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Via Hand Delivery

June 30, 2016

Luly E. Massaro
Commission Clerk
Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02888

Re: The Narragansett Electric Company d/b/a National Grid
Aquidneck Island Reliability Project
PUC Docket No. 4614

Dear Ms. Massaro:

I am enclosing for filing on behalf of The Narragansett Electric Company d/b/a National Grid five (5) copies of prefiled testimony of David M. Campilii in PUC Docket No. 4614.

We are sending electronic copies to the Service List and will provide a hard copy to anyone that requests it. Please acknowledge receipt of this filing on the enclosed copy of this letter and return it with my messenger. Thank you for your cooperation.

Sincerely,

Peter V. Lacouture

Enclosure

Copy to: Cynthia Wilson-Frias, Esq. *(via hand delivery)*
PUC Docket No. 4614 Service list *(via e-mail)*

The Narragansett Electric Company

d/b/a National Grid (Aquidneck Island Reliability Project)

RIPUC Dkt. No. 4614

Testimony of

David M. Campilii, P.E.

June 30, 2016

PREFILED TESTIMONY OF DAVID M. CAMPILII

INTRODUCTION

Q. Please state your name and business address.

A. My name is David M. Campilii. My business address is 280 Melrose Street, Providence, RI 02907.

Q. By whom are you employed and in what position?

A. I am employed as a Consulting Engineer by National Grid USA Service Company, Inc. d/b/a National Grid ("National Grid") in the Transmission Asset Management Department.

Q. What are your responsibilities as a Consulting Engineer in the Transmission Asset Management Department?

A. I am responsible for the design, licensing, and construction of underground transmission facilities, and I provide engineering services as requested for National Grid underground distribution facilities.

Q. Please describe your education, training and engineering background.

A. I have a Bachelor of Science degree in electrical engineering from Northeastern University, and I am a registered Professional Engineer in the State of Rhode Island. I am a member of the Institute of Electrical and Electronic Engineers (IEEE) Insulated Conductors Committee (ICC) and a member of the IEEE Standards Association. I have been providing engineering services for underground transmission and distribution projects for approximately 32 years.

Q. Have you testified before the Public Utilities Commission ("PUC") or Energy Facility Siting Board (the "Siting Board") in previous cases?

A. Yes, I testified before the Siting Board on the Manchester Street Repowering Project, the E-183 Relocation Project, the Southern Rhode Island Transmission Project, the Rhode Island Reliability Project and the New England East-West Solution Interstate Reliability Project. I have testified before the PUC on the E-183 Project and the Southern Rhode Island Transmission Project.

Q. Are you familiar with National Grid's Aquidneck Island Reliability Project (the "Project")?

A. Yes. I was involved in the examination and development of underground transmission alternatives for the Project.

Q. What is the scope of your testimony in this proceeding?

A. The purpose of my testimony is to describe the underground alternatives which were considered as part of this Project.

Q. Are you familiar with National Grid's Siting Board application, including the Environmental Report ("ER") prepared by Vanasse Hangen Brustlin, Inc. ("VHB") for the Project?

A. Yes, I prepared the analysis of underground alternatives in the ER.

<u>UNDERGROUND ALTERNATIVES</u>

Q. Please explain the underground technology you considered for this Project.

A. As summarized in Section 5.3.4 of the ER, we selected extruded dielectric cable as the preferred underground technology. Extruded dielectric cable consists of a conductor insulated with an extruded synthetic polymer material. At 115 kV, the insulation can be either cross-linked polyethylene or ethylene-propylene rubber. Additional layers consisting of a metallic shield, radial moisture barrier and a jacket are applied over the insulation, and then the individual cables are pulled into individual plastic conduits encased in concrete. Extruded dielectric cable has become the most common type of cable used for new underground transmission cable installations in the United States.

Q. Are there operational and maintenance issues related to underground transmission lines compared to overhead lines?

A. Yes, there are several as discussed in Section 5.3.4 of the ER.

(a) Lengthy Outage Repair Times: When an overhead transmission line experiences an outage, it can typically be repaired within 24 to 48 hours. In the case of a failure of an underground transmission cable, repair times can be in the range of two weeks to a month or more. The extended outage times for underground cables expose the remainder of the transmission system to emergency loadings for longer periods of time. There is also increased exposure to loss of another transmission element, with possible loss of load, during the extended underground outage.

(b) Reclosing: Many faults on overhead lines are temporary in nature. Often it is possible to "reclose" (re-energize) an overhead line after a temporary fault, and return the line to service with only a brief interruption, measured in seconds. Faults on underground transmission cables are almost never temporary, and the cable must remain out of service until the problem is diagnosed and repairs can be completed.

(c) Line Ratings: It is often difficult to match overhead line ratings with underground cables. It is also much more difficult to upgrade ratings on underground lines should that become necessary in the future.

(d) Cable Capacitance: Underground cables have significantly higher capacitance than overhead transmission lines, meaning that it takes reactive power (MVARs) to "charge up" the cable before the cable can transmit real power (MWs). This has several ramifications: (i) Part of the cable's capacity is used up by the charging current, so larger conductors are needed to transmit an equivalent amount of power. These have been included in the system design described above. (ii) Capacitance can create voltage control problems, meaning that the voltage can get too high when the transmission system is at light load. If the 61 and 62 Lines were constructed underground, there would be approximately 11 MVAR of cable charging per cable, or 22 MVAR for the two circuits. The transmission system may be able to absorb this much capacitance, or it may be necessary to install additional equipment, in the form of shunt reactors, at one or both terminal substations.

