

TECHNICAL SPECIFICATIONS
SINGLE PHASE DEAD FRONT PAD-MOUNTED
DISTRIBUTION TRANSFORMER

JPS # 6951-S-14 (Effective February 26, 2018)

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The "Technical Specifications, General Requirements" forms a part of this specification.

1. SCOPE

1.1 This specification covers the design, manufacture, testing and delivery of Single Phase, Dead Front, Pad-Mounted Distribution Transformers for the Jamaica Public Service Company Limited. All works listed previously shall be as described in this specification and in accordance with the latest issues of the following standards and other publications referred to by these standards except for the special provisions of these specifications stated herein.

1.2 Conditions of Operation

Transformer shall be suitable in all respects for operation on JPSCo. 50 Hz. Multi-grounded neutral system and ungrounded delta system.

The supplier shall acquaint himself with the conditions under which the transformers will operate, and therefore shall assume full responsibility for understanding conditions of supply operation and service.

2. GENERAL REQUIREMENTS

2.1 SUBMITTALS

2.1.1 Information to Accompany Tender

The supplier shall submit the following information with the tender:

- 2.1.1.1 General standard layout drawing of the transformers showing overall dimensions location of all bushings and external attachments.
- 2.1.1.2 Standard nameplate drawing including approximate weight and quantity of insulating liquid.
- 2.1.1.3 Separate optional prices for performing type tests as stated in this specification.
- 2.1.1.4 Paint specifications and finishes.
- 2.1.1.5 Guarantee that the PCB level of the insulating fluid is less than two (2) parts per million (<2ppm).
- 2.1.1.6 Guaranteed average no-load and load losses.
- 2.1.1.7 Bidder MUST complete and submit with his Bid, for each rating and type of transformer, the "Transformer Data Form" (Exhibit "A") included in the "Schedule of Technical Data."

All information accompanying the tender shall be bound with and form part of the contract should an order be placed.

2.1.2 Refer to "Submittal of Information" Section 2 paragraph 2.1 of "Technical Specifications, General Requirements."

2.2 DRAWINGS, ETC. BY SUPPLIER

2.2.1 Submission of Drawings

Three (3) copies of the following drawings of one transformer from each group of identically rated transformers in an order shall be submitted for review by JPSCo after ordering but before manufacturing commences:

- 2.2.1.1. Transformer outline indicating dimensions and the locations of all attachments and accessories;
 - 2.2.1.1.1. Low-voltage phase terminal and bushing detail.
 - 2.2.1.1.2. Low-voltage neutral terminal detail.
 - 2.2.1.1.3. High-voltage bushing detail
 - 2.2.1.1.4. Nameplate detail
 - 2.2.1.1.5. The name of the paint manufacturer and types of paint to be used (product number with catalogues) and the painting process.
 - 2.2.1.1.6. The name and type of transformer protective device used including the product catalogue.
 - 2.2.1.1.7. High voltage load break switch detail and design.

2.2.2 Submission of Test Results

Five (5) copies of the certified test results shall be submitted to JPSCo for review after fabrication. JPS shall provide suppliers with a permit to ship after a satisfactory review process. Under no circumstance shall shipment commence without written approval from JPS.

2.2.3 Instruction Manuals

Two instruction manuals shall be supplied for each transformer to be supplied. The instruction manuals shall be supplied to JPSCo before delivery of the transformers.

2.2.4 Exceptions to Specifications

Nothing contained in the tender shall be construed as permitting any modification to the requirements of this specification unless JPSCo grants approval in writing. Accordingly, bidders are free to submit tenders on equipment differing from this specification, provided they clearly define the differences they propose in a separate letter entitled "Exceptions to Specifications".

2.2.5 Warranty

The minimum warranty period shall be 18 months from date of payment or 12 months in service, whichever occurs first. The transformer shall be guaranteed for a minimum of 3 years in normal operating conditions, against any manufacturing defects or design anomalies.

2.2.6 Omissions

Notwithstanding any omissions in this specification, the equipment as specified herein is to be delivered, ready for operation on JPSCo's Distribution System without additional charge.

