RHODE ISLAND DEPARTMENT OF HEALTH

Energy Facility Siting Board

Advisory Opinion:

Aquidneck Island Reliability Project

11.02.16

Introduction

In its May 2, 2016 "Preliminary Decision and Order on the Narragansett Electric Company d/b/a National Grid Application to Construct the Aquidneck Island Reliability Project in Portsmouth and Middletown Rhode Island" (Docket No. SB-2016-01), the Rhode Island Energy Facility Siting Board (ESFB) issued a "Notice of Designation to the Rhode Island Department of Health (RIDOH) to Render an Advisory Opinion" on that project. This Advisory Opinion responds to that Order.

In preparing this document, RIDOH considered the issues consigned to its review, pursuant to R.I. General Laws 42-98-10. Specifically, the order required the following:

> *The Rhode Island Department of Health shall render an information advisory opinion on the potential public health concerns relating to the biological responses to power frequency electric and magnetic fields associated with the operation of the Facility. In particular, the Department of Health should review and comment on Appendix B of the application.*

Note that Appendix B of the application is a document prepared for National Grid entitled the "Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health."

In this Advisory Opinion, RIDOH summarizes electric and magnetic field (EMF) exposures associated with the current configuration and proposed reconstructed system, as reported by the applicant, and discusses the public health implications of exposure to those fields, considering the information supplied in Appendix B, along with other sources.

EMF Exposures

The subject project would:

- Rebuild and upgrade from 69 kV to 115 kV the 61 and 62 transmission lines on an existing right of way (ROW) between the Dexter Substation in Portsmouth and the Jepson Substation in Middletown;
- Relocate the Jepson Substation, currently located west of Jepson Lane, to a proximate site east of Jepson Lane and rebuild it at 115 kV; and
- Reconfigure the Dexter Substation to accommodate the 115 kV upgrade.

The application includes an analysis of (1) calculated pre-construction and post-construction electric field levels (in kV/m) at the edges of the ROW, (2) calculated annual average load pre-construction and post-construction magnetic fields (in mG) at the edges of the ROW, and (3) calculated annual peak load pre-construction and post-construction magnetic fields (in mG) at the edges of the ROW. Note that, while electric fields remain constant, magnetic field levels fluctuate in response to changing loads.

The applicant states that:

> *The electric and magnetic fields produced by the existing transmission lines at the edges of the ROW in 2018 are compared here to the expected field levels after completion of the Project and five years later. [Note: Usage is projected to increase over five years].* ***The Project will result in substantial reduction in edge of ROW electric and magnetic fields****. [Emphasis added.]*

Pre- and post-construction electric and magnetic field levels are presented in Tables 8-1 to 8-3 or the applicant's Environmental Report, which are reproduced below.

Table 8-1 Calculated Electric Field Levels (kV/m) Pre-Construction and Post-Construction at Edges of ROW+

ROW Segment	ROW Configuration**	Timeframe	West Edge of ROW	East Edge of ROW
SECTION 1				
Without Distribution Lines	Single-circuit H-frame	pre-construction (2018)	0.46	0.46
	Two monopoles	post-construction (2018)	0.11	0.11
	Two monopoles	post-construction (2023)	0.11	0.11
With Distribution Line	Single-circuit H-frame w/ distribution circuit	pre-construction (2018)	0.48	0.33
	Two monopoles	post-construction (2018)	0.06	0.15
	Two monopoles	post-construction (2023)	0.06	0.15
SECTION 2				
Without Distribution Lines	Double-circuit 3-pole wood structures	pre-construction (2018)	0.46	0.46
	Two monopoles	post-construction (2018)	0.11	0.11
	Two monopoles	post-construction (2023)	0.11	0.11
With Distribution Line	Double-circuit 3-pole wood structures w/ dist circuit	pre-construction (2018)	0.48	0.34
	Two monopoles	post-construction (2018)	0.06	0.15
	Two monopoles	post-construction (2023)	0.06	0.15

+ Electric field levels do not vary with load.
**Physical arrangement of lines on ROW.
Source: Vanderweil 2014.

