MWh

ii.) ***Subcontractor –*** Any firm/individual that the *Contractor* may contract with to perform a portion or all of the *Work* and for which the *Contractor* assumes liability

jj.) ***System Control Center*** or ***SCC*** – The *LUCELEC* control center that dictates power system commands to distributed generators through the *LUCELEC SCADA*

kk.) ***Uninterruptible Power Supply*** or ***UPS*** - an electrical apparatus that provides emergency power to a load when the input power source or mains power fails.

ll.) ***Work*** or ***Supply –*** All or any part of the services and obligations required to be performed under the *Contract*.

1.1.1.3 This specification outlines the general requirements for the quality of materials and workmanship for the design, fabrication, assembly, factory acceptance testing, performance, delivery of a new *Power Transformer* to be used as part of a new *Energy Storage System (ESS)* to be installed in Vieux Fort, St. Lucia, beside the La Tourney Solar PV.

1.1.1.4 The work called for is subject to the purchase order documents. They include the Specification, the general conditions of contract, any specific conditions, and any other attachments, all of which form an integral part of the contract. The *Contractor* shall be responsible for and be governed by all requirements therein. **Any exceptions to this**

Specification shall be stated in writing by the *Contractor* and a suitable alternative can be priced as an option.

1.1.1.5 The supplied equipment shall be designed for continuous operation, and all components shall be of a robust, industrially proven design.

1.1.1.6 The *Contractor* supply shall include all components and accessories as required for the proper and safe operation of the complete system.

1.1.1.7 Compliance with this Specification does not relieve the *Contractor* of the responsibility to provide safe and reliable equipment. The *Contractor* shall have overall responsibility for the safety of the *ESS* design. Any areas of the *ESS* that pose a risk to the environment, personnel, or *LUCELEC*'s assets are to be clearly communicated to *LUCELEC* and its representative.

1.1.1.8 The equipment shall be complete in every aspect and ready to operate after installation and connection.

2. Codes and Regulations

2.1.1.1 The *Power Transformer* shall comply with all applicable provincial regulations and local codes for the federal, provincial, and local jurisdiction in which the *Power Transformer* are to be installed.

2.1.1.2 All electrical components shall meet all National Building Code, and National Electrical Code requirements and bear a recognized certification mark such as one of IEC, ANSI, UL, FM, etc. All electrical assemblies or sub-assemblies shall also bear such certification. All Power Transformer subsystems shall either be listed or be field evaluated for installation in the St. Lucia by an approved agency.

2.1.1.3 *Proponents* shall clearly indicate in their *Proposals* the standards which the requested equipment meets. *Proponents* shall clearly indicate if field certification is required for any necessary standards.

2.1.1.4 Certification of equipment shall be at the *Contractor*'s expense.

2.1.1.5 In case of conflict between these standards and this Specification, the *Contractor* shall notify *LUCELEC* and its representative in writing of such conflicts as soon as they become known.

2.1.1.6 *LUCELEC*'s standard design and material requirements are included in *Schedule H – LUCELEC Design Criteria and Standards*. For the Power Transformer components, it is preferred that *Proponent* comply with any applicable *LUCELEC* requirements when possible. However, should complying with these requirements for the *Power Transformer* lead to considerable added costs, *Proponent*s may take exception. *Proponent*s shall note any exceptions.

2.2 Standards

2.2.1.1 The supplied equipment shall be designed, manufactured, and tested in accordance with the most current revision of the following applicable standards, codes, and regulations:

- IEC 60076-1 Power Transformers – General
- IEC 60076-2 Power Transformers – Temperature rise
- IEC 60076-3 Power Transformers – Insulation levels, dielectric tests and external clearances in air
- IEC 60076-5 Power Transformers – Ability to withstand short-circuit
- IEC 60076-7 Power Transformers – Loading guide for oil-immersed power transformers
- IEC 60076-10 Power Transformers – Determination of sound levels
- IEC 60137 Insulated bushings for AC voltages above 1000 V

2.2.1.2 The *Contractor* is responsible for any on-site certification or other inspection requirements, if required.

2.2.1.3 Compliance of the equipment and all its associated parts with the above-mentioned codes, standards and regulations does not release the *Contractor* from the responsibility of supplying the equipment and accessories of proper design, electrically and mechanically suited to meet the guaranteed values at the specified service conditions.