2.2.7 Basis for Penalties and Rejection

- 2.2.7.1 Transformers may, notwithstanding any payments which may have been made upon delivery, be rejected based on the certified test report submitted, inspection or breach of any part of this specification.
- 2.2.7.2 The basis for rejection of a transformer or entire order shall be based on the transformer not meeting requirements specified in this document and on the following:
 - 2.2.7.2.1 If the transformer Temperature Rise exceeds the guarantee value during full load head run.
 - 2.2.7.2.2 If the voltage ratio and tap ratio vary by more than 0.5%.
 - 2.2.7.2.3 If during normal service operation, the winding insulation shows signs of rapid deterioration, dissolving in the insulating liquid or carbonizing.
 - 2.2.7.2.4 If the PCB level is exceeded.
 - 2.2.7.2.5 If the transformer tank and parts thereof shows signs of premature rust resulting from improper exterior finishing or scratching of the paint during the shipment by the manufacturer.
 - 2.2.7.2.6 If the final average measured losses of "identical" units comprising the order, exceed the guaranteed values by 10% for no load loss and /or 6% for quoted total loss, i.e. no load + load loss.
 - 2.2.7.2.7 If the full load impedance at 85°C is less than the guaranteed value.

- 2.2.7.3 If there are no grounds for rejection based on the above, but an order of transformers exceeds loss guarantees on an average basis, a penalty shall be imposed. Penalties imposed for excess losses will be calculated on the basis of the average of the order, and the calculation will be based on the accompanying inquiry.

2.2.8 Witnessing of Test and Production

During the period of manufacture, the contractor shall provide JPSCo Representatives with safe and proper facilities for inspection of work at the factory or factory of a sub-contractor at all reasonable time until completion.

The contractor shall provide JPSCo with at least fourteen (14) days notice, plus travel time, in writing before any shop tests for acceptance are carried out in case it is decided to have a JPSCo Representative witness the testing procedure.

Refer to "Submittal of Information" Section 2 paragraph 2.2 of "Technical Specifications, General Requirements." for other information

3. STANDARD AND SERVICE CONDITIONS

3.1 STANDARDS

- 3.1.1 Refer to "Codes and Standards" Section 3 of "Technical Specifications, General Requirements."
- 3.1.2 Applicable parts of the following standards shall be observed in the design, manufacture, performance and tests:-
- a) ANSI C57.12.00 Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
 - b) ANSI C57.12.22-1989 Requirements for Pad Mounted, Compartmental-Type, Self Cooled, Three Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34 500 GrY/1920 Volts and Below; Low Voltage, 480 Volts and Below.
 - c) ANSI C57.12.21-1992 Standard for Transformers – Pad –Mounted, Compartmental-type, Self Cooled, Single Phase Distribution Transformers with High Voltage Bushings; High Voltage 34 500 GrY/19 920 Volta and Below: Low Voltage, 240/120 Volts; 167 kVA and Smaller.

- d) ANSI C57.12.10 Safety Requirements for transformers 230 kV and below 833/958 through 8333/10417 kVA, single phase and 750/862 through 60,000/80,000/100,000 kVA, three phase Without Load Tap Changing and 3750/4687 through 60,000/80,000/100,000 kVA with load Tap Changing.
- e) ANSI C57.12.28-1988 Switchgear and Transformers - Pad Mounted Equipment-Enclosure Integrity.
- f) ANSI C57.12.70 Terminal Markings and Connections for Distribution and Power Transformers.
- g) ANSI C57.12.80 Standard Terminology for Power and Distribution Transformers.
- h) ANSI C57.12.90-1993 Test Code for Liquid- Immersed Distribution, Power and Regulating Transformers and Guide for Short Circuit Testing of Distribution and Power Transformers.
- i) ANSI Z55.1 Seafoam Green finishes for Industrial Apparatus and Equipment.
- j) ANSI C57.92-1981 Guide for Loading Mineral Oil Immersed Power Transformers up to and including 100 MVA with 55 °C or 65 °C Average Winding Rise.
- k) ASTM D1816 Test method of dielectric oil
- l) CSA C50 Insulating oil, electrical for transformers and switches.
- m) EEMAC B6-1 Insulating mineral oil for new electrical apparatus.
- n) NEMA TR-1 Transformers, Regulators and Reactors.
- o) NEMA TR-P9
- p) Western Underground Standards, WUG 2.13 Rev 4
- q) ANSI/IEEE 386-1977
- r) American Welding Standard, AWS D1.1/D1.1 M: 2008
- s) Ontario Hydro Specification M-104M-85
- t) EEMAC Standard L16-1
- u) NETA Inter-National Electrical Testing Association

3.2 SERVICE CONDITIONS

Refer to "Geographic Conditions" Section 4 of "Technical Specifications, General Requirements".

3.3 CONFLICTS

In case of conflicts between this specification and any standards referenced herein, the more stringent shall have precedence and shall govern. The bidder is obligated to indicate all conflicts at the time of bid submission.

