Foundation for Resilient Societies

SUPPLEMENTAL COMMENTS - SEVERE ACCIDENT RISKS AND COST-EFFECTIVE MITIGATION ALTERNATIVES PROPOSED FOR INCLUSION IN FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR RELICENSING OF SEABROOK STATION NO. 1

IN RE: SECOND DRAFT SUPPLEMENTAL COMMENTS SUPP. 46 TO NUREG-1437, APRIL 2013

Comments due and filed June 30, 2013 in Docket NRC-2010-0206

Foundation for Resilient Societies
52 Technology Way
Nashua NH 03060
www.resilientsocieties.org

The Foundation for Resilient Societies, a non-profit corporation organized in the State of New Hampshire, appreciates the opportunity to provide Supplemental Comments on environmental impacts and, more importantly, cost-effective risk mitigation options for Seabrook Station No. 1 in Seabrook, New Hampshire.

Our Foundation previously commented on both environmental risks and risk mitigation options in October 2011. Our primary concerns remain unaddressed in the Second Supplemental Draft Analyses (released in April 2013) for both severe accidents and alternative mitigation options.

We comment because nuclear power plants are integral to reliable operation of regional electric grids. One hundred and two currently-licensed nuclear power plants provide electricity generally at costs below most alternative sources of electric power; previously constructed power plants, if licensable for additional periods of operation, provide dispatchable baseload power critical to grid stability.

We understand that the risks of severe solar geomagnetic storms and of high altitude electromagnetic pulse (EMP) explosions were not risks included in the Design Basis for currently licensed nuclear power plants. Hence, these risks are not included in Section 5.1 of the Supplemental EIS analyses that reviews "Design Basis Accidents."

It is our understanding that – despite the bounds of Design Basis risk management – when the Commission initiated a post-Fukushima review of the need to reanalyze the scope and efficacy of safety regulation for nuclear power plants, the Commission made a commitment to address high-consequence, low-probability risks, even if some of these hazards were beyond Design Basis risks. The Miller Report of July 2012[1]proposed to broaden the scope of safety analyses for both operating and future licensable power plants.

However, the Commission's consideration of "Severe Accidents" that might affect Seabrook Station, as contained in Sections 5.2 and 5.3 of the Supplemental Severe Accident Analyses of April 2013, continues to exclude the substantial risk of solar geomagnetic storms.

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[1] Charles Miller, et al., Recommendations for Enhancing Reactor Safety in the 21st Century, NRC, July 12, 2012. The Miller Report proposed inclusion of beyond Design Basis hazards, strengthening blackout mitigation capabilities, enhancing spent fuel makeup capability and instrumentation, and other defense-in-depth concepts.

In April 2013, the owner-operator of Seabrook Station reported to a Space Weather Conference in Boulder, Colorado that NRC-licensed nuclear power plants at Seabrook Station in New Hampshire and at Point Beach, Wisconsin are "GIC hot spots" – meaning that northern latitude, soil conductivity, and transmission line topology combine to produce high observed GIC for Generator Step-Up (GSU) transformers. [2] According to multiple government and industry reports, high GIC can cause overheating and unexpected failure of GSU transformers. In turn, unexpected transformer failure during and after solar storms can cause reactor trips and attendant nuclear safety issues.[3]

In May 2013, Lloyd's of London, in collaboration with Atmospheric and Environmental Research, Inc. of Lexington, Massachusetts, released a risk assessment of U.S. electric grid vulnerability to severe solar geomagnetic storms.[4] AER corroborates that generation plants proximate to coastlines and high salinity water bodies have greater exposure to GIC.

During the period that the Commission has prepared its Supplemental Analyses for Seabrook Station's severe accident risks and mitigation alternatives, evidence has mounted that certain foreign nations – including North Korea and Iran – may be acquiring high altitude electromagnetic pulse (HEMP) weapons. Protections against both solar weather and a significant portion of man-made EMP hazards could be accomplished using the same mitigation equipment, a solution that could be both prudent and cost-effective.

