STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
ENERGY FACILITY SITING BOARD

In re The Narragansett Electric Company	:	
d/b/a National Grid	:	Docket No. SB-2008-02
(Rhode Island Reliability Project)	:	

Testimony of

David M. Campilii, P.E.

June 29, 2009

TESTIMONY OF DAVID M. CAMPILII, P.E.

Q. Please state your full name and business address.

A. My name is David M. Campilii. My business address is 40 Sylvan Road, Waltham, MA.

Q. Have you previously testified in this matter?

A. Yes. I filed prefiled testimony in RIPUC Dkt. No. 4029 on February 20, 2009. I understand that the prefiled testimony in RIPUC Dkt. No. 4029 will be incorporated in this hearing. I also filed rebuttal testimony in SB-2008-02 on June 4, 2009 regarding this matter.

Scope of Testimony

Q. What is the purpose of your testimony?

A. The primary purpose of my testimony is to address issues pertaining to underground alternatives that have arisen during the various Zoning and Planning Board hearings for the Rhode Island Reliability Project.

Q. Please describe the underground alternative issues that have arisen.

A. The primary underground alternative issue pertains to the installation of short underground segments, commonly referred to as “dips”, along portions of the overhead transmission project route. This has taken the form of statements or requests to the effect of “Just put the line underground past my house, neighborhood, town, etc.”

Q. Mr. Campilii, please describe in general what is required to underground a section of 345 kilovolt (kV) overhead transmission line.

A. Although lower voltage distribution lines are frequently installed underground, installing an underground dip in a 345 kV transmission line requires much more significant

construction. Putting a segment of 345 kV transmission line underground also creates operational issues for the overall transmission system. In many cases, it is not possible to match the power ratings of an overhead transmission line with a single underground cable, so it is often necessary to install two or more cables to "match" the overhead line. Underground cables have substantially longer repair times than overhead lines (typically 24 to 48 hours for overhead lines, a month or more for underground lines at 345 kV). Because of this, and because transmission lines serve much larger geographic areas than distribution lines, more than one underground cable may be required per overhead line to provide for a faster restoration in the event of a transmission cable failure. Underground cables also have different electrical characteristics than overhead lines, which may require the installation of additional substation and line equipment. These effects become more significant as the length of the underground line increases.

At both ends of an underground 345 kV dip, it is necessary to construct a "transition station". Each transition station provides a means to connect the overhead line to the underground cables. The transition station also provides space for additional equipment (switches, circuit breakers, protective relaying equipment, etc.) required to operate the overall "hybrid" overhead/underground system. These transition stations have the appearance of an electrical substation.

Installing an underground transmission cable "dip" requires trenching the entire segment length between the transition stations to install the conduit and manhole system. The trenching could occur either along the ROW (if suitable), or along established roadways (if available). Areas with wetlands or water bodies would require special construction

techniques, as further described in Section 5 of the ER. Underground construction in such resource areas has the potential to cause much more significant impacts to the resource than would overhead construction, which can often span resource areas or only cause marginal impacts at structure sites. Once the conduit system was in place, transmission cables would then be pulled into the conduits, spliced in manholes, and terminated in the transition stations.

Q. Mr. Campilii, please describe the form that an underground 345 kV transmission dip would take for the Rhode Island Reliability Project.

A. If an underground dip were to be installed as a segment in the proposed Project, the existing overhead 345 kV line (the 332 line) and the two existing overhead 115 kV lines (the S171 and T172 lines) on that segment of ROW would remain in place. For the new 345 kV line, National Grid would require two 345 kV cables to underground the single overhead line. We have preliminarily sized the cable as 3,000 kcmil copper, and have preliminarily selected a solid dielectric (cross linked polyethylene, or XLPE) cable system. The conduit system would consist of six 8 inch polyvinyl chloride (PVC) conduits, with several smaller auxiliary conduits, installed in a trench approximately 4 feet wide and 5 feet deep. Manholes, 10 feet wide and 30 feet long, would be required at approximately 1,500 foot intervals for splicing the cables.

Transition stations would be required at both ends of the dip. For the Rhode Island Reliability Project, each transition station would require a fenced area of approximately one acre, with additional space required for setbacks, access roads, etc. The fenced area would contain the overhead line dead end structure, the underground transmission cable

risers, 345 kV switching equipment, and a control building. There is not enough room on the ROW to fit the transition stations, so a suitable site, approximately 1.5 to 2 acres in size, and located adjacent to the ROW, would be required at both ends of a dip. Each transition station site would have to have access to the overhead transmission line and to a suitable underground transmission route. Access to a public road would also be required for operation and maintenance of the transition station equipment. Suitable sites meeting all of these criteria would have to be identified and purchased by the Company.

Q. Mr. Campilii, please discuss the costs of an underground 345 kV dip for the Rhode Island Reliability Project.

A. The Company developed a study grade cost for underground dips for the Rhode Island Reliability Project. For illustration purposes, National Grid examined a half mile long and a one mile long "generic" dip. By "generic," we mean that the dips are not tied to a particular location along the ROW, but are intended to give a representative idea of the cost of a dip.

