

**JAMAICA PUBLIC SERVICE COMPANY LIMITED**

**TECHNICAL SPECIFICATIONS  
POLE MOUNTED AUTOMATIC CIRCUIT RECLOSER**

**JPS SPECIFICATION NO. 6545-S-01/07**

\_\_\_\_ Prepared by \_\_\_\_  
Technical Standards Department

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

## **1. SCOPE**

- 1.1 This specification covers the supply of automatic circuit reclosers. Reclosers shall be suitable for installation on distribution lines to enable the switching distribution feeders on fault current.

Reclosers shall be outdoor, 3-pole type, with vacuum interrupters in solid dielectric insulation and shall be equipped with accessories to facilitate remote tripping and closing operations. Each recloser shall be supplied with microprocessor-based protection, meter, monitoring and control equipment (Specified under RTU). Mounting Bracket must be 254 mm (10 inches) center.

## **2. GENERAL REQUIREMENTS**

### **2.1 INFORMATION**

- 2.1.1 Refer to "Submittal of Information" Section 2 paragraph 2.1 of "Technical Specification, General Requirements".

### **2.2 DRAWINGS ETC. BY SUPPLIER**

- 2.2.1 Refer to "Submittal of Information" Section 3 of "Technical Specifications, General Requirements".
- 2.2.2 Manufacturer shall provide drawings of reclosers showing principal dimensions and weight of components.
- 2.2.3 All information requested in this specification shall be supplied at the time of tendering except where specified.

## **3. STANDARDS AND SERVICE CONDITIONS**

### **3.1 STANDARDS**

- 3.1.1 Refer to "Codes and Standards" Section 3 of "Technical Specifications, General Requirements".
- 3.1.2 The circuit reclosers shall comply with the requirements of all applicable standards in the ANSI C37 series and any other ANSI relevant standard.

### 3.1.3 **CONFLICTS**

In the event of conflicts between any referenced standards/specification mentioned herein and this specification, the more stringent specification shall have precedence and shall govern. However, the bidder shall point out these conflicts in his bid at the time of tendering.

## 3.2 **SERVICE CONDITIONS**

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

## 4. **DETAILED REQUIREMENTS**

### 4.1 **TYPE**

4.1.1 The recloser shall be outdoor type, with vacuum interrupter in solid dielectric insulation, single-tank, frame-mounted, three-pole with single-throw operation. The phase-to-ground insulation of the recloser shall be coordinated with the internal open-gap insulation in order that flashover due to impulse and switching surges will always occur to ground and external to the interrupting device.

The housing should be made of Aluminum secured by stainless steel bolts and incorporating rubber 'O' ring seals throughout. Porcelain, EPDM or silicone bushings will be accepted. The pole mounting bracket should be made of galvanized steel with 254 mm (10 inch) center.

The recloser shall be mounted on wood or concrete poles and provided with ground studs with clamp type terminal connectors suitable for All Aluminum Alloy Conductors (AAAC) 40 mm<sup>2</sup> – 200 mm<sup>2</sup> ( #2 AWG - 394.5 MCM). Clamp-type terminal connectors for All Aluminum Alloy Conductors (AAAC) 40 mm<sup>2</sup> – 200 mm<sup>2</sup> (#2 AWG - 394.5 MCM) shall be provided on the bushings for primary connections.

A junction box with terminal blocks shall be installed on the recloser to facilitate accessory connections.

## 4.2 RATINGS ETC.

The reclosers shall have the following ratings.

Nominal System Voltage	24/13.8 kV GRD Y
Maximum Rated Voltage	25.8 kV
Lightning Impulse Withstand Level	150 kV
Rated Continuous Current	560-800 A
Interrupting capability at Rated voltage	12,000 A symmetrical 50 Hz
Reclosing Time	Selectable between 0 to 200 seconds

## 4.3 OPERATING MECHANISM

The reclosing operating mechanism shall be operable on either normal system voltage (24kV) or on low voltage (125Vdc/48Vdc).

The recloser shall be provided with the following:

- 4.3.1 Manual operating facility.
- 4.3.2 Non-reclosing mode facility.
- 4.3.3 Mechanical position status indicator, which clearly indicates the closed or open position of the recloser. The indicator shall be visible from the ground.
- 4.3.4 Operations counter

The operating mechanism shall be equipped with an auxiliary switch with at least three "a" and three "b" contacts for the Purchaser's use.

