CERTIFICATE OF SERVICE

I hereby certify that, on the 12th day of September 2016, I filed this Energy Facility Siting Board Advisory Opinion: Clear River Energy Center, Docket No. SB-2015-06 (i) in hard copy via first class mail to the person listed below and (ii) electronically to the persons listed on Attachment A.

Todd Bianco, Coordinator
Energy Facility Siting Board
89 Jefferson Boulevard
Warwick, RI 02888
401-780-2106

Joseph K. Alston, Esq.
Chief Legal Counsel
Rhode Island Department of Health
Three Capitol Hill
Providence, RI 02908
401-222-1685

ATTACHMENT A

SB-2015-06 Invenergy CREC Service List as of 09/09/2016

Name/Address	E-mail	Phone/FAX
File an original and 10 copies with EFSB: Todd Bianco, Coordinator Energy Facility Siting Board 89 Jefferson Boulevard Warwick, RI 02888 Margaret Curran, Chairperson Janet Coit, Board Member Assoc. Dir., Div. of Planning Parag Agrawal Patti Lucarelli Esq., Board Counsel Susan Forcier Esq., Counsel Rayna Maguire, Asst. to the Director DEM Catherine Pitassi, Asst. to. Assoc. Dir. Plann.	Todd.Bianco@puc.ri.gov; Patricia.lucarelli@puc.ri.gov; Margaret.Curran@puc.ri.gov; janet.coit@dem.ri.gov; Catherine.Pitassi@doa.ri.gov; susan.forcier@dem.ri.gov; rayna.maguire@dem.ri.gov; Parag.Agrawal@doa.ri.gov;	401-780-2106
Parties (Electronic Service Only, Unless by Request)		
Invenergy Thermal Development LLC Alan Shoer, Esq. Richard Beretta, Esq. Elizabeth Noonan, Esq. Nicole Verdi, Esq. Adler, Pollock & Sheehan One Citizens Plaza, 8th Floor Providence, RI 02903 John Niland, Dir. Of Business Development Tyrone Thomas, Esq., Asst. General Counsel Invenergy Thermal Development LLC One South Wacker Drive, Suite 1900 Chicago, IL 60600	ashoer@apslaw.com; rberetta@apslaw.com; enoonan@apslaw.com; nverdi@apslaw.com; jniland@invenergyllc.com; Tthomas@invenergyllc.com;	401-274-7200 312-224-1400
Town of Burrillville Michael McElroy, Esq., Special Counsel Leah Donaldson, Esq., Special Counsel Schacht & McElroy PO Box 6721 Providence, RI 02940-6721 Oleg Nikolyszyn, Esq., Town Solicitor 155 South Main St., Suite 303 Providence, RI 02903	Michael@mcelroylawoffice.com; leah@mcelroylawoffice.com; Nikolyszyn@gmail.com;	401-351-4100 401-474-4370
Conservation Law Foundation Jerry Elmer, Esq. Max Greene, Esq. 55 Dorrance Street Providence RI, 02903	Jelmer@clf.org; Mgreene@clf.org;	401-351-1102
Ms. Bess B. Gorman, Esq. Assistant General Counsel and Director Legal Department, National Grid	Bess.Gorman@nationalgrid.com;	781-907-1834

40 Sylvan Road Waltham, MA 02451 Mark Rielly, Esq. Senior Counsel	Mark.rielly@nationalgrid.com;	
Office of Energy Resources Andrew Marcaccio, Esq. Nick Ucci, Chief of Staff Chris Kearns, Chief Program Development One Capitol Hill Providence, RI 02908 Ellen Cool Levitan & Associates	Andrew.Marcaccio@doa.ri.gov;	401-222-3417
	Nicholas.Ucci@energy.ri.gov;	401-574-9100
	Christopher.Kearns@energy.ri.gov;	
	egc@levitan.com;	
	Brenna.McCabe@doa.ri.gov;	
Rhode Island Building and Construction Trades Council Gregory Mancini, Esq. Sinapi Law Associates, Ltd. 2374 Post Road, Suite 201 Warwick, RI 02886	gmancinilaw@gmail.com;	401-739-9690
Residents of Wallum Lake Road, Pascoag, RI Dennis Sherman and Kathryn Sherman Christian Capizzo, Esq. Shechtman Halperin Savage, LLP 1080 Main Street Pawtucket, RI 02869	ccapizzo@shslawfirm.com;	401-272-1400
	kags8943@gmail.com;	
Residents of Wallum Lake Road, Pascoag, RI Paul Bolduc and Mary Bolduc Joseph Keough Jr., Esq. 41 Mendon Avenue Pawtucket, RI 02861 Paul and Mary Bolduc 915 Wallum Lake Road Pascoag, RI 02859	jkeoughjr@keoughsweeney.com;	401-724-3600
	oatyss1@verizon.net;	401-529-0367
Abutter David B. Harris Michael Sendley, Esq. 600 Putnam Pike, St. 13 Greenville, RI 02828	msendley@cox.net;	401-349-4405
Entities with Pending Motions to Intervene (Electronic Service Only)		
Harrisville Fire District Richard Sinapi, Esq. Joshua Xavier, Esq. 2347 Post Road, Suite 201 Warwick, RI 02886	ras@sinapilaw.com;	401-739-9690
	jdx@sinapilaw.com;	
Interested Persons (Electronic Service Only)		
Residents of 945 Wallum Lake Road, Pascoag, RI (Walkers)	nickgorham@gorhamlaw.com;	401-647-1400

Nicholas Gorham, Esq. P.O. Box 46 North Scituate, RI 02857	edaigle4@gmail.com;	
Peter Nightingale, member Fossil Free Rhode Island 52 Nichols Road Kingston, RI 02881	divest@fossilfreeri.org;	401-789-7649
Sister Mary Pendergast, RSM 99 Fillmore Street Pawtucket, RI 02860	mpendergast@mercyne.org;	401-724-2237
Patricia J. Fontes, member Occupy Providence 57 Lawton Foster Road South Hopkinton, RI 02833	Patfontes167@gmail.com;	401-516-7678
Burrillville Land Trust Marc Gertsacov, Esq. Law Offices of Ronald C. Markoff 144 Medway Street Providence, RI 02906	marc@ronmarkoff.com;	401-272-9330
Paul Roselli, President Burrillville Land Trust PO Box 506 Harrisville, RI 02830	proselli@cox.net;	401-447-1560
Rhode Island Progressive Democrats of America Andrew Aleman, Esq. 168 Elmgrove Avenue Providence, RI 02906	andrew@andrewaleman.com;	401-429-6779
Fighting Against Natural Gas and Burrillville Against Spectra Expansion Jillian Dubois, Esq. The Law Office of Jillian Dubois 91 Friendship Street, 4th Floor Providence, RI 02903	jillian.dubois.esq@gmail.com;	401-274-4591
Burrillville Town Council c/o Louise Phaneuf, Town Clerk 105 Harrisville Main Street Harrisville, RI 02830	lphaneuf@burrillville.org;	401-568-4300
Thomas J. Kravitz, Town Planner Christine Langlois, Deputy Planner Town of Burrillville 144 Harrisville Main Street Harrisville, RI 02830 Joseph Raymond, Building Official	tkravitz@burrillville.org; clanglois@burrillville.org; jraymond@burrillville.org;	401-568-4300

Michael C. Wood, Town Manager Town of Burrillville 105 Harrisville Main Street Harrisville, RI 02830	mcwood@burrillville.org;	401-568-4300 ext. 115
Mr. Leo Wold, Esq. Department of Attorney General 150 South Main Street Providence, RI 02903	LWold@riag.ri.gov;	401-274-4400
Public Utilities Commission Cynthia Wilson Frias, Esq., Dep. Chief of Legal Alan Nault, Rate Analyst	Cynthia.Wilsonfrias@puc.ri.gov; Alan.nault@puc.ri.gov;	401-941-4500
Division of Public Utilities and Carriers John J. Spirito, Esq., Chief of Legal Steve Scialabba, Chief Accountant Tom Kogut, Chief of Information	john.spirito@dpuc.ri.gov; steve.scialabba@dpuc.ri.gov; thomas.kogut@dpuc.ri.gov;	401-941-4500
Matthew Jerzyk, Deputy Legal Counsel Office of the Speaker of the House State House, Room 302 Providence RI, 02903	mjerzyk@rilin.state.ri.us;	401-222-2466
Hon. Cale Keable, Esq., Representative of Burrillville and Glocester	Cale.keable@gmail.com;	401-222-2258
Nick Katkevich	nkatkevich@gmail.com;	
Ambar Espinoza	aespinoza@ripr.org;	
Joseph Bucci, Acting Administrator Highway and Bridge Maintenance Operations RI Department of Transportation	joseph.bucci@dot.ri.gov;	
Jared Rhodes, Chief Statewide Planning Program Jennifer Sternick Chief of Legal Services RI Department of Administration	jared.rhodes@doa.ri.gov; Jennifer.sternick@doa.ri.gov;	
Doug Gablinske, Executive Director TEC-RI	doug@tecri.org;	
Tim Faulkner ecoRI News 111 Hope Street Providence, RI 02906	tim@ecori.org;	401-330-6276
Robert Tormey Conanicut Energy, LLC	rjtormey@conanicutenergy.com;	617-306-1601
Sally Mendzela	salgalpal@hotmail.com;	
Keep Burrillville Beautiful Paul LeFebvre	paul@acumenriskgroup.com;	401-714-4493

Mark Baumer	everydayyeah@gmail.com;	
Nisha Swinton Food & Water Watch New England	nswinton@fwwatch.org;	
Kaitlin Kelliher	Kaitlin.kelliher@yahoo.com;	
Joe Piconi, Jr.	jiggzy@hotmail.com;	
Hon. Aaron Regunberg Representative of Providence, District 4	Aaron.regunberg@gmail.com;	
Paul Ernest	paulwernest@gmail.com;	
Skip Carlson	scarlson@metrocast.net;	
Kathryn Scaramella	kscaramella@outlook.com;	
Diana Razzano	Dlrazzano13@verizon.net;	
David Goldstein	tmdgroup@yahoo.com;	
Douglas Jobling	djobling@cox.net;	
Claudia Gorman	corkyhg@gmail.com;	
Curt Nordgaard	Curt.nordgaard@gmail.com;	
Colleen Joubert	Colleenj1@cox.net;	
Matt Smith Food & Water Watch	msmith@fwwatch.org;	
Christina Hoefsmit, Esq. Senior Legal Counsel RI Department of Environmental Management	Christina.hoefsmit@dem.ri.gov;	
Steven Ahlquist, RIFuture	atomicsteve@gmail.com;	
Pascoag Utility District William Bernstein, Esq. Michael Kirkwood, General Manager Robert Ferrari, Northeast Water Solutions, Inc.	mkirkwood@pud-ri.org; Wlblaw7@gmail.com; rferrari@nwsi.net;	
Ben Weilerstein Toxics Action Center	ben@toxicsaction.org;	

RHODE ISLAND DEPARTMENT OF HEALTH

Energy Facility Siting Board

Advisory Opinion:

Clear River Energy Center

FINAL

09.12.2016

1.0 SUBMISSION OVERVIEW

The Rhode Island Department of Health (RIDOH) compiled this Advisory Opinion on the Proposed Clear River Energy Center (CREC) in response to the Rhode Island Energy Facility Siting Board (ESFB)'s "Notice of Designation to the Rhode Island Department of Health to Render an Advisory Opinion," issued on March 10, 2016. In this document, RIDOH considered the issues consigned to its review, pursuant to R.I. General Laws 42-98-10. Notice of a public hearing on a draft of this Advisory Opinion was posted on July 8, 2016 and the hearing was held on August 9, 2016 at the Burrillville High School. The Advisory Opinion, modified in response to written and oral comments received at the hearing and written comments received during the public comment period, will be submitted to the EFSB by September 10, 2016, per the EFSB Order. The public process complied with the following requirements:

> In accordance with Rule 1.11(a) of the Board's Rules of Practice and Procedure (Rules), the designated agency shall render its advisory opinion, to the extent possible, pursuant to the procedures that would be followed absent Board designation of the agency. Where necessary, an agency shall modify its procedures to conform to the requirements of the Act, the Rules, and the Preliminary Decision. In accordance with Rule 1.11(c) the advisory opinion shall conform with the Rhode Island Administrative Procedures Act R.I. Gen. Laws § 42-35 requirements regarding Decisions and Orders and shall be clearly identified as an advisory opinion issued to the Board for consideration at the Board's final hearing. A designated agency lacking a process compliant with the Administrative Procedures Act may, and shall at the direction of the Board's Chairperson, make a witness available to sponsor and be examined on its advisory opinion at the final hearing to be scheduled and held following the advisory opinion deadline.

2.0 CONTENT OUTLINE

The RIDOH Advisory Opinion reviews a select set of health issues potentially associated with the proposed CREC. This information was compiled from a review of the ESFB Preliminary Decision and Order and other publicly available documentation. The content of the document is organized as follows:

- Introduction;
- Electromagnetic Fields;
- Noise;
- Drinking Water Quality;
- Air Pollution and Asthma;
- Emergency Response and Prevention;
- Climate Change and Health;
- Other Health Considerations; and
- Summary of Conclusions.

