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**Underground Line Sensors for Cellular Communication**

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## Document History

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## **Underground Line Sensors for Cellular Communication**

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### **1. Introduction**

This specification covers underground line sensors and engineering visualization tools for use on the 60 Hertz WYE connected multi-grounded in range of 4.16 to 14kV (phase to phase) in Puerto Rico. Further information will be provided by LUMA Energy at time of order placement and will provide information on site specific conditions, quantity, type, and electrical requirements.

### **2. Special Requirements**

- 2.1. Hardware samples must be furnished as requested by LUMA Energy. Vendors that have supplied this material to LUMA on previous orders, will not have to furnish samples at bid opening. The material will be received at the LUMA's general warehouse (011) at Palo Seco, Puerto Rico. Shipping will include transportation and unloading at the indicated warehouse.
- 2.2. Any changes or update to the supplier's approved designs, procedures, quality routines and/or inspection layout must be communicated to the LUMA Energy in writing.
- 2.3. The purchaser reserves the right to refuse shipment and to determine the acceptability and reject ability of material received. The supplier will be liable for all costs incurred for shipments that are refused, rejected, or replaced.

### **3. Literature**

- 3.1. Descriptive and technical literature must be supplied by vendor at time of bidding. This literature may include, but is not limited to details of material, drawings, documented testing, and instructions for use and installation. Failure to submit documents on time will cause bidder disqualification. For products described in this specification as requiring qualification, awards will be made only for such products that, prior to the time for opening of bids, had been tested and/or approved by LUMA. Evidence of PREPA's and/or LUMA Energy's approval of the equipment or material shall be supplied by vendor if requested by LUMA Energy.
- 3.2. In an agreed upon time frame, after receipt of purchase order, the vendor must submit any special procedures, techniques, or precautions that must be followed during installation. The vendor shall provide digital and hardcopies of Operation and Maintenance manuals (O&M Manuals).

### **4. Markings, Packing, Shipping and Storage**

- 4.1. Each device shall be permanently identified with the appropriate catalog number, supplier's catalog number, and manufacturing date.
- 4.2. Additionally, each device will also be permanently identified with the trip current value and minimum reset value, (when applicable).

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- 4.3. All devices must be individually boxed with the outside of each box marked with the LUMA warehouse item number, the supplier's name, and the supplier's catalog number.
- 4.4. Each device must be supplied with a unique MAC address or serial number that would facilitate the configuration of each device through a configuration software. The supplier must provide the list of these MAC addresses per shipment.
- 4.5. If devices are stored outdoors open to the elements, packaging must prevent equipment from being damaged by rain, snow, ice, wind, etc.
- 4.6. The supplier shall include installation instructions in a medium agreed upon by the purchaser. Warning Label shall be placed on the equipment for special handling and storage requirement.
- 4.7. All materials, elements, parts, and hardware crates shall be shipped on flatbed trailers and stored in such a way so that they can be unloaded by finger lifts. Deliveries in containers or closed platforms where finger lifts cannot be used will not be accepted.
- 4.8. A copy of each detailed packing list must be sent to LUMA Energy personnel in charge of the requisition, prior to the delivery.

### **5. Acceptance Criteria**

- 5.1. Each device must be built following the latest applicable ANSI/IEEE, NEMA, NEC, IEC, and ASTM Standard and the herein included requirements. When conflict occurs between ANSI/IEEE and purchaser's specifications, the purchaser's specification shall prevail.
- 5.2. The following standards must form a part of this specification unless otherwise stated:
  - a. ANSI/IEEE Standard 495-2007 Guide for Testing Fault Circuit Indicators
  - b. ASMT B-117 Standard Practice for Operating Salt Spray Apparatus
  - c. Certified design test reports shall be provided.

### **6. Description**

#### **6.1. Material and Make-Up**

- a. Line Sensors shall be compatible with shielded insulated conductors.
- b. Must be compatible with conductor overall diameter 1.5 inch to 2.4 inch, 1000 KCMIL cable or smaller.
- c. The sensors must support the following switch manufacturers: S&C, ABB, Hubbell, Federal Pacific, G&W
- d. All connectors of FCI solution must be IP67 rated for underground vault application.

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### **6.2. Current Sensor**

- a. The current sensor portion of the device must be capable of ASTM B-117 Class 2 for glove installation on an energized cable.
- b. The line sensor shall be able to operate self-powered in a current range of 0 to 600 amps, minimum.
- c. LUMA prefers that the device be self-powered without the need of external power supplies or photocells. The supplier shall present alternatives for products used on circuits with minimum load (i.e., 0 to 10 amps) where batteries are necessary for the operation. The batteries must have a minimum operating life of 10 years.
- d. The device and application software must have the capability to eliminate false tripping of the unit.