## 4.4 BUSHING CURRENT TRANSFORMERS

- 4.4.1 Three current transformers, one in each source side bushing, shall be provided for operating meters. All CT secondary terminal leads shall be

brought to shorting-type terminal blocks located and accessible in the Mechanism housing.

4.4.2 Bushing CTs shall be rated as follows:

Ratio	600:5/1200:5 multi-ratio
Accuracy	C100/C200 at 600:5/1200:5

4.4.3 The polarity should be towards external bushing terminals.

#### **4.5 OPERATING CHARACTERISTICS**

The recloser shall have a selection of either fast or retarded operation for any or all trips in the operating sequence. The retarded operation should have a selection of time-current characteristics (including extremely-inverse) to facilitate coordination with other protective devices (including ANSI type "K" fuses and line reclosers).

The recloser should reclose automatically following either instantaneous or time-delayed tripping. The automatic reclosing scheme should have the following features:

- (a) Option of 1, 2, 3 or 4 operations to lockout;
- (b) Common operations-to-lockout settings for phase-fault and ground-fault tripping;
- (c) Independent fast-operations settings for phase and ground tripping;

The recloser should reset automatically after a prescribed interval following a successful reclosure, or from the lockout position following a successful manual closure.

#### **4.6 OPERATING REQUIREMENTS**

Phase overcurrent:	Pickup range up to 1200Amps
Ground overcurrent:	Pickup range up to 600Amps
Reclosing function:	Multi-shot reclosing; 0 – 4 Reclosures; fast, time-delayed Operations selectable
Phase-trip curve:	Definite-time &

Ground-trip Curve:	inverse-time curves Definite-time & inverse-time Curves
Ground-trip blocking:	Facility required
Control voltage:	125 Vdc/48Vdc stand alone
Metering:	Power, voltage, current, maximum current Demand

#### 4.7 **TROPICALIZATION OF EQUIPMENT**

In the selection of materials and equipment, due regard shall be given to the hot and humid conditions to which they 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.

#### **4.8 FINISH**

All ungalvanized metal parts shall be thoroughly cleaned, primed, undercoated and finished with two coats of outdoor paint suitable for installation in direct sunlight in a tropical climate. Finish coats shall be light gray epoxy paint applied over the primer.

Each recloser shall be supplied with one liter of finish paint for retouching on site.

#### **4.9 TOOLS AND ACCESSORIES**

The Supplier shall furnish without extra charge a complete set of any special tools or accessories, which may be necessary or convenient for the operation, assembly, adjustment or for the routine maintenance of the recloser.

#### **4.10 SPARE PARTS**

The Bidder shall quote separate itemized prices for the following spare parts:

- 1 - complete quenching chamber
- 2 - set arcing contacts, moving
- 2 - set arcing contacts, fixed
- 1 - arcing ring
- 1 - set of gaskets
- 2 - closing coil
- 2 - trip coil
- 1 – X relay( if applicable)
- 1 – Y relay(if applicable)
- 1 - set insulated drive rods
- 1 - set accessories for recloser inspection and maintenance, including maintenance closing device
- 1 –bushings
- 2- microprocessor relays



The bidder shall recommend and price any additional spare parts considered necessary.

#### **4.11 SUBMISSION AND APPROVAL OF DRAWINGS**

The Supplier shall submit four (4) 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 four 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 for final approval revised copies within one (1) month of the receipt of the marked-up drawings. 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.

#### **4.12 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).

The graphical symbols on electrical drawings, diagrams, and other documents shall be in accordance with ANSI standards.

Dimensions of Drawing frames with bending 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 shall be A1 format.

Units of measure and weights shall be expressed in the metric (SI) system of measurements.

#### **4.13 OPERATING REQUIREMENTS**

Seven (7) copies of the installation, operation and maintenance manual shall be furnished by the supplier before shipment of equipment and materials. The manual shall contain the following minimum information:

- General descriptive information
- Assembly and/or erection details
- Operating and Maintenance instruction
- 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

Preliminary copies of the operating and maintenance manuals shall be submitted for approval in sufficient time to allow for issue prior to shipping the equipment from the factory.

## **5. REMOTE TERMINAL UNIT (RTU)**

### **5.1 GENERAL CONSIDERATIONS**

The RTU shall be an integral subsystem of the pole mounted switch/recloser system and shall be supplied as such requiring no electrical or mechanical assembly. All communication protocols, data collection and processing applications and general operating system software shall require minimum configuration for operation.

The RTUs communication, monitoring and control parameters shall be configurable using an application which runs on portable IBM compatible computers. The configuration shall not require reloading due to power outage. Diagnostic and testing applications to allow any required maintenance will be supplied. These shall run in the same computer environment as the configuration application.

