UNITED STATES OF AMERICA

BEFORE THE

FEDERAL ENERGY REGULATORY COMMISSION

Reliability Standard for	**)**	
Transmission System Planned Performance	**)**	**Docket No. RM15-11-000**
for Geomagnetic Disturbance Events	**)**	

SUPPLEMENTAL COMMENTS OF THE FOUNDATION FOR RESILIENT SOCIETIES
Submitted to FERC on March 15, 2016

EXECUTIVE SUMMARY

The comprehensive record of FERC Docket RM12-22-000 and FERC Docket RM15-4-000 indicates that the Federal Energy Regulatory Commission ("FERC" or "the Commission") enabled the designated Electric Reliability Organization ("ERO" or "NERC"), via Order No. 779[1], to select a Benchmark Geomagnetic Disturbance (GMD) Event so low that electric utilities will not be required under Reliability Standard TPL-007-1 to install hardware protection against solar storms. What can the Commission practically do to enable prompt protection of the Bulk Power System—and the American population whose lives depend upon reliable power—while a better reliability standard is developed? One option within the Commission's legal authority is immediate establishment of cost recovery for prudent installation of Geomagnetic Induced Current ("GIC") instrumentation and hardware protection.

The Foundation for Resilient Societies ("Resilient Societies") recommends that the Commission adopt flexible cost recovery criteria so that "best practices" beyond the imprudent minimums in Reliability Standard TPL-007-1 are encouraged for procurement of

1. GMD modeling studies
2. Hardware protection such as neutral ground blocking devices, series capacitors, and spare transformers

[1] 143 FERC ¶ 61,147, May 16, 2013.

3. Instrumentation devices such as Geomagnetically Induced Current (GIC) monitors, magnetometers, geoelectric field meters, and synchrophasor measurement systems
4. Other protective actions as the Commission may determine to be prudent

The burden of demonstrating net reliability improvements should remain with Applicants filing Section 205 tariffs. The Commission should allow cost-recovery without specifying any minimum amp threshold for damage to transformers, generators, or other equipment. Or, in the alternative, the Commission could enable cost-recovery at a transformer thermal assessment threshold of 15 amps per phase, per the IEEE Transformer Guide issued in September 2015. Because the authority of the Commission to set rates, terms, and conditions of sale is broad and independent of Section 215,[2] the Commission can and should adopt broad and flexible cost recovery incentives, as was done for Black Start services, reactive power capabilities, and other reliability services, including those supplied by Generator Owners.

To encourage "best practices" through improved GMD modeling and proactive hardware protection, the Commission should follow its year 2009 precedent when it adopted Smart Grid cost recovery procedures. These cost recovery procedures included mandatory information sharing with the U.S. Department of Energy, in order to advance the Smart Grid Demonstration Program.[3]

The Commission should revise Open Access Transmission Tariff (OATT) tariff approval conditions and order mandatory sharing of GIC data with the Commission, the U.S. Department of Energy, Reliability Coordinators, research organizations, and the public. Shared GIC data is essential to increase scientific understanding and prediction of space weather environments and their earth-based impacts, including impacts on the Bulk Power System.

[2] See Sections 201, 205, and 206 of the Federal Power Act, in effect now and for seventy years before the enactment of reliability standard-setting procedures per Section 215.
[3] FERC "Smart Grid Policy Statement," Docket PL09-4-000, Para. 122, at p. 73, and Para 126 at p. 75 (mandatory participant information sharing to advance public policy), Docket PL09-4-000, 128 FERC ¶ 61,060, July 16, 2009.

BACKGROUND

Resilient Societies is a 501(c)(3) non-profit organized to perform research and education to improve the reliability of critical infrastructures in 21st century societies. Resilient Societies has: participated in the NERC Geomagnetic Disturbance (GMD) Task Force since year 2011; has initiated the only Level 2 Appeal of NERC's standard development processes since their initiation in year 2006; has supported independent modeling of solar storm vulnerabilities of electric grid systems; has obtained a federal power authority GMD model via the Freedom of Information Act; and has participated in the FERC reliability standard process for the past five years.