Our Foundation encourages the Commission to address low probability hazards for which the consequences may be severe, but for which cost-effective remedies may also be available. Our Board is appreciative that the Commission has determined to proceed with analysis of Petition for Rulemaking PRM-50-96, a petition that

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[2] Available on the internet is a NextEra Energy briefing by Kenneth R. Fleischer, "NextEra Nuclear GMD Mitigation," PowerPoint Presentation, Space Weather Workshop, Boulder, Colorado, April 16, 2012. See the www.swpc.noaa website. Specific NextEra view graphs form this presentation relating to Seabrook Station and Point Beach are reproduced as Appendix 2 of Foundation for Resilient Societies Comments, May 1, 2012, in FERC Docket RM12-22-000, 47 pp.

[3] The Foundation for Resilient Societies is currently conducting a study of reactor trips during solar storms and expects to publish the results in 2013.

[4] Solar Storm Risk to the North American Electric Grid, found at: http://www.lloyds.com/~/media/lloyds/reports/emerging%20risk%20reports/solar%20storm%20risk%20to%20the%20north%20american%20electric%20grid.pdf, last accessed June 30, 2013.

proposes on-site backup power to protect spent fuel pools during prolonged Loss of Outside Power (LOOP).[5]

In our current Comments we have added a request to consider the retrofit of the Seabrook spent fuel pool by adding elevated containers of water (possibly with soluble boron added), as a relatively low-cost complementary method of prolonging the availability of water makeup. Using gravity feed and manual turn-on, turn-off controls, these simple water storage containers could be both continuously available and immune to remote cyber-attack.

When considering severe accident mitigation alternatives (SAMAs) for solar geomagnetic storm risks, we request that the Commission consider the baseline threat to be the geomagnetic disturbance magnitude of the New York Central Railroad Storm of 1921, in addition to the Carrington Event of 1859. We have extrapolated from the March 13, 1989 Quebec solar storm that the New York Railroad Storm of 1921 might produce about 1,600 amps of GIC at Seabrook in a storm with magnitude of about 4,800 nanoTeslas/minute.[6] A storm of the magnitude of the New York Central Railroad storm of 1921 has not reoccurred for 92 years. This return period implies that the New England electric grid has risk of prolonged electric grid blackout at an estimated frequency of approximately 1-in-100 years.

We request that the Nuclear Regulatory Commission consider in its Final Supplemental Environmental Impact Statement for Seabrook Station Relicensing as Severe Accident Risks the hazards contained in the following Table, and also the proposed mitigation alternatives (SAMAs) explained in the first column of this Table. The Table is provided as an Appendix to our Comments.

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[5] See NRC-PRM-50-96, and ruling of the NRC published at 77 Fed. Reg. 74788-74798 dated December 18, 2012.

[6] See Foundation for Resilient Societies, Interim Report, Solar Storm Risks for Maine and the New England Electric Grid, and Potential Protective Measures, March 19, 2013. This report is available on our Foundation website, http://www.resililentsocieties.org and is retrievable via FERC Docket RM12-22-000. The Report reviews current operating procedures of ISO-New England during warnings of solar geomagnetic storms and ensuing geomagnetic disturbances. It compares both transmission capabilities at-risk and generating facilities at-risk with operating reserves projected to be available. The report estimates the cost to protect the Maine grid against geomagnetic disturbance and compares this cost to the cost of a pending transmission upgrade to the Maine grid.