The RTUs shall communicate using the DNP 3.0 protocol to an existing master station via cellular GSM links. Remote retrieval of SOE, fault, and energy demand data shall be implemented in the RTUs.

### **5.2 PROCESSOR**

The RTU processor shall accept commands received from the master station, perform address recognition, assemble response messages in accordance with received command messages and transmit these messages to the master station. The processor shall perform data acquisition and execute control requests.

Check-before-operate verification of control point selection shall be performed and an appropriate select acknowledge response issued to the master station prior to executing a control. Circuitry shall be provided to prevent control operation if more than one control point has been selected. The RTU shall automatically reset a previously received control

selection if the next following received command is not the valid execute command. It shall also reset a previously received control selection if the valid execute command has not been received within 30 seconds of the select command.

The RTU shall feature a 16-bit (minimum) micro-processor.

The processor shall provide diagnostic information in the message structure that the master station computer shall monitor. A flag shall be set if the RTU performs a restart for any reason including power failure. Turning off the RTU for maintenance shall be treated the same as a power failure.

### **5.3 COMMUNICATION PORTS**

The RTU will support at least two (2) RS232C serial I/O ports. One port will be used to report scanned data to the master station using the DNP 3.0 protocol. A separate port will be available for configuration, diagnostics and operational testing. This port will have at least two (2) levels of password protected access to allow separation of configuration and maintenance/operation functions.

The control panel shall include:

Quad-Band GSM module to operate on the following frequencies: 850/900/1800/1900 MHz, with option for the following depending on the installation location:

- a) Fiber (single mode ST connector) to RS 232 media converter, or
- b) Ethernet microwave radio(spread spectrum ) operating at 2.4 GHz operating at 12 volts dc inclusive of antenna and all necessary accessories .

All ports will function independently of each other and will be capable of communicating through a cellular GSM modem. The baud rate for each port will be software configurable from 1200 to 9600.

### **5.4 INPUT/OUTPUT**

The RTU will be supplied with all input/output points required by the switch/recloser system for efficient and effective use of all monitoring, control, and data collection functions.

#### **5.4.1 ANALOG INPUT REQUIREMENTS**

The RTU shall contain analog-to-digital conversion equipment necessary to meet the analog conversion rates necessary to satisfy scan rate of two (2) scans per second.

The A/D converter shall have a digital resolution of at least 11 binary bits plus sign. The accuracy of the analog input system shall be at least 0.05% at 25°C with a temperature coefficient of at least  $\pm 10$  ppm/°C. Linearity shall be better than  $\pm 0.05\%$ . The input to the analog-to-digital subsystem shall exhibit common mode noise rejection characteristics of at least 100 dB from 0 to 50 Hz. Normal mode noise rejection shall be at least 60 dB at 50Hz. The overall accuracy tolerance and rejection characteristics shall include the effects of any scaling resistors, amplifiers, and signal conversion equipment used between the input terminals and the final converted value. Data conversion and transducer termination techniques utilized shall not effectively degrade these accuracy and noise immunity characteristics. The analog-to-digital converter input amplifier shall be protected against permanent change from induced energy surges. Transient voltage protection shall meet or exceed the IEEE surge requirements stated in Section 1.6 (below).

The analog-to-digital converter equipment shall include an integrity check feature with reference checks at a minimum of two points ( $\pm 90\%$ ) across its normal full scale range. The integrity check feature will be monitored periodically by the master station to assure that the RTU A/D converter(s) is/are operating satisfactorily. If multiple A/D converters are required, each A/D converter shall have an integrity check feature. The overall accuracy and stability of the integrity check reference signal shall not exceed 0.02% of full scale throughout the specified temperature range.

The analog points monitored will include:

- Voltage on all three phases
- Line Current on all three phase
- Real and Reactive power
- Power flow direction
- Power Factor and Phase angle
- Energy Demand
- Fault current values

#### **5.4.2 DIGITAL INPUT REQUIREMENTS**

The digital inputs transient voltage protection shall meet or exceed the IEEE surge requirements stated in Section 5.6 (below). Stored data shall not be corrupted when this test is applied.

All input circuits of the digital input modules shall be electrically isolated from the external signal. Optical isolation techniques shall be used throughout the RTU for digital input circuit protection.

Circuit protection to eliminate the possibility of catastrophic effects of short circuit conditions on device contacts and input circuits shall be included in the RTU.