2.2.1.4 All electrical equipment and components shall be CE approved and shall carry the CE labels. In the event of equipment not bearing the CE standard certification, the *Contractor* must validate the possibility of installing the equipment on *LUCELEC*'s site, even if it is not accredited by CE standard certification.

2.2.1.5 Where there is a discrepancy in requirements between the codes, standards and regulations, the references, or this document, the *Contractor* shall apply the most stringent requirements of the conflicting documents so that the design, manufacture and testing of the equipment are carried out to the highest degree of quality set forth by this group of documents.

2.2.1.6 If any of the requirements in this Specification are in conflict with the standards, the *Contractor* shall notify *LUCELEC*. Equipment that does not comply with this specification will be rejected and shall be credited, replaced, or brought into full compliance at the *Contractor*'s expense.

3. Construction

3.1 Application

3.1.1 Step-down Transformer

3.1.1.1 Step-down transformer shall be standard design going along with all the requirements of the datasheet (See Schedule L).

3.2 Tank and Base

3.2.1.1 The tank shall be of sealed type.

3.2.1.2 The base arrangement of the tank shall be suitable for skidding or rolling the fully assembled transformer filled with oil in either axial direction.

3.2.1.3 A welded cover with lifting lugs shall be provided.

3.2.1.4 The tank shall be treated to remove all dust, grease and chemicals, and the inside shall be painted with a high-gloss white paint that is not affected by, or does not affect, the transformer oil.

3.2.1.5 The bottom plate of the transformer tank shall be designed 3 mm thicker than required by standard design strength requirements to resist possible rusting.

3.2.1.6 Pulling eyes shall be provided at each bottom corner of the base.

3.2.1.7 Lifting lugs or hooks suitable for fitting shackles or lifting cables shall be provided near the top of the tank at each corner, for lifting the fully assembled transformer filled with oil.

3.2.1.8 Sloped or domed covers shall be provided to drain water and to help collect internal gases.

3.2.1.9 The transformer tank and radiators shall be designed to withstand, without deformation, full vacuum and positive and negative pressures, in accordance with IEC 60076-1 standard.

3.2.1.10 The design of the tank shall minimize the risk of tank rupture in any case, especially under the following extreme conditions:

- The energization of a cold unit at the specified minimum temperature, considering an incipient fault occurring under these conditions.
- Operation at full load of a cold unit energized at the specified minimum temperature.

3.3 Grounding

3.3.1.1 Two (2) stainless steel NEMA 2-hole ground pads shall be provided on diagonal opposites of the bottom of the tank, with compression-type lugs for #4/0 to 500 MCM bare copper conductors.

3.4 Gasketing

3.4.1.1 Sealing gaskets of superior quality shall be provided to prevent all risks of oil leakage. Such gaskets shall withstand the maximum temperatures of the tank and oil, as well as the low ambient temperature down to the minimum specified temperature when the transformer is de-energized.

3.4.1.2 The *Contractor* shall take extreme precautions in ensuring proper sealing of the transformer tank, cooling system and accessories to avoid any chronic issues that may arise further to oil leakage.

3.4.1.3 Gaskets shall be fully compatible with the type of oil supplied and a certificate of compatibility shall be provided.

3.4.1.4 Gaskets shall not cause any adverse foaming effect during the oil treatment process.

3.5 Core

3.5.1.1 The core shall be a stacked cruciform configuration, made from high-grade grain-oriented non-aging sheet steel laminations. The type of joints shall be mitered step-lap. Core bolts holding the laminations together are not acceptable.

3.5.1.2 Core lifting attachments shall be provided and designed to prevent distortion of the core or damage to the core bolt insulation under lifting stresses.

3.5.1.3 The core and clamping assembly shall be separately grounded at one point only with core ground straps of sufficient cross-sectional area and conductivity to withstand the worst possible short-circuit current for two seconds. The ground connections shall be brought out of the tank using core ground bushings allowing separate core and clamping assembly insulation resistance tests to be performed from the outside of the tank using a 1,000 V Megger. Suitable weatherproof mechanical protection shall be provided over the core ground bushings which shall be rated at least 3 kV.

3.6 Windings

3.6.1.1 The windings shall be manufactured from material specified in datasheet.

3.6.1.2 Certified thermally upgraded insulation material shall be used and the certificate of the specific winding insulation material purchased for this transformer shall be provided.

