

UNITED STATES OF AMERICA  
BEFORE THE  
FEDERAL ENERGY REGULATORY COMMISSION

Reliability Standard for ) Docket No. RM14-1-000  
Geomagnetic Disturbance Operations )

REQUEST FOR REHEARING OF FERC ORDER No. 797, RELIABILITY STANDARD FOR  
GEOMAGNETIC DISTURBANCE OPERATIONS, 147 FERC ¶ 61209, JUNE 19, 2014  
AND MOTION FOR REMAND

Submitted to FERC on July 21, 2014<sup>1</sup>

Pursuant to section 313(a) of the Federal Power Act (“FPA”), 16 U.S.C. § 825 (a), and Rule 713 of the Federal Energy Regulatory Commission’s (“FERC” or “Commission”) Rules of Practice and Procedure, 18 C.F.R. § 385.713, the Foundation for Resilient Societies hereby respectfully submits this Request for Rehearing of the Final Rule issued in this docket and Motion for Remand, relating to FERC Order No. 797.

The Foundation for Resilient Societies (or “Resilient Societies”) is incorporated in the State of New Hampshire as a non-profit organization engaged in scientific research and education with the goal of protecting technologically-advanced societies from infrequently occurring natural and man-made disasters. All technologically-advanced societies rely on critical infrastructures—electric power generation and transmission, telecommunications, transportation, financial services, petrochemical refining, food production, water, and sanitation, to name just a few. Sustained interruption of any one of these critical infrastructures can result in economic, political, and social chaos. The profit incentive, which normally serves society well, provides inadequate protection from disasters that occur infrequently but have impact beyond the responsibilities of commercial enterprises. Resilient Societies seeks to identify cost-effective

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<sup>1</sup> The Petition for Rehearing is timely filed, because the 30-day filing deadline falls on Saturday July 19, 2014, and the FERC Office of the Secretary advised that filing on Monday, July 21, 2014 would be timely. See also *Cities of Batavia, et al. v. FERC*, 672 F.2d 64 at 72 (D.C. Circuit, 1982)(FERC regulations extend filing deadlines for weekend due dates and for legal holidays in the District of Columbia).

opportunities to protect societies and then develop policy initiatives. Information about Resilient Societies may be found at [www.resilientsocieties.org](http://www.resilientsocieties.org).

## Background

Pursuant to Section 215 of the Federal Power Act (“Section 215”), the Commission approved Reliability Standard EOP-010-1 (Geomagnetic Disturbance Operations) as just, reasonable, not unduly discriminatory or preferential, and in the public interest. The North American Electric Reliability Corporation (hereinafter “NERC”), the Commission-certified Electric Reliability Organization (ERO), submitted the Reliability Standard for Commission approval in response to a Commission directive in Order No. 779. The Reliability Standard is designed to mitigate the effects of geomagnetic disturbances (GMD) on the Bulk-Power System by requiring responsible entities to implement Operating Plans and Operating Procedures or Processes.

Resilient Societies participated in standard-setting at NERC for Reliability Standard EOP-010-1 as a member of the ballot body and submitted comments to the Standard Drafting Team. Resilient Societies submitted comments in rulemaking under FERC Docket RM14-1-000.<sup>2</sup>

In this request for rehearing, Resilient Societies asserts a reasonable person should not conclude that FERC Order 797 and Reliability Standard EOP-010-1 are just, reasonable, and in the public interest. Moreover, a reasonable person reviewing the entire proceedings and Docket filings preceding Order No. 779 and No. 797 would conclude that FERC Order 797 and Reliability Standard EOP-010-1 are unjust, unreasonable, unduly discriminatory, anti-competitive, preferential among NERC registered entities, and interfere with established statutory rights and duties of the President of the United States, the Secretary of Energy, and the Nuclear Regulatory Commission. FERC Order 797 and Reliability Standard EOP-010-1 are inconsistent with Section 215 and its implementation as expressed in FERC Orders 672 and 672-A. FERC Order 797 and Reliability Standard EOP-010-1 are inconsistent with the bright-line definition of the Bulk Electric System per FERC Orders 743, 743-A, and 773. Finally, FERC Order

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<sup>2</sup> See “Comments of the Foundation for Resilient Societies Submitted to FERC on March 24, 2014” under FERC Docket RM14-1-000, incorporated in its entirety by reference.

797 is arbitrary and capricious and otherwise violates due process requirements of the Administrative Procedure Act as expressed in statute and in applicable court precedent.

## Statement of Issues and Specifications of Error

### 1. Capricious Approval of Empty Standard.

FERC erred by approving an ineffective standard, devoid of any implementation of operational requirements upon applicable NERC entities, and not including any requirement whatsoever for mandatory exercises, unscheduled drills, authentication of de-energizing orders, or practice of GMD operating procedures, when lack of implementation requirements sacrifice uniformity, create uncertainty, make enforcement difficult, and increase the likelihood of cascading outages and separations. Addressing the complexity of the Commission's oversight and review process, the Commission indicated in FERC Order 672<sup>3</sup>, para 260:

While we are sympathetic to ISO/RTO Council's suggestion that, in general, a Reliability Standard should address the “what” and not the “how” of reliability and that the actual implementation of a Reliability Standard should be left to entities such as control area operators and system planners, in certain limited situations there may be a good reason to leave implementation practices out of a Reliability Standard. In other situations, however, the “how” may be inextricably linked to the Reliability Standard and may need to be specified by the ERO to ensure the enforcement of the Reliability Standard. For some Reliability Standards, leaving out implementation features could: (1) sacrifice necessary uniformity in implementation of the Reliability Standard; (2) create uncertainty for the entity that has to follow the Reliability Standard; (3) make enforcement difficult; and (4) increase the complexity of the Commission's oversight and review process. Accordingly, we leave it to the ERO to develop proposed Reliability Standards that appropriately balance reliability principles and implementation features.

In this instance, NERC did not appropriately balance reliability principles and implementation effectiveness, because its own GMD Task Force developed implementation templates for Generator Operator and Transmission Operator operating procedures that were approved by

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<sup>3</sup> See FERC Order No. 672, Rules Concerning Certification of the Electric Reliability Organization; and Procedures for the Establishment, Approval, and Enforcement of Electric Reliability Standards, FERC Stats. & Regs. ¶131,204; Order on rehearing, FERC Order No. 672-A, FERC Stats. & Regs. ¶131,212 (2006).

the NERC Planning Committee but were not included in the approved standard.<sup>4</sup> No reasonable person would conclude that when the lives and safety of millions of Americans depend upon reliable implementation of GMD operating procedures that there should be no requirement for system wide exercises, unannounced drills, and authenticated actions to prevent widespread loss of critical equipment.

Instead of containing reasonable requirements, Reliability Standard EOP-010-1 is a “lowest common denominator” standard designed to achieve consensus within the NERC standard development process. Indeed, Reliability Standard EOP-010-1 easily passed with a vote of 92% in favor once [Generator Operators and Balancing Authorities](#) were eliminated from the list of applicable entities.

FERC anticipated how the standard-setting process might be manipulated in this manner and prohibited it in Order 672:

A mandatory Reliability Standard should not reflect the “lowest common denominator” in order to achieve a consensus among participants in the ERO’s Reliability Standard development process. Thus, the Commission will carefully review each Reliability Standard submitted and, where appropriate, remand an inadequate Reliability Standard to ensure that it protects reliability, has no undue adverse effect on competition, and can be enforced in a clear and even-handed manner.<sup>5</sup>

In its comment under FERC Docket RM14-1-00, Resilient Societies stated:

In essence, Standard EOP-010-1 proposes a balkanized self-regulatory scheme, where Reliability Coordinators and Transmission Operators would devise their own plans and procedures within timeframe buckets (“Long-term Planning, Operations Planning, Same-day Operations, and Real-Time Operations”) but there would be no mandatory mitigative actions within the timeframes. GMD Operating Procedures of Transmission Operators would be subject to review by Reliability Coordinators. There would be no mandatory external review of GMD Operating Plans of Reliability Coordinators.

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<sup>4</sup> See “Geomagnetic Disturbance Operating Procedure Template Transmission Operator” available at [http://www.nerc.com/docs/pc/gmdtf/Template\\_TOP.pdf](http://www.nerc.com/docs/pc/gmdtf/Template_TOP.pdf) and “Geomagnetic Disturbance Operating Procedure Template Generator Operator” available at [http://www.nerc.com/docs/pc/gmdtf/Template\\_GOP.pdf](http://www.nerc.com/docs/pc/gmdtf/Template_GOP.pdf).

<sup>5</sup> *Ibid.*, para 29.

In Order 797, FERC erred because it did not address the Resilient Societies' comment regarding lack of mandatory mitigative actions and lack of mandatory external review of GMD Operating Plans of Reliability Coordinators.<sup>6</sup>

## 2. Arbitrary Exclusion of Networks Operating at 200 kV and below.

FERC erred by approving a standard that exempts transmission networks with no transformer with a high side (wye-grounded) voltage at or above 200 kV when actual data and lessons learned from past operating incidents show significant adverse impacts of solar storms on equipment operating below 200 kV. FERC Order 672, para 324 reads:

The proposed Reliability Standard must be designed to achieve a specified reliability goal and must contain a technically sound means to achieve this goal...It should be based on actual data and lessons learned from past operating incidents, where appropriate.

