MAINE STATE LEGISLATURE

STATE OF MAINE
PUBLIC UTILITIES COMMISSION

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June 20, 2013

Honorable John J. Cleveland, Senate Chair
Honorable Barry J. Hobbins, House Chair
Energy, Utilities and Technology Committee
100 State House Station
Augusta, Maine 04333

Re: LD 131, Resolve, Directing the Public Utilities Commission To Examine Measures To Mitigate the Effects of Geomagnetic Disturbances and Electromagnetic Pulses on the State's Transmission System – Interim Report

Dear Senator Cleveland and Representative Hobbins:

As you know, LD 131, Resolve, Directing the Public Utilities Commission To Examine Measures To Mitigate the Effects of Geomagnetic Disturbances and Electromagnetic Pulses on the State's Transmission System was enacted earlier this session (Resolves 2013, ch. 45). The Resolve directs the Commission to examine the vulnerabilities of the State's transmission infrastructure to the potential negative impacts of a geomagnetic disturbance or electromagnetic pulse capable of disabling, disrupting or destroying transmission and distribution system elements and to identify potential mitigation measures.

The Resolve also directs the Commission to monitor the efforts by the Federal Energy Regulatory Commission (FERC), the North American Electric Reliability Corporation (NERC), ISO New England and other regional and federal organizations to develop reliability standards related to geomagnetic disturbances and electromagnetic pulses. Finally, the Resolve directs the Commission to provide a report to the Committee on the results of its examination and the progress of regional and national efforts to develop reliability standards by January 20, 2014.

By letter dated May 2, 2013, the Committee Chairs also requested that the Commission provide an interim report to the Committee by June 20, 2013, that contains a preliminary list of the sources that the Commission will be reviewing during the study, any pertinent information that the Commission would like to share with the Committee and a description of the Commission's approach or process for completing the full study.

Attached is a bibliography providing a preliminary list of sources the Commission will be referring to during this study. It contains a number of the reports referred to during the public hearing and work sessions on LD 131. To complete the full study, the Commission will open an inquiry and provide the opportunity for interested persons to comment on issues related to the study. We will direct Maine's investor-owned electric utilities to provide information on present practices regarding protection from electromagnetic pulses and geomagnetic disturbances and the need for and cost of additional measures. The Commission will also contact agencies, such as FERC and NERC, which have expertise in this matter.

If you have any questions, please do not hesitate to contact us.

Sincerely,

Thomas L. Welch, Chairman

On behalf of the Chairman and
David P. Littell, Commissioner
Mark A. Vannoy, Commissioner
Maine Public Utilities Commission

Attachment
cc: Energy, Utilities and Technology Committee Members
Jean Guzzetti, Legislative Analyst

LD 131

BIBLIOGRAPHY

Molinski, Tom S., William E. Ferro, and Ben L. Damsky, "Shielding Grids from Solar Storms." *IEEE Spectrum* (2000); http://thayer.dartmouth.edu/spacescience/wl/res/ae/biblio/molinski00.pdf

This article discusses risks to power systems resulting from Geomagnetic Disturbances (GMDs) and steps that have been taken since the GMD of 1989 to prepare systems to anticipate and respond to GMDs. The article also discusses some of the challenges in establishing guidelines to mitigate harm done by GMDs.

North American Electric Reliability Corporation, Industry Advisory – *Preparing for Geo-Magnetic Disturbances* May 10, 2011 *http://www.nerc.com/fileUploads/File/Events%20Analysis/A-2011-05-10-01_GMD_FINAL.pdf*

This Advisory provides information on the solar cycle expected to peak in May 2013. The Advisory describes planning operational actions to be considered by the Reliability Coordinator if a Geomagnetic Disturbance (GMD) is predicted. In addition the Advisory outlines real-time operator actions that are to be coordinated with the Reliability Coordinator in the event of a predicted severe GMD. Finally, the Advisory outlines longer-term actions to be considered by planners to prepare for future occurrences of severe GMDs.

North American Electric Reliability Corp. *High-Impact, Low-Frequency Event Risk to the North American Bulk Power System*. Rep. 2010. Web. <http://www.nerc.com/files/ HILF.pdf>.

This summary report of a joint Department of Energy and North American Electric Reliability Corporation workshop defines High-Impact Low-Frequency (HILF) events, identifies risk and possible mitigations as well as efforts already underway. The report stresses that the interconnected and interdependent nature of the bulk power system requires that risk management actions be consistently and systematically applied across the entire system to be effective.