3.6.1.3 The assembly of the core and coils shall be heavy duty class, of circular coil design and adequately braced to withstand the dynamic stresses caused by the short-circuit current corresponding to the maximum asymmetry of a bolted fault at the output terminals.

3.6.1.4 When applicable, windings shall be of helical and/or disk construction.

3.6.1.5 Continuously Transposed Conductors (CTC) shall be used when desirable.

3.6.1.6 A layer-type winding is generally not acceptable, except for regulating winding if technically justified and approved by the *LUCELEC* and its *Representative.*

3.6.1.7 All joints shall be welded or brazed without hydrogen embrittlement.

3.6.1.8 Compression-type connectors may be used for terminal connections or to attach leads to winding conductors.

3.6.1.9 Bolted connections shall be avoided when possible; otherwise, they shall be provided with suitable locking devices.

3.6.1.10 Vapor phase drying of the individual windings and of the completely assembled active part prior tanking is mandatory.

3.7 Bushings and Connectors

3.7.1 General

3.7.1.1 The bushings and all current carrying parts shall have the capacity to withstand the highest rating of the transformer, in compliance with IEC 60137 standard.

3.7.1.2 The bushings shall be from the composite type or approved equivalent. Porcelain type is prohibited.

3.7.1.3 All HV bushings shall be suitable for power factor and capacitance testing. Same requirement applies to LV bushings, when applicable to the specified voltage rating.

3.7.1.4 HV bushings shall be provided with Elastimold type terminal pad.

3.7.1.5 LV bushings shall be provided with Elastimold type terminal pads.

3.7.2 Terminal Box Configuration

3.7.2.1 When required in datasheet a NEMA 3R terminal box shall be provided.

3.7.2.2 Padlockable front plate shall be provided to allow access to the terminal pads.

3.8 Insulating Liquid

3.8.1 General

3.8.1.1 The transformer shall be supplied complete with the first filling of transformer oil.

3.8.1.2 The transformer shall be filled under vacuum at the factor.

3.8.2 Standards type

3.8.2.1 If selected in the datasheet, the insulating liquid shall be as per Ester type oil or an equivalent to be approved by *LUCELEC* or its *Representative,* meeting the most stringent requirements of the ASTM D1275 standard regarding the admissible corrosive sulphur/copper sulphide deposition.

3.8.2.2 The oil provided shall not require the addition of passivator.

3.9 Surge Arrester

3.9.1.1 A set of three (3) gapless metal oxide surge arresters shall be provided for the HV and LV side, mounted in the vicinity of each bushing.

3.9.1.2 The surge arresters shall be from the composite type or approved equivalent. Porcelain type is prohibited.

3.9.1.3 The structural support for the surge arrester shall be strong enough to withstand the maximum cantilever strength of the surge arresters without deformation.

3.9.1.4 Square or round steel hollow structural sections (HSS) are accepted but not C-channels.

3.9.1.5 Corona rings shall be provided on each HV surge arrester, when recommended by the arrester manufacturer.

3.9.1.6 Line terminal connectors shall be provided and be suitable for conductors specified on the single line diagram.

3.9.1.7 Ground terminal connectors shall be provided, suitable for 4/0 AWG up to 500 MCM bare copper conductors.

3.9.1.8 If required in datasheet, surge arrester shall be provided with a hermetically sealed and shock-proof discharge counter.

3.9.1.9 If required in datasheet, a hand-held remote transceiver for measuring total leakage current and surge data shall be provided.

3.9.1.10 Compression type lugs, suitable for 4/0 AWG bare copper conductors shall be provided with the discharge counters.

3.9.1.11 An insulating sub-base shall be provided for each arrester, complete with mounting bolts, as required by the surge arrester discharge counter.

3.10 Accessories

3.10.1 Off-load Tap

3.10.1.1 If required in datasheet, an off-load tap shall be supplied.

3.10.1.2 The tap changer external operating mechanism shall be operable from ground level and the local tap position indicator shall be visible from ground level.

3.10.1.3 The tap changer shall be padlockable in any position.

3.10.1.4 The tap shall have five off-loads taps over a range of ±5% (-5%, -2.5%, 0%, +2.5% and +5%).

3.10.1.5 These devices shall not be located within any type of enclosure.

3.10.2 Dial-Type Thermometer

3.10.2.1 If required in the datasheet, Dial-type thermometers shall be supplied. One (1) for the winding temperature (HV or LV), and one (1) for top liquid temperature, each indicating the maximum temperature reached since last resetting.