3.0 CONTACT INFORMATION

For additional information related to this Advisory Opinion, please address all correspondence to:

Nicole E. Alexander-Scott, MD, MPH
Director of Health
Rhode Island Department of Health
Three Capitol Hill
Providence, RI 02908

4.0 INTRODUCTION

According to the World Health Organization, health is a state of complete physical, mental, and social well-being—not simply the absence of disease. Health is place-based, meaning that it is influenced by the environments in which individuals live, learn, work, and play. Health equity is achieved when everyone has the opportunity to attain their full health potential. Based on this understanding, RIDOH has established three leading priorities to guide the Department's work:

- *Address the social and environmental determinants of health in Rhode Island;*
- *Eliminate disparities of health in Rhode Island and promote health equity; and*
- *Ensure access to quality health services for Rhode Islanders, including our vulnerable populations.*

To move forward these leading priorities effectively, five strategies were established, each associated with its own set of integrated population health goals. These strategies and goals provide a framework for programmatic activities across the state to improve all elements of health for Rhode Islanders. Examples of the RIDOH strategies and related population health goals that are most relevant to the analysis in this document are:

- *Promote healthy living for all through all stages of life;*
    - **Goal:** Reduce chronic illnesses, such as diabetes, heart disease, asthma, and cancer
    - **Goal:** Promote good behavioral health and wellness among all Rhode Islanders

- *Ensure access to safe, food, water, and healthy environments in all communities;*
    - **Goal:** Increase compliance with health standards in recreational and drinking water supplies
    - **Goal:** Reduce environmental toxic substances, such as tobacco and lead

- *Promote a comprehensive health system that a person can navigate, access, and afford;*
    - **Goal:** Improve access to care including physical health, oral health, and behavioral health systems

- *Prevent, investigate, control, and eliminate health hazards and emergent threats;*
    - **Goal:** Improve emergency response and prevention in communities
    - **Goal:** Minimize exposure to traumatic experiences, such as bullying, violence, and neglect

  To address these goals within the context of the "Notice of Designation to the Rhode Island Department of Health to Render an Advisory Opinion," RIDOH has taken into account the valued written and oral comments received at the hearing and written comments received during the public comment period as part of this Advisory Opinion.

5.0 ISSUE 1: Electromagnetic Fields

Background

The recent proposal submitted for CREC of Burrillville, Rhode Island, includes an analysis of the estimated increased intensity of electric and magnetic fields (EMFs) projected to occur in proximity to electric transmission lines originating at CREC. The new transmission lines will use an existing right of way (ROW) for electric transmission lines. The ROW is currently populated by two sets of lines. The new lines will add a third set, and thereby increase the EMFs within the ROW and in close proximity to the ROW. Estimates of the increase were produced by Exponent at the request of ESS Group, which prepared the *Rhode Island Energy Facility Siting Board Application* for CREC at the request of Invenergy. Exponent's report is appended to the *Application* as *Appendix F – EMF Analysis – CREC Transmission Line*. Results of this report are summarized in the *Application* in pages 99-105. Excerpts of the Exponent analysis are attached to this document as Appendix I.

In its analysis, the applicant used standard assumptions about the generation and magnitude of EMFs, and a conservatively generous assumption about the magnitude of EMFs, i.e., that CREC would operate continuously at peak load, thus generating magnetic fields of maximum intensity. **As expected, the proposed new transmission lines would not increase the strength of electric fields significantly, but would increase the strength of magnetic fields**. (The latter are related to increased transmission, while the former are not.)

The estimated increased EMF strength at the edges of the ROW does not exceed existing standards as set by international organizations for whole body exposure to 60-Hz fields for the general public. As the applicant points out, "These exposure limits are based on extensive weight-of-evidence reviews and evaluations of relevant health research and are designed to prevent acute, short-term biological responses such as perception, annoyance, and the stimulation of nerves and tissue that can occur at very high EMF exposure levels to which the general public [might] be exposed."

Furthermore, the applicant's results demonstrate that the projected intensity of the magnetic field that will be produced 100 feet from the ROW when CREC is operating at peak load is equal to the existing intensity of the magnetic field at the border of the ROW, so the increased EMF intensity would occur only within 100 feet of the ROW. This is because the intensity of an EMF diminishes very quickly as you move away from the source. As discussed above, EMF exposures in all areas beyond the ROW do not exceed health-based standards.

60 Hz Magnetic Fields and Cancer

Over the past four decades, many studies have been done to explore the potential relationship between exposure to 60 Hz (extra low frequency or ELF) magnetic fields 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.

More information is available at http://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/electromagnetic-fields-fact-sheet.

Research in this area continues, with a decided focus on 60 Hz magnetic fields and childhood cancer. The latter studies have been equivocal. Some find no relation between EMF exposure and cancer, while others find a weak relationship. However, after decades of research, when all the evidence is weighed as a body, "No consistent evidence for an association between any source of non-ionizing EMF and cancer has been found," as per the NCI. 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 one's 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.

A speaker at the public hearing on a draft of this document provided the following comment:

> Let's start with electromagnetic fields, EMF. You state that research is inconclusive with pediatric cancer. Research in this field started in the US around 1990. There has been less than 26 years of research, and research has found very significant health impacts. Your health report dismisses any health effects of EMF, which is not the case through the current research. There are links between EMF causing diabetes, multiple sclerosis, attention deficit disorders, asthma, and many more. In 2006 studies support three percent of the US population having electro hypersensitivity and 35 percent having symptoms of electro hypersensitivities. This is significant and means that people are becoming ill by high voltage lines along with cumulative effects from other forms of electricity they are exposed to on a daily basis.[1]

While there are many publications in the scientific literature purporting to demonstrate harmful health effects of EMF, there are many others which demonstrate no harmful health effects. Individual studies are of varying scientific value, depending on their subject matter, scope, and methods. In situations such as this, we rely on "the preponderance of the evidence," based on careful analyses and summarizations of the literature. The National Institute of Environmental Health Sciences (NIEHS) of the U.S. National Institutes of Health summarized the data on EMF health effects for the U.S. government as follows:[2]

> "Since the mid-twentieth century, electricity has been an essential part of our lives. Electricity powers our appliances, office equipment, and countless other devices that we use to make life safer, easier, and more interesting. Use of electric power is something we take for granted. However, some have wondered whether the electric and magnetic fields (EMF) produced through the generation, transmission, and use of electric power [power-frequency EMF, 50 or 60 hertz

[1] RIDOH Public Hearing transcript, appended to this document, page 48.
[2] National Institute of Environmental Health Sciences webpage of Electric and Magnetic Fields http://www.niehs.nih.gov/health/topics/agents/emf/

(Hz)] might adversely affect our health. Numerous research studies and scientific reviews have been conducted to address this question.

Unfortunately, initial studies of the health effects of EMF did not provide straightforward answers. The study of the possible health effects of EMF has been particularly complex and results have been reviewed by expert scientific panels in the United States and other countries. This booklet summarizes the results of these reviews. Although questions remain about the possibility of health effects related to EMF, recent reviews have substantially reduced the level of concern.

The largest evaluation to date was led by two U.S. government institutions, the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health and the Department of Energy (DOE), with input from a wide range of public and private agencies. This evaluation, known as the Electric and Magnetic Fields Research and Public Information Dissemination (EMF RAPID) Program, was a six-year project with the goal of providing scientific evidence to determine whether exposure to power-frequency EMF involves a potential risk to human health.

In 1999, at the conclusion of the EMF RAPID Program, the NIEHS reported to the U.S. Congress that the overall scientific evidence for human health risk from EMF exposure is weak. No consistent pattern of biological effects from exposure to EMF had emerged from laboratory studies with animals or with cells. However, epidemiological studies (studies of disease incidence in human populations) had shown a fairly consistent pattern that associated potential EMF exposure with a small increased risk for leukemia in children and chronic lymphocytic leukemia in adults. Since 1999, several other assessments have been completed that support an association between childhood leukemia and exposure to power-frequency EMF.

These more recent reviews, however, do not support a link between EMF exposures and adult leukemias. For both childhood and adult leukemias, interpretation of the epidemiological findings has been difficult due to the absence of supporting laboratory evidence or a scientific explanation linking EMF exposures with leukemia.

EMF exposures are complex and exist in the home and workplace as a result of all types of electrical equipment and building wiring as well as a result of nearby power lines.

In short, epidemiological studies of the chronic health effects of exposure EMFs that have been done over the course of the last half century have yielded only one weak link—between EMFs and childhood leukemia. This link is poorly understood, especially because no analogous link has been found for adults and because childhood leukemia is rare. In Rhode Island between 2005 and 2014, an average of 11 cases of leukemia (all forms of leukemia) were newly diagnosed each year among residents aged 0-19. Based on the weak association between EMFs and leukemia found in some (but not all) of the studies of this association, the WHO estimates that EMFs from all sources may cause between "0.2% to 4.9% of the total annual incidence" of childhood leukemia cases[3]. In Rhode Island, this translates to a maximum of one case of childhood leukemia every two years across the entire state that may be linked to exposure to

[3] WHO, Extremely Low Frequency Fields, Environmental Health Criteria Monograph No.238, http://www.who.int/peh-emf/publications/elf_ehc/en/

EMFs from all sources. Note that, due to the fact that EMF strength decreases rapidly with distance from a source, EMF exposures from other sources, including household appliances, electronic devices and local electric power supply lines, are likely to be far greater than exposure from high-tension power lines. Therefore, it is very unlikely that the additional EMF generated by the transmission lines connecting to the CREC facility would cause a significant increase in the number of children who develop leukemia in the State.

The commenter also discusses the issue of electromagnetic hypersensitivity (EHS). People identifying as being hypersensitive to EMF report a variety of symptoms, including redness, tingling, and burning sensations in the skin; fatigue; difficulties with concentration; dizziness; nausea; heart palpitations and digestive disturbances. While some individuals report mild symptoms manageable by avoiding EMF as best they can, others are so severely affected that they make dramatic changes to their lifestyles.

The WHO convened a workshop in 2004 to evaluate scientific studies on EHS and concluded that "well controlled and conducted double-blind studies have shown that symptoms were not correlated with EMF exposure" and that "the majority of studies indicate that EHS individuals cannot detect EMF exposure any more accurately than non-EHS individuals." Although the WHO acknowledged that the symptoms reported by affected individuals are real, the organization suggested that those symptoms may be caused by other environmental conditions, such as flickering fluorescent lights, glare, or poor indoor air quality, or by other factors.[4]

Summary and Conclusion

The proposed addition to the electrical transmission in the ROW to be used by CREC will increase the strength of magnetic fields therein and close by, but the resulting intensity of potential human exposure is well within limits set by international standard-setting agencies. Furthermore, EMFs have not been demonstrated to create health risks—acute or otherwise—at the levels generated by the transmission lines in question. For this reason, the health impact of CREC attributable to EMFs is negligible, and may in fact be non-existent.

[4] World Health Organization, "Electromagnetic Fields and Public Health: Electromagnetic Hypersensitivity," 2005. http://www.who.int/peh-emf/publications/facts/fs296/en/

6.0 ISSUE 2: Noise

Background

Exposure to intense or long-term highly elevated noise levels, such as may occur in an occupational setting, can cause the loss of auditory sensory cells in the cochlea, resulting in permanent hearing loss. Indoor and outdoor environmental noise exposures are unlikely to cause hearing loss, but have been linked to a variety of effects, including annoyance; cognitive effects in children, including impairment of reading comprehension and memory; sleep disturbances; and cardiovascular effects, including an increased risk of hypertension and myocardial infarction.[5]

Noise-related annoyance manifests as sleep disruption, interference with speech intelligibility, stress reactions, and negative feelings, such as anger, depression and anxiety. The World Health Organization (WHO) defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity;" [6] therefore, noise-related annoyance is considered a health effect. According to the WHO, sleep disturbance, one of the most common complaints raised by noise-exposed populations, can have a major impact on health and quality of life. People can recognize and react to sounds even when they are asleep. Those reactions, including wakening and changes in sleep stage, are associated with daytime after-effects, such as sleepiness, reduced cognitive and motor performance, and impairment of cardiovascular function.

Several studies have confirmed that environmental noise; including noise from road, rail and air traffic; can impair children's cognitive functioning. One of the most compelling of these studies was performed during the relocation of the airport in Munich, Germany in 1992. Children living in the vicinity of the old and new airports were evaluated before and two years after the airport was moved. Before the move, children living near the operating old airport showed deficits in reading comprehension and long-term memory. Two years after the relocation, those deficits were no longer seen in the children near the old airport but had emerged in children living near the new airport site.[7]

Studies have also demonstrated a link between transportation noise and cardiovascular effects, particularly hypertension and an increased risk of myocardial infarction. Noise exposure can cause increased blood pressure and alter heart rates and the release of stress hormones. There are two separate mechanisms for those effects, a direct neural pathway and an indirect pathway that is due to perceived discomfort. Since the direct pathway does not require conscious perception of noise, noise exposure during sleep, as well as during waking hours, is linked with cardiovascular outcomes.

Note that, in comments received during the public comment period for this document, the Burrillville Land Trust and other commenters asked RIDOH to include a discussion of the effect of noise on all species within the impacted area. Although RIDOH acknowledges that wildlife are also affected by noise, the discussion in this document is limited to the potential public health impacts on human beings of the facility.

---

[5] Basner, Mathias, et al, "Auditory and Non-Auditory Effects of Noise on Health," Lancet Apr 2014, 383(992):1325-1332

[6] World Health Organization Regional Office for Europe, "Burden of Disease from Environmental Noise," 2011. http://www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf

[7] Hygge S, et al, "The Munich Airport Noise Study – Effects on Chronic Aircraft Noise on Children's Perception and Cognition," inter.noise 2000, 29th International Congress and Exhibition on Noise Control Engineering, Nice, France, Aug 26-30, 2000. http://www.conforg.fr/internoise2000/cdrom/data/articles/000676.pdf

CREC Noise Analysis

A noise analysis was submitted as part of the EFSB application for the proposed CREC facility. In that analysis, the applicant reported existing noise levels measured at five locations surrounding the proposed facility, as well as the modeled noise impacts at those locations associated with the construction and operation of the proposed facility. The locations of the noise receptors, which were chosen to represent the closest residential areas, are shown in Table 1.

Table 1 – Locations of Noise Receptors

Receptor	Street	Direction/Distance from Center of Facility Site
M1	Wallum Lake Road	2,300 feet NE
M2	Jackson Schoolhouse Road	2,500 feet E
M3	Wilson Trail and Doe Crossing Drive	4,300 feet NW
M4	Buck Hill Road	4,300 feet N
M5	Jackson Schoolhouse Road	7,200 feet SE

The applicant's analysis predicted that noise from construction of the proposed facility would not increase ambient levels significantly and that "(t)he average individual is likely to tolerate construction noise given its temporary nature and that the majority of construction will take place during daytime hours." Further, the modeling analysis demonstrated that, with the proposed acoustical design, operation of the proposed facility would not cause noise impacts that exceed the Town of Burrillville's limit on nighttime noise of 43 A-weighted decibels (dBA). The Town noise ordinance also includes limits for octave-band frequencies; the applicant stated that "attaining the unusually restrictive octave-band limits was found to require extraordinary mitigation measures commercially untenable and even beyond engineering feasibility." Since RIDOH does not know the basis for the noise limitations in the Town ordinance, the discussion below is based on a comparison of current and predicted noise levels with health-based reference values, rather than on a determination of whether noise levels comply with the Town's ordinance.