Resilient Societies has urged, and still urges, that the Commission remand the defective NERC Benchmark GMD Event and other defective aspects of Standard TPL-007-1. If cost recovery is limited to the 75 amp threshold for transformer thermal assessment set forth in Standard TPL-007-1, we reasonably anticipate that almost no hardware protection will be installed in the U.S. electric grid.

We have witnessed and exchanged information with electric utilities that were once inclined to procure hardware protection for their transformers, but have now withdrawn their tentative commitments to install such protection—because NERC Standard TPL-007-1 set in January 2015 will not require it and therefore cost recovery will not be available. It is apparent that NERC Standard TPL-007-1 as currently drafted is an excuse for utility inaction and a net harm to society.

American Transmission Company had installed one neutral ground blocking device in February 2015 and, based on preliminary results and PowerWorld modeling, was preparing to install four additional neutral ground blockers. Modeling indicated that blocking of large GIC flows at key entry points would significantly protect against voltage collapse during solar storms.[4] Now, this

[4] See Graph. "ATC Grid Voltage Collapse vs. GMD Fields," with PowerWorld modeling of 0, 1, 5, or 25 transformers protected by neutral ground blocking devices, Emprimus, "Transformer Neutral Ground Blocking Protection System," Idaho National Laboratory, GMD Workshop, 27-28 July 2013; and F. R. Faxvog, et al., "Power Grid

proactive initiative has stalled. Instead, a filing by company lawyers, making reference to support of the position of the Trade Associations, brings forth the red herring that "GIC blocking at one location will ***likely*** cause the GIC flows to increase on other parts of the System, which ***could*** cause harm to assets at those locations." (Emphasis added.)[5]

American Transmission Company, apparently in coordination with the Trade Associations, brings forth harms that are speculative and unsupported by evidence in the docket, as a reason to delay industrywide protection against harms of solar storms that have already been demonstrated by the March 1989 blackout and associated transformer failures. If the Commissioners were to go along with the positions brought forth by American Transmission Company and the Trade Associations, it would be exceedingly poor public policy, unsupported by technical study. Moreover, modeling tools now commercially available can show whether partial implementation of neutral ground blocking devices might cause harm in isolated circumstances and how any potential harm might be eliminated by more comprehensive protection.

In the State of Maine, Resilient Societies participates in an Advisory Task Force that reviews assessments of solar storm hazards to Maine and the ISO-New England region. Here we witnessed the development of two models of the Maine electric grid, one done by Central Maine Power and another done by Emprimus and PowerWorld. Both assessments proposed installation of neutral ground blockers, for about half of the 345 kV transformers, or for all of them.[6] After the setting of NERC Standard TPL-007-1 in January 2015, containing a scientifically-

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Protection against Geomagnetic Disturbances (GMD)," Electrical Power & Energy Conference (EPEC) 2013 IEEE, Aug 21- 23, 2013, pages 1-13, ISBN: 978-1-4799-0105-0, INSPEC # 14282939, DOI: 10.1109/EPEC.2013.6802963.

[5] See the July 27, 2015 filing of American Transmission Company in FERC Docket RM15-11-000, p. 4. See also the July 27, 2015 comments of Edison Electric Institute, et. al. ("Trade Associations) in FERC Docket RM15-11-000, p. 7.

[6] The Central Maine Power (CMP) modeling concurred with the Emprimus assessment that selective installation of neutral ground blocking equipment reduces reactive power demand (MVar) and increases the effective voltage at which system collapse is projected during GMD events; and both reports identify transformers at risk of thermal damage during GMD events. Under the NERC benchmark model only one site in Chester, Maine required thermal damage assessment. CMP modeled protection of about half (7 to 9) of CMP 345 kV transformers, while Emprimus proposed protection of all of the Maine 345 kV transformers, plus four transformers in New Brunswick, Canada. The December 2014 CMP Report and the January 2015 Emprimus Report are filed on September 10, 2015 in FERC Docket RM15-11-000, and are retrievable, as part of the Documentary Record of the NERC Level 1 and Level 2 Appeal ("DR"). See DR pp. 77-118 for the Central Maine Power Report of Dec. 2014, with mitigation and

unsupported Benchmark GMD Event, Central Maine Power has retreated from plans to install neutral ground blockers. Even installation of a single neutral ground blocker as a demonstration project has been put aside. Instead, Central Maine Power now proposes to add reactive power support devices onto the $1.4 billion Maine Power Reliability Program. Reactive power support will not protect against transformer overheating and harmonics. Nonetheless, Central Maine Power seeks ISO-New England and FERC approval for cost-recovery—approval would place an expensive burden on all New England ratepayers.[7]