4. DETAILED REQUIREMENTS

4.1 TRANSFORMER TYPE, SIZE AND RATINGS

Transformer shall be Single Phase, Oil immersed, Self Cooled, Outdoor, Loop Feed, Pad-Mounted distribution transformer, with two (2) fully insulated primary high voltage bushing (one (1) to facilitate loop feed arrangement). The transformers shall be manufactured with a two-fuse primary protection system (bayonet fuse and current-limiting fuse), with overload indicating device and with two (2) 2 ½% primary taps above and below normal voltage. Taps shall be provided for both the primary voltage levels of the dual voltage transformer.

The transformer is required for operation on the following primary distribution system voltages; 23900GRDY/13800V, 11950GRDY/6900V, and 13800V Delta. Secondary rated voltage shall be 120/240V. The transformer capacity shall be from 25kVA to 150KVA with the maximum allowable losses as outlined in section 4.2 Transformers shall be manufactured from Mild or Stainless Steel.

Insulation and Impedance Ratings

| | |
|--|--|
| Primary Voltage (kV) | 13.8 or 6.9 |
| BIL (kV) | 125 |
| Insulation Class (kV) | 15 |
| Secondary Voltage (Volts) | 120/240 |
| BIL (kV) | 30 |
| Insulation Class (kV) | 1.2 |
| Frequency (Hz) | 50 |
| Continuous rated capacity at 65°C temperature rise | See Material Schedule for Quantities and Sizes |
| Impedance (Nominal) as per ANSI | 2.5% +/- 7.5% for 25 kVA or less 4.00% +/- 7.5% for 37.5 kVA-167kVA |

4.1.1. Type 1 – 25 kVA Transformer

Transformers shall be 25 kVA, Dual Voltage, Primary Rated 23900GRDY/13800V x 11950GRDY/6900V and is required for operation on a 23900GRDY/13800V x 11950GRDY/6900V solidly multi-grounded primary distribution system.

4.1.2. Type 2 – 25 kVA Transformer

Transformer shall be 25 kVA, Primary Rated 23900GRDY/13800V and is required for operation on 23900GRDY/13800V, solidly multi-grounded primary distribution system.

4.1.3. Type 3 – 37.5 kVA Transformer

Transformer shall be 37.5 kVA, Primary Rated 23900GRDY/13800V and is required for operation on 23900GRDY/13800V, solidly multi-grounded primary distribution system.

4.1.4. Type 4 – 37.5 kVA Transformer

Transformers shall be 37.5 kVA, Dual Voltage, Primary Rated 23900GRDY/13800V x 11950GRDY/6900V and is required for operation on a 23900GRDY/13800V x 11950GRDY/6900V solidly multi-grounded primary distribution system.

4.1.5. Type 5 – 50 kVA Transformer

Transformer shall be 50 kVA, Primary Rated 23900GRDY/13800V and is required for operation on 23900GRDY/13800V, solidly multi-grounded primary distribution system.

4.1.6. Type 6 – 50 kVA Transformer

Transformers shall be 50 kVA, Dual Voltage, Primary Rated 23900GRDY/13800V x 11950GRDY/6900V and is required for operation on a 23900GRDY/13800V x 11950GRDY/6900V solidly multi-grounded primary distribution system.

4.1.7. Type 7 – 100 kVA Transformer

Transformer shall be 100 kVA, Primary Rated 23900GRDY/13800V and is required for operation on 23900GRDY/13800V, solidly multi-grounded primary distribution system.

4.1.8. Type 8 – 100 kVA Transformer

Transformers shall be 100 kVA, Dual Voltage, Primary Rated 23900GRDY/13800V x 11950GRDY/6900V and is required for operation on a 23900GRDY/13800V x 11950GRDY/6900V solidly multi-grounded primary distribution system.

4.1.9. Type 9 – 150 kVA Transformer

Transformers shall be 150 kVA, Dual Voltage, Primary Rated 23900GRDY/13800V x 11950GRDY/6900V and is required for operation on a 23900GRDY/13800V x 11950GRDY/6900V solidly multi-grounded primary distribution system.

4.1.10. Type 10 – 167 kVA Transformer

Transformers shall be 167 kVA, Dual Voltage, Primary Rated 23900GRDY/13800V x 11950GRDY/6900V and is required for operation on a 23900GRDY/13800V x 11950GRDY/6900V solidly multi-grounded primary distribution system.

4.2. LOSSES

| SIZE (KVA) | TRANSFORMER LOSSES (W) | |
|-------------------|------------------------|-----------|
| | No Load | Full Load |
| 25 | 72 | 157 |
| 25 Dual Voltage | 78 | 165 |
| 37.5 | 95 | 280 |
| 37.5 Dual Voltage | 118 | 338 |
| 50 | 130 | 350 |
| 50 Dual Voltage | 116 | 445 |
| 100 | 205 | 801 |
| 100 Dual Voltage | 205 | 836 |
| 150 Dual Voltage | 303 | 1103 |
| 167 Dual Voltage | 332 | 1155 |

Each individual transformer manufactured shall be test for No Load (core) losses at 100% rated voltage, and for Load (copper) losses at 85 degrees Celsius and full load current. These tests shall be conducted at the nominal tap setting. The test results for each transformer by serial number shall be forwarded to the Purchaser (Buyer) for evaluation purposes.