The comment of Resilient Societies quoted a report of the Oak Ridge National Laboratory that presented "actual data and lessons learned from past operating incidents" to make the case that networks operating below 200 kV were in fact impacted by a moderate solar storm on March 13, 1989. The comments of Resilient Societies to NERC, also included in its comment under Docket RM14-1-000, quoted PowerWorld modeling results showing that reactive power in networks at 200 kV and above left out more than 40 percent of cumulative reactive power (MVAR) consumed in solar storm modeling scenarios for some regions.

In Order 797, FERC concluded,

The NERC petition and White Paper Supporting Network Applicability provide an adequate technical basis to conclude that transformers operating at 200 kV and below are likely to have a limited impact on the Bulk-Power System during a GMD event. We are not persuaded by the Foundation comments, discussed above, which do not refute this

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<sup>6</sup> Courts have repeatedly held that the Commission is obligated to address issues raised before it, and that a "failure to respond meaningfully" to objections raised by a party renders its decision arbitrary and capricious." See *PPL Wallingford Energy LLC v. FERC*, 419 F.3d 1194, 1198 (D.C. Cir. 2005) (quoting *Canadian Association of Petroleum Producers v. FERC*, 254 F.3d 289, 299 [D.C. Cir. 2001]). Unless the Commission "answers objections that on their face seem legitimate, its decisions can hardly be classified as reasoned." See *Motor Vehicle Mfrs. Ass'n v. State Farm Mu. Auto Insurance Co.*, 463 U.S. 29, 43 (1983); *North Am Gas Transmission Co. v. FERC*, 148 F.3d 1158 (D.C. Cir. 1998) ("It most emphatically remains the duty of this court to ensure that an agency engage the arguments raised before it that it conduct a process of reasoned decision-making.") (quoting *K N Energy, Inc. v. FERC*, 968 F.2d 1295, 1303 (D.C. Cir. 1992)); *Ill. Pub. Telecomm. Ass'n v. FCC*, 117 F.3d 555, 564 (D.C. Cir. 1997).

conclusion, or the materials cited by SmartSense. SmartSense cites a table in the Oak Ridge Laboratory GMD Study identifying at-risk transformers operating at 345 kV, which fall within the applicability criteria. Moreover, the Oak Ridge Laboratory GMD Study found that significantly higher GIC flows occur at higher operating voltages.

The report of Oak Ridge National Laboratory cited by FERC shows that Geomagnetically Induced Current (GIC) flows of up to 1,800 amps are expected to occur during severe solar storms.<sup>7</sup> The report of the Oak Ridge National Laboratory also showed experiential data that transformers can be permanently damaged at 90 amps of GIC.<sup>8</sup> Therefore, while GIC flows may be lower in networks operating at lower voltages, the Oak Ridge report does not state that the GIC flows in lower voltage networks will be so trivial as to have no impact, or that lower but still damaging GIC flows will not nonetheless cause cascading failure or violation of thermal, voltage, or stability limits.

FERC Order 672 holds the ERO to a higher standard than “limited impact” on Reliable Operation, requiring reliability failures will not occur, not merely a lower likelihood:

Reliable Operation 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 of such system *will not occur* as a result of a sudden disturbance, including a Cybersecurity Incident, or unanticipated failure of system elements. (Emphasis added.)

### 3. Arbitrary Inconsistency with Prior Definition of Bulk Electric System.

The exclusion of networks operating at 200 kV and below is inconsistent with the prior bright-line definition of the Bulk Electric System. FERC acted arbitrarily and capriciously in departing from its own precedent and not discussing in Order 797 rationale for departure from the “bright-line” Bulk Electric System definition, other than citing a NERC whitepaper at odds with the Oak Ridge GMD study.<sup>9</sup>

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<sup>7</sup> See “Geomagnetic Storms and Their Impacts on the U.S. Power Grid,” Oak Ridge National Laboratory, January 2010, available at [http://web.ornl.gov/sci/ees/etsd/pes/pubs/ferc\\_Meta-R-319.pdf](http://web.ornl.gov/sci/ees/etsd/pes/pubs/ferc_Meta-R-319.pdf), at page 4-12.

<sup>8</sup> *Ibid.* at page 2-30.

<sup>9</sup> The Commission must explain a departure from precedent and Order 797 fails to adequately address the Commission’s departure from Orders 743, 743-A, and 773. See, e.g, *Greater Boston Television Corp. v. FCC*, 444 F.2d 841, 852 (D.C. Cir. 1970) (“an agency changing its course must supply a reasoned analysis indicating that prior policies and standards are being deliberately changed, not casually ignored, and if an agency glosses over or

#### 4. Lack of a Concomitant and Reasonable Requirement for Monitoring of Solar Storm Impacts by GIC Detectors and Remote Reporting of GIC Data.

FERC erred by approving a standard that does not require instrumentation of electric utility networks during solar storm conditions when installation of GIC monitors would be cost-effective and in the public interest. When FERC, in Order No. 779 directed, *sua sponte*, the submission by the ERO of reliability standards to mitigate geomagnetic disturbances, NERC had an open standards development project to mandate equipment monitoring and diagnostic devices for critical grid equipment.<sup>10</sup> By year 2013, the cost of Geomagnetically Induced Current (GIC) monitoring equipment had dropped by more than an order of magnitude from costs several years earlier: from \$200,000 per GIC monitor to \$10,000 per GIC monitor, including programmable SCADA devices that are capable of automated, near-real-time reporting of various GIC thresholds (rising, or falling) to transmission or generator operating control centers, and to regional Reliability Coordinators. Representatives of Generator Operators owning generating plants identified as GIC “hotspots” urged NERC to eliminate this in-development standard just as FERC was nearing the issuance of FERC Order 779 in May 2013.

Resilient Societies, with observers attending the NERC Reliability Issues Steering Committee meeting on May 9, 2013, was concerned that the deletion of equipment monitoring (including GIC monitoring) as a requirement to assess and protect high voltage transformers would reduce visibility of transformer damage or permanent losses, both at Generator Operator facilities and at regional Reliability Coordinator facilities. We filed our concern at the elimination of essential GIC monitoring with FERC on Docket RM12-22-000, two days before FERC issued Order No. 779. The NERC Standards Committee then proceeded to eliminate the project for the equipment monitoring standard in June 2013, and the NERC Board of Trustees ratified that decision in November 2013.<sup>11</sup>

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swerves from prior precedents without discussion it may cross the line from the tolerably terse to the intolerably mute”); *La. Pub. Serv. Comm’n v. FERC*, 184 F.3d 892, 897 (D.C. Cir. 1999)

<sup>10</sup> NERC Project 2012-01 — Equipment Monitoring and Diagnostic Devices

<sup>11</sup> In May 2013 the NERC RISC Committee claimed that “further research” was required, as a rationale to eliminate NERC standards project 2012-01. Tracking through the NERC Committee documents, Resilient Societies found that no “research” was specified by any of the relevant NERC Committees. The apparent goal of the RISC Committee and the Standards Committee was to terminate the project in time to rationalize the removal of Generator

By eliminating a potential standard requiring mandatory installation of low-cost GIC monitors, the Generator Operators in the NERC standards development process then argued that Generator Operators might not know the state of solar storm conditions at their generating facilities, because they might not own installed GIC monitors! Hence, NERC now claimed, Generator Operators should be eliminated from mandatory participation in GMD operating procedures.

In Order No. 797, the FERC Commissioners dismissed our concerns that, without a concurrent requirement for GIC monitors at critical grid equipment, operating procedures would be less effective, and incentives to purchase hardware protection would diminish. FERC noted that Resilient Societies had not provided the counts or locations of actually deployed GIC monitors. Was this a reasonable precondition for FERC to address the key role of GIC monitoring? It appears to be unreasonable, and not in the public interest to exclude the essential need for GIC monitoring equipment, yet at the same time to assign primary responsibility for operational mitigation to 16 regional Reliability Coordinators who will have little or no visibility as to actual GIC conditions at the critical but remote GSU transformers requiring protection from severe solar storms.

In its whitepaper to support FERC approval of Reliability Standard EOP-010-1, NERC in November 2013 admitted: "Generator step-up transformers are typically situated at electrical end points of the network where GIC tends to be highest."<sup>12</sup>

Without GIC monitors at GSU transformers, and automated data readout at regional Reliability Coordinator facilities, it will be impractical and imprudent to expect that regional Reliability Coordinators could save GSU transformers that are unprotected by hardware from serious damage or permanent loss in a severe solar storm. Even with the best space weather forecasts from NOAA, only awareness of conditions at the actual GSU transformers would justify ordering

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Operators (GOPs) from mandatory participation in GMD operating procedures because GOPs might have insufficient information about GMD conditions at their facilities.

<sup>12</sup> See NERC whitepaper "Network Applicability, Project 2013-03 (Geomagnetic Disturbance Mitigation); EOP-010-1 (Geomagnetic Disturbance Operations)" available at [http://www.nerc.com/pa/Stand/Project201303GeomagneticDisturbanceMitigation/ApplicableNetwork\\_clean.pdf](http://www.nerc.com/pa/Stand/Project201303GeomagneticDisturbanceMitigation/ApplicableNetwork_clean.pdf).

the de-energizing of GSU transformers, effectively requiring the loss of generation at each of these de-energized sites.

What about the role of the regional Reliability Coordinators relative to GSU transformers whose owners opt to install neutral ground hardware protection? The manufacturers of neutral ground blocking devices install GIC monitors as part of the equipment packages to be sold. Owners of the hardware-protected GSU transformers should be able to “operate through” a severe solar storm, and they will know the GIC variations and conditions of their on-site GSU transformer. They will not require assistance or instruction from a regional Reliability Coordinator; they will generate electricity, unless a most severe solar storm exceeds the design tolerances of the protective equipment.