A new reactive power facility at Coopers Mills Substation, Maine, will add $60 million of capital costs and will not protect against transformer damage, one of the most serious effects of solar storms. For that sum, one could purchase as many as 120 neutral ground blockers, at $400,000 apiece plus $100,000 per unit installation cost.

The Trade Associations claim neutral ground blockers are "expensive."[8] Without FERC criteria for cost recovery, no neutral ground blockers are being installed in the United States. Ironically, the May 2013 FERC Order 779 to protect against severe solar geomagnetic storms has now led to a *halt* of protective equipment installation.

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conclusions addressed at DR pp. 111-115. See DR pp. 119-164 for the January 5, 2015 Emprimus Report, which models voltage collapse (at increased voltage levels) with selective installation of neutral ground blockers reported at DR pp. 125-126, and 155-161.

[7] Maine ratepayers are billed for about 8 percent of these reliability program costs, incurred between 2010 and 2017. Massachusetts ratepayers pay 44 percent of the Maine reliability program costs, so far without complaint; but the purchase of lower priced equipment, such as neutral ground blockers, would perhaps save ratepayers from the alternative of purchasing yet additional Reactive Power facilities, at a cost of $60 million per facility, and perhaps additional Series Capacitors, also at higher costs. Broad FERC cost recovery criteria can reduce overall costs to electric ratepayers by incentivizing lower cost GMD-protective equipment not previously approved in rate making cases.

[8] See Edison Electric Institute, et al. (Trade Associations), filing in Docket RM15-11-000, dated March 4, 2016. In actuality, it is more expensive to leave GICs that flow through the transmission system, and that increase demand for reactive power. Neutral ground blockers reduce reactive power demand and also protect transformers from overheating. While delaying consideration of neutral ground blockers, Central Maine Power in May 2015 added plans for a reactive power installation along its 345 kV backbone system at Coopers Mills. There are other benefits of additional reactive power for grid stability, but overall, a set of neutral ground blockers reduces peak demand for reactive power at a lower cost per MVar. So the Trade Associations appear to have no problem with higher net capital outlays, as by purchasing reactive power units. The alternative solution is for FERC to provide broader cost recovery eligibility, while keeping the burden of proof for outlays to enhance reliability on Section 205 Applicants.

The low Benchmark GMD Event in Standard TPL-007-1 might be satisfactory if the FERC's main goal in Order 779 was to broaden liability protection of electric utilities from blackout damage claims. Were FERC to approve this defective standard, utilities could claim any event exceeding the Benchmark was an "Act of God." But for the public, the utility safe harbor from liability is imprudent, unjust, discriminatory against communities at lower latitudes or near saline coastal waters, and just plain contrary to the purpose of the Energy Policy Act of 2005. The clear purpose of the law was to improve the reliability of the Bulk Power System, not to perfect liability shields for electric utilities.

POTENTIAL FERC ACTIONS TO ENCOURAGE HARDWARE PROTECTION

There are a number of potential FERC actions that would encourage hardware protection against solar storms while the Benchmark GMD Event is improved by NERC:

1. Provide for cost recovery for hardware protections implemented by both Generator Owner-Operators and Transmission System Operators
2. Establish FERC criteria for cost recovery
3. Alter Tariff Approvals to Require GIC Data Sharing

We provide the legal basis for each of these potential actions below.