### **6.3. LED Fault Indications**

- a. The LED Fault must be mountable on the switch enclosure as part of the current sensor solution of the device for fault indication.
- b. The LED indicator must be weatherproof LED FCI-type indicator for outdoor installation visible from 1000 feet.
- c. The target or LED must display a red color for a permanent fault condition. Other colors must be submitted to the LUMA Energy for evaluation and approval.

### **6.4. Environmental conditions**

- a. Temperature & Humidity: Materials for the device must withstand the environmental and operating conditions as defined in ANSI/IEEE Std. 495, ASTM B-117 salt spray, ASTM G 155 UV exposure, ISTA 3A over the anticipated 40-year life of the installation. Equipment supplied must be adequate for an operating temperature range of 0°C to 50°C (32°F to 122°F), with humidity up to 100%.

LED indicator unit must be suitable for outdoor installation IP67.

- b. Pollution: The equipment must be designed and constructed for the corrosive environment of an electrical system in a tropical zone close to sea and it must provide reliable performance in environments with high exposure to salt, minerals, chemicals, or wind-borne particulate. The insulator contamination levels for the equipment should be adequate to prevent flashover. All exposed material must be made of materials with anti-corrosive capabilities.

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### **6.5. Sensing and Characteristics**

- a. Must be able to measure the following:
  1. Load current
  2. Fault current
  3. Sags and surges
  4. GPS location and time-stamp reference of events
- b. Must be able to send alarms for the following events:
  1. Permanent fault
  2. Line or power disturbance
  3. High current threshold

### **6.6. Device communication accessories and features**

- a. The system shall allow for DNP 3.0 SCADA communications via a communication gateway.
- b. Optional gateway can be used. Supplier must provide technical information for any product offered to the LUMA Energy for evaluation and approval.

Ability to receive SCADA commands sent via DNP3 through the communication gateway to the devices.

The DNP 3.0 mapping for SCADA shall include, as a minimum, the items described in Section 7.5.

The communication module must accept certified Cellular 4G LTE (AT&T) communication interface.

The devices must have the capability to integrate and send any relevant data to proprietary software or any other interface (SCADA, OMS, etc.). The supplier must provide technical documentation of any software offered for this system for evaluation.

## **7. Engineering Visualization Tool**

- 7.1. The sensors will be used to provide important loading data and fault to the engineering and operations personnel.
- 7.2. The visualization tool shall be a hosted service or be developed and delivered by the supplier to provide real-time access for engineering and operations personnel to the sensor measurements and alarms.
- 7.3. The tool must accept the LUMA feeder and substation identification numbering format.
- 7.4. Luma personnel must be able to enter new devices into the tool as they are deployed.
- 7.5. The tool must provide the following information for each feeder preferably in a single screen.

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- 7.6. The supplier must provide at the time of bidding an option for their current standard screen and an option to develop the screen with information as indicated below:
- a. Substation #:
  - b. Feeder #:
  - c. FCI Location #:
  - d. GPS Coordinates of each device:
  - e. MAC Address of each device
  - f. Measurements
    - 1. Primary Load Current
    - 2. % Phase Load Unbalance
  - g. Alarms
    - 1. High current alarm
    - 2. % Phase unbalance alarm
    - 3. Fault alarm
    - 4. Outage
  - h. Statistics
    - 1. Maximum load current per phase
    - 2. Minimum load current per phase
    - 3. Maximum phase unbalance.
    - 4. Outage counter
    - 5. Fault counter
  - i. Fault Reports
    - 1. Fault Type (FA; FB; FC; FG)
    - 2. Fault Duration
    - 3. Outage Duration
  - j. Control
    - 1. Generate waveform capture.
    - 2. Download waveform capture.

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7.7. The tool must provide a means to achieve statistics and reports to the LUMA FCI number. A device can thus be replaced but the device history will be associated with a Luma assigned FCI Location Number

7.8. The sensors may be supplied turnkey with cellular communication enabled.

### **8. The supplier will be responsible for cellular plan activation.**

8.1. The supplier can provide 12-month cellular data plans for the devices.

8.2. The cellular data plans must be transferable to LUMA in the future.

### **9. Qualification and Testing Requirements**

9.1. At the time of request for quotation, the supplier must submit a certified report of the design tests performed demonstrating full compliance to ANSI/IEEE 495-2007 (or latest). The test report shall include description, details, results, and pertinent data of samples tested. Retesting is required for a change in any product.

9.2. At the time of request for quotation, the purchaser may require the supplier to submit a copy of their Quality Control Manual to show how the supplier has incorporated the measures to produce a quality product in their operation. The quotation shall include SPC data in graph form containing routine test results for the last 1000 devices produced.

9.3. Suppliers will be required to submit product samples for inspection by the LUMA's Material Specifications Section. This inspection will verify that the supplier's product meets the requirements of applicable specifications.