In contrast, the GSU transformer operators who have not opted to install neutral ground blocking equipment have no obligation to have low-cost GIC monitors on site. They should expect no practical assistance from regional Reliability Coordinators who have no knowledge of risks of permanent damage to remote GSU transformers.

Were the regional Reliability Coordinators to order de-energizing of GSU transformers owed by entities without any duty to participate in GMD operating procedures, would a Generator Operator have good cause to refuse to implement a regional Reliability Coordinator order to de-energize an unprotected transformer when the regional Reliability Coordinator lacks apparent legal authority for the order?<sup>13</sup> FERC has established a system of solar storm mitigation that might work for minor solar storms but it is altogether unworkable,

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<sup>13</sup> Generator Operators, along with other entities receiving directives from Reliability Coordinators under Reliability Standard IRO-001-01.1 (approved by FERC on May 13, 2009) “shall comply with Reliability Coordinator directives” per requirement R8, “unless such actions would violate safety, equipment, or regulatory or statutory requirements.”

Without mandatory reporting to Reliability Coordinators of readouts from near-real-time GIC monitoring equipment at Generator Operator sites – requirements presently lacking – the Generator Operators may reasonably assert they have better visibility of safety and equipment protection requirements than do the regional Reliability Coordinators. Is FERC Order No. 797 by itself a regulatory defense against the need to comply with a directive from a Reliability Coordinator to de-energize a remote transformer? For a gas-fired generation facility, is the exclusive statutory authority vested in the President to order shutdown of a generating facility a valid basis to decline to implement a Reliability Coordinator directive?

unreasonable, imprudent, and unjust to utilize this design for “operating procedures” in a severe solar storm.

Lack of visibility at regional Reliability Coordinator centers, and their backup centers will provide discriminatory impacts upon electric consumers: those served by hardware-protected equipment are more likely to avert or minimize regional blackouts. Those depending upon regional Reliability Coordinators and remote generation sites that lack GIC monitors are more likely to suffer extended blackouts. This is not just and reasonable; it is discriminatory; and it is not in the public interest. Moreover, there may be inequitable and unjust shielding of Generator Operators and owners from liability for failure to cope with foreseeable risks in solar storms. FERC’s Order No. 797 exempts Generator Owners and Operators from responsibility for participating on GMD operating procedures. In effect, FERC enables risk-shifting and cost-shifting from the generator entities to the consumers and businesses that suffer avoidable electric blackouts. This is unjust, unreasonable, and in violation of the standards of Section 215 of the Federal Power Act.

Resilient Societies addressed the alleged high costs of GIC monitors in a Maine Docket on GMD and EMP mitigation (Maine Docket 2013-00415). In that Docket it was alleged by a Maine utility that GIC monitors cost about \$200,000 apiece. We conducted research on the Internet, and identified a manufacturing entity in New Jersey that sold GIC monitors at \$10,000 per unit, or \$15,000 per unit if dissolved gas and transformer temperatures were also reported, using the same SCADA devices, to owner-operators and remote third parties needing the data. We learned that wind power generators are on their own initiative installing GIC monitors, so they could demonstrate the adequacy of power quality at connections to bulk power transmission entities. But we had and still have no ability to identify each of the customers and installation locations for GIC monitors nationwide. This is proprietary data of manufacturers of GIC monitoring equipment. We filed information about the GIC equipment and costs in the relevant FERC Docket. But we lack authority to compel disclosure of GIC monitoring equipment locations, installation by installation nationwide.

Resilient Societies asserts that FERC is using an improper, impossible-to-meet standard in deciding whether to consider the need for GIC monitoring and remote reporting systems as an essential element of operating procedures to mitigate geomagnetic disturbances.

Are GIC monitors (and associated automated data readout and remote reporting capabilities) both cost-effective and essential to effective solar storm mitigation? These are more pertinent questions that FERC should ask and answer.

GIC monitors cost only \$15,000 per unit. There are approximately 2,100 extra high voltage transformer locations in the United States. GIC monitors at every high voltage transformer would cost only \$31.5 million, or a one-time expenditure of merely ten cents per American.

The Oak Ridge National Laboratory summary report on GMD, "Electromagnetic Pulse: Effects on the U.S. Power Grid" concluded that a severe solar storm could leave 130 million Americans without power for over one year.<sup>14</sup> Because 130 million Americans represent 40% of the total population, we estimate that 40% of GDP would be lost for at least one year, or about \$6.4 trillion. Oak Ridge National Laboratory estimates that the chance of a severe solar storm in any single year is about 1%; therefore the risk-adjusted economic loss would be 1% of \$6.4 trillion or \$64 billion. By not immediately requiring GIC monitors in Order 797, FERC takes the illogical position that the electric utility industry should not expend \$32 million to protect the American public against a risk adjusted loss of \$64 billion per year for the next five or more years.

FERC's defective logic and faulty cost-benefit position are clearly not in the public interest, but only in the interest of electric utilities which seek to avoid regulatory responsibilities and to place the costs and risks of blackout upon the public.

5. Unreasonable Delay of Benefits of Effective GMD Protection and Necessity of Rework upon Passage of a Phase II Hardware Protection Standard. In Order 979, FERC erred by taking the position that defects in Reliability Standard EOP-010-1, including the lack of required GIC

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<sup>14</sup> See "Electromagnetic Pulse: Effects on the U.S. Power Grid, Executive Summary," Oak Ridge National Laboratory, available at [http://web.ornl.gov/sci/ees/etsd/pes/pubs/ferc\\_Executive\\_Summary.pdf](http://web.ornl.gov/sci/ees/etsd/pes/pubs/ferc_Executive_Summary.pdf).

monitoring, need not be immediately remedied because the subsequent Phase II GMD standard might provide alternative or adjunct protection. From our perspective, no reasonable person would accept the FERC position that GIC monitoring and its benefits can be delayed until some speculative point in the future when another NERC standard might require it.<sup>15</sup> The current timeline for implementation of a Phase II standard would be one year after approval by FERC plus up to four years of additional implementation at utilities.<sup>16</sup> A severe solar storm can happen at any time, including during the next five years. Moreover, if a Phase II standard were to require GIC monitors, then the Phase I GMD standard for operating procedures would need to be reworked. No reasonable person would forego “getting it right the first time,” especially when the risks to the American public are so great.

#### 6. Lack of Reasonable Planning Requirement for Utilities to Perform Rudimentary Mathematical Calculations to Ensure Efficacy of GMD Operating Procedures.

FERC erred by approving a standard that does not require utilities to perform the most rudimentary planning for solar storms, i.e., mathematical comparison of megawatt capacity of assets at risk during solar storms to power reserves (the operations of addition and subtraction). In its comment in Docket RM14-1-000 and as an example, Resilient Societies presented actual data and operating experience from New England showing that megawatt capacity assets at risk during moderate solar storms exceeded reserves and asking that FERC require “quantified contingency planning” of utilities in any GMD operating procedure standard.<sup>17</sup> <sup>18</sup> “Contingency planning” is a well-known term of art in the electric utility industry. In discounting the comment of Resilient Societies, FERC claimed that the term “quantified

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<sup>15</sup> Rulemaking must prevent an “arbitrary result.” See *Borden, Inc. v. FERC*, 855 F.2d 254, 258 (5<sup>th</sup> Circuit, 1988). Under the Administrative Procedures Act, an order of a regulatory commission must be set aside if it is “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.” 5 U.S.C. § 706(2)(A).

<sup>16</sup> See “Implementation Plan Project 2013-03 Geomagnetic Disturbance Mitigation” at pages 2-3 available at [http://www.nerc.com/pa/Stand/Project201303GeomagneticDisturbanceMitigation/tpl\\_007\\_1\\_implementation\\_plan\\_20140603\\_CLEAN.pdf](http://www.nerc.com/pa/Stand/Project201303GeomagneticDisturbanceMitigation/tpl_007_1_implementation_plan_20140603_CLEAN.pdf)

<sup>17</sup> Resilient Societies objected to the “Lack of Requirements for Quantified Contingency Planning” at pp. 21-23 of Comments submitted March 24, 2014 in FERC Docket RM14-1-000.

<sup>18</sup> See Foundation for Resilient Societies, “Solar Storm Risks for Maine and the New England Electric Grid, and Potential Protective Measures, Interim Report”, March 19, 2013, available at [http://www.resilientsocieties.org/images/Interim\\_Foundation\\_Report\\_on\\_Maine\\_Solar\\_Storm\\_Risks\\_March\\_19\\_2013.pdf](http://www.resilientsocieties.org/images/Interim_Foundation_Report_on_Maine_Solar_Storm_Risks_March_19_2013.pdf)

contingency planning” was not defined but FERC did not present substantial evidence in the docket that it is unnecessary to mathematically compare assets at risk to available reserves.

Reliability standards set by NERC are subject to review by an “independent” Board of Trustees. According to the NERC Governance Guidelines, the Board of Trustees has a Duty of Care:<sup>19</sup>

Duty of Care requires the Trustee to use the care that an ordinarily prudent person would exercise in a like position and under similar circumstances in respect to performing the functions of a member of a board of directors. This duty of care is generally thought to have two components: the time and attention devoted to the organization’s affairs (including preparation for and attendance at meetings) and the skill and judgment reflected in decisions that affect the organization.

