Engineering Standards Department

Technical Specification No. CB-0711-2020

69kV and 138kV SF6 Circuit Breaker

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INDEX OF REVISIONS

Revision Number	Date of Revision	Revision Made	Checked By
01	February 11, 2020	Include section TS.02.16 to list appropriate stock numbers. Updated section TS.03.9.(a) to specify bushing terminals to be NEMA four (4) thru hole terminal pads with TIN plating on top cap.	

Prepared By:	Approved By:
N. Brackett 11-Feb-2020.	FEB/14/2020
Neville Brackett **Standards Engineer** **Engineering and Standards**	**Osawaki Wickham** **Manager** **Engineering and Standards**

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TS.01 Summary of Work

TS.01.1 Description of Works

This specification covers the design, manufacture, factory testing and delivery 69kV and 138kV, SF6, 50Hz high voltage power circuit breakers complete with all necessary fittings, mounting frames accessories and spare parts.

TS.01.2 Location

Jamaica Public Service Company Limited – 113 Washington Blvd, Kingston

TS.01.3 Scope of Work

The Supplier shall design, supply, factory test and deliver to Kingston, Jamaica; all equipment and material in accordance with these specifications.

TS.01.4 Specification Drawings

The Supplier is free to use designs and arrangements that best suit the equipment proposed. Detailed design and provision of proper electrical working clearances (phase to phase and phase to ground) shall be the responsibility of the Supplier.

TS.01.5 Works Not Included

The following work shall not form part of this contract: Assembly, installation, adjustment and commissioning of equipment on site unless separately and specifically requested by Purchaser.

TS.01.6 Supplier's Drawings and Schedules

The Supplier shall submit two (2) copies of drawing(s) showing any proposed deviations from the original tender, for review by the Purchaser. The Supplier shall submit, for review, within the time specified in the agreed Work Schedule, two (2) copies of all general assembly drawings, together with such additional detailed drawings as are required or specifically requested to fully demonstrate that all parts of the equipment to be furnished will conform to the provisions and intent of this specification. Any drawing of a preliminary nature must be so indicated.

One copy of each drawing submitted for review will be returned with any necessary changes or comments noted on the drawing. The drawings will be reviewed for general design, overall dimensions and materials. Review by the Purchaser will not relieve the supplier of responsibility for conformity to the specification, correct details and fit of parts when erected. Drawings which have been reviewed except "as noted" will not have to be resubmitted for review unless so indicated. No revision affecting the design shall be made after a drawing has been approved, without resubmitting the drawing for review. Every revision shall be shown by number, date and subject in a revision block; symbols used shall be in accordance with ANSI/IEEE Standards.

All applicable requirements in the preceding paragraphs, with reference to drawings, shall apply to catalog cuts, illustrations, printed specifications or any other data submitted. After reviewed drawings have been received, the Supplier shall without delay complete all necessary corrections or additions and furnish the Purchaser with one (1) copy of each drawing. If minor revisions are made subsequently, one (1) copy of the revised drawing shall be forwarded to the Purchaser. Soft copy in AutoCAD 2015 - shall also be provided for all final drawings.

The Bill of Materials shall be treated as a drawing and one (1) hard copy shall be furnished.

TS.02 General Requirements

TS.02.1 Work Schedule

The Supplier shall submit within 15 working days of acceptance of the tender a general Work Schedule showing key dates required for sub-orders and drawing approvals so that the specified delivery date(s) shall be met. The schedule shall indicate commencement and completion dates for the principal features of the works including, but not limited to, engineering design and submittal of drawings for review.

TS.02.2 Information to be submitted by the Supplier

The Supplier shall submit to the purchaser drawings, design data, operation and maintenance manuals, as may be called for herein, or as the purchaser may reasonably require. The Supplier's drawings and design data shall bear the Supplier's official verification that the information shown has been checked by the Supplier and is correct for use in construction, except for drawings of a preliminary nature furnished for information only, which shall be clearly identified as such.
Where applicable, the following essential drawings and information are to be submitted for approval before manufacture commences.