Provide Cost Recovery for Hardware Protection

There are precedents and FERC authority supporting cost recovery, as illustrated by Commission rulings and comments in the docket. In the Notice of Proposed Rulemaking ("NOPR") issued for Transmission Planning Standard TPL-007-1 in May 2015, the Commission observed in ¶ 49:

> 49. Cost recovery is potentially available for costs associated with or incurred to comply with proposed Reliability Standard TPL-007-1, including for the purchase and installation of monitoring devices.**60** The Commission seeks comment on whether it should adopt a policy specifically allowing recovery of these costs. [Fn. 60]
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> Fn. 60 Order No. 779, 143 FERC ¶ 61,147 at P 14 n.20 (stating that "nothing precludes entities from seeking cost recovery if needed"); see Extraordinary Expenditures Necessary to Safeguard National Energy Supplies, 96 FERC ¶ 61,299, at 61,129 (2001) (stating that the Commission "will approve applications to recover prudently incurred costs necessary to further safeguard the reliability

and security of our energy supply infrastructure in response to the heightened state of alert. Companies may propose a separate rate recovery mechanism, such as a surcharge to currently existing rates or some other cost recovery method"); see also Policy Statement on Matters Related to Bulk Power System Reliability, 107 FERC ¶ 61,052, at P 28 (2004) (affirming and clarifying that "the policy extends to the recovery of prudent reliability expenditures, including those for vegetation management, improved grid management and monitoring equipment, operator training and compliance with NERC standards").

The Trade Associations observed in their July 27, 2015 filings in support of TPL-007-1:

> "The Trade Associations also strongly support the development of FERC policy ensuring cost recovery for the costs incurred to comply with TPL-007-1 as well as GIC monitors and magnetometers."[9]

Later in the same Comment, the Trade Associations reiterated:

> "The NOPR asks whether FERC should adopt a policy specifically allowing entities to recover costs associated with complying with TPL-007-1. See NOPR at P 49. The Trade Associations support the development of FERC policy ensuring cost recovery for the costs to comply with Proposed Reliability Standard TPL-007-1 and for GIC monitors and magnetometers. The Trade Associations agree and encourage the Commission to set clear policy ensuring that both the costs associated with the installation of monitors as well as other costs of mitigating or remediating identified impacts associated with GMD events can be recovered by owners of both transmission and generation assets affected by TPL-007-1. Such cost recovery is especially appropriate due to the nature of this standard – a high impact, low frequency event that goes beyond the level of Reliability Standards that historically have been used. Moreover, entities that may be affected, such as generators, may have no direct method to recover such costs through current rate schedules assets affected by TPL-007-1. These are extraordinary costs that could not be anticipated when generators went into service."

Also on July 27th, Exelon, a major owner of generating facilities, stated:

> "…In complying with TPL-007-1, generation owners may incur substantial costs to mitigate the impacts of GMDs and protect customers from the risk that these rare events occur. The Commission should make clear that costs incurred in complying with TPL-007-1 may be recovered through appropriate means, such as,

[9] Edison Electric Institute, et al. [Trade Associations], Comments in Docket RM15-11-000, at p. 9.

but not limited to, a tariff similar to those used to recover black start costs." [fn 8][10]

The Commission's duty to provide for "Reliable Operation" per Section 215(a)(4) of the Federal Power Act means "operating the elements of the Bulk Power System within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures … will not occur…." In support of this mandate the Commission has provided for sales of equipment, capacity, fuel, and services provided by third parties to assure reliable operations.

One cost-recovery precedent set by the Commission allowed third party compensation for reactive power capacity and operational services.[11] More recently, the Commission has approved amendments to FERC approved tariffs that strengthen incentives for Black Start facilities and restoration services, to be provided by Generator Operators and Transmission Operators. These are examples of low probability, high consequence reliability enhancements essential to reliable operation of the Bulk Power System.[12]

Establish FERC Criteria for Cost Recovery

Resilient Societies suggests that the Commission link eligibility for cost recovery to a showing that the proposed reliability enhancements will contribute to the "reliable operation" of the Bulk Power System, per Sec. 215(a)(4). A secondary displacement of some GIC to other transformers should not be a bar to cost recovery if the overall effect of removing GICs from