A loss evaluation will be completed to determine the lowest responsible bidder with respect to the overall best interest of JPSCo. JPSCo will evaluate losses based upon the following criteria:

a. Total Owning Cost

The total owning cost/evaluated cost will be calculated by adding the quoted unit price for each item bid, plus the cost of core losses, plus the cost of copper losses for each item bid. JPSCo will use each bidder's losses as submitted on the Bid Form to complete the loss evaluation calculations.

b. Qualified Bidders

JPSCo will consider the lowest evaluated bidder and any/all additional bidders with total evaluated costs that fall within a range of plus three percent (+3%) of the minimum evaluated bid for each item as qualified bidders for final evaluation.

c. Final Evaluation/Bid Price Analysis

The evaluation committee will complete a final evaluation to analyze first cost/bid prices submitted by each qualified bidder for each item bid. JPSCo will award each bid item based upon first cost/bid price criteria and the overall best interest of the company.

4.3. PERFORMANCE

4.3.7. Temperature Rise

The temperature rise measured by resistance method shall not exceed 65°C at a maximum ambient temperature of 30°C when operating continuous at rated capacity.

4.3.8. Dielectric Strength

The temperature rise measured by resistance method shall not exceed 65°C at a maximum ambient temperature of 30°C when operating continuous at rated capacity.

4.3.9. Overload Capacity

The transformers shall be able to carry overloads in accordance with requirements of ANSI C57.92, with moderate sacrifice of life expectancy.

4.4. AUDIBLE SOUND

The audible sound level of transformers when operating at rated voltage, and measured as per ANSI C57.12.90 shall not exceed the stipulated sound levels indicated below.

| Transformer Size kVA | Audible sound level dB (Max) |
|----------------------|------------------------------|
| 25 | 48 |
| 37.5 | 48 |
| 50 | 48 |
| 100 | 48 |
| 150 | 48 |
| 167 | 48 |

4.5 CONSTRUCTION

Transformer shall be mechanically designed to ANSI requirements, unless otherwise specified.

4.5.1 Dimensions

The overall dimensions of the transformer and compartment shall be kept to a minimum.

4.5.2 Exterior finish

Modestly sculptured corners and round edges are encouraged.

The transformer and compartments shall be painted standard Sea foam Green as per CIL/Glidden, Guertin Brothers SP2422 or owner approved equivalent paint.

There shall be no plates or exterior stenciling positioned on the outside of the transformer tank or switching compartment except for a small plate or decal showing the name of manufacturer and high voltage warning labels.

4.5.3 Tank Compartment Assembly

- 4.5.3.1 Provision for lifting shall be provided and shall be adequately strengthened, sized and arranged on the tank to provide a suitable lift for the completely assembled unit. The transformer base shall be arranged so that the tank bottom does not touch the pad.
- 4.5.3.2 The welding shall conform to AWS Standard. Diagonal break marks on large surfaces sharp edges and protruding parts shall be avoided where possible.
- 4.5.3.3 The strength of the transformer shall be as such to withstand a minimum gauge pressure of 70 kPa without leakage or permanent distortion of the tank exceeding 0.25% of the diagonal dimension of the surface so affected.
- 4.5.3.4 Provision for lifting shall be provided and shall be adequately strengthened, sized and arranged on the tank to provide a suitable lift for the completely assembled unit. The transformer base shall be arranged so that the tank bottom does not touch the pad.
- 4.5.3.5 Furnished with side mounted parking stand, the parking stand shall be between the two (2) High Voltage bushings. The parking stand shall have sufficient space around it to accommodate Elastimold Cat. #163FTR or equivalent feed-thrust. Bushing spacing shall meet the minimum dimension of ANSI C57.12.26 figures 2 and 4.
- 4.5.3.6 The switching compartment door shall be capable of being closed and locked when elbows of the H.V. cable and grounding elbows are inserted into the feed-thru connectors.
- 4.5.3.7 Provided with a pull-ring type automatic pressure relief system with means for manual operation in accordance to ANSI.
- 4.5.3.8 Provided with two 25 mm (1 inch) minimum brass pipe plugs or fittings for filing, draining and pressure testing.
- 4.5.3.9 Provided with a temperature gauge.
- 4.5.3.10 Provided with a magnetic type insulating fluid level gauge; the gauge shall not show residual fluid liquid levels if the fluid level is below the gauge.
- 4.5.3.11 Provided with the protective caps to cover unused bushing well inserts.
- 4.5.3.12 Provided with two (2) position load break switches.