Table 8-2 Calculated Magnetic Fields (mG) Pre-Construction and Post-Construction at Edges of ROW (Annual Average load)

ROW Segment	ROW Configuration**	Timeframe	West Edge of ROW	East Edge of ROW
SECTION 1				
Without Distribution Lines	Single-circuit H-frame	pre-construction (2018)	38.1	39.6
	Two monopoles	post-construction (2018)	6.6	10.2
	Two monopoles	post-construction (2023)	6.8	10.4
With Distribution Lines	Single-circuit H-frame w/ distribution circuit	pre-construction (2018)	39.2	30.9
	Two monopoles	post-construction (2018)	6.6	24.8
	Two monopoles	post-construction (2023)	6.7	25.0
SECTION 2				
Without Distribution Lines	Double-circuit 3-pole wood structures	pre-construction (2018)	38.7	40.1
	Two monopoles	post-construction (2018)	6.6	10.2
	Two monopoles	post-construction (2023)	6.8	10.4
With Distribution Lines	Double-circuit 3-pole wood structures w/ dist circuit	pre-construction (2018)	39.7	31.7
	Two monopoles	post-construction (2018)	6.6	24.8
	Two monopoles	post-construction (2023)	6.7	25.0

* Physical arrangement of lines on ROW.
Source: Vanderweil 2014.

Table 8-3 Calculated Magnetic Fields (mG) Pre-Construction and Post-Construction at Edges of ROW (Annual Peak Load)

ROW Segment	ROW Configuration**	Timeframe	West Edge of ROW	East Edge of ROW
SECTION 1				
Without Distribution Lines	Single-circuit H-frame	pre-construction (2018)	53.1	55.1
	Two monopoles	post-construction (2018)	9.9	14.7
	Two monopoles	post-construction (2023)	10.8	16.4
With Distribution Line	Single-circuit H-frame w/ distribution circuit	pre-construction (2018)	54.0	45.2
	Two monopoles	post-construction (2018)	9.9	28.4
	Two monopoles	post-construction (2023)	10.8	29.8
SECTION 2				
Without Distribution Lines	Double-circuit 3-pole wood structures	pre-construction (2018)	53.8	55.8
	Two monopoles	post-construction (2018)	9.9	14.7
	Two monopoles	post-construction (2023)	10.8	16.4
With Distribution Line	Double-circuit 3-pole wood structures w/ dist circuit	pre-construction (2018)	54.7	46.1
	Two monopoles	post-construction (2018)	9.9	28.4
	Two monopoles	post-construction (2023)	10.8	29.8

* Physical arrangement of lines on ROW.
Source: Vanderweil 2014.

The analysis also evaluated exposures associated with moving the Jepson Substation and found that:

> *Calculated magnetic field levels at the property line of the proposed Jepson Substation site are generally 2 mG or less except where the transmission and distribution lines enter and leave the property.*

Therefore, the applicant concludes that:

> *Rebuilding the 61 and 62 Lines will significantly reduce both electric and magnetic fields along both edges of the ROW. In particular, modeled magnetic fields on the west edge of the ROW under 2018 average loads range from 38.1 mG to 39.7 mG under the current line configuration. Following the rebuild, these modeled magnetic fields decline to 6.6 mG. On the east edge of the ROW, magnetic fields under 2018 average loads range from 31.7 mG to 40.1 mG, and decline to 10.2 to 24.8 mG following the rebuild.*

The reduction in exposure to both electric and magnetic fields will be achieved by "optimiz[ing] the phasing of the [reconfigured/rebuilt] lines to minimize edge of ROW magnetic fields."

Health Effects of EMF Exposure

Over the past four decades, many studies have explored the potential relationship between exposure to 60 Hz (extra low frequency or ELF) magnetic fields, such as those associated with power lines, and cancer. The National Cancer Institute (NCI) summarizes the findings of these studies as follows:

> *No mechanism by which ELF-EMFs or radiofrequency radiation could cause cancer has been identified. Unlike high-energy (ionizing) radiation, EMFs in the non-ionizing part of the electromagnetic spectrum cannot damage DNA or cells directly. Some scientists have speculated that ELF-EMFs could cause cancer through other mechanisms, such as by reducing levels of the hormone melatonin. There is some evidence that melatonin may suppress the development of certain tumors. Studies of animals have not provided any indications that exposure to ELF-EMFs is associated with cancer. […] Although there is no known mechanism by which non-ionizing EMFs could damage DNA and cause cancer, even a small increase in risk would be of clinical importance given how widespread exposure to these fields is.*

Research in this area continues, with a focus on 60 Hz magnetic fields and childhood cancer. Those studies have been equivocal. Some find no relation between EMF exposure and cancer, while others find a weak relationship. After decades of research, when all the evidence is weighed as a body, the NCI found "No consistent evidence for an association between any source of non-ionizing EMF and cancer." One reason for the equivocality of findings is that childhood cancer is rare, which means that researchers do not have many cases to study. Another reason is that people are exposed to EMFs from a variety of sources, so the level of exposure to EMFs in the course of one's life is very difficult to measure.

