



M E M O R A N D U M

TO: Pamela Monroe, Administrator, New Hampshire Site Evaluation Committee

FROM: Benjamin Cotts, Ph.D.

CC: Paul Kasper, Assistant Director, Safety and Security, New Hampshire Public Utilities Commission
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Christopher Soderman, P.E., Eversource Energy

DATE: June 15, 2020

PROJECT: 1501863.001 Seacoast Reliability Project
(New Hampshire Site Evaluation Committee Docket 2015-04)

SUBJECT: Protocol for Post-energization Measurements of Electric and Magnetic Fields

To comply with the Order and Certificate of Site and Facility with Conditions issued by the New Hampshire Site Evaluation Committee (NHSEC) for the Seacoast Reliability Project (SRP or Project) on January 31, 2019, Eversource Energy (Eversource) requested that Exponent provide a draft protocol for performing measurements of electric and magnetic fields (EMF) both before and after the Project is placed into service. Exponent submitted this protocol on April 18, 2019 in consultation with the Safety Division of the of the New Hampshire Public Utilities Commission (PUC).

Exponent conducted pre-construction measurements in April (1 site) and June (10 sites) 2019, and a report on the findings was submitted to the NHSEC and PUC on August 6, 2019.

The SRP 115-kV (F107) line was energized and in-service on May 29, 2020; all of the distribution line re-builds associated with the Project were completed and energized by June 10, 2020. Post-energization measurements are planned to be performed in July and August 2020 to comply with the condition requiring that measurements be performed at or near summer peak loading of the lines, with the acknowledgement that the Applicants cannot know in advance when peak loading will occur, or if compliance with state or local requirements or public safety concerns about SARS-CoV-2 might delay measurements or measurement analysis.

Proposed Measurement Protocol

The proposed measurement protocol is divided into sections including measurement locations, measurement procedure, and reporting.

Measurement Locations

Locations for measurements in 11 cross sections were previously selected for pre-energization measurements. Table 1 summarizes the locations of these pre-construction measurements as well as the corresponding Application Line Section description and, F107 structure type. An aerial photograph showing these locations also is included in Figure 1. Post-energization measurements will be performed at the same pre-energization measurement locations. Where it is not feasible to take post-energization measurements at the same location as previously performed, Eversource and Exponent will find another suitable location for the post-energization measurements and note the change in the final report. Spot measurements of magnetic field levels also will be performed beneath the F107 line and at various points on the property of the Fitch residence at 291 Durham Point Road.

Table 1. EMF measurement location summary

Site	Line Section (Application Section)	F107 Structure Type	Municipality	Monitoring Location
1	Madbury Substation to Route 4 Crossing	Delta	Madbury	North of Madbury Rd.
2	Underground through University of New Hampshire Parking Lot A	Underground	Durham	University of New Hampshire Parking Lot A
3	University of New Hampshire to Durham Substation	Delta with underbuild	Durham	Off Water Works Rd.
4	Packers Falls Substation to Newmarket Rd.	Delta with underbuild and adjacent line	Durham	North of Bennett Rd.
5	Timber Brook Ln. to Sandy Brook Dr.	Delta with underbuild	Durham	East of Sandy Brook Rd.
6†	Sandy Brook Dr. to Durham Point Rd.	Delta and adjacent line	Durham	North of Durham Point Rd.
7*	Durham Point Rd. to Little Bay Launch	Delta	Durham	South of Durham Point Rd.
8	Little Bay Crossing	Direct bury	Durham	West side of Little Bay
9†	Underground through Frink Farm	Underground	Newington	West of Nimble Hill Rd.
10	Fox Point Rd. to Spaulding Turnpike Crossing	Delta and adjacent line	Newington	North of Fox Point Rd.
11	Crossing at Fox Run to Portsmouth Substation	Vertical and adjacent lines	Newington	Mall Parking Lot

† Amended line section

* The Fitch property (291 Durham Point Road) is located along this portion of the route.