- 4.5.3.13 Provided with one (1) oil-immersed arrestor with a positive disconnect device.

4.5.4 Insulating Fluid

- 4.5.4.1 Transformer shall be furnished with new, unused mineral oil. The dielectric strength of the fluid, when shipped, shall not be less than 40kV, when tested in accordance to ASTM D1816 using 2mm electrode spacing.
- 4.5.4.2 Provide insulating fluid certified to be PCB free when tested in accordance with Ontario Hydro Specification M-104M-85.
- 4.5.4.3 The type of insulating fluid used is to be stenciled on the inside of the transformer switching compartment cover in the bold 25mm letters.

4.5.5 Drip Tray

- 4.5.5.1 A fixed tray, designed to retain 100ml of insulating fluid and prevent the fluid from dripping down the tank wall or onto accessories, shall be installed below the location of each withdrawable fuse. Owner approved removal oil-absorbent material shall be installed in the tray. Water running down the tank wall shall not collect in the trays.
- 4.5.5.2 In all instances, the design of the withdrawable fuse assembly shall be such that repeated insertions and withdrawal of the fuse cannot result in loosening or detachment of any parts.

4.5.6 Tap Changer

All tap leads shall be brought to a tap changer inside the transformer tank. Tap changer shall be externally operated and provided with a lockable handle and plate clearly designated by number or letters the tap setting. Such designation will be easily identified with voltage of the tap shown on the name- plate. The operating handle shall be installed in the cable entrance compartment at such a location that it is visible and accessible with cables in place and handle shall be capable of being locked in any position.

Tap changer will be operated only with the transformer de-energized. Tap changer shall meet requirements of ANSI C57.12.10 paragraph 9.2.1. All transformers are required to have taps of 2.5 percent and 5 percent above and below nominal rated primary voltage that shall operate on all voltage positions for multi-voltage units.

The tap position must be clearly identified in the cable compartment by a suitable method such that, the identification marks provided and furnished

with a separate warning sign mounted close to the operating handle, cannot be removed under any operating conditions and last the life of the transformer under normal operating conditions. Letterings are to be 15 - 25 mm high.

4.5.7 Connections and Terminations

4.5.7.1 General

Each unit shall be supplied with terminals for loop feed pad-mounted transformers. Six high-voltage bushing wells equipped with parking stands shall be supplied.

Low-voltage bushings and high-voltage bushing wells shall be replaceable without removing the core and coil assembly from the tank.

4.5.7.2 High Voltage Terminations

Each transformer shall be equipped with two (2) 200A fully insulated high-voltage bushing wells complete with inserts. The bushing well shall be Elastimold catalogue # K1601PC-S1 (or -T1) or approved equivalent and the insert Elastimold catalogue # 2701A4 or approved equal.

The high-voltage neutral shall be securely connected internally to the grounded clamping structure or the tank. This connection shall be independent of all other electrical connections.

4.5.7.3 Low Voltage Terminations

Each transformer shall be equipped with three (3) low-voltage tinned copper terminals of the spade-type, in accordance with ANSI Standards.

The secondary terminals shall be capable of withstanding a minimum vertical cantilever force of 750N continuously applied at the outermost hole of the terminal without any fluid leakage, damage or permanent distortion to the terminal.

The low-voltage neutral shall be connected to an insulated neutral terminal designated x_2 having a **current-carrying capacity equal to the other low-voltage terminals**. Low-voltage neutral shall be a fully insulated terminal. For the fully insulated terminal, a ground pad shall be provided on the outer surface of the tank. One or more removable ground straps suitably sized for the short circuit rating of the transformer as defined in ANSI C57.12.00

shall be provided and connected between the low-voltage neutral terminal and the ground pad (ANSI C57.12.21-1992, 6.2).

4.5.7.4 Grounding

A copper ground bus shall be mounted horizontally in the cable compartment on the lower front of the tank wall. The ground bus shall be drilled with four 15-mm diameter holes to allow ground connections.

Low voltage bushings, 600 volts and below, shall be equipped with spade type terminals, NEMA drilled. Spade size and ampacity to be determined by transformer rating. Clamp type terminals, complete with non-ferrous bolts, nuts, washers, and lock washers for attaching these terminals to the spade shall be furnished. The clamp type terminals shall be of the "Cable Range" type with maximum range exceeding the ampacity of cable(s) required to continuously carry full load to the transformer, and shall be suitable for either copper or aluminum conductors.

