FOUNDATION FOR RESILIENT SOCIETIES
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November 11, 2014

Mr. Curtis A. Beveridge
Manager, Electric System Planning
Central Maine Power Company
83 Edison Drive
Augusta, ME 04336-1083

Dear Curt:

Tom Popik and I (President and Secretary, Foundation for Resilient Societies) appreciate the opportunity to participate in the Task Force created by the Maine Public Utilities Commission (MPUC) on mitigation alternatives for Geomagnetic Disturbances (GMD) and Electromagnetic Pulse (EMP) hazards.

Yesterday, the principal drafter of the planned Second Report of the Maine PUC pursuant to assessment requirements of L.D. 131, Justin Michlig of your System Planning Staff, reviewed with me some elements of the diverging and converging models of geomagnetic storm impacts upon the reliability of the Maine high voltage transmission system.

Justin also requested that I provide contact and other information on the ECLIPSE geomagnetic induced current (GIC) monitoring systems offered by a commercial firm in New Jersey, and I provide that information as an attachment to this letter.

Justin also indicated that Central Maine Power is now an operating participant in the EPRI SUNBURST network that shares solar GIC data among the SUNBURST program participants. We are pleased that CMP has joined this network.

Central Maine Power should note that, in the comments filed on the NERC GMD Phase 2 standard, with comment deadline of October 10, 2014, comments were filed by a participant in the SUNBURST GIC network indicating that the geoelectric fields in the NERC GMD model appear to be inconsistent with actual GIC readings at transformer sites. This comment appears to be compatible with the Kappenman-Radasky White Paper, referenced below and attached to this letter.

One comment filed with NERC this past October compares the NERC GMD model projections with actual GIC readings at U.S. sites. It indicates there have been *higher* GIC readings in more *southerly* latitudes, and it confirms that the model based on Finland is not reliable at lower latitudes.

> "GMD Event of Sept 11-13, 2014 - EPRI SUNBURST GIC data over this period suggests that the physics of a GMD are still unknown, in particular the proposed geoelectric field cut-off is most likely invalid. Based on the SUNBURST data for this period in time one transformer neutral current at Grand Rapids Manitoba (above 60 degrees geomagnetic latitude) the northern most SUNBURST site just on the southern edge of the auroral zone only reached a peak GIC of 5.3

Amps where as two sites below 45 degrees geomagnetic latitude (southern USA) reached peak GIC's of 24.5 Amps and 20.2 Amps. Analysis of the EPRI SUNBURST GIC data also indicates that the ALL peak GIC values between 10 Amps to 24 Amps were measured in NERC's supposed geoelectric field cut-off zone (between 40 to 60 degrees geomagnetic latitude)."

Therefore, to protect the Maine electric grid in a cost-effective manner, it is essential in Phase I of Maine's mitigation program to deploy low-cost GIC monitors and report readings to the Maine PUC and the state legislature, and to develop for the State of Maine a more science-based model than the current NERC model. The GIC network should be feasible for 18 GIC monitors (including temperature probes and dissolved gas data at high voltage transformers) at total costs of under $0.5 million, if GIC monitors with installation cost are about $25 thousand per site.

It is our understanding that the Maine PUC Draft Report will bound the scope of designated solar storm hazards by utilizing a revised assessment by EMPrimus, based in part on PowerWorld modeling, which recommends protective equipment for 18 345 kV transformers including 18 GIC monitors (at the high end); and using an assessment by Central Maine Power based upon the NERC Benchmark Event and Benchmark Model of October 2014, proposing no need for any protective equipment (at the low end).

In our conversation yesterday, Justin Michlig indicated he was not familiar with two White Papers that criticize the methodology and data underlying the NERC GMD model of June-October 2014. It is important that the drafters of the Maine PUC Second Assessment understand the scope and sources of concern by third party experts as to why the NERC GMD model systematically understates and under-projects the hazards of solar geomagnetic storms to North America, hence to the State of Maine in particular.

Central Maine Power and the Maine Public Utilities Commission should be aware that the NERC Phase 2 standard for assessment of GMD will almost certainly be appealed, using the NERC Standards Process Manual appeals system, as incompatible with ANSI standards, and incompatible with NERC's own standards for reliability standard setting: through failure to utilize and account for inconsistent empirical data and modeling calculations that show the NERC GMD model to systematically under project GMD hazards to the bulk power system.

If, therefore, the Maine PUC Second Phase Report fails to disclose that under-appeal NERC GMD modeling issues indicate that the "low end" GMD threat should include higher voltage levels and greater need for protective equipment, the Maine report will be misleading to the state legislature and other concerned readers.

To assist CMP and your report drafter, I attach two White Papers that have been submitted as public documents in the NERC-FERC process considered in FERC Docket RM14-1-000:

- The John Kappenman-William Radasky White Paper of July 30, 2014, which disputes the validity of a geoelectric field model, the *Alpha* component, based on conditions In Finland and the Baltic states, when applied to geoelectric fields in North America. At 60 degrees latitude, the geoelectric fields appear to be compatible in Finland and in Canada. But analysis of historical, empirical geoelectric field readings indicates that at latitudes of 45 to 40 degrees north, the NERC model erroneously underreports geoelectric fields by roughly a factor of 3X. Applied to Maine, the 4.5 volts per kilometer geoelectric field that CMP assumes based on the NERC model may understate real-world voltages by roughly a factor of 3.

- The John Kappenman-Curtis Birnbach White Paper of August 2014, which disputes the validity of the soil conductivity variable, the *Beta* component of the NERC GMD model. This also results in significant underestimation of induced voltages in long distance transmission lines within the U.S. and in the State of Maine.

Since these two factors require multiplication to estimate and project risks to critical equipment within the Maine high voltage transmission system, use of the NERC benchmark model without these corrections results in systematic bias against protecting the Maine grid with cost-effective equipment. With these corrections in the Kappenman-Radasky and Kappenman-Birnbach White Papers, the lower bound of solar storm hazards and the EMPrimus model may be relatively close to each other.

Moreover, I wish to point out the obligation under the statute enacted in June 2013 to estimate impacts upon the ratepayers of the State of Maine. To date, the Maine PUC and CMP have not attempted to estimate the considerable cost savings that result from keeping geomagnetic induced currents out of high voltage transformers, and out of high voltage transmission systems. Components of these savings include: the elimination of substantial *reactive power* costs, both in energy and in dollars; the reduction in transmission system congestion due to voltage sags and off-cost sales [See work by Kevin Forbes on the PJM system, showing more than 10% off-cost sales due to moderate GMD events in a 25 month period during 2002-2004]; higher capacity utilization rates for generators; and higher net operating income during years with low solar GMD intensity. It is likely that improved efficiencies, through better management of GMD impacts, can allow CMP to expand transmission throughput from Canada to other ISO-New England states. Hence, over time rate-payers should benefit from the exclusion of GICs from the Maine high voltage transmission network. Fully 88 percent of the Maine Power Reliability Program capital costs have been shared with other ISO-New England states under FERC approved tariffs. The Maine PUC Report should address these cost-recovery opportunities with GMD mitigation costs, as well.

It would be improper for the Maine PUC Report to the Maine legislature to only report on costs and not to report on projected benefits to Maine's prospects for greater grid reliability, greater state employment, and ultimately lower costs to Maine rate-payers.

Hopefully these comments and attachments will be helpful as CMP provides drafting support to the Maine PUC.

Sincerely,

William R. (Bill) Harris
Secretary
Foundation for Resilient Societies