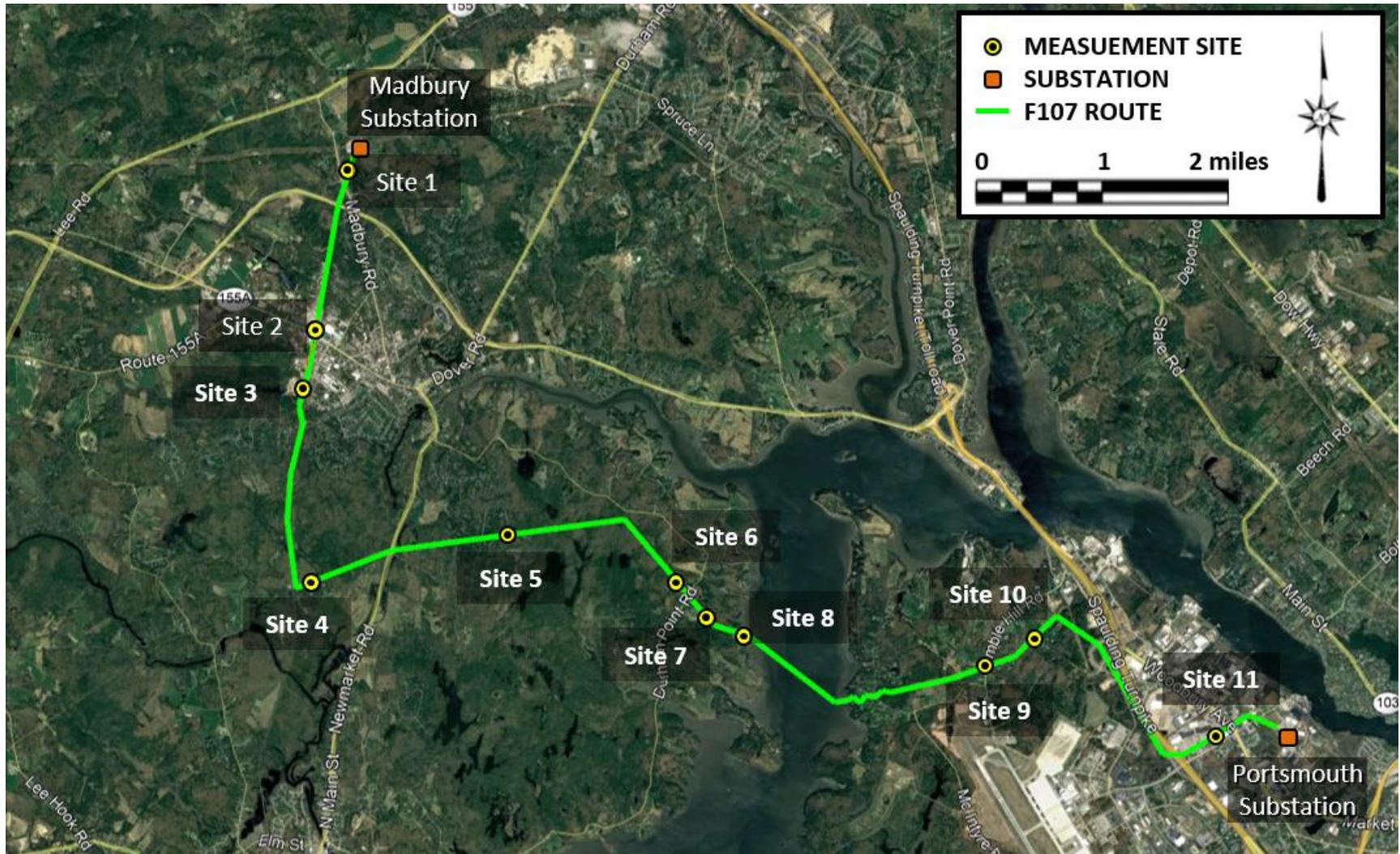


Figure 1. Route of the transmission line and locations of pre-construction measurement sites.

Measurement Procedure (same as pre-construction measurement procedure)

At each measurement location, Eversource will clear underbrush and other conductive objects, if necessary, to facilitate access and minimize interference with the electric field measurements. Exponent engineers will photo-document the condition of the right-of-way (ROW) at each location where measurements around the lines will be made. Engineers will then lay a long measuring tape on the ground beneath the lines that will be used to identify the horizontal location of conductors. The vertical height of each conductor will be measured and recorded using an acoustic or optical line height sensor, or both. The time and date of the field measurements will be noted so that the loading on each of the lines can later be determined.