- equipment arrangement - plan and elevations
- dimensioned outline drawings, details and weights of all equipment
- equipment type
- test reports
- nameplate diagram
- equipment wiring diagrams
- schematic control diagrams
- manuals for installation, operation and maintenance of the equipment
- testing and commissioning procedures
- For equipment which uses oil; Certification from an independent testing laboratory, attesting that the level of PCBs in the oil is not more than 2 ppm shall be provided.

TS.02.3 Submission and Approval of Drawings

The Supplier shall submit two (2) copies of all drawings, and data to the Purchaser for approval.
The Purchaser will either approve these documents or, request changes or modifications to be made, and shall return one (1) copy to the Supplier within two (2) weeks after receipt of the drawings. The time required for the approval, revision and possible resubmission of drawings must be allowed for in the overall schedule.

The Supplier shall submit revised copies within two (2) weeks of the receipt of the marked-up drawings for final approval. Any manufacturing done before approval of the drawings will be at the Supplier's own risk. The Purchaser will have the right to require the Supplier to make any changes in design which are necessary, in the opinion of the Purchaser, to make the equipment conform to the requirements and intent of the Specifications without additional cost.

All drawings or documents submitted to the Purchaser shall bear the Supplier's stamp "For Approval", the date of submission and the Supplier's signature. Drawings will be reviewed only for general design, overall dimensions and materials. Approval by the Purchaser of the Supplier's drawings shall not relieve the Supplier of his responsibility for

the correctness of his drawings. Drawings and data shall be submitted within the agreed time after the date on which an order or letter of intent is received by the Supplier.

TS.02.4 Drawing Format

Each Drawing shall have a title block provided at the lower right-hand corner. At least the following information shall be included in the title block:

- the Supplier's name
- the Purchaser's name (Jamaica Public Service Company Limited)
- drawing title (brief description of drawing)
- drawing and revision number
- first date and revision dates
- scale and scale bar (where applicable)

Letters and figures shall be clear, uniform and evenly spaced. Dimensions of drawing frames without folding margin shall be as follows;

Drawing Size	Dimension of Drawing Frame (mm)
A1	566 x 801
A2	400 x 566
A3	283 x 394

Outline drawings of major electrical equipment, panels, schematics and substation steel details shall be A1 format. Units of measure and weights shall be expressed in the metric (SI) system of measurements.

TS.02.5 Installation, Operation and Maintenance Manual

Three (3) copies of the installation, operation and maintenance manual shall be furnished by the Supplier not later than thirty (30) days before shipment of equipment and materials. This must be written in English. If this schedule is not met, the supplier shall send the O&M manuals by airfreight to arrive Kingston, Jamaica before the equipment.

The manual shall contain the following minimum information:

- General descriptive information
- Assembly and/or erection details
- Operating and maintenance instructions
- Instructions for testing and adjustments
- One copy of each approved drawing including catalog cuts and other pertinent data.
- Test certificate(s)
- List of recommended spares
- Equipment insulation curves

- Parts identification list for each item of equipment furnished
- Manufacturer's descriptive information and instructions for all accessory equipment.

TS.02.6 Inspection and Witness Testing

All equipment and materials supplied under this Contract shall be subject to inspection and testing by the Purchaser or his appointed representative. Satisfactory completion of such inspection and testing shall not prejudice the right of the Purchaser to reject the equipment if it fails to comply with the Specifications or fulfill the function for which it was intended. The Supplier shall perform factory tests on all materials, equipment, parts, assemblies and sub-assemblies in accordance with the latest revisions of the applicable standards.

The supplier shall notify the purchaser three (3) weeks in advance of the date, time and place of all tests so that arrangements can be made to witness the tests. The Supplier shall conduct the tests and provide all necessary labor and equipment to carry out the tests.

TS.02.7 Standards

All equipment and materials shall conform to the latest editions of all relevant ANSI standards. Where equipment, components or materials are not covered by appropriate ANSI standards, relevant IEEE, NEMA, ASTM, AISC and AWS shall apply. If equipment or materials conforming to other recognized national standards are offered, the bidder shall submit a copy, in English, of the standard offered and shall itemize the pertinent areas where the standard differs from the requirements of the relevant ANSI standard.