The following types of status points shall be supported:

- Two-State Status
- Pulse Accumulator
- SOE (Sequence Of Event)

#### **5.4.2.1 DIGITAL INPUT - TWO-STATE STATUS**

Two-state status inputs shall be used to monitor device status and alarm states. The status inputs shall be appropriately filtered so that a true current indication is always retrieved upon request. In general, the status of circuit breakers is provided by an "a" contact.

#### **5.4.2.2 DIGITAL INPUT - PULSE ACCUMULATOR REQUIREMENTS**

Accumulators shall be provided with sixteen (16) bit register capability. The RTU shall respond to a universal freeze command from the master station. On receipt of a "Freeze" command, the accumulators shall transfer their contents to holding registers and continue accumulation of meter pulses without reset. Data stored in holding registers will be retained for transmission to the computer. Read requests shall not reset the holding register. Capability to issue and receive an external freeze signal via control output and status input, respectively, shall be provided.

The accumulators shall rollover from maximum count to zero and continue counting. The master station shall account for the rollover of the count.

#### **5.4.2.3 DIGITAL INPUT - SOE**

The RTU shall be designed and configured with support for SOE.

The RTU shall have an internal clock capable of maintaining relative time accuracy to  $\pm 1$  msec over a fifteen minute period. The RTU clock shall be periodically reset via time codes received from the master station.

The RTU shall allow SOE to be activated and deactivated on an RTU basis using one command message.

The RTU shall have a buffer to store SOE inputs. The buffer size shall be, at a minimum, equal to the number of SOE points capable in the RTU but no less than 256 events. The RTU shall set a flag in the return message of any communication from the Master Station indicating there is SOE data. The Master Station will then request SOE data. SOE data shall not be deleted unless directed by the

Master Station. SOE data, if not specifically deleted, shall be overwritten when the buffer is full with the oldest data being overwritten. The RTU shall have a retransmit capability of all SOE data currently in memory if it is desired.

The digital inputs monitored will include:

- Switch/recloser trip/close
- Remote/local indication
- Manual/auto indication
- Overcurrent breaker operation and lockout on a per phase basis
- Line voltage failure indication
- Battery charger over or low voltage indication
- Battery charger failure indication
- Security/Tamper indication

### **5.4.3 DIGITAL OUTPUT**

The RTU shall be capable of outputting two-state supervisory controls. The RTU shall be designed such that only one output can be activated at a time. Select-before-operate methodology shall be used. The maximum time the RTU waits between receipt of a control select command and the activate command shall be configurable between 0.1 and 5 seconds in 0.1-second increments. If the activate command is not received within the set time, the operation shall be terminated. The factory setting shall be 1.0 seconds.

The digital output security shall meet the requirements given in Section 5.6 (below).

Each control output relay shall provide a contact closure or opening for a configurable time period. The closure time shall be from 0.1 to 5.0 seconds in increments of 0.1 seconds.

Digital outputs will include:

- Switch / Recloser Trip/Close
- Battery load test

### **5.5 RTU POWER SUPPLY**

The RTU will have primary and backup power supplies. The primary supply will be derived from the line supply to the switch/recloser system. The backup power supply will be derived from a rechargeable battery with an endurance of at least twenty four (24) hours.

The RTU will have a switch to disconnect both primary and secondary supplies. An LED will indicate the presence of primary or secondary power.

## **5.6 RTU SECURITY**

The RTU encoding and decoding logic shall be designed to prevent false commands from being executed and erroneous data from being transmitted due to communication channel errors.

All communications security features recommended by the latest ANSI Standard C37.1 shall be provided. This shall include error control to ensure that the probability of undetected bit errors is no greater than  $10^{-10}$  when the channel is operating within the limits of less than or equal to 1 bit error in  $10^{10}$  bits.

The RTU shall be fail-safe in design. The following design criteria shall be incorporated in the digital output and jog control logic:

- (0) Select-check-operate sequence for control output. The verification message for check-before-operate control sequences shall be obtained by re-encoding the verification message directly from the control point selection lines. Thus, a simple reflection of the received message is not acceptable.
- (1) No more than one control point shall be selected at any given time. Hardware circuitry shall also be provided that prevents control operation if more than one control point has been selected whether by hardware or Master Station command.
- (2) No false output shall result from a single point of failure in the RTU.
- (3) No false output shall result during power up or power down.
- (4) No false output shall result from inadvertently inserting a circuit card into a wrong slot.
- (5) The control selection shall be automatically canceled if after receiving the "control selection" message, the "operate" command is not the next received message and/or is not received within an adjustable time period.
- (6) The local/remote switch must be in the remote position for control outputs to energize relays.