<u>Nighttime Noise Exposures</u>

Noise levels during nighttime hours are particularly critical because of the importance of undisturbed sleep to health and wellbeing. The WHO's 2009 "Night Noise Guidelines for Europe" states that:

> There is no sufficient evidence that the biological effects observed at the level below 40 dB Lnight,outside are harmful to health. However, adverse health effects are observed at the level above 40 dB Lnight,outside, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives. Therefore, 40 dB Lnight,outside is equivalent to the lowest observed adverse effect level (LOAEL) for night noise.[8]

[8] World Health Organization, Regional Office for Europe, "Night Noise Guidelines for Europe," 2009. http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf

The WHO document also states that, when nighttime noise levels are between 40 and 55 dB:

> Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.

And, for noise levels above 55 dB:

> The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

As shown in Table 2, the existing nighttime noise levels measured at all receptors except for M3, as reported in the CREC application, were above the 40 dBA LOAEL. Note that those levels were short-term measurements and may not accurately represent average nighttime levels measured over a longer period. According to the CREC analysis, at the time of measurement, the predominant source of nighttime noise at receptors M1, M2 and M4 was the nearby Algonquin compressor station, while frog sounds predominated at the other two sites.

The modeled nighttime noise levels associated with CREC operations were above the sleep effect LOAEL at all receptors except for M5.[9] When the CREC noise contributions were combined with existing noise levels, the total nighttime noise levels at all sites were above the LOAEL. Note that, when two noise sources (in this case the existing noise and noise from the CREC facility) impact a location, the total noise level at that location is 0 - 3 dBA higher than the louder of the two noises. Note also that the noise survey conducted for the CREC EFSB application did not consider noise that will be generated by an additional turbine at the Algonquin compressor station that has been approved by the Federal Energy Resource Commission (FERC) and permitted by the Rhode Island Department of Environmental Management (RIDEM), but is not yet operating. The analysis presented in the Environmental Impact Statement for the Algonquin project does not identify the nighttime or daytime average noise levels associated with operation of that turbine.[10]

---

[9] In comments on the draft of this document, the applicant noted that the WHO's nighttime LOAEL of 40 dBA is an annual average and stated that the modeled 8-hour values predicted for CREC operations are not directly comparable to that value, because the model "assumes 100% of the time the facility is at full operation, 100% of the time atmospheric conditions are conducive to sound propagation, and that all residences are always downwind of the CREC." The applicant's comments also state that, "(i)f Invenergy were to average all the nights of no or low operation, as well as the nights of upwind or poor propagation conditions, the annual average would be below 40 dBA. Thus, CREC would comply with the WHO standard." RIDOH does not have sufficient information to support or refute this assertion. The RIDOH analysis was conducted using the information supplied in the application.

[10] The applicant's comments on the draft of this report state that "Invenergy's understanding is that Algonquin intends on upgrading its facility prior to the CREC coming online. The new compressors may be similar to the Solar turbine(s) installed as part of their previous upgrade, which are relatively quiet. Regardless, because the new compressor units will replace old reciprocating engine units, it can safely be assumed that the upgrades will improve the facility's efficiency and lower its noise emissions. Thus, if Invenergy were to factor in the noise level of the planned Algonquin facility upgrades overall noise levels would, if anything, be lower than they are today." RIDOH stands behind its statement that the CREC noise analysis did not consider the increased noise levels associated with the Algonquin equipment that has already been permitted and installed but was not operational at the time that the CREC noise study took place. That upgrade did not replace existing equipment and thus will be associated with additional noise producing equipment. Since permits for future Algonquin upgrades have not yet been filed or reviewed, it is not possible to evaluate the effects that such additional future upgrades would have on noise levels in the area.

As shown in Table 2, the CREC modeling indicates that operation of the CREC facility would increase the average nighttime noise levels at M1, M4 and M5 by less than 3 dBA, the minimal increase that is generally discernable to the human ear. However, as discussed previously, existing noise levels measured at four of the five receptors already exceed the LOAEL for sleep disturbance. Whether or not CREC operations will result in an increase in the number or severity of those disturbances is dependent on a number of factors, including the time pattern and nature of the noise emissions at the two facilities. That issue is discussed further below.

Table 2 – Nighttime Noise Levels (8-hour average, in dBA)

Location	Measured Existing Nighttime Noise Level [11] (CREC EFSB Application)	Modeled CREC Operations Level (CREC EFSB Application)	Total Nighttime Noise Level (Existing & CREC) (Calculated)
MI	45-48	43	47-49
M2	40-41	41	44
M3	34-36	40	41
M4	51	41	51
M5	44-45	34	44-45

Daytime Noise Exposures

Exposure to elevated environmental noise levels during daytime hours causes annoyance and can impact speech intelligibility, children's cognition, and the cardiovascular system. According to the WHO, an outdoor daytime average noise level of 50 dBA is associated with moderate annoyance and a level of 55 dBA with serious annoyance.[12] 55 dBA is also at the lower end of the range of noise levels associated with an increased risk of hypertension.[13]

Current measured daytime noise levels at the five receptors, as well as modeled levels associated with the construction and operation of the CREC facility, are shown in Table 3. Existing daytime noise levels measured at all receptors except M3 were above the 50 dBA moderate annoyance threshold on at least one of the measurement days. The primary source of daytime noise at sites M1 and M2 was recorded as the compressor station, while birds predominated at M3 and M5 and traffic on Buck Hill Road was the main noise source at M4.

As shown in Table 3, the CREC analysis predicts that noise levels associated with construction activities will be highest at location M2 (Jackson Schoolhouse Road); at that location, average daytime noise levels from construction activities would be as high as 53 dBA, resulting in a total noise level at that site of 55–

[11] Existing sound levels reported in this table were measured for 20 minute periods. In addition to these short-term measurements, continuous measurements were conducted for 65 hour periods at Locations M1 and M3 and the results of those measurements were presented graphically in the CREC application. 8-Hour nighttime averages of the continuous noise measurements were not provided, but appear to be similar to the lower range of the short-term levels presented in Table 2.
[12] Berglund, Birgitta et al, "Guidelines for Community Noise," World Health Organization, Geneva, Switzerland, April 1999. http://www.who.int/docstore/peh/noise/guidelines2.html
[13] World Health Organization Regional Office for Europe, "Burden of Disease from Environmental Noise," 2011. http://www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf

56 dBA, an increase of 4-5 dBA from current levels. Therefore, the total daytime noise at that location during construction activities would exceed the serious annoyance threshold and may cause a slightly increased risk of hypertension for nearby residents. [14]

Table 3 – Daytime Noise Levels (16-hour average, in dBA)

Location	Measured Existing Daytime Noise Level[15] (CREC EFSB Application)	Modeled CREC Construction Noise Level (CREC EFSB Application)[16]	Modeled CREC Operations Noise Level (CREC EFSB Application)	Total Daytime Noise During Construction (Calculated)	Total Daytime Noise During Operation (Calculated)
MI	52-53	49	43	54	53
M2	50-52	53	41	55-56	51-52
M3	36-44	41	40	42-46	41-45
M4	50-51	47	41	52	51
M5	46-52	37	34	46-52	52

Operation of the facility, once constructed, is predicted to have a minimal impact on current average daytime noise levels. However, as with nighttime noise, existing daytime noise levels measured at four of the five receptor sites are already in the moderate annoyance range and, depending on factors like the time pattern and nature of the noise emissions at the two facilities, the frequency or severity of annoyance may increase at some locations as a result of CREC operations. As discussed previously, noise associated with operation of the permitted additional turbine at the Algonquin compressor station was not included in these calculations.

Day/Night Noise Exposures

Another important measure of noise exposure is L_{DN}, a metric which combines daytime and nighttime exposures. To calculate L_{DN}, noise levels in the nighttime hours are increased by 10 dBA to account for the increased need for quiet during those hours, and a 24-hour average level is then calculated. The US Environmental Protection Agency (US EPA) has identified a L_{DN} of 55 dBA as the outdoor exposure level that would prevent annoyance, including interference with the intelligibility of speech.[17] According to the WHO, exposure to a L_{DN} of 50 dBA has not been shown to cause adverse effects, while some children showed cognitive effects at a L_{DN} of 55 dBA and the risk of myocardial infarction was slightly increased when L_{DN} levels were above 60 dBA.

[14] In comments on the draft of this document, the applicant states that adding modeled construction noise levels to measured existing levels is not appropriate and that "(a)ny negative reaction on the part of residents to construction noise should be judged on construction noise levels only." The applicant did not supply a justification for excluding background noise in an evaluation of health impacts.

[15] Measured existing daytime noise levels are based on 20-minuted measurements reported in the CREC application and may not reflect average background conditions during construction.

[16] These values are for grading and excavation and steel erection. Noise levels during concrete pouring, equipment installation and finishing are projected to be lower than the levels in this table.

[17] US EPA Office of Noise Abatement and Control, "Information on Levels of Environmental Noise Requisite to Protect Public Health and the Environment," March 1974 http://nepis.epa.gov/Exe/ZyPDF.cgi/2000L3LN.PDF?Dockey=2000L3LN.PDF

L_{DN} levels associated with the CREC facility are shown in Table 4. Measured existing L_{DN} levels were not presented in the CREC application. However, the Environmental Impact Statement for the expanded Algonquin compressor station includes L_{DN} values for three of the receptors modeled in the CREC application; those values were used to calculate total L_{DN} values for those sites.

Table 4 – Day/Night L_{DN} Noise Levels (weighted 24-hour average, in dBA)

Location	Day/Night Noise Level With New Compressor Operating Before CREC (Algonquin FERC Application)	Modeled Day/Night Noise Level (CREC EFSB Application)	Total Daytime Noise During Operation (Calculated)
M1 (Algonquin 1)	57	55	59
M2		58	
M3 (Algonquin 4)	45	57	59
M4 (Algonquin 3)	53	53	56
M5		51	

As shown in Table 4, the L_{DN} noise level at M1, before the addition of CREC impacts, was above 55 dBA and the L_{DN} impacts of the CREC operations alone at M1, M2 and M3 locations were at or above 55 dBA, the L_{DN} value associated with cognitive effects in some children. The total L_{DN} values for the three sites (M1, M3 and M4) for which existing L_{DN} noise levels were available in the Algonquin application were all above 55 dBA.

Note that, in comments on the draft of this document, the applicant stated that RIDOH's total L_{DN} calculations are not appropriate because the modeled L_{DN} levels for the CREC operations, as reported in the noise evaluation in the EFSB application and listed in Table 4 above, have already been "adjusted to account for low ambient levels." However, even without the calculation of total L_{DN} values, the L_{DN} for location M1 reported in the Algonquin application and the L_{DN} calculated in the CREC application for locations M1, M2 and M3 were at or above 55 dBA. Therefore, RIDOH stands behind the conclusion above that predicted L_{DN} noise levels associated with both the operation of the Algonquin facility and the operation of the CREC facility have the potential to cause cognitive effects in some children.

Summary and Conclusions

The measurements of existing nighttime and daytime noise levels in the vicinity of the proposed facility that exceed annoyance thresholds is consistent with testimony submitted to the EFSB and RIDOH by residents living at or near those locations. Written testimony submitted to the EFSB by a resident living on Wallum Lake Road, near receptor M1, the monitored/modeled noise receptor that is closest to the proposed facility, included the following statement:

> Specifically, in the past year, I have experienced excessive noise and vibrations coming from the Algonquin Compressor Station site which this project will be located next to. The noise and vibrations emanating from this site are extremely disruptive and negatively impacting our health and we are unable to sleep or enjoy the peace and quiet of our home. I am concerned that the

> noise levels and vibration are only going to increase during the construction and operational phase of this project.[18]

Another resident living near M1 receptor wrote the following in a letter to the Federal Energy Regulatory Commission concerning the Algonquin facility; that letter was submitted to RIDOH at the public hearing on this document:

> The noise and vibration emanating from the Burrillville [facility] is extremely disruptive to my husband and me and has negatively impacted our ability to sleep, enjoy our property and our health. My husband is a one-hundred percent disabled Vietnam Veteran and his health and survival relies on him getting good quality sleep, not to mention reduced stress levels. As a result of the continued noise and vibration his sleep pattern is negatively impacted and his stress level as a result has increased to a point where his cardiologist has told me not to have him get stressed over this situation. That is easier said than done when faced with the noise and vibration problem on a daily basis.
>
> …..The current noise occurs on almost a daily basis and ranges from a constant drone similar to a diesel truck parked idling in my driveway to a loud – jet plane running. At times it sounds like a jet plane has taken off. When this occurs, the noise is extremely loud and lasts for several minutes. The noise cycles between the diesel truck idling to the jet plane taking off and can last for several hours.[19]

Note that, in the CREC noise survey, the current daytime noise level measured at receptor M1, which is near the homes of these residents, was in the moderate annoyance range and the current nighttime noise level exceeded the threshold for sleep disturbance. The compressor station was the primary existing noise source of both day and night noise noted at that location. Measured noise levels at site M4 (Buck Hill Road) also exceed both nighttime and daytime annoyance thresholds, due primarily to the compressor operations and road traffic.