In approving a reliability standard that did not require utilities to make sure that the megawatt capacity of reserves exceeds the megawatt capacity of assets at risk during a solar storm, the NERC Board of Trustees appears to have violated a reasonable standard of care. No reasonable person would exempt utilities from performing rudimentary mathematical calculations in support of a reliability standard to protect the life and safety of 318 million Americans.

#### 7. Unreasonable Reliance upon Reliability Coordinators and Unreasonable Exemption of Balancing Authorities and Generator Operators.

FERC erred by concluding that sixteen Reliability Coordinators could directly communicate with up to 1,500 Transmission and Generator Operators during severe GMD events with a warning time of as little as 15 minutes and that Balancing Authorities and Generator Operators should not take action on their own because of possible lack of GIC data. In support of its position, Order 797 cites the NERC Reliability Functional Model:

We are not persuaded that GMD events pose unique communication problems for reliability coordinators because a reliability coordinator may only have 15-60 minutes warning of a severe solar storm. Reliability coordinators are responsible for real-time

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<sup>19</sup> See “North American Electric Reliability Corporation Governance Guidelines” available at <http://www.nerc.com/gov/bot/Documents/Governance%20Guidelines%20-%20Approved%202.6.14.pdf>.

system reliability and often must respond quickly or even immediately to Bulk-Power System events with little or no warning.<sup>20</sup>

We checked FERC's citation of the NERC Reliability Functional Model Technical Document at page 7. This document says "The Reliability Coordinator is responsible for Real-time system reliability..." but says nothing about the ability of Reliability Coordinators to actually perform this duty during fast-moving solar storms of regional or nationwide scope. No reasonable person would accept this citation as support for FERC's position, or as "substantial evidence" required to support the FERC Order.

Because Balancing Authorities and Generator Operators are exempted from planning for GMD events under Reliability Standard EOP-010-1, the likelihood that they will reliably execute the directives of Reliability Coordinators during fast-moving and wide-area solar storms is greatly diminished. In particular, Requirement R8 of NERC Standard IRO-001-1.1 — [Reliability Coordination — Responsibilities and Authorities] allows Transmission Operators, Balancing Authorities, and Generator Operators to ignore the directives of Reliability Coordinators when such actions would "violate safety, equipment, or regulatory or statutory requirements" per Requirement R8:

"Transmission Operators, Balancing Authorities, Generator Operators, Transmission Service Providers, Load-Serving Entities, and Purchasing-Selling Entities ... shall comply with Reliability Coordinator directives unless such actions would violate safety, equipment, or regulatory or statutory requirements."

Under these circumstances, "Transmission Operator, Balancing Authority, Generator Operator, Transmission Service Provider, Load-Serving Entity, or Purchasing-Selling Entity shall immediately inform the Reliability Coordinator of the inability to perform the directive so that the Reliability Coordinator may implement alternate remedial actions."<sup>21</sup>

During a solar storm, Reliability Coordinators presumably would direct some Transmission Operators and Generator Operators to decrease load and generation to protect equipment

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<sup>20</sup> NERC, Reliability Functional Model Technical Document Version 5, at 7 (Approved May 2010), available at [http://www.nerc.com/pa/Stand/Functional%20Model%20Archive%201/FM\\_Technical\\_Document\\_V5\\_2009Dec1.pdf](http://www.nerc.com/pa/Stand/Functional%20Model%20Archive%201/FM_Technical_Document_V5_2009Dec1.pdf).)

<sup>21</sup> FERC approved Standard IRO-001-1.1 on May 13, 2009. It is currently in effect, together with the exceptions from mandatory compliance as allowed and specified in Requirement R8, quoted above.

while directing other Transmission Operators and Generator Operators to increase load and generation. But those Transmission Operators and Generator Operators ordered to increase load and generation could decline to do so based on safety, equipment, regulatory, or statutory requirements—i.e., they fear for their equipment because it is shaking, growling, overheating, or otherwise showing deleterious impacts. Under this “every man for himself” regulatory regime, the result would be power shortages or even cascading outages. No reasonable person would conclude that the public interest is served by exempting Balancing Authorities and Generator Operators from both planning and execution of GMD operating procedures.

The EIS Council released a report that indicates above-average risks of regional blackouts from solar storms in high latitude nations such as Canada.<sup>22</sup> The Pacific Northwest, the upper Midwest, and New England would be dependent upon the importation from Canadian Provinces of block hydropower purchases, essential for “black start” of generating facilities after a major electric blackout. It is unreasonable and imprudent for FERC to exclude Balancing Authorities that could learn from moderate solar storms how to prepare for severe solar storms.

#### 8. Capricious Interference with Presidential Execution of Existing Emergency Powers Not Addressed in Order 797.

Resilient Societies included in the FERC Docket RM14-1-000 a letter to the President of June 2013 (previously released by the NRC) identifying in an Appendix presidential authority to order the de-energizing of certain oil and natural gas-fired electric generating facilities under a pre-existing act of Congress.<sup>23</sup> The Executive Branch has in place a system of strategic and tactical warning of potential solar storm damage to North America. A program office of National

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<sup>22</sup> The Electric Infrastructure Council's Report, The International E-Pro Report, Washington, D.C. October 14, 2013, notes particular GMD vulnerabilities and GMD mitigation measures in higher latitude nations, at pp. 117-118.

<sup>23</sup> See Appendix 3 (in the FERC Docket), William R. Harris, “Legal Authority for the President of the United States to Order Interruption of U.S. Electric Generation and Related Electric Grid Protection during a Severe Solar Geomagnetic Storm.” Specifically, under the Power Plant and Industrial Fuel Act of 1978, 42 U.S.C. § 8374, the President has authority during an “energy supply disruption” to order the de-energizing of any oil-fired or gas-fired electric plant, about 28 percent of U.S. electric generation. Moreover, the President has authority to de-energize vulnerable energy facilities owned by the federal government, including, for example, the Bonneville Power Authority and the Tennessee Valley Authority. Combining this authority with authority of the Nuclear Regulatory Commission to order proactive de-energizing of all 102 licensed nuclear power plants, the federal government has de-energizing authority over the majority of U.S. electric generation supporting the Bulk-Power System.

Oceanic and Atmospheric Administration (NOAA) Space Weather Prediction Center maintains a “red line” communication system to the White House Situation Room. William Murtagh of the NOAA Boulder, Colorado Center projects a NOAA capability to provide strategic warning (perhaps a 90% probability) and tactical warning (perhaps 30 to 15 minutes, via the ACE satellite or its successor at the L1 LaGrange Point).

An Executive Agent of the President, perhaps the White House Office of Science and Technology, with other existing presidential authority to manage emergency communications, could order the de-energizing of those of the roughly 2,100 GSU transformers operating without hardware protection from severe GIC and vibrational hazards of those currents.

Was the White House awaiting a FERC designed system to implement operational procedures that would protect the grid from a severe solar geomagnetic storm? However inadvertently, FERC Order No. 797 interferes with, undermines, and perhaps defeats any White House capability to protect the nation’s GSU transformers in a severe solar storm. The Executive Agent for the President would require: a database as to which key transformers had hardware protection, and which had operating GIC monitors. Any action plan that would be reliably effective in a 15 to 30 minute window for execution would require as well: a system of authenticated, encrypted notifications and verifications; mandatory participation by all Generator Operators and owners of critical equipment in a program designed for rapid, reliable, emergency protection; a system to exercise and evaluate performance under emergency conditions; and visibility by other federal officials and by regional Reliability Coordinators.

FERC Order No. 797 excludes Generator Operators and Balancing Authorities from mandatory participation; reduces incentives to install and operate GIC monitors; and makes it impractical and perhaps impossible for the President of the United States to exercise existing statutory and constitutional authority to protect the nation from a severe solar storm under existing Article II powers and specific statutory authorities. By creating unnecessary and unsupported barriers

to exercise of existing emergency powers of the President, FERC is exceeding its regulatory authority.<sup>24</sup>

#### 9. Interference with Statutory Authority of the Secretary of Energy to Order Temporary Interconnection of Electric Generation and Transmission Facilities.

FERC Order No. 797, by excluding Generator Operators and Balancing Authorities, and by failing to require GIC monitors at Bulk-Power System generating facilities, undermines the ability of the Secretary of Energy to provide for prompt, temporary interconnection of generating facilities and/or transmission networks. This authority is not the authority to protect by disconnection, but the power to restore power by reconnection, or by a temporary interconnection that did not previously exist. When the Congress transferred powers of the Federal Power Commission to FERC, it was careful to retain emergency interconnection authority in the Secretary of Energy, and not vest that authority in FERC.<sup>25</sup> Under Section 202(c) of the Federal Power Act, the Secretary of Energy in an emergency existing by reason of a shortage of electric energy may require temporary connection of generating facilities or transmission facilities.<sup>26</sup> FERC Order No. 797, by excluding Generator Operators from mandatory participation in “operating procedures” to mitigate solar geomagnetic storms, and by avoiding a mandate for cost-effective GIC monitoring at GSU transformers and key interconnections in the transmission networks of the Bulk-Power System, creates barriers to effective use by the Secretary of Energy of pre-existing emergency interconnection authority. The loss of visibility by regional Reliability Coordinators of conditions at generating facilities, and the disinclination of Generator Operators to plan for mitigation opportunities, now that they are relieved of liability by FERC Order No. 797, makes it more difficult for an Energy Secretary to identify key interconnection needs to restore the grid after a severe blackout. FERC has failed to analyze the foreseeable impacts of its Order 797: if there are fewer incentives for GIC monitoring and less widespread knowledge of the state of health of high

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<sup>24</sup> “The responsibilities of a reviewing court” includes determining “whether the Commission’s order, read in light of the relevant facts and the Commission’s broad regulatory duties, abused or exceeded its authority...” Further, a reviewing court must “decide whether each of the order’s essential elements is supported by substantial evidence.” Permian Basin Area Rate Cases, 390 U.S. 747 at 791-92 (1968).