4.5.8 Nameplate, Labels and Markings

4.5.8.1 Nameplate

The transformer shall be provided with a nameplate containing all information, connection diagrams, etc., in accordance with ANSI C57.12.00 paragraph 5.12.2. Nameplate shall be bar coded.

In addition to the information to be contained in the combination nameplate and connection diagram as outlined in ANSI, the nameplate shall contain the following information:

- Jamaica Public Service Company Ltd. Purchase Order Number
- Total weight of the insulating liquid in kilograms
- Total volume of the insulating liquid in litres
- PCB content
- Protective devices information

The transformer nameplate and connection diagram shall be mounted on the cable entrance compartment of the transformer

and shall be engraved such that the lettering will last the life of the transformer.

4.5.8.2 Warnings and Labels

Warning Label - Tap Changer

A warning sign shall be mounted close to the tap changer handle and shall have engraved on it in bold 10mm minimum letters in red over white background:

OPERATE TAP CHANGER SWITCH ONLY WHEN
TRANSFORMER IS DE-ENERGISED.

Centre lettering vertically and horizontally with 3mm between lines.

Warning label – Withdraw able fuse

A warning sign shall be mounted close to the withdrawable bayonet fuse holder handle and shall have engraved on it in bold 10mm minimum letters in red over white background:

DO NOT OPERATE FUSE ASSEMBLY UNLESS
TRANSFORMER IS DE-ENERGISED.

OPERATE PRESSURE RELIEF DEVICE FIRST BEFORE
PULLING OUT BAYONET FUSE HOLDER.

Centre lettering vertically and horizontally with 3mm between lines.

Hazard Warning Labels

Hazard warning signs conforming to EEMAC Standard L16-1 shall be affixed to the inside and outside of the compartment doors.

4.5.8.3 Exterior Markings

A self-adhesive tag shall be externally attached to the side of the transformer in the upper left corner. It shall contain the following information:

- Serial number
- kVA
- Manufacturer's Name/Logo
- kV
- Stock code number

4.5.8.4 High Voltage and Low Voltage Terminal Markings

The high and low voltage terminals shall be stenciled H_{1A}, H_{1B} and X₁, X₂, X₃, respectively.

The high and low voltage terminals on the dual voltage transformer shall be stenciled H_{1A}, H_{1B}, H_{2A}, H_{2B} and X₁, X₂, X₃, respectively.

4.5.9 Earthing Pads and Terminals

Tank grounding or earthing pads shall be provided according to ANSI C57.12.10 paragraph 9.28. One terminal suitable for both aluminum and copper conductors to permit the earthing of the transformer shall be furnished for range of sizes from 50 mm² to 120 mm² (1/0 AWG to 250 KCMIL) conductor.

4.5.10 Cores

Cores shall be clamped and braced to resist distortion caused by short-circuit stresses or transportation handling and to prevent the shifting of core laminations.

Cores shall be constructed of high-grade, grain oriented, cold rolled silicon steel laminations, with high magnetic permeability. Core construction shall include provisions that mitigate core losses, excitation current and noise levels.

All standard accessories required by ANSI shall be furnished, in size and location on the units as detailed in ANSI C57.12.10 paragraph 9.2.

4.5.11 Accessories

Each transformer shall be equipped with the following accessories:

4.5.11.1 Internal Fault Detection Device

Each transformer shall be equipped with a non-resettable device which detects and provides external indication of internal transformer faults, and also incorporates pressure relief functionality. The specification for the internal fault detection device shall be submitted for review at the time of tendering.

4.5.11.2 High Voltage Load Break Switch

The transformer shall contain two (2) high voltage, single phase, liquid-immersed, load break switches.

Switch 1 and 2 shall function as a continuous and load breaking device from source A, or Source B, or Source A and B – one for the loop feed and one for the transformer primary winding tap. These two position load break switches shall be clearly identified in the cable compartment by a suitable method such that the identification marks regardless of operating conditions is irremovable.

The switches shall have the following minimum electrical characteristics:

- | | |
|--------------------------------------|--------------------|
| a. Voltage class: | 15 kV |
| b. BIL: | 150 kV |
| c. Continuous and Loadbreak current: | 300A |
| d. Interrupting Current: | 300A |
| e. Momentary, 10 cycle | |
| Current: | 12,000A rms. sys. |
| (X/R ratio = 30) | 19,200A rms. asym. |
| f. Close and Latch Current: | 12,000A rms. sys. |
| (X/R ratio = 30) | 19,200A rms. asym. |
| g. Operating Temperature: | 17°C to 120°C |

The contact speed of the switches shall be independent of operator speed.