The model predicts that construction of the CREC facility would increase daytime average noise levels at the five receptor locations by between 0 and 6 dBA and that operation of the facility would increase nighttime noise levels by 0–7 dBA and daytime levels by 0–6 dBA. In most cases, the average predicted increases are in a range that is generally not discernable to the human ear. However, noise is a complex issue, and the potential for the introduction of an additional noise source to result in an increase in the prevalence or severity of periods of annoyance and sleep disturbance is dependent on a number of factors, including:

- **The pattern of noise variation with time**

For example, a continuous noise may have a different effect than periodic louder noises that are interspersed with relative quiet, even if the average noise levels are the same. Loud noises emitted by a source during a time that neighboring sources are quiet may increase the number of disturbances during the day or night. Regular variations in noise level may create an unpleasant pulsing sensation.

- **The noise frequency (pitch)**

[18] CREC/Invenergy Docket, EFSB. http://www.ripuc.ri.gov/efsb/efsb/SB2015_06_PC_orourke.pdf
[19] Rhode Island Department of Health Invenergy Advisory Opinion – Public Comments https://drive.google.com/drive/folders/0BxabNEtecvGHZ2VCOHZUWWdvbUU

The human ear perceives low frequency (pitch) sounds as not as loud as higher frequency sounds of the same level. The A-weighting procedure used to calculate dBAs attempts to account for these differences, but dBA levels do not always correlate well with subjective perception of complex sounds.

- **Types of noise**

A person's degree of annoyance to a particular noise level is also influenced by the nature of the noise and whether or not it provokes negative associations, like fear.

- **Individual differences**

There is a substantial variation among people in sound perception.[8]

Existing daytime and nighttime noise annoyances in the neighborhood around the proposed facility, due primarily to the operation of the compressor station, have already been documented, both by subjective reports from residents and by objective noise measurements. In addition, due to the factors discussed above, the full impact of noise generated by operation of the new turbine at the compressor station and the CREC facility, in conjunction with the existing noise levels, is impossible to accurately predict.

Note that, in commenting on the draft of this document, the applicant stated the following:

> The CREC will generally operate on a continuous basis, and all transient noise sources/events (i.e. start-up, venting, etc.) have been silenced to a significant degree. With regard to pitch, the frequency spectrum of the CREC will not contain any tones, and is of a broadband nature that is non-intrusive. It is understood that there is substantial variation in the perception of noise throughout the general population, but that is not within the control of CREC. Invenergy has designed the CREC facility such that its noise emissions are below that of the Town's stringent limits and below WHO and US EPA noise level standards.

RIDOH supports the applicant's efforts to reduce noise generation in the facility design. However, as several commenters noted, the ability of those measures to meet sound reduction goals in practice has not yet been proven. In view of the concerns discussed above, RIDOH strongly recommends that the EFSB establish clear noise limitations and require the CREC facility, if constructed, to work in conjunction with Algonquin to ensure that neighborhood noise impacts are minimized to the fullest extent possible.

The applicant commented that "Invenergy does not anticipate the need for additional mitigation measures such as soundproofing or property acquisition." However, RIDOH strongly recommends that EFSB require that, if operation of the facility, by itself or in conjunction with Algonquin, results in noise levels that cause neighborhood disturbances, all available actions to mitigate those impacts be pursued, including, but not be limited to, equipment and operational modifications, soundproofing of impacted residences and, if indicated, the purchase of properties subject to noise levels that cause serious annoyance and/or sleep disruption.

Commenters expressed concern that the above recommendations would be difficult or impossible to enforce after the facility is built. RIDOH acknowledges that concern and urges the EFSB or other regulatory entities to explore mechanisms for ensuring that any unacceptable noise impacts that may occur are appropriately addressed, including but not limited to ensuring that any requirements established of the applicant to minimize noise disturbances are explicitly followed.

7.0 ISSUE 3: Drinking Water Quality

Background

Potential impacts on the quality of drinking water associated with the construction and operation of the CREC were evaluated within the context of the CREC proposal. The Invenergy power plant, as proposed, raised a number of questions regarding potential impacts on drinking water quality in private wells and public wells, groundwater, and public water system licensing. These concerns included possible groundwater depletion, possible contamination of drinking water wells, exposure to MTBE and other contaminants, and pollutant concentrations in discharged wastewater. RIDOH limited its opinion to drinking water quality and public water system licensure. Issues regarding availability of supply fall more properly within the jurisdiction of RIDEM, the Water Resources Board and other agencies and entities. In fact, at this time, there is no actively proposed water supply for the plant as all publicly proffered options have been dismissed.

Situation and Analysis

Approximately 9,300 residents in Burrillville rely on private wells for drinking water. Burrillville currently has 4,232 structures served by private wells, representing 58.9 percent of all Burrillville structures. These wells rely on groundwater within sand and gravel deposits or from wells in fractured bedrock. The proposed power plant is approximately 1,500 feet from the nearest structures and associated wells. Additionally, the proposed project sits within the watershed of Wallum Lake, which provides sourcewater for Zambarano Hospital. The construction may impact the quantity and quality of the water of wells in the vicinity of the plant and its construction activities.

Invenergy had proposed to draw process water from two wells known to have been contaminated with methyl tertiary butyl ether (MTBE), a retired component of gasoline. Whether these wells could be returned to service was a matter of significant public debate and concern. However, this proposal became moot when the Pascoag Utility District and Harrisville Water and Harrisville Fire District and Water Department declined Invenergy's bid for water. In any event, these wells cannot provide drinking water for the facility and a separate, approved source would have to be developed for onsite human consumption.

Summary and Conclusions

At this time, the principal concern is protection of sourcewater for nearby wells and water systems, including private wells and Wallum Lake, the source serving Zambarano Hospital. Effort should be made to protect these and all other sourcewaters from contamination through each phase of the project, including construction and operations.

Should the power plant use well water on-premises for human use and consumption, and their offices serve more than 25 persons more than 60 days out of the year, then the plant will have to obtain a public water system license through RIDOH's Center for Drinking Water Quality.

Concerns were expressed regarding the impact of groundwater withdrawals by the proposed plant. No source for process water is currently under consideration; however, regardless of the source of water for the plant, maintaining the quality of existing drinking water supplies, both public and private, remains a priority. To this end, RIDOH asks to assess the impact of any future proposal on drinking water quality.

8.0 ISSUE 4: Air Pollution and Asthma

Background

The Invenergy power plant, as proposed, will be a major source of nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), carbon dioxide (CO_2), particulate matter smaller than 10 microns (PM_{10}) and particulate matter smaller than 2.5 microns ($PM_{2.5}$). The facility will also emit a number of air toxics, which are pollutants for which the US EPA has not established a National Ambient Air Quality Standard (NAAQS). Pollutants will be emitted primarily from processes that combust natural gas and ultra-low sulfur diesel oil (ULSD). VOC will also be emitted from two aboveground ULSD storage tanks.

Invenergy has applied to RIDEM for a major source air pollution control permit for the facility. To obtain that permit, Invenergy must demonstrate that the facility will comply with the requirements of 18 of RIDEM's Air Pollution Control Regulations (APCRs), including APCR No. 9, "Air Pollution Control Permits," and APCR No. 22, "Air Toxics." Note the APCR No. 22 lists health-based Acceptable Ambient Levels (AALs) for approximately 250 air toxics.

Among the requirements for obtaining a major source permit, APCR No. 9 specifies that permit applications must demonstrate that facility emissions will be consistent with the Lowest Achievable Emissions Rate and that ambient air impacts from the facility will not cause a violation of any NAAQS or AAL. To demonstrate compliance with NAAQS, an applicant must demonstrate that total ambient air levels, including the impacts from the proposed facility, background ambient air pollutant concentrations, and impacts from nearby interacting sources, would not exceed the NAAQS levels. Compliance with NAAQS and AALs is evaluated using US EPA-endorsed air pollution dispersion models, which utilize several years of hour by hour meteorological data to determine impacts under a range of meteorological conditions.

In addition, major source applications must include a Health Risk Assessment (HRA), which evaluates potential impacts by all exposure routes. Note that, while the AAL analysis focuses only on inhalation exposures, the HRA considers exposure to emitted pollutants by other pathways as well, including ingestion of pollutants that are deposited on soil, water and food products and dermal absorption. In addition, the HRA evaluates the cumulative effect of exposure to more than one pollutant associated with the same health effect (e.g. respiratory irritation). To standardize procedures for calculating multi-pathway and cumulative risks, RIDEM's "Guidelines for Assessing Health Risks for Proposed Air Pollution Sources,"[20] which was revised in 2015, requires that HRAs be conducted using software developed by the California Air Resources Board for this purpose.

Situation and Analysis

RIDEM's regulations provide a comprehensive framework for evaluating impacts of air pollution emissions. Rhode Island's Air Toxics regulation is one of the most stringent in the nation, and the requirement for a HRA for major sources provides an extra level of health protection. RIDEM's

[20] RIDEM's "Guidelines for Assessing Health Risks for Proposed Air Pollution Sources" is available on the RIDEM website at: http://www.dem.ri.gov/programs/benviron/air/pdf/riskguid15.pdf

regulations, as well as the HRA guidelines referenced above, have been the subject of a public participation process that included opportunities for submittal of both oral and written testimony.

Questions have been raised concerning the modeling analysis submitted by Invenergy to demonstrate compliance with NAAQS and AALs and which was used as the basis for the HRA. RIDEM is now evaluating the permit application, including the modeling analysis and the HRA; that process is separate from the EFSB proceedings. As discussed above, the modeling analysis considers the impacts from other nearby air pollution sources, as well as background pollutant concentrations, when determining whether the proposed facility would comply the NAAQS. However, RIDOH acknowledges that there are uncertainties in all modeling analyses. RIDOH, as well as members of the public, will have an opportunity to comment on RIDEM's evaluation of the permit application, including the modeling analysis and the HRA, and on the proposed permit during RIDEM's public comment period and hearing, which will occur when that review is complete.

Questions have also been raised about whether the NAAQS adequately protect public health. Specifically, epidemiological studies have reported an association between ambient nitrogen dioxide (NO_2) levels and various health metrics, including new diagnoses of asthma; clinic and emergency department visits for asthma; hospitalizations for asthma, COPD, stroke and heart failure; and death from cardiovascular and respiratory diseases. In some cases, exposure levels reported in those studies were below the current NAAQS for that pollutant.

Those studies and a number of other epidemiological and experimental studies are discussed in some detail in the US EPA's Integrated Science Assessment for Oxides of Nitrogen – Health Criteria (2016 Final Report) document[21], which was prepared as part of the US EPA's required periodic reevaluation of the adequacy of the NAAQS. The US EPA found that experimental and epidemiological data are sufficient to establish a causal relationship between short-term (minutes to one-month) exposures to NO_2 and respiratory effects. Evidence for associations between short-term NO_2 exposures and cardiovascular and related metabolic effects and total mortality are classified as "suggestive, but not sufficient, to infer a causal relationship."

However, the US EPA's consideration of these studies may not lead to the proposal of a more stringent NO_2 NAAQS. A more stringent standard could not be based on experimental data, because experimental studies have focused on exposures to NO_2 concentrations of 100 ppb (the current one-hour average NAAQS) and higher. The US EPA acknowledges that epidemiological studies report health effects at NO_2 levels that are below the NAAQS. However, the document discusses a number of issues that make quantitative interpretation of air pollution epidemiological studies difficult, including issues with accurately characterizing exposure levels and concomitant exposures to other air pollutants.

Questions have also been raised about health effects that may be associated with elevated very short-term (less than one-hour) emissions rates of certain pollutants. While variations in instantaneous emissions rates do occur, quantification and evaluation of the impacts of those variations is virtually impossible, given available modeling tools and health data.

The NAAQS are designed to be protective of public health, including the health of sensitive individuals, however the degree of protection that they provide is limited by the information that is available at the

[21] https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=310879

time that the standards are developed. In its periodic reviews, the US EPA and its Science Advisory Committee consider the results of studies that have become available since the previous revision and determine whether further revisions are indicated. Those revisions may include a change in the level of the standard (e.g. the 2012 change of the $PM_{2.5}$ NAAQS from 15 to 12 $\mu g/m^3$), the addition of a NAAQS for a particular averaging time (e.g. the 2010 promulgation of one-hour average NAAQS for NO_2 and SO_2 to limit short-term exposures), or a change of the form of the pollutant that is regulated. Note that particulate matter (PM) was originally regulated as total particulate matter but, as more information became available about the potential effects of inhalation of very small particles, NAAQS for particles smaller than 10 microns (PM_{10}) and particles smaller than 2.5 microns ($PM_{2.5}$) were developed. In its current review of the PM NAAQS, the US EPA is considering whether enough information is available to develop a NAAQS for even smaller particles, ultrafine particulate matter, which are generally in the range of 0.1 microns.

In comments on the draft of this document, the Burrillville Land Trust advised that, since the CREC facility may operate for 40 years, the RIDOH should conduct its own Health Risk Assessment that considers the current NAAQS and AALs as "historical reference points," projects standards that may be applicable in the future, and uses those anticipated standards for evaluating health impacts. Unfortunately, such an analysis is not feasible, since it is impossible to anticipate future standards.

As discussed by several commenters, exposure to air pollution has been linked to a variety of health effects, including respiratory, cardiovascular and neurological diseases and cancer. Derivations of the NAAQS and AALs consider data on all documented health effects associated with pollutant exposures and the HRA methodology evaluates the cumulative effects of exposure to multiple pollutants that have the potential to affect the same organ system. However, as discussed above, the standards and analysis are limited by the current state of scientific knowledge at the time they are developed and there are uncertainties inherent in any modeling analysis.

Many studies have documented correlations between air pollution and asthma rates and complications. A more thorough discussion of those impacts follows.

Impacts of Air Pollutants on Asthma

Asthma is a chronic respiratory disease that causes a person's airways to narrow, resulting in difficulty breathing. If left untreated, asthma can cause permanent lung damage, disability, and even death. An asthma attack occurs when a person with asthma has greater difficulty breathing than their normal level and requires increased medication and/or medical attention.

The burden of asthma can be described in multiple ways, including asthma prevalence (how many people have asthma), visits to the hospital and emergency department, insurance claims data, and mortality data. There is no cure for asthma, however, with the use of medications and reduction in exposure to asthma triggers, this chronic condition can usually be managed and attacks can be prevented.[22] Asthma management and control is multi-factorial. Asthma triggers include various outdoor air pollutants as well as allergies, mold, pests, pet dander, smoke, dust, and other triggers. Individuals with asthma are sensitive to different sets of triggers, which can change seasonally or over time.