3.10.3 Pressure Relief Device (PRD)

3.10.3.1 If required in the datasheet, a self-reclosing Pressure Relief Device (PRD) shall be supplied, complete with semaphore and two (2) manual reset alarm contacts.

3.10.3.2 Directional shroud and piping shall be provided to direct oil flow safely down to the oil catch basin and shall not restrict in any way the expulsion of oil from the PRD.

3.10.3.3 To avoid tank rupture, the quantity of PRDs shall be as prescribed by the applicable standard or greater if required, further to design calculations.

3.11 Paint Finish

3.11.1.1 An epoxy coating finish shall be provided as a minimum. If additional measures are deemed necessary by the *Contractor* to meet the environmental conditions specified, the *Contractor* shall include in his Tender the full details of its paint specification and its corrosion protection system warranty.

3.11.1.2 The *Contractor* shall take all necessary measures to prevent premature corrosion of the transformer.

3.11.1.3 The epoxy finish is only considered as being a minimum. If the *Contractor* has a better paint process to suggest, it may be submitted as an option.

3.11.1.4 Dried paint thickness, including the rust inhibiting primer, shall be not less than 3 mils.

3.11.1.5 The top cover of the main tank, control cabinet and every other accessible horizontal surface of sufficient dimensions to allow a man to stand on it, and the rungs of the ladder shall have anti-skid coating applied over the final paint coating.

3.11.1.6 The mounting plates inside the control compartments of all equipment shall be painted with matte finish white paint.

3.11.1.7 The paint process shall be submitted to the *LUCELEC*'s *Representative* for review.

3.12 Spare Parts

3.12.1.1 One (1) set of gaskets for all components dismantled for shipping (bushings, radiators, piping, etc.) and for all manhole and handhole covers that need to be open at the site for reassembly of the transformer shall be provided and shipped with each transformer.

3.12.1.2 Two pressurized spray cans (approximately one pint each) and one gallon of the same color finish paint (with activator, if required) shall be provided for touch-ups at the installation site.

3.13 Evaluation of Losses for Tenders

3.13.1.1 For the transformer operation to be the most economical, tenders will be evaluated taking into consideration the capital and operating costs (losses evaluated at nominal fundamental rating).

3.13.1.2 The transformer losses will be evaluated as follows (in EC$). The conversion from USD$ to EC$ was EC$1 = USD$0.37

- $2,178.65/kW for no-load losses.
- $544.59/kW for load losses.

3.13.1.3 The following formula will be used to establish comparative tender prices:

- Ca = C + 2,178.65PV + 544.59PC

where

- Ca = Comparative tender price in East Caribbean dollars
- C = Tender price in East Caribbean dollars
- PV = No-load losses in kW (guaranteed) at nominal ratings
- PC = Load losses in kW (guaranteed) at rated fundamental current

3.13.1.4 If the losses as tested exceed the losses as guaranteed, the following may apply if so accepted by *LUCELEC*:

- The present cost value of the losses as guaranteed will be subtracted from the present cost value of the losses as tested, and the excess of the present cost value will be assumed by the *Contractor* as a penalty using the figures per above item. This penalty is applicable without tolerance if either the no-load losses or the load losses as tested exceed the no-load losses or the load losses as guaranteed.

4. Nameplates, Tagging and Identification

4.1 General

4.1.1.1 The transformer main nameplate shall be located in accordance with the *Contractor*'s standards and fixed at human height.

4.1.1.2 All nameplates shall be made of 0.8 mm satin-finish stainless steel and fixed to the transformer with non-rusting screws.

4.1.1.3 All etching shall be in black.

4.1.1.4 The nameplates shall remain readable and resistant to a prolonged exposure to outdoor UV and the specified environmental conditions.

4.1.1.5 All nameplates, identification tags and engraved lamicoid nameplates shall be in the language specified in the datasheet.

4.2 Transformer Nameplates

4.2.1.1 The information on the transformer main nameplate shall comply with all the requirements of clause 8 of IEC 60076-1 standard.

4.2.1.2 The transformer main nameplate shall indicate that the transformer was designed, built and tested in accordance with IEC 60076-1 Standard.