The foregoing referenced standards and their abbreviations are as follows:

Name	Abbreviations
American National Standards, Inc.	ANSI
American Society for Testing and	ASTM
National Electrical Manufacturers Ass.	NEMA
Institute of Electrical and Electronic	IEEE
Insulated Cable Engineers Association	ICEA
American Society for Welding	ASW
American Institute of Steel	AISC

TS.02.8 System Characteristics

Characteristics	69kV Type	138kV Type
System Phase to Phase Voltage	69kV	138kV
Nominal System Voltage	69kV	138kV
Maximum Operating Voltage	72.5 kV	145 kV
System BIL	350kV	650kV
Number of Phases	3	3
Frequency	50 Hz	50 Hz
System connection	Delta	Wye
Method of Grounding	Grounding Transformer	Effectively Grounded
Fault level (symmetrical), MVA	2500	-
Auxiliary power supply	240/120 V, 1 phase, 50Hz 240 V, 3 phase, 50Hz 125 V dc +10%,-15%	240/120 V, 1 phase, 50Hz 240 V, 3 phase, 50Hz 125 V dc +10%,-15%

TS.02.9 Environmental Conditions

Environmental Parameters	Conditions
Altitude above Sea level	Maximum 1000m
Ambient Temperatures	Maximum 40°C Average over 24hrs 30 °C Minimum 15°C
Atmospheric Conditions	Tropical climate subject to direct sunlight, 200 km/hr wind. High salt spray and dust
Proximity of Coastline	Adjacent to the seashore.
Seismic Coefficient	0.25g
Relative Humidity	Maximum - 100%, Average - 50%

TS.02.10 Operating Conditions

In the selection of materials, due regard shall be given to the harsh, corrosive hot and humid conditions to which the materials will be subjected. Untreated organic materials, such as cotton, paper or wood, shall not be used. Operating coils of relays and meters shall be impregnated with a fungus-inhibiting varnish. Marking strips and nameplates shall be of plastic laminate or anodized aluminum. Paper label shall not be used even if protected in a plastic envelope.

Panels, enclosures and cubicles shall totally enclose the equipment. Doors of panels shall be close fitting and ventilated openings shall be suitably screened to prevent entrance of insects and rodents. All cable entrances to equipment shall be tightly sealed with gland plates. All enclosures containing motors, instruments, control and switching equipment shall be equipped with anti-condensation heaters. The construction of the enclosures and placement of heaters shall be such as to ensure effective air circulation while avoiding local overheating.

Internal wiring shall be dual insulated thermoplastic or rubber and Teflon or halogen based non-flammable insulation suitable for a minimum continuous operating temperature of 105°C. All live and exposed conductors and connections shall be suitably insulated to prevent short-circuiting by vermin.

Prior to shipment, surfaces of wiring and all other parts susceptible to moisture absorption or fungus attack shall receive treatment with fungicidal varnish.

TS.02.11 Design and Workmanship

The design of the equipment and materials shall be such as to give long and continuous service with minimum maintenance under all operating conditions. Equipment shall be of the best quality and most suitable for the function intended, and shall withstand all normal working conditions without deterioration. All equipment shall operate without excessive vibration and noise. Equipment and accessories shall be of well-proven design and provide ease of inspection and maintenance.

The Specification layout drawings showing structures are intended to show only governing dimensions, unless otherwise indicated, and are not intended to define exact details to be furnished. The Supplier should utilize designs and arrangements to suit his particular equipment and the design loads specified.

TS.02.12 Spare Parts

The Supplier shall supply spare parts required for 2 years normal operation. All spare parts shall be identical to the original parts and shall be properly treated and packed for prolonged storage in the prevailing ambient conditions. Each part shall be clearly identified with its description and function on the outside of the package. All spare parts shall be shipped with the main equipment and shall be appropriately labeled as spares.