[22] *The burden of asthma in Rhode Island*. (2014). Providence, RI: Rhode Island Department of Health, Asthma Control Program

Due to these complexities, it is difficult to establish causal relationships between a single environmental factor and asthma outcomes without conducting rigorous scientific research. However, it has been demonstrated that people with asthma or other respiratory diseases are more susceptible and reactive to the impacts of air pollutants. With regards to general population health, policies which reduce the overall level and concentration of air pollution and other environmental asthma triggers will support improved public health with respect to asthma.

Analysis of Known Triggers and Asthma Burden

The proposed CREC facility would emit several air pollutants that are known asthma triggers, including NO_x, VOC, SO_2, PM_{10} and $PM_{2.5}$. Smaller PM particles are associated with greater respiratory risk due to the ability of those particles to move deep into the lungs. NO_x and VOC also react in the atmosphere, in the presence of light and heat, to form ozone, another pollutant which is of concern for asthma. In addition, the facility would emit smaller quantities of several other pollutants that are known asthma triggers. In general, children are particularly sensitive to air pollutants because they are more likely to be active outside, breathe more air per unit of body weight and have lungs which are still developing.

The following asthma statistics describe the current asthma burden in Rhode Island and Burrillville; these statistics were derived from multiple data sources, including the Rhode Island Behavioral Risk Factor Surveillance System (BRFSS), the National Survey of Children's Health, Rhode Island Hospital Discharge Data, Rhode Island Emergency Department (ED) Data, and the 2014 Asthma Claims Data Book (RIDOH, 2014), based on a geographic analysis of insurance claims:

- As a state, Rhode Island has asthma rates which are significantly higher than national averages. Approximately 16% of adults in Rhode Island have been diagnosed with asthma at some point in their lifetime, compared to 13% nationally, and 11% of adults in Rhode Island currently experience asthma, compared to 9% nationally.[23] 17.1% of children in RI have been diagnosed with asthma, compared to 14.5% nationally, and 10.9% of children in RI currently experience asthma, compared to 8.8% nationwide.[24]
- Within Rhode Island, the burden of asthma is primarily concentrated within the four core cities of Providence, Pawtucket, Central Falls, and Woonsocket. In 2010– 2012, 12.8% of all children statewide between the ages of 2 and 17 had an asthma claim. Most of northwest Rhode Island had a very low prevalence of asthma claims, with most census tracts having a rate of 0–4.4% of children with an asthma claim. The central census tract in Burrillville was two steps higher than the surrounding area, with the percentage of children with an asthma claim between 6.3% and 7.9%. This was lower than the statewide average, which was driven primarily by the high asthma rates in the high poverty urban core cities, where 10.4-15.4% of children had an asthma claim.[25]
- In addition to asthma prevalence, the severity of asthma can be measured through asthma-related Emergency Department (ED) visits and hospitalizations, which are consistently higher for young children compared to other age groups. In 2010-2014, the statewide rate of children's ED visits due to asthma was 8.9 per 1,000 children. The rate in Burrillville was 4.4 per 1,000 children, compared to 15.1 per 1,000 children in the core cities. The statewide rate of child hospitalizations for asthma is 1.6 per 1,000 children. The rate in the four core cities is 2.4 per 1,000, while

[23] Ibid
[24] National Survey of Children's Health. NSCH 2011/12. Data query from the Child and Adolescent Health Measurement Initiative. Data Resource Center for Child and Adolescent Health website. Retrieved 06/24/2016 from www.childhealthdata.org
[25] *Asthma claims data book.* (2014). Providence RI: Rhode Island Department of Health, Asthma Control Program.

> Burrillville is consistent with the remainder of the state at a rate of 1.2 hospitalizations per 1,000 children. In Burrillville, and across the state, the number of asthma-related pediatric emergency department visits had been steadily decreasing from 2011 to 2013. However, in 2014 there was a slight increase in statewide pediatric asthma ED visits. There were 21 pediatric asthma-related ED visits in Burrillville in 2014, which is higher than in any of the previous three years (17 in 2011, 10 in 2012, and 9 in 2013), though still less than that of the core cities.[26]

Summary and Conclusions

RIDEM is currently conducting a comprehensive review of the Invenergy major source air pollution control permit application. That review includes the evaluation of the applicant's modeling analysis demonstrating that emissions would not cause exceedances of health-based NAAQS and AALs and that multi-pathway and cumulative impacts of those pollutants would not result in adverse health effects.

Even if the NAAQS are not exceeded, emissions from the CREC facility could have an impact on asthma rates or on the wellbeing of nearby individuals with asthma. As discussed above, epidemiological studies have reported an association between ambient NO_2 levels and certain asthma-related health metrics, including new diagnoses of asthma, clinic and emergency department visits for asthma, and hospitalizations for asthma. In some cases, the ambient air levels of NO_2 in those studies were below the NAAQS for that pollutant.

However, no other health-based standard is available for evaluating impacts of NO_2 at this time. The US EPA is currently evaluating scientific data, including the epidemiological data discussed, to determine whether a more stringent standard should be adopted. Note that, to RIDOH's knowledge, no other state or jurisdiction has adopted a NO_2 standard that is more stringent than the NAAQS. The US EPA is also in the process of reviewing its NAAQS for other pollutants, including PM, to include data from recent studies. Standards are needed to make informed, consistent regulatory decisions and predictions of health impacts are limited by the information that is available at the time that the analysis is conducted.

Children, in general, and people of all ages who have asthma or other respiratory diseases are more susceptible to impacts from air pollutants. Although Burrillville and northwestern Rhode Island have low asthma prevalence rates and low rates of asthma-related hospitalizations and emergency department visits compared to the core cities in Rhode Island, there are sensitive individuals living in all areas of the State. RIDOH received a call from a Burrillville resident who lives in close proximity to the existing compressor station and the proposed location of CREC, and who reported lifelong suffering from severe and poorly controlled asthma. Commenters on the draft of this document who live close to the facility also report that they or family members have asthma or other respiratory diseases. The following comment was received at the public hearing:

> As far as the pulmonary part of it, that's of a particular concern to me. I know that people in the audience here know that I, myself, have asthma but mine is, I guess, not as major of a concern as it is to children. Children are much more susceptible to particulate matter, and I happen to have a grandson who has asthma who will be living about 1500 feet from the proposed power plant, and he also has a condition called central congenital hyperventilation syndrome. One of two people in the State of Rhode Island who does have it, and about 600 people in the world who have it. He has a diaphragmatic pacemaker, so air quality is of most concern to him. So when people

[26] Rhode Island Department of Health, Hospital Discharge Database, 2010-2014; U.S. Census Bureau, Census 2010.

> deliberately say if one person will be injured, I can tell you one person will be injured I know of, and that will be my grandson.[27]

RIDOH does not have comprehensive data available on how many other individuals with asthma or other respiratory diseases live in close proximity to the proposed CREC facility.

In addition, exposure to air pollution has been linked to a variety of other health effects, including respiratory, cardiovascular and neurological diseases and cancer. The NAAQS and AALs consider all documented health effects associated with pollutant exposures and the HRA methodology evaluates the cumulative effects of exposure to multiple pollutants that have the potential to affect the same organ system. However, as discussed above, the standards and analysis are limited by the current state of scientific knowledge at the time they are developed and there are uncertainties inherent in any modeling analysis.

RIDOH plans to review the HRA, as well as RIDEM's permit evaluation, and will have the opportunity to supply comments during RIDEM's public comment period if indicated. Although RIDEM's regulations are designed to minimize the risk associated with air emissions from the facility, it is not possible to determine definitively whether those emissions will impact individual or population health. Therefore, RIDOH recommends that, if the CREC is to be built, all possible steps be taken to reduce harmful emissions and mitigate the health impacts of emissions, with special consideration to individuals with asthma or otherwise impaired respiratory health. RIDOH can collaborate with state partners to help ensure that steps are identified and implemented effectively to prevent and mitigate such health impacts.

[27] Transcript of RIDOH Public Hearing, page 43.

9.0 ISSUE 5: Emergency Response and Prevention

Background

Several areas of concern related to prevention and response to potential emergency releases and catastrophic events involving materials at or in transit to or from the proposed CREC facility have been identified, including:

- Potential for toxic releases of ammonia stored and used at the facility;
- Fire and explosion hazards associated with compressed hydrogen used to cool generators at the facility;
- Potential for spills/releases of fuel oil stored and used at the facility;
- Safe storage and transportation of and hazardous waste generated at the site; and
- Releases and catastrophic events involving natural gas at the facility or in the pipeline and related infrastructure in the vicinity of the facility.

Hazards

Emergency release concerns are minimally addressed in Invenergy's EFSB application, but are discussed in more detail in the applicant's responses to data requests by the Town of Burrillville. The following is a discussion of information supplied by the applicant and RIDOH's recommendations concerning those issues.

Ammonia Storage

The applicant states that the facility will store 40,000 gallons (more than 300,000 pounds) of 19% aqueous ammonia, which will be used to control air pollutant emissions. The US EPA requires facilities that store more than 10,000 pounds of 20% aqueous ammonia to prepare a Risk Management Plan (RMP) as part of a Risk Management Program designed to prevent and mitigate the consequences of accidental/emergency releases. In Response 11-3 to the Town's 11th Set of Data Requests, the applicant states that the 20% concentration criterion was set by the US EPA "because it does not consider aqueous ammonia stored at a concentration less than 20% to pose a public health risk upon release." No documentation was provided to support that statement. Note that, in some cases, threshold concentrations in the RMP rule may have been based on issues other than public health. See the Materials Safety Data Sheet in Appendix II for more information about aqueous ammonia.

In Response 11-3, the applicant reports that, although the CREC facility will not be subject to RMP requirements, an assessment was performed using the Area Locations of Hazards Atmospheres (ALOHA) model to determine the furthest downwind distance that concentrations at the level of the one-hour Acute Exposure Guideline Levels (AEGLs) for ammonia would occur in the event that the full 40,000 gallons of aqueous ammonia were released into the concrete containment area that will house the storage tank and associated pumps, valves and piping. The applicant states that ALOHA predicted that the furthest downwind point at which the most stringent AEGL, AEGL-1; which is associated with effects that are transient, reversible upon exposure cessation and not disabling; is only 121 yards, and that no off-property locations would be affected by such a release.

In comments on the draft of this document, the applicant states that calculations of the 121 yard AEGL-1 toxic endpoint assumed that passive controls on the ammonia tank would be effective; when the applicant

ran the model without the passive controls, that distance was 389 yards, which is still on the facility's property. However, it is RIDOH's opinion that some of the model inputs used in that analysis are inappropriate and, as a result, the distance to the toxic endpoints was substantially underestimated. For instance, according to the modeling documentation appended to the applicant's comments, the modeling analysis used Stability Class A, a highly unstable atmospheric condition that maximizes vertical dispersion and decreases horizontal movement of the plume. The model's default setting is Stability Class F, a stable atmospheric condition that frequently occurs in the night and early morning hours; under those conditions, vertical (upward) movement is limited, so the plume tends to travel further downwind from the release point. In addition, the applicant assumed that the temperature of both the air and the ground was 104^{o} F, a very rare or nonexistent condition in Rhode Island. Higher temperatures can also favor vertical mixing. When the model was run with more realistic and conservative inputs (F stability and an 85^{o} temperature), the downward extent of the plume increased considerably and extensive off-property impacts were predicted.

The applicant states that the following measures will be implemented to minimize the potential for and to mitigate the consequences of an accidental ammonia release:

- The concrete containment area that will house the ammonia storage tank and its associated transfer pumps, valves and piping is designed to contain up to 110% of the storage tank capacity;
- To minimize the evaporation rate of ammonia into the ambient air, the containment area will be filled with passive evaporative controls to reduce the exposed surface area of any aqueous ammonia within the containment area by 90%;
- Ammonia sensors within the containment area will alert plan operators of any system leaks;
- Emergency procedures will be established to evacuate facility personnel from areas on the property potentially impacted by a release and to require emergency personnel to use proper personal protective equipment; and
- The applicant will work with local emergency responders to establish emergency procedures in the event of a release.

Although it appears that, since the ammonia concentration is slightly lower than the RMP threshold, a RMP is not required by the US EPA, RIDOH strongly recommends that equivalent planning and prevention procedures be implemented. RMP programs include a hazard assessment; a prevention program that includes safety precautions and maintenance, monitoring and employee training measures; and an emergency response program that identifies emergency health care, employee training measures and procedures for informing the public and response agencies should an accident occur.[28] Note that such a program is designed to ensure the comprehensive identification and mitigation of potential hazardous releases and the effective implementation of response procedures should a release occur.

In addition, all facilities are subject to the US EPA's General Duty Clause, which requires facilities to identify and assess hazards, design and maintain a safe facility to prevent accidental releases, and minimize the consequences of such releases if they should occur. A factsheet on the General Duty Clause is available at https://www.epa.gov/sites/production/files/2013-10/documents/gdc-fact.pdf.

[28] EPA Risk Management Plan (RMP) Rule Overview webpage: https://www.epa.gov/rmp/risk-management-plan-rmp-rule-overview

RIDOH strongly recommends the following regarded storage of ammonia at the facility:

- Invenergy should establish clear, written procedures for the periodic inspection, testing and maintenance of the integrity of the containment area and the functionality of passive controls, sensors, etc., to ensure that those safety elements will function appropriately should an event occur;
- Invenergy should also establish clear, written emergency procedures. Emergency procedures should identify staff who will be responsible for implementing emergency response and include appropriate training, including periodic refresher training for those staff. Those staff should be fitted for, have available, and be trained in the use of appropriate personal protective equipment.
- According to the applicant, the ALOHA model predicts that, even if the planned passive controls do not reduce the evaporation rate, the distance to the toxic endpoint would not extend off-property. However, as discussed above, RIDOH has determined that the applicant's inputs to that model are not appropriately conservative and that off-site impacts are, in fact, possible. Therefore, RIDOH strongly recommends that appropriate planning be implemented for a release with off-site consequences, including the evaluation of possible impacts on, and safety procedures for, potentially impacted sensitive receptors (residences, schools, health care facilities, etc.) Planning for potential impacts on the Zambarano Hospital is particularly critical, since evacuation of residents of that hospital would be very difficult, due to the special needs of that population and the very limited availability of routes of egress away from the facility.
- Planning activities should include an evaluation of impacts of a fire involving the ammonia tank, including preparation for response to off-site consequences of such an incident.
- Coordination with local emergency responders should include the identification of and coordination with the nearest hazardous materials response team. Emergency responders should be provided with full information about the quantities and locations of chemicals stored on site and of transport routes and procedures, as well as of the results of the worst-case analysis discussed above.