National Grid has estimated that each 345 kV overhead to underground transition station will cost approximately $4.5 million each, <u>not including the cost of the land</u> for the transition stations. Each dip requires two transition stations. The underground transmission cables and duct line system is estimated to cost approximately $11 million for a half mile dip, and $19 million for a 1 mile dip. In total, a half mile dip with the two associated transition stations would cost approximately $20 million. A one mile dip with the two associated transition stations would cost approximately $28 million. These costs would not include the cost of the transition station land, or any additional land or land

rights required for the dip. Unusual construction (wetlands, water crossings, heavy underground utility density, significant rock, etc.) would increase these costs. The equivalent overhead line cost for rebuilding the two 115 kV lines and constructing the new 345 kV overhead line (the Project) is approximately $7.2 million per mile, or $3.6 million per half mile. The underground dip alternative, therefore, represents a substantial cost increase as compared to an equivalent length of overhead installation. For a 1 mile segment, the underground dip is nearly four times the cost of the overhead line as proposed in the Project.

Q. Does putting a transmission line underground eliminate magnetic fields?

A. No. Magnetic fields are present for both overhead and underground transmission cables. Magnetic fields over an underground dip are expected to be comparable to or perhaps higher than the edge of ROW fields associated with the proposed Project.

Q. In its unfavorable advisory opinions pertaining to the Project, the West Warwick Zoning Board has made a number of statements regarding installing underground transmission dips in West Warwick. Please respond to the West Warwick's Zoning Board assertion that "the relief to be granted [i.e. the height variance] is not the least necessary in that portions of the area of the transmission lines could be underground, eliminating the concerns stated, for a nominal increase in cost."

A. We disagree with these assertions. The West Warwick Zoning Board was under a mistaken impression that a short segment of the project in West Warwick could be placed underground for a cost of $2 million, a number that apparently was first mentioned by a member of the public during public comments at the Town Planning Board meeting. As

discussed above, we have estimated the cost to underground a half mile segment of 345 kV line at approximately $20 million, and a 1 mile length at approximately $28 million and I testified about the magnitude of these costs to the Zoning Board.

We further disagree with the assertion that this will have minimal effect on the ratepayer, as stated in the Planning Board's advisory opinions. The Rhode Island Reliability Project as proposed is expected to qualify for regionalization of costs under ISO New England rules, meaning that the project costs will be spread among all electric customers in New England. If a local requirement for undergrounding were to be imposed on the Project in an area where the project could be constructed overhead, it would be very unlikely that ISO-NE would allow for regionalization of the additional underground costs. ISO-NE would more likely allow regionalization of the equivalent overhead line costs, and the balance of the costs would be borne locally. As an example, if West Warwick required a half mile segment to be placed underground in an area where National Grid had ROW for an overhead line, (underground cost $20 Million), ISO-NE would likely only allow regionalization for the equivalent overhead cost ($ 3.6 Million). West Warwick or Rhode Island ratepayers could potentially be exposed to the additional $16.4 million cost. We don't feel that this is a "minimal effect on the rate to the consumer," as asserted by the Planning Board.

Q. Please comment on the West Warwick's Zoning Board assertions that (i) National Grid's "primary objection to placing portions of the transmission lines underground is based on the increased time required to repair breakdowns" and that National Grid "testified that breakdowns were so infrequent that it could not present evidence of the number of times

or places where such breakdowns occur indicating that the concern for breakdowns is negligible" and (ii) because the purpose of the new 345kV line is to have a redundant transmission line, a breakdown in the underground portion would not be a problem because the existing overhead line "will constitute the redundant line to provide service during the time of breakdown."

A. "Breakdowns" (outages) are relatively infrequent on both overhead and underground transmission lines. Even though transmission outages are infrequent, they do occur. National Grid must evaluate the effect of transmission outages on the overall electric supply system. The reliability standards to which National Grid is held include evaluation of the loss of a single transmission component, and after an adjustment of generator output and transmission switching, the subsequent loss of a second transmission component (called N-1-1 criteria). One significant difference between overhead and underground transmission lines is the length of time it takes to repair an outage. At 345 kV, a typical overhead transmission outage can be repaired in 48 hours or less. Underground 345 kV transmission cable repair time is measured in the month or more timeframe. This increases the exposure of the transmission system to the second contingency for a much longer period of time. Transmission lines serve large blocks of load (entire cities, or in the case of the Rhode Island Reliability Project, a significant part of the state of Rhode Island). During the extended time period that an underground transmission line is out of service, the remainder of the transmission system would be operating at higher than normal loads, and possibly at emergency loading. This increased strain on the transmission system may increase the likelihood of a second contingency

(outage) occurring, which could result in voltage collapse and blackouts across a significant portion of the state. This exposure would exist for a much shorter time period under the proposed overhead line project.

Q. Please discuss the West Warwick Zoning Board's assertion that National Grid "has the option of placing the new transmission lines underground for the entire West Warwick route or only in areas where transmission lines will be located next to residential properties, thereby rendering a beneficial use that is not more than a mere inconvenience" and the assertion that "The hardship that will be suffered by the applicant if the dimensional variance is not granted as opposed to the burying of the transmission lines for which the variance will not be required will not amount to more than a mere inconvenience."

A. Placing portions of the 345 kV transmission line underground through West Warwick would significantly increase the cost of the Project, and the majority of these increased costs would likely have to be borne by the West Warwick or all Rhode Island electric ratepayers. Further, installing underground segments would expose portions of the transmission system to more extended outages than they otherwise might experience, which potentially affects the reliability of the electric supply to a significant portion of the state of Rhode Island. Finally, our underground dip would likely increase the environmental impacts associated with the Project. We believe that this constitutes "more than a mere inconvenience" to National Grid, to the ratepayers of West Warwick, and to the electric customers in the larger (statewide) region.

Q. Does this conclude your testimony?

A. Yes.