Respectfully submitted,

William R. Harris, Secretary, and
Thomas S. Popik, Chairman, for the

Foundation for Resilient Societies
52 Technology Way
Nashua NH 03060
www.resilientsocieties.org

APPENDIX TABLE

UNADDRESSED SEVERE MITIGATION ALTERNATIVES (SAMAs) FOR SEABROOK STATION

RETROFIT OPTIONS	**KEY UNADDRESSED RISKS IN SEABROOK STATION SUPPLEMENTAL EIS AND CORRESPONDING BENEFITS OF RETROFIT OPTIONS**		
	SEVERE SOLAR STORM	**MAN-MADE ELECTRO-MAGNETIC PULSE (EMP)**	**CYBER ATTACK**
Option 1: Install Neutral Ground Blocking Device to protect GSU transformers against Geomagnetically Induced Current (GIC) during scheduled transformer replacement in April 2014; one blocking device required.	**Benefits:** 1. Eliminate half-cycle GSU transformer saturation and harmonic production. 2. Prevent GSU transformer overheating and vibration. 3. Reduce chance of unexpected GSU transformer failure and reactor trips during solar storms. 4. Enhance regional grid stability during solar storms and reduce risk of Loss of Outside Power. 5. Prevent harmonic injection into local grid and resulting Uninterruptible Power Supply (UPS) malfunction during solar storms, including UPS for station power.	**Benefits:** 1. Protect GSU transformers against E3 (long pulse) during nuclear EMP attack. 2. Optional installation of Metal Oxide Varistors (MOV) along with Neutral Ground Blocking Device could also protect against E1 (fast pulse). 3. Reduce recovery time for regional grid and reduce risks due to extended Loss of Outside Power in aftermath of nuclear EMP attack.	**Benefits:** None

Option 2: For planned GSU replacement in year 2014, install transformers with high GIC "withstand" rating.	**Benefits:** 1. Reduce core eddy currents and resulting transformer overheating. 2. Enable plant to operate through small-to-moderate solar storms without downrating.	**Benefits:** Due to high GIC during nuclear EMP attack, no significant benefit expected.	**Benefits:** None
Option 3: Install unattended backup power system for spent fuel pool cooling. See analysis in Petition for Rulemaking PRM-50-96 and NRC assessment dated December 18, 2012.	**Benefits:** 1. Prevent boil-off of spent fuel pool during long-term LOOP; reduce radiation from spent fuel pool and allow continuing access to site. 2. Reduce risk of spent fuel pool fire and resulting contamination of surrounding land area during long-term LOOP.	**Benefits:** 1. Prevent boil-off of spent fuel pool during long-term LOOP; reduce radiation from spent fuel pool and allow continuing access to site. 2. Reduce risk of spent fuel pool fire and resulting contamination of surrounding land area during long-term LOOP.	**Benefits:** 1. Backup power system would be unconnected to internet and therefore unaffected by cyber-attack. 2. Prevent boil-off of spent fuel pool during long-term LOOP caused by cyber-attack; reduce radiation from spent fuel pool and allow continuing access to site. 2. Reduce risk of spent fuel pool fire and resulting contamination of surrounding land area during long-term LOOP caused by cyber-attack.

Option 4: Install large tank with makeup water for spent fuel pools; tank to be elevated with gravity feed and manual valve system; water may contain soluble boron.	**Benefits:** 1. Delay boil-off of spent fuel pool during long-term LOOP from regional grid collapse; reduce radiation from spent fuel pool and allow continuing access to site. 2. Reduce risk of spent fuel pool fire and resulting contamination of surrounding land area during LOOP of several weeks duration.	**Benefits:** 1. Delay boil-off of spent fuel pool during long-term LOOP from regional grid collapse; reduce radiation from spent fuel pool and allow continuing access to site. 2. Reduce risk of spent fuel pool fire and resulting contamination of surrounding land area during LOOP of several weeks duration. .	**Benefits:** 1. Manual valve system would be unconnected to internet and therefore unaffected by cyber-attack. 2. Delay boil-off of spent fuel pool during LOOP of several weeks duration; reduce radiation from spent fuel pool and allow continuing access to site. 3. Reduce risk of spent fuel pool fire and resulting contamination of surrounding land area during LOOP of several weeks duration.