TS.02.13 Preparation for Shipment

The Supplier shall prepare all equipment and their components in such a manner as to facilitate handling and to adequately protect them from contamination, corrosion or damage in-transit and shall be responsible for and make good any or all damages due to improper preparation, packaging or loading. Small or fragile pieces shall be packaged in crates or otherwise protected against loss or damage during shipment. Delicate electrical and other parts shall be boxed in weather-proof containers. It shall be the responsibility of the Supplier to take any other precautions required to ensure the arrival of the equipment at the Purchaser's warehouse in an undamaged and satisfactory working condition.

All crates, wooden reels, sacks and bundles shall be clearly marked to facilitate field identification as follows:

Jamaica Public Service Company Limited

Washington Boulevard Stores

69KV and 138kV Circuit Breakers

Order No._____

Kingston, Jamaica, W.I.

All external markings shall be legible and durably printed or stenciled on two sides and both ends (where applicable) of containers in letters at least 50 mm high. In order to facilitate field identification, shipping documents shall include lists with type and quantities of materials contained in each crate.

TS.02.14 Packing and Delivery

The Supplier shall ensure that all shipments are packed properly for shipment and protected from the harsh environment in which it may be subjected over a long period. No delivery of equipment or materials shall be initiated without the written approval of the Purchaser. Deliveries should be made in accordance with the Schedule of Deliveries and unnecessarily early delivery will not be acceptable.

TS.02.15 Shipping Documents

The following should be adhered to when issuing shipping documents;

(a) Original invoice must be signed and state whether prices are FOB or CIF.

(b) No lot value should appear on the invoice, each item should have a unit price and total value.

(c) A proper description or generic description with part number or catalogue number is required and not part number or catalogue number only.

(d) In the case of NO CHARGE ITEMS state "Value for customs purposes only".

TS.02.16 JPS Stock Numbers

The JPS stock numbers for the breakers are as follows:

Stock Number	Switch
020606049008	69kV Circuit Breaker
021803022001	138kV Circuit Breaker

TS.03 High Voltage Circuit Breaker

TS.03.1 General

The 69kV and 138kV circuit breaker will be used for switching and fault current interruption. All equipment furnished shall be suitable for operation under all possible load conditions.

TS.03.2 Standards and Codes

The circuit breakers shall comply with the requirements of all applicable standards in the ANSI C37 series and other relevant ANSI standards.

If this Specification conflicts in any way with any of the above standards or codes, this Specification shall have precedence and shall govern. However, the Bidder shall point out these conflicts in its Bid.

TS.03.3 Circuit Breaker Ratings

Parameter	69kV	138kV
Nominal system voltage	69kV	138kV
Type of circuit breaker	SF6	SF6
Rated maximum voltage	72.5kV	145kV
Rated frequency	50 Hz	50 Hz
Rated lightning impulse withstand level	350kV	650kV
Continuous current	1200 A	1200 A
Short circuit interrupting current	20kA	40kA
Maximum interrupting time	3 cycles	3 cycles
Rated control voltage	125V dc	125V dc
Interlocks	Kirk	Kirk

TS.03.4 Design and Performance

The circuit breaker will be installed in harsh, corrosive, salt spray environment therefore special consideration must be given to this condition during the design exercise.

The circuit breaker shall be of the outdoor SF6 dead tank type. The breaker shall be supplied complete with operating mechanism and other accessories necessary for installation and operation. Gas pressure shall be indicated by gauge and monitored by density monitors with alarm and tripping contacts. SF6 breakers shall have a moisture and SF6 byproducts absorber.

The circuit breakers shall be restrike free, trip free and suitable for remote and local electrical tripping and closing, or local emergency mechanical tripping and closing.

The circuit breakers shall have proven ability for full out-of-phase switching of its rated interrupting capacity, and for handling short-line fault conditions with short-circuit capacity of all current-carrying parts equal to the circuit breakers' rated interrupting capacity. The 69kV circuit breaker shall be suitable for instantaneous, single shot re-closing operation.