[10] Exelon citing "e.g., PJM Interconnection, L.L.C., 138 FERC ¶ 61,020 (2012)." In a later footnote, Exelon "expects that costs incurred to generator owners to comply with TPL-007-1 will be incremental to existing costs necessary for generators to provide energy, power and ancillary services to the system." Exelon Comments at p. 3, fn. 8.
[11] See FERC Docket AD14-7-000, citing FERC Staff Report, *Payment for Reactive Power for Efficient and Reliable Reactive Power Supply and Competition,* Feb. 4, 2005.
[12] FERC approved tariff revisions for both PJM Interconnection LLC and for the New York ISO, providing Black Start service providers eligibility for capital costs, operating costs, and fuel costs. See FERC Order issued Nov. 14, 2014, 149 FERC ¶ 61,121, in Docket No. ER14-2883-000 (Black Start tariff revisions allowed for PJM Interconnection service providers); and FERC Order in Docket ER15-563-000, 150 FERC ¶ 61,057, issued Jan. 30, 2015 (Black Start tariff approvals for providers of Black Start capabilities for the Consolidated Edison service region.) On the PJM Black Start tariff computations, see Thomas Hauske, Review of Black Start Formula and Cost Components, White Paper, Dec. 2014, released Jan 20, 2015. See also FERC Order No. 672, Final Rule, FERC Stats. & Regs. ¶ 31,204 (2006), ¶ 71: "If electric energy from a generating facility is needed to maintain a reliable transmission system, that facility is needed to maintain reliability."

the regional transmission system is to increase robustness. Greater robustness will result from raising the voltage level before system collapse, or by demonstrating a reduction in the cumulative risk of transformer overheating and permanent damage.

It is of particular concern to Resilient Societies that the transformer thermal assessment threshold adopted within Standard TPL-007-1, a modeled assessment of 75 amps per phase or greater, ***not be a threshold for cost recovery eligibility*.** The threshold in the original draft standard submitted to the NERC ballot body was 15 amps per phase or higher. The NERC Standard Drafting Team watered down the standard, apparently to achieve the two-thirds vote of the ballot body not obtained in the first three ballots—a violation of FERC Order No. 672 that prohibits "least common denominator standards." As a practical example for the PJM territory, a standard containing a transformer thermal assessment limit of 75 amps per phase would exclude from cost recovery protection for almost all of their roughly 560 high voltage transformers.

It is notable that the IEEE Transformer Guide, published in September 2015 and referenced in this docket record, recommends transformer thermal assessments at 15 amps per phase or higher. Were instead the 75 amp per phase threshold to be a qualification for cost-recovery, it is likely no hardware protection would be installed—resulting in significant net harm to the reliability of the North American electric grid.

Facilities in coastal regions, a hazard not specifically included in NERC's Benchmark GMD Event, have experienced major transformer damage or total loss at levels below 75 amps per phase.[13] Also note the March 1, 2016 testimony of Professor Gaunt and of Terry Volkmann indicating

[13] The Salem-1 500 kV transformer that melted on March 13, 1989 experienced about 90 amps per phase. Within months, the Salem-2 transformer suffered permanent loss during a smaller storm in September 1989. Another example of a partial transformer loss during a solar storm but under 75 amps per phase involved the Seabrook Unit 1 345 kV transformer. A solar storm on Nov 8-10, 1998 had a North-South Axis, then a reversal and a "sudden impulse" that shook loose a 4 inch stainless steel bolt through vibration effects. See W R Harris Report, Jan 30, 2012 filed with the NERC GMD Task Force. The proximate cause of the 12.2 day outage, with meltdown of the Phase A transformer was the solar storm. But the magnitude of that storm, before GIC instrumentation, is most likely less than 75 amps per phase. Also during the March 1989 solar storm, Maine Yankee suffered damage to its 345 kV GSU transformer, and site managers ordered expedited purchase of a backup transformer within two weeks. Again, the amps per phase, though not monitored at the neutral ground, were most likely under 75 amps. Equipment that would justify protection has been damaged in solar storms at well less than 75 amps per phase.

substantial transformer damage during GMD events with GIC in the 15 amp to 75 amp range, and sometimes below 15 amps. Moreover, as noted by Terry Volkmann on March 1, 2016, Luis Marti has identified potential generator damage at amps per phase of 50 amps.[14] In conclusion, disqualification of cost recovery under a range of modeled GIC of 15 amps to 75 amps per phase range would be arbitrary and capricious, and discriminatory against various geographic regions, such as more southerly latitudes that still incur high insurance claims, or communities near saline coastal waters.