4.5.11.3 Protective Devices

The transformer shall be protected by a two-fuse protection system consisting of a bayonet oil-immersed, expulsion fuse in series with an oil-immersed, partial-range, current-limiting fuse. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer.

Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing that closes when the fuse holder is removed, and an external drip shield. The overall arrangement of the load break and protective devices shall allow loop feed to the transformer and prevent closing of the switch unto internal faults.

Warning shall be displayed adjacent to the bayonet fuse cautioning against removing or inserting fuses unless the transformer has been de-energized and the tank pressure has been released as per JPS Specification # 6951-S-14 Section 4.5.11.1.

The locking clips of the fuse holders, when locked in any position shall not be damaged when closing the transformer hood.

The fuse rating and manufacturer's Catalogue number of the bayonet fuse and current limiting fuse shall be identified on the combination nameplate.

5. TESTS

5.1. Tests defined in ANSI C57-1200 paragraph 9 shall be made in accordance with ANSI C57.12.90 by and at the expense of the manufacturer.

Production Tests

The manufacturer shall carry out standard Production Tests and, before shipment; the manufacturer shall furnish certified copies of the test results for approval. No transformer shall be shipped until tests results are received. Test shall include but not limited to the following:

5.1.1 Excitation current at 100% and 110% rated voltage; test to be made with either the primary or secondary in open circuit.

5.1.2 Winding insulation Resistance

5.1.3 Loss Data

Bidder shall provide guaranteed average no load and load losses as defined in the Detailed Requirements, JPS Specification No. 6951-S-14 Section 4.2.

No load losses shall be provided at 85°C. The following formula can be utilized for temperature correction to 85°C:

$$P_{85} = P_c(T_m)[1+(T_m-85)k_T] \text{ where,}$$

P_{85} = the no-load losses corrected to 85°C

$P_c(T_m)$ = no load losses corrected for waveform at temperature T_m in °C.

k_T = an empirically derived per unit change in no-load loss per °C.

If the actual value of k_T is not available, a value of 0.00065 per unit change per °C should be used. This value is typical for cores constructed of grain oriented Silicon steel and is satisfactory as a correction for no-load losses over the temperature range normally encountered in transformer testing.

Load losses shall be provided at 85°C as described in ANSI C57.12.90, section 9.4 "Calculation of impedance voltage and load loss from test data".

5.1.4 Percent impedance at 100% rated voltage and 85°C.

5.1.5 Resistance in ohms at 85°C at 90% and 100% power factor.

5.1.6 Percent regulation at 85°C at 90% and 100% power factor.

5.1.7 Applied and Induced Potential Tests in accordance with ANSI Standard

5.1.8 Efficiencies at 85°C at ¼, ½, ¾, 1 and 1-1/4 load. Maximum efficiency desired to be at ½ load and should not be less than 98% by wattmeter method.

5.2 Certified Test reports shall be provided for each transformer supplied. Test report shall be in accordance with NEMA Pub TR 1, "TR 1-7.02 Transformer Test Report in both content and format. Test certificate shall be provided to purchaser before shipping transformers.

- 5.3** Manufacturer shall invite the Purchaser's Representatives (2) at the Manufacturers' expense to witness the tests. This invitation shall be extended at least two (2) weeks before commencement of such tests. This condition may be waived at the discretion of the Purchaser. The cost to the purchaser for the witnessing of the tests shall be shown as a separate cost item in the bid.

Refer to "Tests" Section 5 of "Technical Specifications, General Requirements" for further details.

6. BID COMPARISON AND PRICE ADJUSTMENT

Evaluation of Tenders

Tenders will be evaluated based on the following:

1. Evaluated Cost of the transformer
2. Delivery period;
3. Warranty and service.

6.1 COMPARISON OF BIDS

- 6.1.1** For the purpose of comparing Bids, the transformer losses will be evaluated on the following basis: -

Evaluated cost of transformer (EC)

$$EC = P + 5.403 * L_1 + 2.412 * L_2$$

Where:

EC is the evaluated cost in US\$
P is CIF price of transformer in US\$
L₁ is No Load Loss in Watts
L₂ is Load Loss in Watts,

(On the "Transformer Data Form" the maximum losses shall be quoted at specified voltage configuration.)

- 6.1.2** Bids received in currencies other than US Dollars, will, for the purposes of comparison, be converted at the Bank of Jamaica's posted selling exchange rates at it's opening for business on the day the Bids are opened.

(Refer to "Evaluation of BIDS" Section 18 of "Instruction to Bidders" for further information).