Cable capacitance causes higher switching transient voltages on the system (voltage "spikes" during switching). This can damage other system components, may trigger the need to replace surge arresters throughout the area, and complicates future system expansions.

Q. What underground routes were considered?

A. We considered a right of way (ROW) Route and a Public Roadway Route. The ROW Route would follow the existing overhead transmission line ROW from Dexter Substation to the new Jepson Substation. The route is approximately 4.5 miles long, and traverses forested upland, wetland, residential neighborhoods and agricultural fields. The southern portion of the route crosses the Green Valley Golf Course and threads between Saint Mary's Pond and Sisson Pond through a forested ROW and then turns sharply east and crosses the southern portion of Sisson Pond and crosses Jepson Lane where it terminates at the new Jepson Substation. Special construction techniques, such as horizontal directional drilling, would be needed to cross the ponds with an underground route. The ROW Route is shown in ER Figure 5-1.

The Public Roadway Route was developed using the existing public roadway network. This route would exit Dexter Substation onto Freeborn Street, proceed west on Freeborn Street to West Dexter Street, then south on West Main Road (Route 114) where it would turn east on to Union Street, then south on Jepson Lane to the Jepson Substation. The route is approximately 5.0 miles long. The representative roadway route is a reasonably direct connection between the two substations, but is not the result of an exhaustive analysis of possible cable routes. It is intended to provide a representative cost, and to address other issues associated with underground transmission lines. Other roadway routes would be expected to be approximately the same length, and have similar costs. For any underground roadway route, typical open trenching techniques would be used. The use of the public roadway network would create significant traffic impacts during construction of the underground duct bank system. The Roadway Route is shown in ER Figure 5-1.

Q. What is the estimated cost of the underground alternative?

A. Conceptual cost estimates were prepared for both underground route alternatives. The conceptual cost estimates of $48 Million for the ROW Route and $67.5 Million for the Public Roadway Route. These costs do not include: modifications to the terminal substations to accept underground transmission cables; Shunt Reactive compensation, if required; property acquisition costs (if required); and rebuilding of the Jepson Substation (a common cost with the Project).

Q. What is the most practical underground alternative?

A. Any underground alternative would be expected to have significant cost, operational, and schedule disadvantages compared to the proposed Project. At this point, we believe the most practical underground alternative would be one that would use the roadway network, and which would utilize solid dielectric cable construction.

Q. You have discussed a number of disadvantages of underground transmission. When would National Grid consider installing underground transmission lines?

A. In general, National Grid proposes overhead transmission lines as the preferred technology for most additions to the transmission system. This is primarily for reasons of cost, and for the reliability and operational issues discussed in the ER and in this testimony. However, there are occasions when National Grid may propose or accept underground transmission as the technology for a particular project. The most common situation where National Grid would propose underground transmission is where National Grid had no overhead ROW and no practical means to obtain a ROW (due to cost, availability, timing, or other reasons). The E105 and F106 cables between Manchester Street Substation and Hartford Avenue Substation are an example of this, where it would have been impractical to create a 250 foot wide ROW corridor for overhead lines from downtown Providence to the I-295 - Route 6 area of Johnston. Another situation where National Grid would consider underground transmission would be a situation where an overhead transmission line would affect the operation of an airport. In this case, a short "dip" in the overhead transmission line would be installed, with an overhead to underground transition station at each end of the underground transmission line.

National Grid will also consider underground transmission lines at or near existing substations when it is determined that there is not adequate space around or within an existing substation for a proposed expansion. This type of installation will typically take the form of a short underground "getaway" with a transition to an overhead transmission line outside the substation.

In cases of long water body crossings, where it is impractical to span the water body from shore line towers, National Grid will consider submarine cables (a form of underground transmission line) for the water crossing.

Finally, under some circumstances, National Grid will consider installing an underground transmission line when a customer requests underground supply and pays for the cost of the underground line. For this type of request, National Grid would need to evaluate the effect on the larger transmission system before agreeing to an underground installation.

In each of these circumstances, National Grid evaluates the particular issues associated with underground transmission lines (line ratings, longer outage restoration times, different electrical characteristics from overhead lines, etc.) Addressing these issues often results in installing more than one underground transmission cable in situations where a single overhead transmission line would have been adequate. Compensating for underground transmission issues also typically involves installing more equipment at the terminal substations, and sometimes imposing operating restrictions on the system.

Q. You referred to a "dip" in the answer to the previous question. Would National Grid consider putting a dip in an overhead transmission line for reasons other than to avoid interfering with airport operations?

A. We are occasionally asked to put an underground dip in an overhead transmission line as it passes a particular neighborhood. We have included a discussion of the cost and implications of constructing a short underground segment in an overhead transmission line in Section 5.3.5 of the ER. In addition to the significant cost and operational issues that would result, it would be necessary to build transition stations at each end of the dip. This would be a fenced switching station, approximately 100 feet by 100 feet, and similar in appearance to an electrical substation. Because of the operational complications and cost, unless there is a very strong justification, we would not install a dip in an overhead transmission line.

Q. Does this conclude your testimony?

A. Yes, it does.