Therefore, Resilient Societies recommends that the Commission, exercising its broad authority to set rates, terms, and conditions, per Sections 205 and 206 of the Federal Power Act, not set a particular amp threshold. Instead, the Commission should let applicants file for cost recoveries under Section 205 of the Federal Power Act, with the burden upon the applicant to demonstrate enhancement to reliable operation; and to demonstrate no net reduction in grid reliability in other states or regions.

The filing of a Section 205 Application for cost recoveries, with rates, terms and conditions reviewable by the Commission, provides flexibility to adapt to actual conditions measured in local networks and encourages use of regional assessments (e.g. Bonneville Power Administration and PowerWorld modeling) that can be refined to model locational variance in GIC. This modeling is expected to show no net harm to system reliability.

An alternative criterion for cost recovery would be for FERC to apply the IEEE assessment threshold of 15 amps per phase, with 15 amps per phase the minimal threshold for cost recovery. Even a threshold of 15 amps per phase may exclude from cost-recovery protection of some transformers that are vulnerable below the 15 amp cutoff. Specifically, in their March 8, 2016 Comment on the March 1, 2016 Technical Conference, Messrs. Kappenman and Birnbach note that tertiary winding damage, not considered by the NERC Standard Drafting Team, can occur below 15 amps per phase. Hence, Resilient Societies prefers that the Commission

[14] Afshin Rezaei-Zare and Luis Marti, "Generator Thermal Stress During a Geomagnetic Disturbance," IEEE Power and Energy Society Conference, Vancouver, BC, 21-25 July 2013, 5 pp. ("the generator capability limit can be exceeded at moderate GIC levels, e.g. 50A/phase and the [generator] rotor damage is likely during a severe GMD event.")

establish cost recovery criteria that are separate and distinct from the flawed Benchmark GMD Event and associated transformer thermal assessment thresholds in Standard TPL-007-1. In this way, cost recovery via Section 205 Applications can proceed in parallel with improvements to the (defective) NERC standard during the roughly five years of proposed implementation period.

Alter Tariff Approvals to Require GIC Data Sharing by Utilities

Resilient Societies recommends that the Commission require GIC data-sharing by utilities as a precondition for cost recovery. Currently, utilities conceal GIC data from public view. Concealment of public safety data, which also impacts system reliability, should not be tolerated by the Commission, especially when the burden of approved cost recoveries will be borne by the public.

We concur with Comments filed by David Jonas Bardin on March 4 and March 6 in this Docket supporting disclosure of GIC data. We concur with Dr. Jeffrey Love that the withholding of GIC data, including historical time series, would impair the scientific process. We also note that Ping Things, a company on the forefront of modeling GIC through the use of synchrophasor data, has testified that barriers to acquisition of industry data are significant.

During the June 2015 Level 2 NERC Appeals hearing, the Chairman of the NERC Standards Drafting Team conceded that the NERC benchmark model has not been validated with empirical data from the U.S. electric grid. To the contrary, the NERC model has been invalidated by real world data. See the filings in this Docket by John Kappenman and Terry Volkmann; and the August 10, 2015, October 27, 2015, and March 1, 2016 filings by Resilient Societies. To reward the anti-scientific NERC Benchmark GMD Event with further concealment of GIC data would be unconscionable and contrary to the public interest.

The Commission needs to take note of experience with GIC data provided to the Maine State Legislature. This data release by Central Maine Power enabled the Electric Infrastructure Security Council to sponsor investigation of GMD risks in Maine and elsewhere. As a result, it

was possible to benchmark various solar storms, and to confirm that the NERC Benchmark GMD Event systematically underestimates hazards when compared to real-world events.

Improved access to past GIC data for Maine has improved cooperation among the various stakeholders interested in greater grid resilience. Good-faith sharing of GIC data was a critical factor in making progress.