<sup>25</sup> See 42 U.S.C. § 7171(a)(1)(B).

<sup>26</sup> 16 U.S.C. § 824a(c).

voltage transformers, these uncertainties may foreseeably delay action to restore grid operability via Section 202(c) interconnection authority.

#### 10. Interference with Fulfillment of the Safety Objectives of the Nuclear Regulatory Commission.

In Order No. 797, the Commission exempted nuclear power plants licensed by the Nuclear Regulatory Commission from participation in operating procedures proposed in FERC Order No. 797. Resilient Societies, in its comments, supported this exemption in anticipation of proactive requirements for impacted nuclear power plants to de-energize in advance of anticipated impacts of severe solar GMD events. In a previous FERC Technical Conference of April 30, 2012, FERC received testimony of an NRC nuclear engineer that standard safety procedures encouraged protection of NRC-licensed power plants by shutdown or “scramming” these facilities, while control systems could assure safe shutdown.<sup>27</sup> The shutdown of some or all 102 NRC-licensed nuclear power plants in anticipation of a severe GMD event could by itself cause grid instability. Nuclear facilities generate 17 to 19 percent of annual U.S. electric grid net generation. What FERC has failed to do in Order No. 797 is to analyze the foreseeable impact of NRC preemptive shutdown of nuclear power plants on needs of the Bulk-Power System to assure “black start” capabilities essential to protect nuclear power plants and their spent fuel pools from Fukushima-type consequences. With all or most nuclear power plants in shutdown mode during a severe GMD event, FERC’s reliability standards for geomagnetic disturbances must protect “black start” resources so they can bring back nuclear operations in time to safeguard radioactive materials at these NRC-licensed sites. Hence, FERC should have analyzed the need to protect Generator Operator sites, first with mandatory GIC monitoring for transformers, and second, by assuring that standards for hardware protection will cause the protection of sufficient generating and transmission facilities to assure reliable “black start” for all nuclear generating facilities. Order No. 797 fails to take into account the extra burden and extra need for GMD visibility and GMD protection, once NRC facilities are anticipated to shut

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<sup>27</sup> The text of NRC staff testimony on April 30, 2012 is available in FERC Docket AD12-13-000.

down in a severe GMD event.<sup>28</sup> These indirect risks of FERC Order 797 require analysis and rebalancing of regulatory standards.

11. Viable Two-Way Communications Not Supported by Substantial Evidence in the Docket. FERC erred by assuming that there would be reliable and prompt two-way communications between Reliability Coordinators and Generators Operators immediately before and during severe solar storms. FERC has noted that space-based communication systems may be impaired during a severe solar storm.<sup>29</sup> The EMP Commission Report of April 2008, Chapter 2 "Electric Power", provides additional evidence that communication systems are at risk during severe solar weather because the E3 pulse of a man-made EMP event approximates a GMD event.<sup>30</sup> There is not substantial evidence in the Docket records preceding FERC Orders 779 and 797 that there will be reliable two-way communications between the 16 regional Reliability Coordinator centers and other critical grid entities. Without reliable two-way communications, the regional Reliability Coordinators are likely to fail as the primary sources of mitigation instructions. Even if two-way communications exist, or are restored, lack of visibility as to conditions at Generator Operator sites argues for devolution of primary responsibility to mitigate GMD storms from the regional Reliability Coordinators to Generator Operators. Even Generator Operators without GIC monitors on-site may be able to hear clanging, growling, vibrations, and the other audio indicators of equipment distressed by vibrational impacts of solar GMD events. Even without the prudent and cost-effective installation of GIC monitors, they will know if their GSU transformers, or generator rotors, or stators are at risk. FERC needs to include Generator Operators in operating procedures, and FERC needs to require a system of devolutionary responsibility in the event that reliable communications and regional visibility are no longer

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<sup>28</sup> We concede that the NRC has back fitting authority under its existing statutory authorities. Under Title 42 U.S.C. § 2011 et seq. the NRC may require backfitting for essential safety requirements without accounting for economic costs. However, the NRC can apply cost-benefit analysis for various risk reduction initiatives. See *Union of Concerned Scientists v. NRC*, 824 F.2d 108 (1987). So the NRC could mandate retrofit installation of neutral ground blocking equipment at every GSU transformer under NRC license authority. However, the NRC may be reluctant to place a burden upon nuclear licensees, when FERC declines to place a comparable burden on non-nuclear generating facilities.

<sup>29</sup> FERC cited GMD impacts on communications in FERC Order No. 779 (May 2013), Para. 6, citing an Oak Ridge National Laboratory Report (1991).

<sup>30</sup> See "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack; Critical National Infrastructures," April 2008 at page 43.

valid assumptions. Without a primary role for Generator Operators and greater visibility via GIC monitors, FERC is asking the American electric customers to depend upon an impractical system that is likely to fail just when it is needed.

## 12. Unlawful Deference to NERC on a Matter Regarding Competition and FERC's Failure to Address Comment on Anti-Competitive Barriers in Order No. 797.

FERC erred by deferring to NERC on allegations of anti-competitive rulemaking; and by creating barriers to competition to deliver higher reliability electric transmission services. Through Order No. 797, FERC effectively grants Generator Operators a shield against financial liability for failure to participate in GMD operating procedures. Representatives of Generator Operators in the NERC Standards Committee and the NERC RISC Committee advocated eliminating GIC monitoring as a potential mandatory standard. The Generator Operator representatives were successful. FERC has not required a GIC monitoring equipment standard, and Generator Operators have no present duty to know what geomagnetic storms do to critical equipment at their facilities. The direct foreseeable effects are to discourage purchase of hardware protective equipment for GMD, and to discourage installation of GIC monitors at all GSU transformers and other GMD-impacted equipment. The indirect impact of these barriers to solar storm protection is to render difficult or impossible the competition by one or more transmission companies that may wish to compete to provide higher standards of grid reliability.<sup>31</sup>

A transmission company that seeks to provide higher reliability transmission services during adverse solar weather is impaired by Generator Operators that opt not to block the entry of GICs into the bulk transmission system via their GSU transformers. Unprotected transformers not only place the transformers at risk; they facilitate the injection of GICs and resulting reactive power demands into the bulk transmission system. In this light, FERC's Order No. 797 has created barriers to competition among transmission companies that would like to protect

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<sup>31</sup> FERC Order No. 672 expressly considered the potential role of improved reliability as a significant source of marketplace competition. Resilient Societies in the Docket preceding FERC Order 797 quoted CenterPoint Energy's comments in the Order 672 Docket, encouraging FERC to design reliability standards that encourage competitive initiatives to provide higher reliability services.

against GMD events but that also need to incentivize Generator Operators to also purchase GIC blocking equipment. FERC Order No. 797 does just the opposite: it rationalizes failing to install GIC monitors at generator-operator sites; it discourages Generator Operator participation in operating procedures; and it discourages purchase of GMD blocking equipment, which is most unlikely without prior installation of GIC monitoring equipment. It is a violation of Section 215 of the Energy Policy Act and of the policies embedded in FERC Order No. 672 to prohibit FERC from giving weight to NERC proposals that adversely impact competition in electric markets. FERC has failed to analyze the barriers to competition, thereby primarily benefitting Generator Operators and Generator Owners, and violating FERC's Order No. 672.

Prospectively letting NERC set an unrealistically low benchmark standard for a solar storm – NERC is currently proposing only 8 volts per kilometer, at or below the actual data recorded during moderate solar storms – will most likely lead to further barriers to install hardware protection at generation facilities. So the Stage 1 and Stage 2 reliability standards will foreseeably discourage and delay protection of the Bulk-Power System from severe solar geomagnetic disturbances. The result would be an anticompetitive standard that would shift risks from Generator Operators to society at large, and that would discourage higher levels of reliability within transmission companies.

13. FERC Order No. 797 Fails to Recognize That Complexity and Unpredictability of Operating Procedures Requires That Failover Operating Procedures Should Vest in Generator-Operators and Their Facilities and Transmission Operators and Their Facilities.

Professor-Emeritus George Baker, teaching on critical infrastructure at James Madison University for over 14 years and formerly a manager for setting of military specifications at the Department of Defense, submitted comments on Docket RM14-1-00 on the unpredictability of events, and uncertainties in complex modeling of solar storm impacts.<sup>32</sup> In Order 797, FERC acknowledged the concerns raised by Dr. Baker, but failed to analyze the consequences of reduced predictability and reduced visibility during severe solar storms. If the 16 regional

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<sup>32</sup> Dr. Baker is a Director of the Foundation for Resilient Societies.