Supplier shall provide appropriate test data, curves and oscillograms to establish the ability of all equipment proposed to meet the conditions specified.

TS.03.5 Operating Mechanism

The circuit breakers operating mechanism shall be electrically, mechanically, hydraulically and/or pneumatically trip free, where applicable, and anti-pumping.

The circuit breakers shall be equipped with trip and close coils suitable for local and remote operation from the station battery supply. It shall also incorporate a manually operated, independent, local tripping device for use in emergency or during maintenance. The necessary terminals and wiring for trip circuit supervision in both open and closed positions shall be provided.

The circuit breakers, if pneumatically or hydraulically operated, shall have local storage sufficient for at least five complete "close-open" operations. Kirk type key interlocks shall be provided to prevent local manual operation of the associated disconnect switches when the breaker is closed.

Each circuit breaker shall have a facility for mechanical and electrical timing of the main interrupting contacts.

Each circuit breaker pole shall be equipped with an enclosed type mechanical position indicator clearly visible from the ground.

TS.03.6 Current Transformers

All circuit breakers shall be equipped with bushing type, multi-ratio current transformers on each bushing. The quantity on each bushing and ratings of current transformers shall be as follows.

TS.03.6.1 Protection Type CT

- Type 69kV & 138kV
- Ratio 1200:5 Multi Ratio
- Accuracy C400
- Quantity per bushing 2

Current transformers shall be mounted such that the bushing can be removed without disturbing the transformers. The Supplier shall provide ratio and phase angle correction factor curves, excitation curves and resistance values of the secondary winding and connecting leads together with the approval drawings.

TS.03.7 Control and Auxiliary Power

The following power supplies will be provided in the substation and the equipment shall be suitable for operation from these supplies, as applicable:

- DC supply voltage 125 V nominal, range 105 - 140 V
- AC supply 120V 1-phase, 50 Hz; 240V 1-phase, 50Hz

TS.03.8 Grounding Terminals

Two (2) ground studs and clamp type terminal connectors suitable for 7 #5 (0.428"dia) stranded copperweld cable shall be fitted near the base of the circuit breakers. The ground studs shall be of bronze, brazed to the metal unit. Each pole unit (interrupting chamber) shall be electrically bonded to the frame of the circuit breaker.

TS.03.9 Wiring and Terminations

(a) High Voltage Bushings

The HV bushings shall be of extra-creepage type (3.1cm/kV). Bushing terminals shall be NEMA four (4) thru hole terminal pads with TIN plating on top cap.

(b) Control Wiring

All control wiring shall be 600-V, 90degC, flame- and oil-resistant insulated, stranded copper wire. Wire sizes shall be appropriate for the function, but not be less than 2.5 mm^2 for control circuits. All power and control wiring shall be shielded from metering conductors.

All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point. Splices or tee connections are not acceptable. Wire runs shall be neatly trunked inside the panels or in wiring troughs. All wires shall be identified at both ends with sleeve type markers.

Terminal blocks with removable marking strips shall be provided for all circuits and 20% of the total number of spare terminals shall be supplied. Terminal blocks for the current transformer leads shall be of the short-circuiting type, Buchanan type 3B or approved equal

TS.03.10 Nameplates

Nameplates shall be of stainless steel and contain, but shall not be limited to the following:-

- name and address of manufacturer
- type and designation or serial number
- rated voltage
- rated frequency
- lightning impulse withstand voltage
- rated short-circuit breaking current
- year of manufacture
- operating pressure range
- control voltage range

All nameplate data shall be legible to an observer at ground level. All equipment shall be identified, and all nameplate wording shall be subject to Purchaser's approval.