North American Electric Reliability Corp. "Special Reliability Assessment Interim Report: Effects of Geomagnetic Disturbances on the Bulk Power System." (February 2012) (*HILF Report)*. Web. <http://www.nerc.com/files/2012GMD.pdf>.

This document describes risks to the bulk power system from geomagnetic disturbances, existing response capability and potential mitigation devices. The report concludes that voltage instability caused by a significant loss of reactive power support is a more likely impact from a severe GMD event than a failure of a large number of Extra High Voltage (EHV) transformers. The report recommends several follow-on actions for NERC.

North American Electric Reliability Corp., *March 13, 1989 Geomagnetic Disturbance* *http://www.nerc.com/files/1989-Quebec-Disturbance.pdf*

This report contains a general discussion of Geomagnetic Disturbances (GMDs), a description (including a chronology of events) of the March 13, 1989 Hydro-Quebec blackout, a discussion of short-term remedial measures taken after the blackout and a map of North America showing the states and provinces where the March 13, 1989 GMD events were reported.

Oak Ridge National Laboratory. "Electric Utility Industry Experience with Geomagnetic Disturbances." N.p., 1991. Web. <http://www.ornl.gov/~webworks/cpr/v823/rpt/51089.pdf>.

This report documents electric utility experience responding to geomagnetic events and recommends areas that need further study in order to better assess the impact on utility infrastructure. The report also provides comparative analysis between solar-caused geomagnetically-induced storms and geomagnetic field disturbances caused by high-altitude nuclear detonation to provide insight into the likely power system consequences of such a nuclear event.

Oak Ridge National Laboratory. *Electromagnetic Pulse: Effects on the U.S. Power Grid* ORNL/Metatech Reports 319-324 http://www.ornl.gov/sci/ees/etsd/pes/ferc_emp_gic.shtml

This series of reports provides a thorough coverage of GMD, EMP and IEMI impacts on the electric power system. The series includes a review of modeling from historic geomagnetic storms; an in-depth look at the 1989 storm that affected eastern North America; scenario analysis of potential GMD events; and finally an assessment of the most at risk elements on the system.

Office of Risk Management and Analysis. *Geomagnetic Storms: An Evaluation of Risks and Risk Assessments*,. Rep., 2011. www.**dhs**.gov/xlibrary/assets/rma-**geomagnetic-storms**.pdf

This paper provides a literature review on the topic of Geomagnetic Storms and discusses whether the Federal government should consider whether it is appropriate to conduct a formal, comprehensive risk assessment regarding severe geomagnetic storms.

Reliability Standards for Geomagnetic Disturbances, § 143 FERC ¶ 61147 (2013) (Final Rule).

The final rule directs the North American Electric Reliability Corporation (NERC), to submit to the Commission proposed Reliability Standards that address the impact of geomagnetic disturbances (GMD) on the reliable operation of the Bulk Power System (BPS). In stage one, NERC is to submit, within six months of the effective date of the Final Rule, one or more Reliability Standards that require owners and operators of the BPS to develop and implement operational procedures to mitigate the effects of GMDs. In stage two, NERC is required to submit, within 18 months of the effective date of the Final Rule, one or more Reliability Standards that require owners and operators of the BPS to conduct initial and on-going assessments of the potential impact of benchmark GMD events on BPS equipment and the BPS as a whole.

Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, Critical National Infrastructures Rep. 2008
http://empcommission.org/docs/A2473-EMP_Commission-7MB.pdf

With regard to electric power infrastructure, the report includes a description of the power grid, identifies the most at-risk elements and makes recommendations for protecting and mitigating the impact of an Electromagnetic Pulse (EMP). Additionally, the report highlights the interdependency of the power and telecommunication systems, including the growing reliance on automated monitoring and control systems.

Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, Volume 1, Executive Report. Rep. N.p.: n.p., 2004. Print.

This report details electromagnetic pulse (EMP) threats and describes the vulnerability of various aspects of the US infrastructure and economy associated with EMP events. For each category or industry identified, the report makes a series of specific recommendations aimed at preventing attacks and minimizing the risk posed by these EMP attacks.

Schnurr, Avi, *Vulnerability of National Power Grids to Electromagnetic Threats: Domestic and International Perspectives*, Energy Law Journal Volume 34, no. 1 2013.

This article summarizes electromagnetic threat issues, outlines some current regulatory actions regarding geomagnetic disturbances and emphasizes the need for national direction on these issues.