Reliability Coordinators are likely to have impaired visibility of conditions at the generating facilities and transmission operators in their area of responsibility, and of conditions in adjoining regional Reliability Coordinator areas of responsibility, it would be prudent for FERC's GMD operating procedures to include provisions for failover responsibilities vesting in Generator Operators and Transmission Operators in their area. If the nation is to protect its GSU transformers – a dubious proposition under FERC Order No. 797 as proposed – the procedures for GMD operational mitigation should include failover responsibilities at every Generator-Operator above some criticality thresholds such as megawatt capacity. If threat visibility is impaired, if communications are impaired, if a cyber-attack is timed to coincide with a severe solar storm, it would be prudent for FERC reliability standards for GMD events to include provisions for failover responsibilities by Generator Operators, and by Transmission Operators.

Generator Operators will have the best chance to protect their GSU transformers and other critical equipment. And by participation, Generator Operators may accelerate installation of hardware protections that are a surer remedy for severe solar GMD events. Instead, FERC Order No. 797 assumes that unexpected outcomes do not matter, and that regional Reliability Coordinators can solve all the problems that need to be solved. This assumption is unreasonable, discriminatory, not supported by substantial evidence, and not in the public interest.

## Request for Rehearing

For each of the issues presented and for the reasons provided, Resilient Societies respectfully requests that FERC schedule a rehearing on the inadequacies and opportunities to improve FERC Order No. 797 and NERC Reliability Standard EOP-010-1.

## Requests for Remand

Resilient Societies requests that FERC remand to NERC modifications of the GMD Operating Procedure Standard to include:

1. Specific operational requirements such as the operator actions in the NERC templates for GMD operating procedures.
2. A planning requirement that would mandate Reliability Coordinators, Balancing Authorities, and Transmission Operators to mathematically compare the megawatt capacity of assets at risk during solar storms to megawatt capacity of reserve resources.
3. Applicability of the standard to NERC registered entities with networks within the definition of the Bulk Electric System.
4. Required GIC monitoring equipment at high voltage transformers and other critical equipment supporting the Bulk Power System;
5. Mandatory reporting of GIC data to regional Reliability Coordinators, Balancing Authorities, and Transmission Operators;
6. Mandatory planning and participation in GMD operating procedures by Generator Operators and Balancing Authorities;
7. Mandatory exercises, unscheduled drills, order authentication validation, and coordination with representatives of the Executive Office of the President, the Secretary of Energy, and the Nuclear Regulatory Commission to assure a coordinated, cooperative and effective system of anticipation and response to geomagnetic disturbance events; and

8. A system of external review and audit for geomagnetic disturbance plans developed by applicable entities.

## Conclusion

Without rehearing, reconsideration, and remand, FERC Order 779 will leave the Bulk Power System more vulnerable to severe GMD hazards than if FERC had issued no Order for GMD Operating Procedures whatsoever. Through Order No. 779, FERC's Commissioners enabled a promising initiative to protect the electric grid from severe solar storms. The Commission has an opportunity and the nation has a need for the Commission to revise its Order No. 797 and to refocus NERC so the Commission's objectives can be achieved.

Respectfully submitted by:



Thomas S. Popik, Chairman,



William R. Harris, Secretary,

For the

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opportunities to protect societies and then develop policy initiatives. Information about Resilient Societies may be found at [www.resilientsocieties.org](http://www.resilientsocieties.org).

## **Background**

Pursuant to Section 215 of the Federal Power Act (“Section 215”), the Commission approved Reliability Standard EOP-010-1 (Geomagnetic Disturbance Operations) as just, reasonable, not unduly discriminatory or preferential, and in the public interest. The North American Electric Reliability Corporation (hereinafter “NERC”), the Commission-certified Electric Reliability Organization (ERO), submitted the Reliability Standard for Commission approval in response to a Commission directive in Order No. 779. The Reliability Standard is designed to mitigate the effects of geomagnetic disturbances (GMD) on the Bulk-Power System by requiring responsible entities to implement Operating Plans and Operating Procedures or Processes.

Resilient Societies participated in standard-setting at NERC for Reliability Standard EOP-010-1 as a member of the ballot body and submitted comments to the Standard Drafting Team. Resilient Societies submitted comments in rulemaking under FERC Docket RM14-1-000.<sup>2</sup>

In this request for rehearing, Resilient Societies asserts a reasonable person should not conclude that FERC Order 797 and Reliability Standard EOP-010-1 are just, reasonable, and in the public interest. Moreover, a reasonable person reviewing the entire proceedings and Docket filings preceding Order No. 779 and No. 797 would conclude that FERC Order 797 and Reliability Standard EOP-010-1 are unjust, unreasonable, unduly discriminatory, anti-competitive, preferential among NERC registered entities, and interfere with established statutory rights and duties of the President of the United States, the Secretary of Energy, and the Nuclear Regulatory Commission. FERC Order 797 and Reliability Standard EOP-010-1 are inconsistent with Section 215 and its implementation as expressed in FERC Orders 672 and 672-A. FERC Order 797 and Reliability Standard EOP-010-1 are inconsistent with the bright-line definition of the Bulk Electric System per FERC Orders 743, 743-A, and 773. Finally, FERC Order

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<sup>2</sup> See “Comments of the Foundation for Resilient Societies Submitted to FERC on March 24, 2014” under FERC Docket RM14-1-000, incorporated in its entirety by reference.

797 is arbitrary and capricious and otherwise violates due process requirements of the Administrative Procedure Act as expressed in statute and in applicable court precedent.

## **Statement of Issues and Specifications of Error**

### **1. Capricious Approval of Empty Standard.**

FERC erred by approving an ineffective standard, devoid of any implementation of operational requirements upon applicable NERC entities, and not including any requirement whatsoever for mandatory exercises, unscheduled drills, authentication of de-energizing orders, or practice of GMD operating procedures, when lack of implementation requirements sacrifice uniformity, create uncertainty, make enforcement difficult, and increase the likelihood of cascading outages and separations. Addressing the complexity of the Commission's oversight and review process, the Commission indicated in FERC Order 672<sup>3</sup>, para 260:

While we are sympathetic to ISO/RTO Council's suggestion that, in general, a Reliability Standard should address the "what" and not the "how" of reliability and that the actual implementation of a Reliability Standard should be left to entities such as control area operators and system planners, in certain limited situations there may be a good reason to leave implementation practices out of a Reliability Standard. In other situations, however, the "how" may be inextricably linked to the Reliability Standard and may need to be specified by the ERO to ensure the enforcement of the Reliability Standard. For some Reliability Standards, leaving out implementation features could: (1) sacrifice necessary uniformity in implementation of the Reliability Standard; (2) create uncertainty for the entity that has to follow the Reliability Standard; (3) make enforcement difficult; and (4) increase the complexity of the Commission's oversight and review process. Accordingly, we leave it to the ERO to develop proposed Reliability Standards that appropriately balance reliability principles and implementation features.

In this instance, NERC did not appropriately balance reliability principles and implementation effectiveness, because its own GMD Task Force developed implementation templates for Generator Operator and Transmission Operator operating procedures that were approved by

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<sup>3</sup> See FERC Order No. 672, Rules Concerning Certification of the Electric Reliability Organization; and Procedures for the Establishment, Approval, and Enforcement of Electric Reliability Standards, FERC Stats. & Regs. ¶131,204; Order on rehearing, FERC Order No. 672-A, FERC Stats. & Regs. ¶131,212 (2006).

the NERC Planning Committee but were not included in the approved standard.<sup>4</sup> No reasonable person would conclude that when the lives and safety of millions of Americans depend upon reliable implementation of GMD operating procedures that there should be no requirement for system wide exercises, unannounced drills, and authenticated actions to prevent widespread loss of critical equipment.

Instead of containing reasonable requirements, Reliability Standard EOP-010-1 is a “lowest common denominator” standard designed to achieve consensus within the NERC standard development process. Indeed, Reliability Standard EOP-010-1 easily passed with a vote of 92% in favor once [Generator Operators and Balancing Authorities](#) were eliminated from the list of applicable entities.

FERC anticipated how the standard-setting process might be manipulated in this manner and prohibited it in Order 672:

A mandatory Reliability Standard should not reflect the “lowest common denominator” in order to achieve a consensus among participants in the ERO’s Reliability Standard development process. Thus, the Commission will carefully review each Reliability Standard submitted and, where appropriate, remand an inadequate Reliability Standard to ensure that it protects reliability, has no undue adverse effect on competition, and can be enforced in a clear and even-handed manner.<sup>5</sup>

In its comment under FERC Docket RM14-1-00, Resilient Societies stated:

In essence, Standard EOP-010-1 proposes a balkanized self-regulatory scheme, where Reliability Coordinators and Transmission Operators would devise their own plans and procedures within timeframe buckets (“Long-term Planning, Operations Planning, Same-day Operations, and Real-Time Operations”) but there would be no mandatory mitigative actions within the timeframes. GMD Operating Procedures of Transmission Operators would be subject to review by Reliability Coordinators. There would be no mandatory external review of GMD Operating Plans of Reliability Coordinators.

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<sup>4</sup> See “Geomagnetic Disturbance Operating Procedure Template Transmission Operator” available at [http://www.nerc.com/docs/pc/gmdtf/Template\\_TOP.pdf](http://www.nerc.com/docs/pc/gmdtf/Template_TOP.pdf) and “Geomagnetic Disturbance Operating Procedure Template Generator Operator” available at [http://www.nerc.com/docs/pc/gmdtf/Template\\_GOP.pdf](http://www.nerc.com/docs/pc/gmdtf/Template_GOP.pdf).

<sup>5</sup> *Ibid.*, para 29.