Therefore the potential dose-response relationship of EMFs to cancer can only be measured very crudely, using broad categories of exposure intensity which do not lend themselves to standard-setting. Nevertheless, were the relation a strong one – if EMFs, as normally encountered, were a significant cause of cancer – the relation would be

observable despite small numbers and other measurement issues. Note also that, since EMF levels decrease rapidly with distance from a source, an individual's EMF exposures from other sources, including household appliances, electronic devices and local electric power supply lines, are likely to be far greater than from high-tension power lines.

Standards for Exposure of the General Public to 60 Hz Magnetic Fields

The applicant's Environmental Report cites the following guidelines for public exposure to 60 Hz magnetic fields, recommended by the International Committee on Electromagnetic Safety (ICES) and the International Committee on Nonionizing Radiation Protection (ICNIRP):

Table 10. Screening guidelines for EMF exposure

Organization	Exposure (60 Hz)	Magnetic field
ICNIRP	Occupational	10,000 mG
	General Public	2,000 mG
ICES	Occupational	27,100 mG
	General Public	9,040 mG

Sources: ICNIRP, 2010; ICES, 2002

[From *Aquidneck Island Reliability Project Portsmouth and Middletown, Rhode Island*. Appendix B. "Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health."]

These guidelines, as well as alternative guidelines, were summarized in a recent report prepared by the ESS Group, Inc., for the Rhode Island Energy Facility Siting Board in reference to a proposed power plant, illustrating the conservative nature of ICNIRP guidelines:

Table 6.11-2

60-Hz EMF Guidelines Established by Health and Safety Organizations

Organization	Magnetic Field	Electric Field
American Conference of Governmental and Industrial Hygienists (ACGIH) (occupational)	10,000 mG [a] 1,000 mG [b]	25 kV/m [a] 1 kV/m [b]
International Commission on Non-Ionizing Radiation Protection (ICNIRP) (general public, continuous exposure)	2,000 mG	4.2 kV/m
Non-Ionizing Radiation (NIR) Committee of the American Industrial Hygiene Assoc. (AIHA) endorsed (in 2003) ICNIRP's occupational EMF levels for workers	4,170 mG	8.3 kV/m
International Committee on Electromagnetic Safety (ICES)	9,040 mG	5.0 kV/m
U.K., National Radiological Protection Board (NRPB) [now Health Protection Agency (HPA)]	2,000 mG	4.2 kV/m
Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Draft Standard, Dec. 2006 [c]	3,000 mG	4.2 kV/m
*Comparison to **steady** (DC) EMF, encountered as EMF outside the 60-Hz frequency range:*		
Earth's magnetic field and atmospheric electric fields, steady levels, typical of environmental exposure [d]	[550 mG]	[0.2 kV/m up to > 12 kV/m]
Magnetic Resonance Imaging Scan, static magnetic field intensity [d]	[20,000,000 mG]	---

Notes:
[a] *ACGIH guidelines for the general worker.*
[b] *ACGIH guideline for workers with cardiac pacemakers.*
[c] *http://www.arpansa.gov.au/pubs/comment/dr_elfstd.pdf; and http://www.arpansa.gov.au/News/events/elf.cfm*
[d] *These EMF are steady fields, and do not vary in time at the characteristic 60-cycles-per-second that power-line fields do. However, if a person moves in the presence of these fields, the body experiences a time-varying fields*

In the absence of national and local regulations regarding exposure to 60 Hz EMFs, these guidelines provide prudent parameters for planning new/modified electric transmission infrastructure.

Exposure of the General Public to 60 Hz Magnetic Fields Projected for Aquidneck Island

Electric Fields: As discussed above, the proposed power line reconfiguration would decrease potential electric field exposures. As shown in the applicant's Table 8.1, which is reproduced above, pre-construction electric field levels at the edge of the ROW range from 0.33 - 0.48 kV/m; those levels would drop to 0.06 – 0.15 kV/m upon completion of the project. The estimated post-construction levels are more than one order of magnitude lower than ICNIRP guidelines for continuous exposure to the general public cited in the above table (4.2 kV/m).

Magnetic Fields: Similarly, the applicant's analysis determined that the proposed modification of the transmission lines on Aquidneck Island would reduce annual peak load magnetic field levels at the edge of the ROW from 45.2 -55.8 mG pre-construction to 9.9 – 29.8 mG post-construction. (See Table 8.3 above). Those levels are about two orders of magnitude lower than ICNIRP guidelines for exposure to the general public (2,000 mG). As discussed above, magnetic field levels at the property line of the new Jepson Substation are projected to be even lower, approximately 2 mG.

Summary and Conclusion

The proposed modifications to electrical transmission lines on Aquidneck Island will reduce the strength of EMFs adjacent to the right of way. Electric and magnetic fields levels, as projected, will be much lower than even the most conservative international guideline for exposure of the general public to EMFs. For this reason, the health impact of the proposed changes are either negligible or slightly positive.