TS.03.11 Control Cabinet

The circuit breakers shall be provided with a rigidly framed, weatherproof, sheet steel control cabinet, minimum 3 mm thick, mounted on the breaker supporting structure and positioned such that all controls may be operated from grade level. The cabinet shall be fitted with a hinged door complete with a 3-point latch with padlocking facility and shall be equipped with a detachable bottom entry conduit plate suitable for drilling in the field. The control cabinets shall

contain, but shall not be limited to the following;

1. One circuit breaker trip-close control switch, rotary, panel-mounted type, enclosed contact mechanism with removable cover one set of control components, as required, to operate the 3-pole breakers.
2. Two indicating lamps, one red and one green, for circuit breaker position indication.
3. One molded case 2-pole circuit breaker for dc control supply with minimum of 10 000A interrupting capability.
4. One operation counter.
5. One two-position selector switch marked 'remote-local'.
6. One mechanically driven circuit breaker auxiliary switch with necessary contacts for proper circuit breaker operation, remote indication, supervisory control and indication, and six "a" and six "b" spare contacts. All contacts shall be rated 20A continuous and 2.5A break of inductive load at 125-V DC ungrounded circuit. Each contact shall be electrically independent and adjustable for late or early opening or closing. All 'a' and 'b' contacts shall be readily interchangeable.
7. One 15-A molded case circuit breaker having a 10 000-A rms. symmetrical interrupting capacity controlling the 240-V ac supply.
8. One incandescent lamp with door activated switch.
9. One duplex convenience outlet, 15 A, 120 V, 2-pole, 3-wire, polarized, grounded.
10. One control cabinet dual element anti-condensation heater with thermostat.
11. One approved mechanical emergency hand trip device with mechanically interlocked contacts to disconnect circuits from remote closing devices, easily accessible and clearly marked 'emergency trip'.
12. Copper ground bus, minimum 6 mm x 25 mm.
13. All necessary terminal blocks for all remote control, indication and trip circuit supervision circuits.
14. All pressure gauges, density meters, and breaker position indicators shall be readily visible without opening door covers.
15. Alarm devices with independent NO and NC contacts for remote indication of breaker abnormal conditions, including low SF6 gas pressure, low closing mechanism pressure, etc.
16. One set of auxiliary contacts for monitoring spring charge status.
17. The charging motor shall be dual voltage operated ie: 120VAC and 125VDC for emergency operation.
18. The cable entry plate shall be furnished with 4 x 2inches perforated knockout plates spaced at equal distances apart in one line.

TS.03.12 Painting

All painted surfaces shall be shop painted with a compatible primer which shall have a dry film thickness of not less than 75 µm. Two finish coats of light grey epoxy paint shall be applied over the primer. The paint should be weatherproof and specially treated for use in a tropical environment.

TS.03.13 Bases and Structures

The support structures shall be supplied complete with adequately sized anchor bolts. The equipment and its supporting structures shall be designed such as to prevent any distortion under a suddenly applied load, which would adversely affect the operation of the equipment.

TS.03.14 Spare Parts

The Supplier shall provide a separate price for his recommended spare parts for the circuit breakers. These spare parts shall include, but not be limited to the following.

- Porcelain housings and bushings
- Complete sets of interrupting contacts
- One (1) set interrupting chamber
- Trip and close coils
- Density monitor
- Sets of all necessary gaskets and 'O' rings
- One (1) spring charge motor

TS.03.15 Tools and Accessories

The Supplier shall furnish a complete set of any special tools or equipment that may be necessary or convenient for assembly, filling or maintenance of the breakers. Manual operating levers and any other devices necessary for satisfactory operation shall also be furnished. The quotation for the dew point test set shall be separated from the price of the circuit breakers and shall be evaluated separately.

TS.03.16 Factory Tests

The circuit breakers shall be completely assembled at the factory, and shall be subjected to all routine and type tests in accordance with ANSI Standards. If the Supplier can supply satisfactory proof of type tests having been completed on identical equipment, then Purchaser will waive such type tests entirely. Purchaser reserves the right to witness all tests and shall be notified at least 3 weeks prior to the commencement of the tests. Supplier shall furnish six certified copies of all test reports, curves and oscillograms within 2 weeks after completion of any tests.

The total cost for carrying out these tests, inclusive of the cost of all expenses paid including air fares, hotel transfers, meals and accommodations paid for two (2) of the Purchaser's Engineers to witness such tests, shall be included but itemized separately in the quoted CIF cost for the circuit breakers.