Compressed Hydrogen Storage, Use, and Transport

The applicant states that hydrogen will be used at the facility for cooling electric generators. Hydrogen will not be generated on-site, but will be delivered to the facility in compressed gas cylinders or tube trailers. In its responses to the Town's 9th Set of Data Requests, the applicant outlines safety procedures that will be employed to assure safe storage and use of those tanks, including:

- To prevent the formation of flammable mixtures, the generator will be purged of hydrogen before opening the system to the atmosphere and purged of air, oxygen or other oxidizers before admitting hydrogen into the system;
- The hydrogen control system will automatically purge the generator using inert carbon dioxide gas to remove the hydrogen;
- When the generator is in operation, the hydrogen storage and supply system is designed to a nonexplosive level (i.e., 99.99%);
- Hydrogen cylinders and tube trailers will be located outside and away from high traffic areas and normally occupied spaces. The location will be based on NFPA 55 guidelines;
- A dedicated concrete pad will be constructed next to the cylinders for a tube truck as a back-up source of hydrogen;

- Protective bollards will be installed around the cylinders and the trailer pad to protect from traffic;
- Hazard signage will be posted;
- Systems will be designed and installed according to NFPA requirements to prevent sources of ignition, including the use of properly rated equipment in hydrogen storage and safety systems;
- The generator is equipped with end shields designed to direct a blast away from possible occupied spaces;
- Enclosed spaces will be furnished with hydrogen sensors to monitor leaks;
- An automated seal oil system control system, equipped with emergency pumps to maintain the seal in the event of a power loss, will be employed;
- Pressure release devices will be used in the compressed storage system to relieve pressure in a controlled manner through a vent system;
- The hydrogen system has a dedicated control panel to monitor hydrogen purity, backed up by an uninterruptible power supply;
- The manifold that supplies hydrogen to generator has a gas control valve assembly and gas pressure monitor;
- The building ventilation system is designed to prevent the accumulation of hydrogen, including redundant fans;
- Purged hydrogen sill be piped and vented to an elevated point outside of the generator building.
- Hydrogen sensors with an externally mounted alarm and control panel will be installed in all battery rooms;
- Hydrogen delivery trucks will follow Department of Transportation (DOT) guidelines;
- Hydrogen tubes and trailers are designed and operated according to DOT specifications to ensure safe transportation; and
- The hydrogen storage and supply system will be designed to meet NFPA 55.

The threshold quantity for hydrogen storage in the US EPA's RMP rule is 10,000 pounds. If the total amount of hydrogen stored on the facility's site will not exceed that threshold at any time, a RMP is not required. However, as discussed above, RIDOH strongly recommends the implementation of equivalent planning and prevention procedures, including a comprehensive hazard assessment, prevention program and emergency response program. It appears that the applicant has designed a system for the storage and use of compressed hydrogen that considers these issues; however, a RMP-like plan would ensure, to the extent possible, that all possible hazards are identified and mitigated in advance and that emergency procedures would be effectively implemented if an incident were to occur. Note that hydrogen storage and use is also covered by the US EPA's General Duty Clause, as discussed above.

RIDOH strongly recommends the following regarding hydrogen storage and use at the facility:

- Clear written procedures should be in place for the periodic inspection, testing and maintenance of all equipment, controls, sensors, etc. related to the storage and use of hydrogen at the facility to ensure that they are functioning appropriately;
- All staff that are involved with the storage, transfer and use of hydrogen should be provided with appropriate training, including periodic refresher training, in procedures necessary to ensure the safe maintenance and operation of the hydrogen system, as well as in emergency procedures.
- As discussed above, coordination with local emergency responders, including the nearest hazardous materials response team, is essential. Emergency responders should be provided with

full information about the quantities and locations of hydrogen on site and of transport routes and procedures, as well as any other information relevant to ensure optimum response. Special attention should be given to planning for impacts on sensitive receptors, including the Zambarano Hospital, that may occur as a result of an on-site or transport incident.

Additional Considerations and Conclusions

Concerns also have been raised about the potential for spills associated with the storage of two million gallons of fuel oil at the facility, the storage and transportation of hazardous waste generated at the site, and the potential for catastrophic events involving natural gas at the facility or in the pipeline and related infrastructure. RIDOH expects that the former two issues will be addressed by RIDEM's regulations. The potential for catastrophic events related to the safety of the transport and use of natural gas in the area is important, and should be considered in a more comprehensive context, beyond just in an analysis that is limited to the CREC facility.

In addition to the specific recommendations concerning use, storage and transport of ammonia and hydrogen, above, RIDOH strongly recommends that all potential hazards, including the potential for a breach of the oil tanks and a fire at the facility, be evaluated in a facility-wide RMP-like hazard analysis and when ensuring compliance with General Duty Clause requirements. As discussed above, a preliminary run of the ALOHA model using inputs that are more realistic and conservative than those used by the applicant predicted the potential for off-site consequences associated with an ammonia release.

It is essential that the applicant establish an on-site emergency response team and implement planning and training activities, as discussed above, including emergency response drills. Coordination with local and state responders is essential, and special consideration should be given to potential impacts on sensitive receptors, such as residences, schools, workplaces, medical facilities and other places that people congregate. As discussed above, RIDOH is particularly concerned about potential impacts on Zambarano Hospital, since it would be very difficult to evacuate residents from that facility and since routes of egress from the facility are very limited. Invenergy should provide emergency responders in the towns which could be affected by emergency incidences that could occur at or in transit to the facility with any additional equipment that may be needed for responding to such an event.

10.0 ISSUE 7: Climate Change and Health

Background

As stated in the first Principle of the Rio Declaration from the United Nation Environment Programme, "human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature." Additionally, Principle 15 says, "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[29]

RIDOH believes these Principles to be critical when considering climate change. The sustainability of our State and the ability of Rhode Islanders to live happy and healthy lives, now and into the future, are dependent on reducing or eliminating climate change related impacts. The U.S. Global Change Research Program states that human induced climate change caused by the burning of fossil fuels "is a significant threat to the health of the American people"[30] and can include negative physiological and mental health impacts. Climate change threatens the health of Rhode Islanders in several salient ways, from warming air, storms, flooding, and sea-level rise to the introduction of infectious diseases and infectious disease vectors formerly confined to more southern latitudes. Climate change also threatens our food supply and supply of fresh water, both critical to the public's health. The magnitude of these effects is uncertain, but scientists and health officials project real threats to the public's health in the short, medium, and long-term.

Here in Rhode Island, communities are already experiencing these threats.

- The floods of 2010 damaged homes, business, and critical infrastructure throughout a number of municipalities. Community mental and physical health was strained, as neighborhoods were uprooted and health impacts arose due to mold, flood damage, and long term stress.
- As temperatures warm and winters are less harsh, tick populations in Rhode Island may increase across the state, exposing more RI residents to the risk of Lyme and other tick-borne diseases.[31]
- Heat and humidity impact Rhode Islanders significantly. With summers continuing to be warmer and more humid, we see increased numbers of heat related morbidity and mortality.[32]
- The SafeWater RI report highlights the risks posed to our drinking water sources due to climate change. Risks of storms, flooding, sea level rise, warming air, and drought threaten our surface water reservoirs, water utilities, and water treatment infrastructure.[33]

The Resilient Rhode Island Act,[34] passed in 2014, "seeks to protect the people of Rhode Island and make our state economy and society resilient in the face of nearly certain, but not precisely predictable, effects

---

[29] Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972 http://www.unep.org/documents.multilingual/default.asp?documentid=78&articleid=1163

[30] Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, 2016: Executive Summary. T*he Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.* U.S. Global Change Research Program, Washington, DC, page 1–24. http://dx.doi.org/10.7930/J00P0WXS

[31] http://www.tickencounter.org/resources/rhode_island_map

[32] Kingsley SL, Eliot MN, Gold J, Vanderslice RR, Wellenius GA. 2016. *Current and projected heat-related morbidity and mortality in Rhode Island*. Environ Health Perspect 124:460–467; http://dx.doi.org/10.1289/ehp.1408826

[33] Rhode Island Department of Health, 2013: *SafeWater RI: Ensuring Safe Water for Rhode Island's Future*, http://www.health.ri.gov/publications/reports/2013EnsuringSafeWaterForRhodeIslandsFuture.pdf

[34] http://webserver.rilin.state.ri.us/BillText/BillText14/SenateText14/S2952A.pdf

of climate change. The Act provides a framework for state government to adaptively plan for and manage climate change impacts. The bill emphasizes the need for inclusive public dialogue on the challenges ahead, and seeks to position Rhode Island for future economic development."[35] It includes that state agencies will assist the Council to "increase the deployment of in-state generation of renewable energy and energy efficiency" and sets the State's carbon emission reduction goals as:

(i) Ten percent (10%) below 1990 levels by 2020;
(ii) Forty-five percent (45%) below 1990 levels by 2035; and
(iii) Eighty percent (80%) below 1990 levels by 2050;

Discussion of Potential Concerns

The burning of fossil fuels and the extraction of fossil fuels by means of hydraulic fracking both contribute to climate change by emitting various greenhouse gases to the atmosphere, most notably, carbon dioxide and methane. Both will affect the health of Rhode Islanders today and for future generations.

The following were among the written comments submitted:

> Furthermore, while the burning of "natural" gas causes far fewer health problems than the burning of coal for those living near the power plant, this public health benefit disappears when you factor in the harms of fracking for communities in Pennsylvania, and the still more devastating impacts of climate change in developing countries—let alone the escalating impacts that can be expected in the coming decades. In fact, if we aggressively cut carbon dioxide emissions but fail to cut methane emissions, we will likely pass the tipping point for runaway, catastrophic global warming within the next 15-35 years—in other words, well within the anticipated lifetime of this power plant. On the other hand, "If we can control the methane, we have a chance to reverse course," according to Dr. Robert Howarth of Cornell University…. As Dr. Timmons Roberts, Ittleson Professor of Environment and Sociology at Brown University, has repeatedly stated, this power plant would make it absolutely "impossible to meet the emissions reduction targets set forth in the Resilient Rhode Island Act of 2014.[36]

The contribution to climate change from the facility expansion proposed for Burrillville can be assessed indirectly by noting the projected annual rate of greenhouse gas emissions at the plant site (both from gas and oil), and by estimating the annual rate of greenhouse gas emissions attributable to the hydraulic fracking of the quantity of gas projected to be burned in the Burrillville plant. While we cannot measure the direct contribution of the proposed plant to the public's health by means of climate change, we acknowledge that these contributions will have local and global implications for public health, as climate change must be considered collectively and on a larger scale, not just simply within local borders.

Summary and Conclusions

Climate change is a local and global challenge, but it is also an opportunity for positive change. It provides us a challenge to change the way we have done things in the past, to ultimately live healthier and

[35] http://www.resilientri.org/

[36] Comment received during RIDOH public comment period posted at: https://drive.google.com/drive/folders/0BxabNEtecvGHZ2VCOHZUWWdvbUU

happier lives. It is imperative that action be taken individually and collectively to mitigate climate change--- for the health and well-being of our communities.

When considering expansion of the fossil fuel-based energy system, RIDOH believes that alternative energy should be prioritized, when at all possible. This will not only help to prevent negative health outcomes, but will also protect the environment and the natural systems on which we rely. Given the negative impacts of climate change on public health, RIDOH supports the Resilient Rhode Island Act's goals and encourages efforts aimed at maximizing carbon emission reductions and the development of alternative and renewable energy sources.

11.0 ADDITIONAL HEALTH CONSIDERATIONS

Commenters identified several areas of potential health concerns that were not discussed in the draft of this document. Those issues include:

- **Stress/Mental health**

Many commenters discussed the traumatizing impacts on the community of the gasoline spill that contaminated their drinking water fifteen years ago and the response of officials to that spill. Commenters also described the stress that has been caused in recent years by the siting or expansion of several energy-related facilities, including the Algonquin compressor station and Ocean State Power, in the rural community of Burrillville. The proposal for building yet another energy facility, which will be associated with a variety of additional hazards and perceived hazards, is felt as a further blow to the physical and mental health of area residents.

According to the National Institute of Mental Health (NIMH), biological release of human nerve chemicals and hormones during short-term stressful times can be life-saving, as those chemicals cause responses like increased pulse and breathing rates, muscle tension, and increased use of oxygen and activity in the brain, which prepare people or animals to face a threat or flee to safety.

However, according to the NIMH, "with chronic stress, those same nerve chemicals that are life-saving in short bursts can suppress functions that aren't needed for immediate survival. Your immunity is lowered and your digestive, excretory, and reproductive systems stop working normally." People exposed to chronic stress may experience digestive symptoms, headaches, sleeplessness, depressed mood, anger and irritability and "are prone to more frequent and severe viral infections, such as the flu or common cold, and vaccines, such as the flu shot, are less effective for them."

The NIHM goes on to state that:

> Of all the types of stress, changes in health from routine stress may be hardest to notice at first. Because the source of stress tends to be more constant than in cases of acute or traumatic stress, the body gets no clear signal to return to normal functioning. Over time, continued strain on your body from routine stress may lead to serious health problems, such as heart disease, high blood pressure, diabetes, depression, anxiety disorder, and other illnesses.[37]

RIDOH acknowledges the impact of increased stress associated with the proposed facility on nearby residents, particularly in view of the previous water contamination and the influx of other large, community-changing facilities, and urges that the EFSB consider this issue in siting decisions.

