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Transmission Line Optical Sensor System

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Related/Referenced Documents

Include the applicable document, section, or reference "[add link here](#)".

Version History

Version	Date	Revision
01	07/05/24	First Issue

1. Introduction

The primary goal of deploying these optical sensors and the associated visualization, data management and analysis system is to help with accurate event location on the transmission lines in Puerto Rico and to help prioritize grid improvements (line/tower/insulator and vegetation work) by identifying the most problematic areas on the grid. Ultimately, the goal is to realize operational benefits through high accuracy fault and incipient fault location; the desired functional outcomes are reduced outage time and improved reliability indices. The initial focus is on the 230 kV and 115 kV systems.

The vendor must supply passive optical sensors that will be mounted by Luma in existing structures, electronic cabinets will be mounted in close proximity to the optical sensor installation. The vendor must in addition supply visualization and analysis software as specified in this document. The software will be installed in the LUMA OT environments and must comply with Power Utility cyber security standards.

2. Special Requirements

Samples shall 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 equipment/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.

3. Literature

Descriptive and technical literature must be supplied by the 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/material shall be supplied by vendor if requested by LUMA Energy.

4. Markings

- 4.1. Containers shall be marked outside with LUMA Energy's purchase order, item number, name and size, net and gross weight, manufacturer's name, and lot number.
- 4.2. Packaging labels and tags shall be waterproof.

5. Packaging

All equipment/material shall be packaged and marked in such a way as to facilitate handling and protection from damage and that the receiving warehouse can readily identify it and send it, in one complete unit, to a field location without opening crates or boxes to sort items and/or parts.

6. Number Per Package (Logistics)

Supplier shall indicate the logistics at opening bid or as required by LUMA Energy.

7. Acceptance Criteria

- 7.1. **Test required:**
 - 7.1.1. Certified by external laboratories.
- 7.2. The latest applicable codes, standards, and other regulations.
 - 7.2.1. LUMA & Supplier will develop minimum requirements and guidelines criteria for acceptance.

8. Description

- 8.1. **LUMA Warehouse Number:**
 - 8.1.1. **032-85893**
- 8.2. **Primary Sensor**
 - 8.2.1. Voltage Range - 5kV to 800kV.
 - 8.2.2. Fiber Optic Cable - All-dielectric connectorized cable
 - 8.2.3. Standard cable length – 80 feet
 - 8.2.4. Maximum cable length 2,5 to 3 miles

8.2.5. Weight 0.5 to 1 lbs

8.2.6. Dimensions LxWxH 3x3x2 to 4x4x3 Inches

8.2.7. Operating Temperature: -40°C to 70°C / -40°F to 158°

8.2.8. Humidity: 90% RH @ 60°C (140°F)

8.3. **Sensor Housing**

8.3.1. Weight 15 to 20 lb

8.3.2. Height 7.4 to 8.4 inches

8.3.3. Diameter 12 to 13.4 inches

8.3.4. Installation requiring no outage.

8.4. **Secondary optical digital converter**

8.4.1. Power Input 24 Vdc

8.4.2. Analog Signal Output +/- 10 Vpeak

8.4.3. Digital Output IEC 61850-9-2

8.4.4. Voltage PMU

8.4.5. Timing Input IEEE 1588 / IEC 61588 PTP or IRIG-B

8.4.6. Data files time stamped to < microsecond.

8.4.7. Traces of interest must be MHz oscillography, 61850 SV-rate (4.8 kHz and 14.4 kHz) oscillography, and PMU time series.

8.4.8. Six optical sensor inputs to support two transmission lines.

8.5. **Sensing**

8.5.1. Passive optical primary sensor

8.5.2. 90 kHz to 100 kHz bandwidth

8.6. **Electronics Cabinet**

8.6.1. Weatherproof IP 65 stainless-steel construction

- 8.6.2. 110 Vdc input supply.
- 8.6.3. 120 Vac heater and thermostat.
- 8.6.4. Fuses or MCBs for AC and DC supply circuits.
- 8.6.5. The wire used will be 18-gauge NEC SIS wire with a soft annealed tinned copper wire.
- 8.6.6. All wires will be crimped and terminated using ring tongue or ferrule terminals.
- 8.6.7. 24 Vdc Supply for sensor electronic and 5 W cellular router.
- 8.6.8. Weatherproof Antenna Surge protected SMA type connectors mounted in panel floor.
- 8.6.9. Weatherproof gland plate for optical cable and power cable entry
- 8.6.10. Padlock able door handle.
- 8.6.11. Operating temperature range: -40°C to 70°C / -40°F to 158°
- 8.6.12. Storage temperature range: -40°C to 85°C / -40°F to 185°F
- 8.7. **Optical Sensor Waveform Analysis Software**
 - 8.7.1. The software must enable users to view and analyze from waveform captures supplied by the optical sensors.
 - 8.7.2. The users must be able to overlap and Time Align Synchronous Measurements from 2 captures events.
 - 8.7.2.1. View 3 phases each from the two sensors.
 - 8.7.2.2. Find timing differences.
 - 8.7.2.3. Identify traveling wave edges.
 - 8.7.2.4. Look Up GPS Coordinates based on time difference between wavefronts.
 - 8.7.2.5. Transform a time difference between nodes into a physical location on power grid.
 - 8.7.2.6. Provide sharable reports with key information.
 - 8.7.2.7. Auto-generate a Google maps link pointing at the location.
 - 8.7.2.8. Connect multiple lines together, with only one sensor at either end of the composite line.
 - 8.7.2.9. Support single ended (one sensor) or double ended (two sensors) analysis.

- 8.7.3. The software must provide the user with the ability to filter and select files.
- 8.7.4. Analysis:
 - 8.7.4.1. Application of high pass, lowpass, bandpass, or bandstop filters.
 - 8.7.4.2. Combine signals using matrix multiplication.
 - 8.7.4.3. Calculate and display RMS, frequency, amplitude, and phase quantities.
- 8.7.5. Visualization of raw MHz Data sampled values (SV), and synchro phasor data to support analysis with protection action, system events and continuous monitoring.
- 8.7.6. File export functionality of bulk or single files in COMTRADE, CVS, TDMS.
- 8.7.7. Traces of interest must be displayed at MHz oscillography, 61850 SV-rate (4.8 kHz and 14.4 kHz) oscillography, and PMU time series.
- 8.7.8. The software must show waveforms/traces, FFT of the waveforms, as well as input file meta-data.
- 8.7.9. The software must organize data files in order by time, and transmission lines.
- 8.7.10. The vendor must provide details on key physical and cyber security practices in the areas of Threat and Vulnerability Management, Security Incident Management and Forensics, Infrastructure Security, Identity and Access Management, Procedures and Training, Privacy, Governance, Data Encryption, Data Security, and Audit Assurance.

9. Inspection

The acceptance of any material or equipment/material shall in no way relieve the vendor from his responsibility to meet all the requirements of this specification, and it would not prevent subsequent rejection if such equipment/materials were found later to be defective.

10. Proposal Information

10.1. Submitted proposals must include:

- 10.1.1. Required technical information mentioned in section 3 of this specification.











4752.338 Transmission Line Optical Sensor System

Final Audit Report

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