In Order 797, FERC erred because it did not address the Resilient Societies' comment regarding lack of mandatory mitigative actions and lack of mandatory external review of GMD Operating Plans of Reliability Coordinators.<sup>6</sup>

## **2. Arbitrary Exclusion of Networks Operating at 200 kV and below.**

FERC erred by approving a standard that exempts transmission networks with no transformer with a high side (wye-grounded) voltage at or above 200 kV when actual data and lessons learned from past operating incidents show significant adverse impacts of solar storms on equipment operating below 200 kV. FERC Order 672, para 324 reads:

The proposed Reliability Standard must be designed to achieve a specified reliability goal and must contain a technically sound means to achieve this goal... It should be based on actual data and lessons learned from past operating incidents, where appropriate.

The comment of Resilient Societies quoted a report of the Oak Ridge National Laboratory that presented "actual data and lessons learned from past operating incidents" to make the case that networks operating below 200 kV were in fact impacted by a moderate solar storm on March 13, 1989. The comments of Resilient Societies to NERC, also included in its comment under Docket RM14-1-000, quoted PowerWorld modeling results showing that reactive power in networks at 200 kV and above left out more than 40 percent of cumulative reactive power (MVAR) consumed in solar storm modeling scenarios for some regions.

In Order 797, FERC concluded,

The NERC petition and White Paper Supporting Network Applicability provide an adequate technical basis to conclude that transformers operating at 200 kV and below are likely to have a limited impact on the Bulk-Power System during a GMD event. We are not persuaded by the Foundation comments, discussed above, which do not refute this

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<sup>6</sup> Courts have repeatedly held that the Commission is obligated to address issues raised before it, and that a "failure to respond meaningfully" to objections raised by a party renders its decision arbitrary and capricious." See *PPL Wallingford Energy LLC v. FERC*, 419 F.3d 1194, 1198 (D.C. Cir. 2005) (quoting *Canadian Association of Petroleum Producers v. FERC*, 254 F.3d 289, 299 [D.C. Cir. 2001]). Unless the Commission "answers objections that on their face seem legitimate, its decisions can hardly be classified as reasoned." See *Motor Vehicle Mfrs. Ass'n v. State Farm Mu. Auto Insurance Co.*, 463 U.S. 29, 43 (1983); *North Am Gas Transmission Co. v. FERC*, 148 F.3d 1158 (D.C. Cir. 1998) ("It most emphatically remains the duty of this court to ensure that an agency engage the arguments raised before it that it conduct a process of reasoned decision-making.") (quoting *K N Energy, Inc. v. FERC*, 968 F.2d 1295, 1303 (D.C. Cir. 1992)); *Ill. Pub. Telecomm. Ass'n v. FCC*, 117 F.3d 555, 564 (D.C. Cir. 1997).

conclusion, or the materials cited by SmartSense. SmartSense cites a table in the Oak Ridge Laboratory GMD Study identifying at-risk transformers operating at 345 kV, which fall within the applicability criteria. Moreover, the Oak Ridge Laboratory GMD Study found that significantly higher GIC flows occur at higher operating voltages.

The report of Oak Ridge National Laboratory cited by FERC shows that Geomagnetically Induced Current (GIC) flows of up to 1,800 amps are expected to occur during severe solar storms.<sup>7</sup> The report of the Oak Ridge National Laboratory also showed experiential data that transformers can be permanently damaged at 90 amps of GIC.<sup>8</sup> Therefore, while GIC flows may be lower in networks operating at lower voltages, the Oak Ridge report does not state that the GIC flows in lower voltage networks will be so trivial as to have no impact, or that lower but still damaging GIC flows will not nonetheless cause cascading failure or violation of thermal, voltage, or stability limits.

FERC Order 672 holds the ERO to a higher standard than “limited impact” on Reliable Operation, requiring reliability failures will not occur, not merely a lower likelihood:

Reliable Operation 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 of such system *will not occur* as a result of a sudden disturbance, including a Cybersecurity Incident, or unanticipated failure of system elements. (Emphasis added.)

### **3. Arbitrary Inconsistency with Prior Definition of Bulk Electric System.**

The exclusion of networks operating at 200 kV and below is inconsistent with the prior bright-line definition of the Bulk Electric System. FERC acted arbitrarily and capriciously in departing from its own precedent and not discussing in Order 797 rationale for departure from the “bright-line” Bulk Electric System definition, other than citing a NERC whitepaper at odds with the Oak Ridge GMD study.<sup>9</sup>

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<sup>7</sup> See “Geomagnetic Storms and Their Impacts on the U.S. Power Grid,” Oak Ridge National Laboratory, January 2010, available at [http://web.ornl.gov/sci/ees/etsd/pes/pubs/ferc\\_Meta-R-319.pdf](http://web.ornl.gov/sci/ees/etsd/pes/pubs/ferc_Meta-R-319.pdf), at page 4-12.

<sup>8</sup> *Ibid.* at page 2-30.

<sup>9</sup> The Commission must explain a departure from precedent and Order 797 fails to adequately address the Commission’s departure from Orders 743, 743-A, and 773. See, e.g., *Greater Boston Television Corp. v. FCC*, 444 F.2d 841, 852 (D.C. Cir. 1970) (“an agency changing its course must supply a reasoned analysis indicating that prior policies and standards are being deliberately changed, not casually ignored, and if an agency glosses over or

#### **4. Lack of a Concomitant and Reasonable Requirement for Monitoring of Solar Storm Impacts by GIC Detectors and Remote Reporting of GIC Data.**

FERC erred by approving a standard that does not require instrumentation of electric utility networks during solar storm conditions when installation of GIC monitors would be cost-effective and in the public interest. When FERC, in Order No. 779 directed, *sua sponte*, the submission by the ERO of reliability standards to mitigate geomagnetic disturbances, NERC had an open standards development project to mandate equipment monitoring and diagnostic devices for critical grid equipment.<sup>10</sup> By year 2013, the cost of Geomagnetically Induced Current (GIC) monitoring equipment had dropped by more than an order of magnitude from costs several years earlier: from \$200,000 per GIC monitor to \$10,000 per GIC monitor, including programmable SCADA devices that are capable of automated, near-real-time reporting of various GIC thresholds (rising, or falling) to transmission or generator operating control centers, and to regional Reliability Coordinators. Representatives of Generator Operators owning generating plants identified as GIC “hotspots” urged NERC to eliminate this in-development standard just as FERC was nearing the issuance of FERC Order 779 in May 2013.

Resilient Societies, with observers attending the NERC Reliability Issues Steering Committee meeting on May 9, 2013, was concerned that the deletion of equipment monitoring (including GIC monitoring) as a requirement to assess and protect high voltage transformers would reduce visibility of transformer damage or permanent losses, both at Generator Operator facilities and at regional Reliability Coordinator facilities. We filed our concern at the elimination of essential GIC monitoring with FERC on Docket RM12-22-000, two days before FERC issued Order No. 779. The NERC Standards Committee then proceeded to eliminate the project for the equipment monitoring standard in June 2013, and the NERC Board of Trustees ratified that decision in November 2013.<sup>11</sup>

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swerves from prior precedents without discussion it may cross the line from the tolerably terse to the intolerably mute”); *La. Pub. Serv. Comm’n v. FERC*, 184 F.3d 892, 897 (D.C. Cir. 1999)

<sup>10</sup> NERC Project 2012-01 — Equipment Monitoring and Diagnostic Devices

<sup>11</sup> In May 2013 the NERC RISC Committee claimed that “further research” was required, as a rationale to eliminate NERC standards project 2012-01. Tracking through the NERC Committee documents, Resilient Societies found that no “research” was specified by any of the relevant NERC Committees. The apparent goal of the RISC Committee and the Standards Committee was to terminate the project in time to rationalize the removal of Generator

By eliminating a potential standard requiring mandatory installation of low-cost GIC monitors, the Generator Operators in the NERC standards development process then argued that Generator Operators might not know the state of solar storm conditions at their generating facilities, because they might not own installed GIC monitors! Hence, NERC now claimed, Generator Operators should be eliminated from mandatory participation in GMD operating procedures.

In Order No. 797, the FERC Commissioners dismissed our concerns that, without a concurrent requirement for GIC monitors at critical grid equipment, operating procedures would be less effective, and incentives to purchase hardware protection would diminish. FERC noted that Resilient Societies had not provided the counts or locations of actually deployed GIC monitors. Was this a reasonable precondition for FERC to address the key role of GIC monitoring? It appears to be unreasonable, and not in the public interest to exclude the essential need for GIC monitoring equipment, yet at the same time to assign primary responsibility for operational mitigation to 16 regional Reliability Coordinators who will have little or no visibility as to actual GIC conditions at the critical but remote GSU transformers requiring protection from severe solar storms.

In its whitepaper to support FERC approval of Reliability Standard EOP-010-1, NERC in November 2013 admitted: “Generator step-up transformers are typically situated at electrical end points of the network where GIC tends to be highest.”<sup>12</sup>

Without GIC monitors at GSU transformers, and automated data readout at regional Reliability Coordinator facilities, it will be impractical and imprudent to expect that regional Reliability Coordinators could save GSU transformers that are unprotected by hardware from serious damage or permanent loss in a severe solar storm. Even with the best space weather forecasts from NOAA, only awareness of conditions at the actual GSU transformers would justify ordering

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Operators (GOPs) from mandatory participation in GMD operating procedures because GOPs might have insufficient information about GMD conditions at their facilities.