All RTU interfaces to the switch/recloser environment shall meet or exceed the most current ANSI Surge Withstand Capability (SWC) standard (IEEE STD 472; ANSI C37.90a).

All RTU interfaces to the switch/recloser environment shall meet or exceed the most current ANSI Dielectric standard on electrical insulation (ANSI Std 930). The purpose of this test is to show that inputs and outputs are properly isolated from the RTU ground.



## **5.7 RTU ENCLOSURES**

All RTUs shall be protected against the electromagnetic, electrostatic, and induced transients and currents which may be present in switch/recloser environment.

Inside the enclosure, hot-spot temperatures shall not exceed the recommended operation temperatures of the components, as established by the manufacturer of the components, while the equipment is subjected to the temperature ranges specified herein.

Equipment shall be sufficiently sturdy to withstand handling during shipment, placement, and start-up without damage.

The RTU equipment shall be designed to operate continuously in an ambient temperature range of 0 deg to 70 deg Celsius with relative humidity range of 5 to 95 percent noncondensing, without forced air cooling.

## **5.8 RTU CONSTRUCTION REQUIREMENTS**

New material of the best industrial grade shall be used. Wire and cable connectors and terminators shall be permanently labeled for identification. Connection points for external cables and wires shall be easily accessible for connection/disconnection and shall be permanently labeled. All components and equipment shall be of current production from component manufacturers. To facilitate expansion and maintenance, modularity shall be employed throughout the equipment. Wiring shall be neatly laced or clamped. Materials which are susceptible to corrosion shall not be used unless properly coated for protection.

Plug-in assemblies and subassemblies shall be employed wherever possible, using as few mounting screws as are consistent with stress and vibration requirements.

Plug-in contact finishes that ensure reliable long-term operation in a high-humidity environment shall be provided and each card shall have a model number and/or part number and revision level to uniquely identify it.

Components shall be industrial grade and readily available from two or more suppliers, to the greatest extent possible.

Cabling shall comply with applicable codes and general safety practices.

## **5.9 RTU MAINTENANCE REQUIREMENTS**

### **5.9.1 DOCUMENTATION**

A complete set of schematic drawings and technical manuals for the RTU shall be supplied.

These shall be sufficiently detailed to allow trouble-shooting and repair at the component level. The technical manuals shall contain functional explanations of the RTU modules.

### **5.9.2 SOFTWARE**

Suitable configuration, diagnostic and operational testing applications shall be provided. These applications will run in a Microsoft Windows environment on IBM compatible portable computers. The computer will interface to the RTU via an RS232 connection.

Documentation for these applications will be supplied in both hard copy and CDROM formats.

The configuration application will allow setting of communication, protocol and data acquisition parameters to allow integration with the existing SCADA system.

The diagnostic application shall allow hardware module level fault location and monitoring of communication data to the master station.

The operational testing application will allow testing of each data acquisition and control feature of the RTU.

### **5.9.3 TRAINING**

Training on Principle of Operation and Maintenance procedures for the RTU shall be supplied and should include:

- RTU Configuration
- Configuration of DNP 3.0 protocol for SCADA master station integration
- GSM Cellular module
- Fault location and correction
- Switch/Recloser operation and maintenance
- Trouble shooting
- Use of relevant test equipment.
- Safety

### **5.9.4 SPARES**

RTU spare modules will be 10% of operational modules.

## **6.0 TESTS**

- 6.1** The reclosers 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 certified copies of type tests on identical equipment, the Purchaser may waive such 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.
- 6.2** The total cost (all expenses paid) for witnessing the final shop and functions tests by two (2) of the Purchaser's Engineers, shall be included in the quoted CIF cost of supply of Automatic Circuit Reclosers. This cost shall be itemized separately for identification purposes.
- 6.3** Supplier shall furnish six certified copies of all test reports, curves and oscillograms within 2 weeks after completion of any tests.

## **7.0 PACKAGING AND MARKING**

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 or loading.

Small or fragile pieces shall be carefully boxed or crated 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 precaution required to ensure the arrival of the equipment in an undamaged and satisfactory working condition.

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

Jamaica Public Service Co. Ltd.  
Kingston  
Jamaica, W.I.

**Automatic Pole Line Recloser**

Purchase Order Number:

and any other relevant identification marks.

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 document shall include lists with type and quantities of materials contained in each crate.

## **8. SHIPMENT**

- 8.1** Manufacturer shall await written authorization of purchaser before commencing shipment of transformers.