- **Light pollution**

A commenter stated the following:

> Your advisory opinion did not focus on light pollution from the plant, which is another major health effect. The population in this area love their dark-night skies, one of the many reasons why many have moved out here to Burrillville. There are a slew of negative impacts on human health and safety from light pollution. Being exposed to blue light, in particular, like that of a power plant has been linked to obesity, depression, sleeping disorders, cancer, diabetes and more. Like

[37] NIMH Fact Sheet on Stress https://www.nimh.nih.gov/health/publications/stress/index.shtml

> most life on Earth, humans adhere to a circadian rhythm, our biological clock, a sleep-wake pattern governed by day-night cycle. Artificial light at night can disrupt that cycle. Our bodies produce the hormone melatonin in response to circadian rhythm. Melatonin helps keep us healthy. It has antioxidant properties, induces sleep, boosts the immune system, lowers cholesterol, and helps the functioning of the thyroid, pancreas, ovaries, testes and adrenal glands. Nighttime exposure to artificial light, especially blue light, which is that of power plants, suppresses melatonin production. The scientific community is studying the range and complexity of circadian disruption and the role of melatonin suppression from too much artificial light at night. Scientists are finding an undisputed connection between sufficient sleep and good health. On the 15th of June 2009 the American Medical Association also adopted resolutions that support the reduction of light pollution and glare. In 2012 the American Medical Association has recognized light at night as a carcinogen and a health risk. Ongoing research continues to probe the connection between natural darkness and human health.[38]

RIDOH acknowledges that studies have documented health effects associated with shift work and other situations (e.g. hospital settings and the extensive use of electronic devices) in which people are exposed to bright lights over long periods. However, it is not clear how those studies would pertain to this situation. The CREC application does not present information about nighttime visual impacts from the facility, except to say the following:

> The Project will have minimal visibility from most locations within the visual study area. As suggested by the vegetated viewshed analysis and the field confirmation, less than one percent of the entire five mile visual study area will have project visibility. From the locations with visibility, it will be a partial view, often with the lower portions of the project screened by vegetation. Based on the existing mitigating factors such as vegetation and structures, the Project is not likely to have any significant visual impact during daytime viewing conditions. However, since the stack is 200 feet tall, the Federal Aviation Administration (FAA) must be consulted to determine lighting needs. If nighttime lighting is required, additional analysis should be completed to determine the potential for nighttime visual impacts.

RIDOH recommends that the applicant determine whether nighttime lighting will be installed at the facility and conduct an analysis of the impacts of any such lighting on neighboring residents.

- **Cancer**

Commenters at the public hearing reported observing large numbers of people with cancers in certain areas of Burrillville and asked RIDOH to determine whether cancer rates in Burrillville and near power plants in the State were different from those in the State as a whole.

The Rhode Island Cancer Registry does, in fact, fill such requests, but warns that such a comparison, given the small population of Burrillville (less than 16,000), will almost certainly not yield interpretable results. This is because cancer rates for very small populations, when compared to one another (e.g., among small towns in Rhode Island) and even to cancer rates for much larger populations (e.g., Rhode Island or the United States), do not usually yield statistically significant results at the normative 95% probability level. This means that we can't be sure if any differences observed would continue to exist if the small population were larger, or if the population of individuals "at risk" (in this case, residents of Burrillville) were observed for a longer period of time. If the study population was confined to people

[38] RIDOH Public Hearing Transcript (appended to this document), pages 48-50.

living near a power plant, the studied population would be even smaller, so we would be even less likely to demonstrate statistically significant associations.

The comparison would be even less interpretable if the intent of the comparison was to assess the environmental risk of cancer, as the most common cancers (breast, prostate, colon-rectum, and lung) have either been shown not to be of environmental origin (e.g., breast, prostate, colon-rectum), or to be of predominantly other-than-environmental origin (as in the case of lung cancer in Rhode Island, whose predominant cause is tobacco use). Cancers of possible environmental origin (e.g., leukemias, cancers of the brain, central nervous system, bladder, pancreas, etc.) are generally of such low incidence—such low numbers—in small populations that their rates cannot be demonstrated to differ, statistically, from one area to another.

In sum, the Rhode Island Cancer Registry does, in fact, conduct epidemiological analyses of cancer rates for small areas. However, the results of such analyses are almost always challenging to interpret, statistically, and therefore, inconclusive, especially when the focus of analysis is a cancer or cancers of very low incidence, as, for example, in the case of most cancers of possible environmental origin.

12.0 SUMMARY OF CONLCUSIONS

RIDOH is strongly committed to its mission "to protect and promote the health of Rhode Islanders," which includes a vision of "safe and healthy lives in safe and healthy communities." As such, RIDOH advocates for including the consideration of health, defined by the WHO as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity,"[39] in all decision-making about policy and programmatic issues.

It is not possible to create a no-risk environment. However, RIDOH strongly supports mitigation of health risks to the extent possible. In particular, mitigation of health risk should be considered in evaluation of and planning for:

- The development of new infrastructure, particularly for projects in which social and environmental determinants of health are affected and health disparities can result;
- The changing and evolving threat to the environment, including but not limited to community disruptions from, economic turmoil, disasters, climate change, emergency releases and other incidents; and
- Those cases in which additional research or evidence base is needed for decision-making, especially when considering the challenges of changing technologies, population characteristics, and industry roles.

Since all of three of those scenarios are applicable to the CREC proposal, RIDOH commends the EFSB for requesting an advisory opinion on public health impacts from the RIDOH and strongly recommends that health risks be critically considered in the evaluation of the CREC application. To that end, RIDOH has included specific recommendations in the content area discussions in Sections 5.0 – 11.0, above. Those recommendations include the following:

- RIDOH strongly recommends that the EFSB establish clear noise limitations and require the CREC facility, if constructed, to work in conjunction with Algonquin to ensure that neighborhood noise impacts are minimized to the fullest extent possible. If noise levels from operation of the facility, by itself or in conjunction with Algonquin, cause neighborhood disturbances, all available actions to mitigate those impacts should be pursued, including, but not be limited to, equipment and operational modifications, soundproofing of impacted residences and, if indicated, the purchase of properties subject to noise levels that cause serious annoyance and/or sleep disruption.
- RIDOH's principal water-related concern that sourcewater for nearby wells and water systems, including private wells and Wallum Lake, the source serving Zambarano Hospital, be protected throughout each phase of the project, including construction and operations. Since no process water source is currently under public consideration, RIDOH asks to assess the impact of any future water source proposal on drinking water quality. Should the power plant use well water on-premises for human use and consumption, and their offices serve more than 25 persons more than

[39] Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948

60 days out of the year, then the plant will have to obtain a public water system license through RIDOH's Center for Drinking Water Quality.

- RIDOH plans to comment on CREC's application to RIDEM for an air pollution permit, including the health risk assessment submitted in support of that application. RIDOH recommends that, if the CREC is to be built, all possible steps be taken to reduce harmful air emissions and mitigate the health impacts of emissions, with special consideration to individuals with asthma or otherwise impaired respiratory health.
- RIDOH strongly recommends that the facility be required to implement the emergency release prevention and response planning the recommendations listed in Section 9.0 above. Those recommendations include specific measures related to the use, storage and transport of ammonia and hydrogen and the recommendation that all potential hazards, including the potential for a breach of the oil tanks and a fire at the facility, be evaluated in a facility-wide RMP-like hazard analysis and in the context of compliance with General Duty Clause requirements. This is particularly crucial because a preliminary run of the ALOHA model using inputs that are more realistic and conservative than those used by the applicant predicted the potential for off-site consequences. It is also essential that the applicant establish, equip and train an on-site emergency response team and coordinate with and, if necessary, equip local and responders, with special planning consideration given to potential impacts on sensitive receptors, such as residences, schools, workplaces and medical facilities. RIDOH is particularly concerned about potential impacts on Zambarano Hospital, since it would be very difficult to evacuate residents from that facility and since routes of egress from the facility area are very limited.
- RIDOH supports the Resilient Rhode Island Act's goals and encourages efforts aimed at maximizing carbon emission reductions and the development of alternative and renewable energy sources. Prioritization of alternative energy over fossil fuels, when at all possible, will help minimize the negative public health outcomes associated with climate change and to protect the environment and the natural systems on which we rely.
- RIDOH acknowledges the impact of increased stress associated with the proposed facility on nearby residents, especially in view of Burrillville's past experience with water contamination and the clustering of energy-related facilities in and near that rural town. RIDOH urges that this issue be considered in siting decisions.
- The application did not include sufficient information for evaluation of impacts of potential nighttime lighting of the facility. Such impacts should be evaluated when that information is available.

To summarize, RIDOH maintains its expectation that any decision related to sustainable economic development, health service delivery, or community health infrastructure building will be aligned to address the needs of the affected communities. Supported by statewide goals to focus on achieving health equity, improving integrated population health, and transforming communities, RIDOH has presented the above concerns on the long-term impacts and the risk mitigation tools to reduce short-term impacts pertaining to the CREC application.

13.0 ATTACHMENTS

The following documents are attached:

Appendix I – Excerpt from the EFSB application related to electromagnetic fields

Appendix II – Material Safety Data Sheet for 19% aqueous ammonia

Appendix III – Transcript of oral comments received at public hearing

Appendix I

Excerpted from: Rhode Island Energy Facility Siting Board Application

[Received as: SB_Invenergy_application.pdf]

6.11 Electric and Magnetic Fields

This section provides an assessment of electric and magnetic fields (referred to as EMF) resulting from the operation of the Project's dedicated 345 kV AC electric transmission line that will interconnect the Project into the regional electric transmission system. The complete EMF Analysis Report for the CREC Transmission Line is located in Appendix F.

[…]

Above ground transmission lines are typically located in transmission corridors or Rights of Ways (ROWs) with the conductors suspended from towers or poles to keep the transmission lines at a safe height above the ground. Access to transmission line ROWs is usually restricted for safety reasons.

Table 6.11-2 is provided to illustrate guidelines suggested by various national and international health organizations for exposure to both electric and magnetic fields. The EMF guidelines identified in Table 6.11-2 were developed by the identified organizations to be protective against adverse health effects from EMF, but which should not be viewed as representing EMF levels that have been proven as safe versus levels that are un-safe; the values shown are simply guidelines based on current knowledge.

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*

Table 6.11-3 shows guidelines that have been adopted by a number of states to establish EMF design guidance for future transmission line right of ways that are equivalent to that currently measured within or at the edge of existing transmission rights of way for similarly configured transmission-lines. These EMF state guidelines are not health-based standards, but simply guidelines to maintain EMF values for new transmission lines at EMF measurements experienced for existing similarly configured transmission lines.

Table 6.11-3
State EMF Standards and Guidelines for Transmission Lines

State / Line Voltage	Electric Field		Magnetic Field	
	On ROW	Edge ROW	On ROW	Edge ROW
Florida [c] 69 – 230 kV	8.0 kV/m	2.0 kV/m [f]		150 mG
230 kV and <= 500 kV	10.0 kV/m	2.0 kV/m [f]		200 mG,
>500 kV	15.0 kV/m	5.50 kV/m		250 mG [e]
Minnesota	8.0 kV/m			
Montana	7.0 kV/m [a]	1.0 kV/m [b]		
New Jersey		3.0 kV/m		
New York [c]	11.8 kV/m 11.0 kV/m [d] 7.0 kV/m [a]	1.6 kV/m		200 mG
Oregon	9.0 kV/m			

Key: ROW = right of way; mG = milliGauss; kV/m = kilovolts per meter

Notes:

[a] Maximum for highway crossings
[b] May be waived by the land owner
[c] Magnetic fields for winter-normal, maximum line-current capacity
[d] Maximum for private road crossings
[e] 500 kV double-circuit lines built on existing ROW's
[f] Includes the property boundary of a substation

Sources: "Questions and Answers about EMF." National Institute of Environmental Health Sciences and U.S. Department of Energy, 2002. http://www.niehs.nih.gov/health/topics/agents/emf/index.cfm
Florida, see: http://www.dep.state.fl.us/siting/files/rules_statutes/62_814_emf.pdf

[…]

6.11.3 Projected EMF Impacts

EMF standards and guidelines are applied at those locations where the public could have access to the Project. Most electric generation facilities are closed for general public access and as a result exposure to EMF within the facility is not an issue for the general public. Areas open to the public are typically publically accessible land along the edges of the ROW or for homes located contiguous to transmission rights of way.

As a result of the construction and operation of the Project the EMF levels along the six miles of the transmission ROW used by the Project will be impacted. To assess these impacts EMF estimates were developed that included impacts for the two existing 345 kV transmission lines (lines 341 and 347) and the addition of the Project's new 345 kV transmission line interconnecting the Project into the regional transmission system.

Table 6.11-4 provides the analysis of the magnetic fields (existing and proposed) within the ROW, at the edges of the ROW and 100 feet to either side of the ROW for the two arrangements of transmission towers depicted in Figure 6.11-1.

Table 6.11-4

Magnetic-field Levels (mG) at Peak Loading of CREC Line and Average and Peak Loading of the Existing 341 and 347 Lines

			Distance from Centerline of ROW				
Section	Loading	Condition	East ROW Edge -100 ft	East ROW Edge	Max on ROW	West ROW Edge	West ROW Edge +100 ft
4.4 Mile Section (See Figure 6.11-1)	Average	Existing	1.0	1.8	116	1.9	1.1
		Proposed	5.0	12	365	4.3	2.3
	Peak	Existing	0.5	1.1	171	8.2	2.0
		Proposed	6.4	14	342	3.8	1.6
1.6 Mile Section (See Figure 6.11-1)	Average	Existing	4.5	21	116	1.9	1.1
		Proposed	13	65	366	5.9	1.6
	Peak	Existing	3.5	22	171	8.2	2.0
		Proposed	19	79	336	46	14
Reference Exponent, Inc. Report Dated October 27, 2015 See APPENDIX F							

Table 6.11-5 provides the analysis of the electric fields (existing and proposed) within the ROW, at the edges of the ROW and 100 feet to either side of the ROW for the two arrangements of transmission towers depicted in Figure 6.11-1.