More recently, at the January 2016 Central Maine Power review of ongoing research by Ping Things, researchers have generated the hypothesis that the Chester Maine time series of GIC readings may substantially understate actual magnitudes. With new GIC instrumentation at Albion Road substation and at McGuire Road Substation, both in good agreement, it now appears that the Chester, Maine monitoring may have systematically under-reported GIC. New GIC instrumentation may be installed in Chester, Maine, and time will be needed to determine if the past GIC data needs to be reconsidered. Without public availability of GIC data, and opportunities for fresh thinking by newly involved scientists, progress towards a more resilient Maine electric grid would be much slower.

Were FERC, in the alternative, to adopt the Trade Association proposal to suppress public access to GIC data,[15] what would be the consequences? The Commission knows that NERC's Standard Drafting Team failed to validate the Benchmark GMD Event with North American data. As a result, the Commission can reasonably expect that "improvements" to the Benchmark GMD Event would also lack scientific foundation.[16] Also, as witnesses at the March 1 technical conference testified, technical journals are increasingly refusing to publish articles that reference non-public data. Restriction of public access to GIC data will surely demotivate

[15] See Edison Electric Institute, et al. Comments filed March 4, 2016 in Docket RM15-11-000.

[16] It is also noteworthy that the first EPRI-sponsored SUNBURST data for the period of roughly 1990 through year 2000 have never been publicly released. To the best of our information and belief, the entire time series of SUNBURST network GIC data was lost on a SUNBURST contractor computer that crashed in Pittsburgh, Pennsylvania without adequate computer file backups. No SUNBURST program employee will confirm or deny the loss of historical SUNBURST GIC time series data. One risk of suppressing public access to scientific data is the risk that the data series will be irretrievably lost or compromised. For example, Mr. Frank Koza of PJM stated during his March 1, 2016 testimony at the FERC GMD Technical Conference that GIC data at PJM might be stored for only a few years.

future scientific study—competent researchers will simply move on to other areas of investigation.

Restrictions on the public disclosure of GIC data and GMD planning studies would harm electric reliability and are not in the public interest. Utilities have a record of selective disclosure of GIC data for specific times and locations when it is their interest and, in contrast, have declined to disclose and/or use GIC data when that data might be inconsistent with the NERC Benchmark GMD Event, or when that data might subject them to more prudential reliability standards. For example, American Electric Power (AEP) disclosed GIC data in a December 2015 article in IEEE's *Electrification* magazine,[17] but this GIC data was not cited by the NERC Standard Drafting Team.

The limited number of GMD planning studies that have been publicly highlighted have shown conflict in their conclusions which should be explained to FERC and to the public; explanations that can only be provided and independently validated if the studies become public. For example, the AEP planning study presented in *Electrification* magazine found that installation of blocking devices would not significantly reduce GIC, the opposite of results found for other regions such as the Central Maine Power network in Maine.

Peer review, FERC review, and public review of GMD planning studies is especially important because some engineering approaches will cost-effectively mitigate GIC flows while others may be less effective—especially when the public will be paying for GMD mitigation. For example, in the AEP article in *Electrification* magazine, their engineers do not propose the use of series capacitors in combination with neutral ground blocking devices, but only state that use of blocking devices alone would minimally reduce GIC flows. However, proper engineering practice is to use series capacitors at substations with autotransformers.[18]

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[17] Qlu, Qun et. al. (2015),"Geomagnetic Disturbance," IEEE *Electrification Magazine*, December 2015, pp. 22-33.
[18] The AEP article "Geomagnetic Disturbance" in *Electrification Magazine* (Dec. 2015) states, at p. 31: "When the blocking device is added to an autotransformer, this primarily only reduces the GIC flow in the common winding and has limited impact on the series winding GIC flows; in fact, the GIC flow in the series winding might actually increase." However, a reference guide on electromagnetic pulse and GMD mitigation states: "The blocking device only blocks GIC flow in the ground connected winding…. To fully block the GIC for an autotransformer, a series capacitor would also be needed on at least one side of the transformer." See Stockton, Paul, et. al. (2014). *EPRO Handbook*. The Electric Infrastructure Security Council, p. 139.