### **10. Guarantee**

10.1. In reply to purchaser's request for quotation, suppliers must respond to the terms and conditions for the material being proposed to include warranty period and coverage. The devices shall be designed and manufactured to provide a life expectancy of a minimum of 40 years. Replacement costs associated with premature failure due to inadequate design or faulty manufacturing shall be the responsibility of the supplier.

10.2. Replacement costs associated with device failure due to inadequate design, faulty manufacturing, or software errors are to be the responsibility of the supplier.

10.3. Non-conformance observed during sampling will require the supplier to bring the devices into compliance with the specification 14 days after notification. The units to be brought into compliance with the specification must be shipped to the supplier at the Supplier's expense.

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### **11. Proposal Information**

- 11.1. Submitted proposals shall include:
- a. Technical information
  - b. Any exceptions taken to this specification.
  - c. Copies of sample nameplates
  - d. Lists of special and standard maintenance tools
  - e. List of recommended spare parts
  - f. Example of existing engineering visualization tool screens.

— End of Specification —

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## **Underground Line Sensors for Cellular Communication**

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# Appendix

## Underground Line Sensors for Cellular Communication

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### Appendix: 1 Table of Compliance

Criteria	Description	Pass/Fail (P/F)	Comments
Specification	<ul style="list-style-type: none"> <li>The Proponent complies with the corresponding specification document</li> </ul>		
Industry Standards	<ul style="list-style-type: none"> <li>The Proponent complies with the industry standards established in the specification document.</li> </ul>		
Material	<ul style="list-style-type: none"> <li>Line Sensors shall be compatible with shielded insulated conductors.</li> <li>Must be compatible with conductor overall diameter 1.5 inch to 2.4 inch, 1000 KCMIL cable or smaller.</li> <li>The sensors must support the following switch manufacturers: S&amp;C, ABB, Hubbell, Federal Pacific, G&amp;W</li> <li>All connectors of FCI solution must be IP67 rated for underground vault application.</li> </ul>		
Current Sensor	<ul style="list-style-type: none"> <li>The current sensor portion of the device must be capable of ASTM B-117 Class 2 for glove installation on an energized cable.</li> <li>The line sensor shall be able to operate self-powered in a current range of 0 to 600 amps, minimum.</li> <li>LUMA prefers that the device be self-powered without the need of external power supplies or photocells. The supplier shall present alternatives for products used on circuits with minimum load (i.e., 0 to 10 amps) where batteries are necessary for the operation. The batteries must have a minimum operating life of 10 years.</li> <li>The device and application software must have the capability to eliminate false tripping of the unit.</li> </ul>		

## Underground Line Sensors for Cellular Communication

Criteria	Description	Pass/Fail (P/F)	Comments
Sensing Characteristic	<ul style="list-style-type: none"> <li>Must be able to measure and send alarms as per Section 7.5</li> </ul>		
Fault Indication	<ul style="list-style-type: none"> <li>The LED Fault must be mountable on the switch enclosure as part of the current sensor solution of the device for fault indication.</li> <li>The LED indicator must be weatherproof LED FCI-type indicator for outdoor installation visible from 1000 feet.</li> <li>The target or LED must display a red color for a permanent fault condition. Other colors must be submitted to the LUMA Energy for evaluation and approval.</li> </ul>		
Environmental Conditions	<ul style="list-style-type: none"> <li>Temperature &amp; Humidity: Materials for the device must withstand the environmental and operating conditions as defined in ANSI/IEEE Std. 495, ASTM B-117 salt spray, ASTM G 155 UV exposure, ISTA 3A over the anticipated 40-year life of the installation. Equipment supplied must be adequate for an operating temperature range of 0°C to 50°C (32°F to 122°F), with humidity up to 100%.</li> <li>LED indicator unit must be suitable for outdoor installation IP67.</li> <li>Pollution: The equipment must be designed and constructed for the corrosive environment of an electrical system in a tropical zone close to sea and it must provide reliable performance in environments with high exposure to salt, minerals, chemicals, or wind-borne particulate. The insulator contamination levels for the equipment should be adequate to prevent flashover. All exposed material must be made of materials with anti-corrosive capabilities.</li> </ul>		

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Criteria	Description	Pass/Fail (P/F)	Comments
Sensing Characteristics	Must be able to measure and send alarms as per Section 7.5.		
Communications	<p>The system shall allow for DNP 3.0 SCADA communications via a communication gateway.</p> <ul style="list-style-type: none"> <li>• Ability to receive SCADA commands sent via DNP3 through the communication gateway to the devices.</li> <li>• The DNP 3.0 mapping for SCADA shall include, as a minimum, the items described in Section 7.5. Must be able to measure and send alarms as per Section 7.5.</li> <li>• The communication module must accept cellular communication interface.</li> <li>• The devices must have the capability to integrate and send any relevant data to proprietary software or any other interface (SCADA, OMS, etc.).</li> </ul>		











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