Table 6.11-5

Electric-field Levels (kV/m) With CREC and the Existing 341 and 347 Lines At Maximum Voltage

			Distance from Centerline of ROW				
Section	Voltage	Condition	East ROW Edge -100 ft	East ROW Edge	Max on ROW	West ROW Edge	West ROW Edge +100 ft
4.4 Mile Section (See Figure 6.11-1)	Maximum	Existing	0.02	0.05	7.5	0.39	0.02
		Proposed	0.04	0.11	7.5	0.38	0.04
1.6 Mile Section (See Figure 6.11-1)	Maximum	Existing	0.14	1.2	7.5	0.39	0.14
		Proposed	0.13	1.2	7.7	1.5	0.13
Reference Exponent, Inc. Report Dated October 27, 2015 See APPENDIX F							

The results of the analysis of the Magnetic and Electric field levels (EMF Levels) for the existing and the proposed addition of the CREC's transmission line within the National Grid ROW finds that the Magnetic and Electric Field levels at the edges of the ROW and 100 feet to either side of the ROW are calculated to be well below the reference levels recommended by International Committee on Electromagnetic Safety (ICES) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) (see Table 6.11-1) and well within the Standards and Guidelines set by many other States for new transmission line additions (see Table 6.11-3).

Appendix II: Material Safety Data Sheet (Aqua Ammonia – 19%)

Terra Industries Inc.
Terra Centre – 600 Fourth Street
Sioux City, Iowa 51101

Material Safety Data Sheet

Aqua Ammonia (19% NH_3)

MSDS Number 2050A (Revised February 16, 2007) 8 Pages

1. CHEMICAL PRODUCT and EMERGENCY TELEPHONE CONTACT

Product Name:	Aqua Ammonia (19% NH_3)
Chemical Family:	Inorganic Nitrogen Compound
Synonyms:	Ammonium Hydroxide; Ammonia Solution, Aqueous Solution; Ammonia Monohydrate; Ammonia Water; Ammonia Liquor
Formula:	NH_4OH in H_2O
Product Use:	Fertilizers; Pharmaceuticals; Lubricants; Household Cleaners; SCR NO_x Control

EMERGENCY TELEPHONE NUMBERS

CHEMTREC (U.S.):	800-424-9300
CANUTEC (Canada):	613-996-6666

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient Name/CAS Number	Concentration	Exposure Limits (NH_3)
Ammonium Hydroxide / 1336-21-6	39.1%	25 ppm TWA
Water / 7732-18-5	60.9%	35 ppm STEL
		50 ppm PEL
Contains 19% ammonia as NH_3		300 ppm IDLH

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Corrosive liquid! May be fatal if swallowed. Vapor is toxic and irritating to eyes, nose, throat and skin. Liquid will burn skin and eyes. Vapor is flammable under limited conditions. Use water to control fire and disperse vapors.

NFPA Hazard Classification (for ammonia vapor)	Health Hazard (Blue)	3
	Flammability (Red)	1
	Reactivity (Yellow)	0

Page 1 of 8

POTENTIAL HEALTH EFFECTS

Primary Routes of Entry: Inhalation, skin contact/absorption and eye contact.

General Acute Exposure: Aqua ammonia may cause caustic injury. The severity of injury depends upon the concentration and duration of exposure. The extent of injury ranges from mild skin irritation or cough to severe burns or laryngeal edema and life-threatening pulmonary edema.

Inhalation:
Corrosive! Ammonia vapor is toxic and a severe irritant of the respiratory tract. It may cause a running nose, coughing, chest pain, cessation of respiration and death. It may cause severe breathing difficulties, which may be delayed in onset. ADDITIONAL MEDICAL INFORMATION: Bronchospasm, laryngitis, tracheitis, wheezing, dyspnea, and laryngeal stridor may be noted. Mucosal burns to the tracheobronchial tree, Pulmonary Edema, and associated hypoxemia frequently occur following exposure to concentrated ammonia.

Skin Contact:
Corrosive! Aqua ammonia is a severe irritant of the skin. Skin exposure to high concentrations may cause pain and deep and severe burns to the skin. ADDITIONAL MEDICAL INFORMATION: Corrosive effects on the skin and other tissues may be delayed, and damage may occur without the sensation or onset of pain. Strict adherence to first aid measures following exposure is essential.

Eye Contact:
Corrosive! Vapors cause irritation. Effects as a result of direct contact with aqua ammonia may range from irritation and lacrimation to severe injury and blindness. ADDITIONAL MEDICAL INFORMATION: Eye exposure may result in conjunctivitis, lacrimation and/or corneal irritation. Total corneal epithelial loss may occur.

Ingestion:
Toxic! May cause corrosion to the esophagus and stomach with perforation and peritonitis. Symptoms may include pain in the mouth, chest, and abdomen, with coughing, vomiting and collapse. Ingestion of as little as 3-4 ml of ammonium hydroxide may be fatal.

Note to the Physician: Pneumonitis should be anticipated after severe inhalation or ingestion. If severe exposure is suspected, observe for 48-72 hours for delayed pulmonary edema.

Carcinogenicity:

NTP:	Not Listed
IARC:	Not Listed
OSHA:	Not Regulated

Medical Conditions Aggravated by Exposure: Chronic respiratory or skin disease.

4. FIRST AID MEASURES

First Aid for Eyes: Immediately flush eyes with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, excessive tearing, or light sensitivity persists, the patient should be seen in a health care facility and referral to an ophthalmologist considered.

First Aid for Skin: Immediately flush exposed area with copious amounts of tepid water for at least 15 minutes followed by washing area thoroughly with soap and water. The patient should be seen in a health care facility if irritation or pain persists.

First Aid for Inhalation: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If trained to do so administer supplemental oxygen with assisted ventilation as required. Administer artificial respiration if patient is not breathing.

First Aid for Ingestion: Call a physician. If conscious, give the patient 4 to 8 ounces of milk or water to drink immediately. Do not induce vomiting.

5. FIRE FIGHTING MEASURES

Flash Point:	Not Applicable
Lower Flammable Limit:	15.5 % Volume in Air (for NH3)
Upper Flammable Limit:	27.0 % Volume in Air (for NH3)
Autoignition Temperature	1204° F (651° C) (for NH3)

Extinguishing Media: Stopping the flow of gas rather than extinguishing the fire is usually the best procedure to follow when escaping gas is burning.

Small Fire:	Dry chemical or CO_2
Large Fire:	Water spray, fog or foam

Special Fire Fighting Procedures: Use water to keep fire exposed containers cool. Use water fog or foam to reduce vapor concentrations if necessary. Full protective equipment including a self-contained breathing apparatus should be worn in a fire involving the material.

6. ACCIDENTAL RELEASE MEASURES

Spill or Leak Measures: Stop leak if you can do so without risk. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Evaluate the affected area to determine whether to evacuate or shelter-in-place by taping windows and doors, shutting off outside air intake (attic fans, etc.), and placing a wet towel or cloth over the face (if needed). Self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing used in conjunction with water spray will provide limited protection in outdoor releases for short-term exposure. Fully encapsulating, vapor-protective clothing should be worn for spills and leaks with no fire. Use water spray to control vapors.

CAUTION:
Runoff from vapor control or dilution of spilled product may cause pollution.

Determining Spill Size: Generally, a small spill is one that involves a single, small Package (i.e. up to a 55 gallon drum), small cylinder, or a small (non-continuing) leak from a large container. **Small Spill:**

a. Flush area with flooding amounts of water.
b. First isolate 100 feet in all directions and then protect persons downwind 0.1 miles during daylight and 0.1 miles at night (recommended for ammonia vapor).

Large Spill:

a. Dike far ahead of liquid spill for later disposal.
b. Follow local emergency protocol for handling.
c. First isolate 200 feet in all directions, than protect persons downwind 0.4 miles during daylight and 1.4 miles at night (recommended for ammonia vapor).

7. HANDLING AND STORAGE

Handling: Avoid contact with either liquid or vapors. Direct contact with mercury must be avoided. Use proper PPE when working with or around aqua ammonia (See section 8).

Storage: Ambient temperature. Store in dry, well-ventilated area away from incompatible materials. Protect against physical damage. Keep out of direct sunlight and away from heat sources.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Respiratory Protection Requirements: (for NH3)

<25 ppm:	No protection required.
25 to 35 ppm:	Protection required if the daily TWA is exceeded.
35 to 50 ppm:	Protection required if exposed for more than 15 minutes.
50 to 250 ppm:	Minimum of an air-purifying respirator equipped with ammonia canister(s) or cartridge(s).
250 to 300 ppm:	Minimum of a full-face air-purifying respirator equipped with ammonia canister(s) or cartridge(s).
>300 ppm:	A fresh air supply system must be used (i.e. SCBA)

Skin Protection Requirements: Nitrile rubber, neoprene, or PVC gloves and protective clothing should be used.

Eye Protection Requirements: Use chemical (indirectly vented) goggles when there is a potential for eye contact. A full-face shield is recommended in addition to goggles for added protection.

Other Protective Equipment: Safety shower and eyewash fountain should be provided in the aqua ammonia handling area. When transporting, provide at least 5 gallons of readily accessible, clean water and personal protective equipment.

Engineering Controls: Maintain adequate ventilation to keep ammonia concentrations below applicable standards.

NOTE: See Section 2 for regulatory exposure limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Liquid
Color:	Colorless
Odor:	Strong pungent penetrating odor, ammonia.
pH:	12.0 (neat)
Specific Gravity:	0.9277 (@ 20° C)
Vapor Density:	0.60 (@ 15.5° C) for NH3
Vapor Pressure:	236 mm Hg (@ 15.5° C)
Molecular Weight:	35.05
Relative Density:	0.9261 kg/l (@ 20° C)

10. REACTIVITY

Stability:	This is a stable material.
Hazardous Polymerization:	Will not occur.

Decomposition: Will liberate ammonia if heated. Hydrogen is released on heating ammonia above 850° F (454° C). The decomposition temperature may be lowered to 575° F (300° C) by contact with certain metals such as nickel. At 1290° F (690° C) or in the presence of electric spark ammonia decomposes into nitrogen and hydrogen gases, which may form a flammable mixture in the air.

Conditions to avoid: Excessive heat.

Materials to avoid: Contact with calcium hypochlorite, bleaches, gold, mercury, and silver may form highly explosive products. Contact with iodine, bromine or chlorine may cause violent spattering.

11. TOXICOLOGICAL INFORMATION

Toxicity

Acute Oral Toxicity
LD_{50} Rat:.....350 mg/kg bw
LD_{50} Cat:.....750 mg/kg bw
Acute Toxicity, Other Routes
LD_{LO} Rabbit:.....10 mg/kg bw
Skin Irritation / Corrosion
Rabbit:.....Corrosive at 20% but not 10%
Eye Irritation / Corrosion
Rabbit:.....Irritating
Genetic Toxicity *in vitro*
Gene Mutation *E. Coli*:.....Negative
Genetic Toxicity *in vivo*
Gene Mutation *Drosophila melanogaster*:....No evidence for mutagenicity

Ecotoxicity

Acute Toxicity to Fish
LC_{50} *Cyprinus carpio*:.....1.34 – 1.70 mg un-ionized NH_3/L (48 hr semi-static)
Acute Toxicity to Aquatic Invertebrates
LC_{50} *Daphnia magna*:.....32 mg NH_4OH/L (48 hr static)
Chronic Toxicity to Fish
LC_{50} *Ictalurus punctatus*:.....37.5 ppm (8 days)

Source: TFI Product Testing Program April 2003

12. ECOLOGICAL INFORMATION

a. Ammonia is harmful to aquatic life in very low concentrations and may be hazardous if it enters water intakes.
b. Local health and wildlife authorities, as well as operators of water intakes in the vicinity, should be notified of water releases.
c. Waterfowl toxicity may occur at elevated concentrations.
d. Ammonia does not concentrate in the food chain.
e. The conversion of ammonia to nitrites/nitrates by bacteria in aquatic systems can reduce the concentration of dissolved oxygen (referred to as nitrogenous oxygen demand).

Effect on water treatment process: Chlorination will produce chloramines, which are more readily detected by taste and odor.

Note: See Ecotoxicity information in section 11.

13. DISPOSAL CONSIDERATIONS

Reclaim as fertilizer if possible. Otherwise, waste must be disposed of in accordance with federal, state, and local environmental control regulations.

14. TRANSPORTATION INFORMATION

U.S. DOT and Canadian TDG Act

Shipping Name:	Ammonia solutions, (*more than 10% but not more than 35 % ammonia*)
Hazard Class/Division:	8
Label Code:	8 Corrosive Liquid
Product Identification Number (PIN):	UN2672
Packing Group	III
OSHA Label Required:	Yes
RQ (Reportable Quantity):	1000 pounds (as NH_4OH)
TDG Reporting Quantity:	5 kg or 5 liters

15. REGULATORY INFORMATION

Controlled Products Regulations Classification:
D-1B: Toxic (Acute Lethality); E: Corrosive

OSHA: This product is considered a hazardous material under criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200 (Toxic; Corrosive).

CAA Chemical Accident Prevention:
Ammonia solution with a concentration less than 20% is not subject to the provisions of 40 CFR Part 68.

CERCLA Hazardous Substances List:

a. RQ (Reportable Quantity): 1000 pounds (as NH_4OH)
b. Regulation: "Designation, Reportable Quantities, Notification" - 40 CFR Part 302

SARA TITLE III:
Ammonia (including ammonia solution) is subject to the reporting requirements of Section 313 "Specific Toxic Chemical Listings" 40 CFR Part 372. Terra is required by 40 CFR Part 372.45 to notify certain customers as to which of its mixture or trade name products contain those chemicals. The purpose of that notification is to ensure that facilities that may be subject to the reporting requirements of Section 313 and that use products of unknown formulation will have knowledge that they are receiving products that contain chemicals subject to those reporting requirements.

In The Matter Of:

Public Hearing

State of RI - Department of Health
August 09, 2016