Critical Energy Infrastructure Information (CEII) restrictions should not be allowed as an excuse to prevent public disclosure or third party validation of GIC data and GMD planning assessments. The industry has not shown a shred of evidence that release of this information would represent a security risk, especially when government-owned utilities such as Bonneville Power Administration (BPA) and Tennessee Valley Authority have already released GIC data and a planning study under the Freedom of Information Act. In fact, the technically unsupported assertion of CEII should be ruled inapplicable by FERC for data on natural hazards, because the release of data will not affect the probability or magnitude of a natural event whatsoever. However, release of GIC data may show hazards to the public interest that utilities have not remedied, and may support economic models of payback periods for investment in protective equipment.

COMMISSION PRECEDENT FOR COST RECOVERY

Resilient Societies encourages the Commission to revisit and utilize the precedent set with Smart Grid partial cost-recovery set in year 2009. In implementing the American Recovery and Reinvestment Act (ARRA) (P.L. 111-5), sec. 405(3) (2009), the Commission determined Smart Grid improvements should not adversely affect reliability, and conditioned the approval of Smart Grid cost recovery upon Applicant agreement *"to provide feedback useful to the interoperability standards development process … by sharing information with the Department of Energy Smart Grid Clearinghouse."*[19]

We also encourage the Commission to develop a broader package of data sharing criteria than merely requiring GIC data in exchange for cost recovery. As mentioned previously, through the Freedom of Information Act we were able to attain the GMD model for the Pacific Northwest developed by the BPA. The release of this model substantially contributed to the public knowledge; namely, by showing the Pacific Northwest grid would collapse during moderate

[19] See Federal Energy Regulatory Commission, "Smart Grid Policy Statement," Docket PL09-4-000, Para. 122, at p. 73, and Para 126 at p. 75 (mandatory data sharing for program participants), 128 FERC ¶ 61,060, July 16, 2009.

solar storms; and also by identifying equipment locations that are candidates for reliability-enhancing demonstration programs. We were also able to file excerpts from the BPA study on the FERC Docket. It would likewise be "in the public interest" if utilities receiving cost recoveries—a burden financed ultimately by electricity ratepayers—were required to share GMD studies that justify cost recovery or that demonstrate the need for "best practices" in operating electric grids during geomagnetic disturbances, in instrumenting electric grids for GIC, and in installing hardware protection.

CONCLUSIONS

In its Final Order and Rulemaking relating to proposed Standard TPL-007-1, the Commission should:

1. Adopt cost recovery criteria and procedures[20] that encourage voluntary initiatives and associated Section 205 rate filings for cost recovery of:
    a. Regional system modeling that may demonstrate the need for GMD protection
    b. Hardware protective devices
    c. GIC monitors and other measurement devices
2. Attain outcomes whereby the floor of a GMD reliability standard does not become the ceiling, and to also encourage "best practices", by either:
    a. Enabling applications for cost recovery without regard to the amps per phase transformer thermal assessment threshold of a NERC standard, or
    b. Enabling cost recovery for protections at a thermal assessment threshold of 15 amps per phase, consistent with the threshold in the IEEE Transformer Guide released in September 2015 and cited in this Docket.
3. Follow FERC precedent set for cost recovery of Blackstart reliability capacity and operational cost upgrades, with a process using Section 205 rate filings.

[20] The burden of proof should be upon applicants to ***publicly*** show hardware protection will enhance regional transmission system reliability and not impair reliability in other states or other RTOs.

4. Utilize precedent set with the year 2009 FERC-approved Smart Grid cost-recovery initiatives (under ARRA), which caused FERC to order Smart Grid data sharing with the U.S. Department of Energy (DOE). Hence, in its final order on GMD standards, FERC should likewise require tariff amendments to require GIC data sharing by utilities with FERC, DOE, Reliability Coordinators, research scientists, and the public.
5. Remand the defective NERC Standard TPL-007-1 and included Benchmark GMD Event for further review as the Commission determines.

Respectfully submitted by:

William R. Harris, Secretary,
williamh@resilientsocieties.org

Thomas S. Popik, Chairman
thomasp@resilientsocieties.org
For the
FOUNDATION FOR RESILIENT SOCIETIES, INC.
52 Technology Way
Nashua, NH 03060
www.resilientsocieties.org