4.2.1.3 Nameplates on bushings shall indicate type, designation, catalog number and all other information specified by the applicable standard.

4.2.1.4 Nameplates on the cover besides each bushing shall indicate the bushing terminal marking.

4.2.1.5 Nameplates on drainage, filling and sampling valves shall indicate their purpose.

5. Testing

5.1 Factory Tests

5.1.1 Factory Acceptance Tests (FAT)

5.1.1.1 Unless otherwise specified, the *Contractor* shall conduct the tests in accordance with IEC 60076-1 standard.

5.1.1.2 In addition to the specified routine tests, the following tests shall also be conducted:

- Winding insulation resistance and polarization index (Megger).
- Core-ground insulation test (Megger).
- Measurement of no-load losses and exciting current complete with transformer saturation curve (10% to 110% rated voltage).
- Measurement of load losses and positive sequence impedance (Z1 H-L) at maximum, minimum and nominal taps.
- Measurement of zero sequence impedance (Z0) at maximum, minimum and nominal taps.
- Impulse test (BIL) on all terminals of all units, on tap giving minimum effective turns in the winding under test. Tests shall be applied in the following order: one (1) reduced full wave, two (2) chopped waves and two (2) full waves. On the neutral, the chopped waves are not required.
- Applied voltage on HV and LV terminals.
- Induced voltage and partial discharge measurement. The magnitude of the partial discharges shall not exceed 500 pC during the one (1) hour test period. However, if the magnitude exceeds 300 pC, the *Contractor* shall investigate the possible source of these partial discharges. The transformer shall be rejected above 500 pC.
- Vacuum and pressure tests of tanks and radiators.
- Oil samples for gas-in-oil analysis (DGA) taken as follows:
  - After completion of all tests.

Table 1: Allowable DGA rises in Ester based Oil

		Increase after Routine Transformer Testing (ppm)	Increase after Heat Run/12-hour Load Run (ppm)
Hydrogen	H2	<100	<300
Carbon monoxide	CO	<100	<100
Carbon dioxide	CO2	<300	<600
Methane	CH4	<1	<5
Acetylene	C2H2	<1	<1
Ethylene	C2H4	<1	<5
Ethane	C2H6	<300	<600

5.2 Site Tests

5.2.1.1 Not applicable.

5.3 Factory Acceptance Tests Witnessing

5.3.1.1 LUCELEC reserves the right to witness any or all tests plus any quality control tests performed, at no additional cost. Sufficient notification shall be given to allow LUCELEC representative(s) to be present for the factory acceptance testing. A minimum of fifteen working days (15) should be allowed.

5.3.1.2 A detailed test procedure including for each test: description of the procedure, applicable standards, testing schematic diagram, tap position, test levels (A, V, Hertz, etc.), acceptance criteria and test equipment.

5.3.1.3 A detailed test schedule listing all tests in the order of realization and planned date of each test.

5.4 Failure to Pass Tests

5.4.1.1 The *Contractor* shall be responsible for ensuring the equipment comply with the specification. If the equipment fails to meet the test requirements, *LUCELEC* and its *Representative* shall be notified immediately and reserves the right to reject such equipment at any time and may, at its sole discretion, cancel the order upon written notice to the *Contractor*.

5.5 Test Report

5.5.1.1 One (1) copy of the FAT test report of each unit shall be submitted for review to the *LUCELEC* and its *Representative*, not later than five (5) working days after completion of the factory acceptance tests, to authorize the release for shipment.

5.5.1.2 The test results shall be placed in the same order as the tests were made and shall be bound to form a single document duly signed and properly identified with a date and a revision number.

5.5.1.3 The test report shall include, in addition to the usual data, the following specific data:

- For the BIL test, include the compare curves (RFW-last FW in voltage and current) of all impulse terminals, in addition to overlays.
- All oil test reports (DGA results, table of DGA rises during FAT, complete analysis report of oil shipped at the site, etc.).

5.5.1.4 Routine test reports from sub suppliers: bushings, surge arresters, bushing current transformers, etc.

6. Factory Assembly

6.1.1.1 The transformer shall be fully assembled in the factory before the factory acceptance testing (FAT) can start.

6.1.1.2 Minimum disassembly shall be done to accommodate shipping clearance restrictions. Whenever practical, a fully assembled unit shall be shipped.

END OF SECTION