Engineers will then proceed to perform EMF measurements using measurement equipment and methodology outlined in Institute of Electrical and Electronics Engineers (IEEE) Standard 644-2019 and IEEE Std. C95.3.1-2010. Measurements will be performed at a height of 1 meter above ground and will be performed along a transect perpendicular to the transmission line. If a transect other than perpendicular is necessary, the angle of the transect to the transmission line will be noted and measurement distances will be adjusted accordingly.

The measurements of electric fields and magnetic fields will be reported as the total field computed as the resultant of field vectors measured along vertical, transverse, and longitudinal axes.¹ The magnetic field will be measured in units of milligauss (mG) by orthogonally-mounted sensing coils whose output is recorded by a digital meter (EMDEX II) manufactured by EnerTech Consultants.

The electric field will be measured in units of kilovolts per meter (kV/m) with a single-axis sensor accessory also manufactured by EnerTech Consultants for the EMDEX II meter. The single-axis sensor will be aligned sequentially along vertical, transverse, and longitudinal axes to capture the full vector electric field. These instruments meet the IEEE instrumentation standard for obtaining accurate field measurements at power line frequencies (IEEE Std. 1308-1994). All meters and measurement accessories will be calibrated by the manufacturer using methods like those described in IEEE Std. 644-2019.

The EMDEX II is calibrated annually by the manufacturer and receives a certificate of calibration. The most recent calibration certificates for the two EMDEX II units to be used for these measurements are included in Appendix A. In addition, the EMDEX II will be checked each morning prior to measurements with a portable calibration coil to ensure that it maintains calibration throughout the measurement trip. If post-energization measurements are taken at line loadings lower than peak levels, magnetic field levels will be adjusted for peak loading conditions on existing lines and the new SRP line for comparisons to values in Appendix 41 and 41a (as applicable) in the Petition.

¹ Measurements along the vertical, transverse, and longitudinal axes will be recorded as root-mean-square magnitude, which refers to the common mathematical method of defining the effective voltage, current, or field of an alternating current system.

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Exponent and Eversource will provide 7 days' written notice to the NHSEC and PUC prior to planned measurements. If inclement weather or other factors require rescheduling, Exponent and Eversource will provide the NHSEC and PUC as much notice as possible and provide regular updates on the status of planned measurements.

Report

Exponent will prepare a measurement report summarizing measurements taken after the Project is placed into service. This report will detail the measurement methods and include aerial maps of each measurement location with annotations reflecting the specific locations of electric- and magnetic-field measurements as well as a graphical summary of both electric- and magnetic-field measurement results. The measurement report will be submitted within 60 days of completion of the measurements. Consistent with the NHSEC Certificate of Site and Facility, measurement values performed outside of near-peak or peak loading conditions will be summarized in raw form as well as adjusted to the peak loading condition specified in the application.

Appendix A

EMDEX II Calibration Certificates

Certificate of Calibration

The calibration of this instrument was controlled by documented procedures as outlined on the Certificate of Testing Operations and Accuracy Report using equipment traceable to N.I.S.T., ISO/IEC 17025:2017(E), and ANIZ540-1 COMPLIANT.

Instrument Model: EMDEX II - Standard

Frequency: 60 Hz

Serial Number: 3074

Date of Calibration: 12/27/2019

Re-calibration suggested at one year from above date.

EMDEX
LLC

Calibration Inspector: *H. Christopher Hooper*

EMDEX LLC
1356 Beaver Creek Drive
Patterson, California 95363
(408) 866-7266

Certificate of Calibration

The calibration of this instrument was controlled by documented procedures as outlined on the Certificate of Testing Operations and Accuracy Report using equipment traceable to N.I.S.T., ISO/IEC 17025:2017(E), and ANIZ540-1 COMPLIANT.

Instrument Model: EMDEX II - Standard

Frequency: 60 Hz

Serial Number: 1134

Date of Calibration: 01/16/2020

Re-calibration suggested at one year from above date.

EMDEX
LLC

Calibration Inspector: *A. Christopher Hooper*

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