6.2 CONTRACT OR ORDER PRICE ADJUSTMENT

- 6.2.1** During witnessing of the tests, one (1) transformer or five percent (5%) (to the nearest integer) whichever is greater, of the quantity of transformers from each rating contracted or ordered shall be taken arbitrarily and tested in the presence of the Purchaser's Representatives. An arithmetic average of the actual measured losses for the number of transformers tested for each rating shall be derived. In case the average measured losses exceeds the guaranteed figures by values not exceeding the stipulation of 2.1.1.7, the following action shall be exercised:

- 6.2.1.1** Invoice, or receive a credit memo from the bidder toward the purchase order issued for the award, for liquidated damages based upon 1.2 times the excess evaluated cost for the total order to be incurred by the purchaser in accepting the transformers supplied by the bidder; ie.

Liquidated Damages= 1.2 x (Delivered EC – Quoted EC)

No credit shall be applied toward delivery and acceptance of transformers of an order with a delivered EC below the quoted EC.

Payment of all damages by the bidder shall be in the form of a credit memo to be applied against the purchase order. JPSCo will not accept substitution of additional transformers or credit toward future purchases.

In addition the purchaser may, at its opinion, remove the manufacturer and/ or distributor from its approved manufacturer and/ or bidder list until all damages are paid and the purchaser is convinced that the manufacturer and/ or bidder can meet all performance requirements and other obligations prescribed by the purchaser.

Currency exchange rates used to evaluate the Bid (Paragraph 6.1.2) will be used to make any price adjustment for failure to meet guarantees.

7. PACKAGING AND MARKING

- 7.1** Transformer shall be individually packaged in wood crates.
- 7.2** All crates shall be suitable constructed to facilitate lifting by forklift.
- 7.3** For “Export Marking” refer to Section 8 of “Specifications and Requirements.”

8. SHIPMENT

- 8.1** Manufacturer/supplier shall await the written authorization of the purchaser before shipment of transformers. Approval for shipment will be given after the receipt of test results for all transformers.
- 8.2** No collect freight shipments will be accepted; all quotations are solicited on a “delivered price” (CIF Kingston) basis.


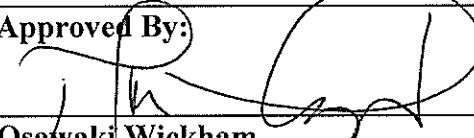
MISCELLANEOUS

Aside from compliance with transformer loss requirements, the purchaser will not accept transformers that are found to be damaged upon delivery or fail to otherwise meet all other bid specifications and requirements.

INDEX OF REVISION

INDEX OF REVISIONS

| Revision Number | Date of Revision | Revision Made | Checked By |
|-----------------|------------------|---|------------|
| 1 | 4 Feb 2012 | Revised clauses 4.1.4 and 4.2 Added clauses 4.1.5 through 4.1.8 to include 37.5 KVA, 50 KVA, 100 KVA and 150KVA dual voltage as well as 100 KVA and 150 KVA single voltages. | |
| 2 | 01 Sep 2014 | Revised clauses 4.1.6 through 4.1.9 to include 50KVA 13.8/6.9 KV (dual voltage) | |
| 3 | 29 Sep 2014 | Revised clause 4.5.11.1 | |
| 4 | 26 Feb 2018 | Revised section 4 to include 167kVA dual voltage transformers | |

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| Prepared By:  26-Feb-2018 Neville Brackett Standards Engineer Engineering and Standards Department | Approved By:  02/05/2018 Osawaki Wickham Manager Engineering and Standards Department |
|--|--|

Pad-Mounted Transformer Data Sheet

The completion of this sheet is mandatory; it forms part of the Bid Evaluation Process

| | |
|---|-----------------|
| Manufacturer Name | |
| Country of Origin | |
| Type(Single) | |
| Size (kVA) | |
| Frequency (Hz) | |
| Primary Voltage(s) (V) | |
| Impedance | |
| Temperature Rise (Over 25°C ambient) | |
| Feed (Loop or Radial) | |
| Primary Taps | |
| Primary BIL (kV) | |
| Primary Termination | |
| Secondary Voltage (v) | |
| Secondary BIL (kV) | |
| Secondary Termination | |
| Guaranteed No Load Loss (W) at 85°C | |
| Guaranteed Load Loss (W) at 85°C | |
| Guaranteed Total Loss (W) at 85°C | |
| Guaranteed Audible Sound Level (dB) | |
| Insulating Fluid | |
| PCB Level (PPM) | |
| Core Steel Grade/Type | |
| Tank Material | |
| Color of finish | |
| Attached drawing indicating all relevant dimensions and weight? | |
| Cost per unit (US\$) | |
| Guaranteed delivery time (weeks) | |
| Warranty Period | |
| Exceptions | |
| Manufacturing Engineer | Signature _____ |