<sup>12</sup> See NERC whitepaper “Network Applicability, Project 2013-03 (Geomagnetic Disturbance Mitigation); EOP-010-1 (Geomagnetic Disturbance Operations)” available at [http://www.nerc.com/pa/Stand/Project201303GeomagneticDisturbanceMitigation/ApplicableNetwork\\_clean.pdf](http://www.nerc.com/pa/Stand/Project201303GeomagneticDisturbanceMitigation/ApplicableNetwork_clean.pdf).

the de-energizing of GSU transformers, effectively requiring the loss of generation at each of these de-energized sites.

What about the role of the regional Reliability Coordinators relative to GSU transformers whose owners opt to install neutral ground hardware protection? The manufacturers of neutral ground blocking devices install GIC monitors as part of the equipment packages to be sold. Owners of the hardware-protected GSU transformers should be able to “operate through” a severe solar storm, and they will know the GIC variations and conditions of their on-site GSU transformer. They will not require assistance or instruction from a regional Reliability Coordinator; they will generate electricity, unless a most severe solar storm exceeds the design tolerances of the protective equipment.

In contrast, the GSU transformer operators who have not opted to install neutral ground blocking equipment have no obligation to have low-cost GIC monitors on site. They should expect no practical assistance from regional Reliability Coordinators who have no knowledge of risks of permanent damage to remote GSU transformers.

Were the regional Reliability Coordinators to order de-energizing of GSU transformers owed by entities without any duty to participate in GMD operating procedures, would a Generator Operator have good cause to refuse to implement a regional Reliability Coordinator order to de-energize an unprotected transformer when the regional Reliability Coordinator lacks apparent legal authority for the order?<sup>13</sup> FERC has established a system of solar storm mitigation that might work for minor solar storms but it is altogether unworkable,

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<sup>13</sup> Generator Operators, along with other entities receiving directives from Reliability Coordinators under Reliability Standard IRO-001-01.1 (approved by FERC on May 13, 2009) “shall comply with Reliability Coordinator directives” per requirement R8, “unless such actions would violate safety, equipment, or regulatory or statutory requirements.”

Without mandatory reporting to Reliability Coordinators of readouts from near-real-time GIC monitoring equipment at Generator Operator sites – requirements presently lacking – the Generator Operators may reasonably assert they have better visibility of safety and equipment protection requirements than do the regional Reliability Coordinators. Is FERC Order No. 797 by itself a regulatory defense against the need to comply with a directive from a Reliability Coordinator to de-energize a remote transformer? For a gas-fired generation facility, is the exclusive statutory authority vested in the President to order shutdown of a generating facility a valid basis to decline to implement a Reliability Coordinator directive?

unreasonable, imprudent, and unjust to utilize this design for “operating procedures” in a severe solar storm.

Lack of visibility at regional Reliability Coordinator centers, and their backup centers will provide discriminatory impacts upon electric consumers: those served by hardware-protected equipment are more likely to avert or minimize regional blackouts. Those depending upon regional Reliability Coordinators and remote generation sites that lack GIC monitors are more likely to suffer extended blackouts. This is not just and reasonable; it is discriminatory; and it is not in the public interest. Moreover, there may be inequitable and unjust shielding of Generator Operators and owners from liability for failure to cope with foreseeable risks in solar storms. FERC’s Order No. 797 exempts Generator Owners and Operators from responsibility for participating on GMD operating procedures. In effect, FERC enables risk-shifting and cost-shifting from the generator entities to the consumers and businesses that suffer avoidable electric blackouts. This is unjust, unreasonable, and in violation of the standards of Section 215 of the Federal Power Act.

Resilient Societies addressed the alleged high costs of GIC monitors in a Maine Docket on GMD and EMP mitigation (Maine Docket 2013-00415). In that Docket it was alleged by a Maine utility that GIC monitors cost about \$200,000 apiece. We conducted research on the Internet, and identified a manufacturing entity in New Jersey that sold GIC monitors at \$10,000 per unit, or \$15,000 per unit if dissolved gas and transformer temperatures were also reported, using the same SCADA devices, to owner-operators and remote third parties needing the data. We learned that wind power generators are on their own initiative installing GIC monitors, so they could demonstrate the adequacy of power quality at connections to bulk power transmission entities. But we had and still have no ability to identify each of the customers and installation locations for GIC monitors nationwide. This is proprietary data of manufacturers of GIC monitoring equipment. We filed information about the GIC equipment and costs in the relevant FERC Docket. But we lack authority to compel disclosure of GIC monitoring equipment locations, installation by installation nationwide.

Resilient Societies asserts that FERC is using an improper, impossible-to-meet standard in deciding whether to consider the need for GIC monitoring and remote reporting systems as an essential element of operating procedures to mitigate geomagnetic disturbances.

Are GIC monitors (and associated automated data readout and remote reporting capabilities) both cost-effective and essential to effective solar storm mitigation? These are more pertinent questions that FERC should ask and answer.

GIC monitors cost only \$15,000 per unit. There are approximately 2,100 extra high voltage transformer locations in the United States. GIC monitors at every high voltage transformer would cost only \$31.5 million, or a one-time expenditure of merely ten cents per American.

The Oak Ridge National Laboratory summary report on GMD, "Electromagnetic Pulse: Effects on the U.S. Power Grid" concluded that a severe solar storm could leave 130 million Americans without power for over one year.<sup>14</sup> Because 130 million Americans represent 40% of the total population, we estimate that 40% of GDP would be lost for at least one year, or about \$6.4 trillion. Oak Ridge National Laboratory estimates that the chance of a severe solar storm in any single year is about 1%; therefore the risk-adjusted economic loss would be 1% of \$6.4 trillion or \$64 billion. By not immediately requiring GIC monitors in Order 797, FERC takes the illogical position that the electric utility industry should not expend \$32 million to protect the American public against a risk adjusted loss of \$64 billion per year for the next five or more years.

FERC's defective logic and faulty cost-benefit position are clearly not in the public interest, but only in the interest of electric utilities which seek to avoid regulatory responsibilities and to place the costs and risks of blackout upon the public.

**5. Unreasonable Delay of Benefits of Effective GMD Protection and Necessity of Rework upon Passage of a Phase II Hardware Protection Standard.** In Order 979, FERC erred by taking the position that defects in Reliability Standard EOP-010-1, including the lack of required GIC

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<sup>14</sup> See "Electromagnetic Pulse: Effects on the U.S. Power Grid, Executive Summary," Oak Ridge National Laboratory, available at [http://web.ornl.gov/sci/ees/etsd/pes/pubs/ferc\\_Executive\\_Summary.pdf](http://web.ornl.gov/sci/ees/etsd/pes/pubs/ferc_Executive_Summary.pdf).

monitoring, need not be immediately remedied because the subsequent Phase II GMD standard might provide alternative or adjunct protection. From our perspective, no reasonable person would accept the FERC position that GIC monitoring and its benefits can be delayed until some speculative point in the future when another NERC standard might require it.<sup>15</sup> The current timeline for implementation of a Phase II standard would be one year after approval by FERC plus up to four years of additional implementation at utilities.<sup>16</sup> A severe solar storm can happen at any time, including during the next five years. Moreover, if a Phase II standard were to require GIC monitors, then the Phase I GMD standard for operating procedures would need to be reworked. No reasonable person would forego “getting it right the first time,” especially when the risks to the American public are so great.

#### **6. Lack of Reasonable Planning Requirement for Utilities to Perform Rudimentary Mathematical Calculations to Ensure Efficacy of GMD Operating Procedures.**

FERC erred by approving a standard that does not require utilities to perform the most rudimentary planning for solar storms, i.e., mathematical comparison of megawatt capacity of assets at risk during solar storms to power reserves (the operations of addition and subtraction). In its comment in Docket RM14-1-000 and as an example, Resilient Societies presented actual data and operating experience from New England showing that megawatt capacity assets at risk during moderate solar storms exceeded reserves and asking that FERC require “quantified contingency planning” of utilities in any GMD operating procedure standard.<sup>17</sup> <sup>18</sup> “Contingency planning” is a well-known term of art in the electric utility industry. In discounting the comment of Resilient Societies, FERC claimed that the term “quantified

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<sup>15</sup> Rulemaking must prevent an “arbitrary result.” See *Borden, Inc. v. FERC*, 855 F.2d 254, 258 (5<sup>th</sup> Circuit, 1988). Under the Administrative Procedures Act, an order of a regulatory commission must be set aside if it is “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.” 5 U.S.C. § 706(2)(A).

<sup>16</sup> See “Implementation Plan Project 2013-03 Geomagnetic Disturbance Mitigation” at pages 2-3 available at [http://www.nerc.com/pa/Stand/Project201303GeomagneticDisturbanceMitigation/tpl\\_007\\_1\\_implementation\\_plan\\_20140603\\_CLEAN.pdf](http://www.nerc.com/pa/Stand/Project201303GeomagneticDisturbanceMitigation/tpl_007_1_implementation_plan_20140603_CLEAN.pdf)

<sup>17</sup> Resilient Societies objected to the “Lack of Requirements for Quantified Contingency Planning” at pp. 21-23 of Comments submitted March 24, 2014 in FERC Docket RM14-1-000.

<sup>18</sup> See Foundation for Resilient Societies, “Solar Storm Risks for Maine and the New England Electric Grid, and Potential Protective Measures, Interim Report”, March 19, 2013, available at [http://www.resilientsocieties.org/images/Interim\\_Foundation\\_Report\\_on\\_Maine\\_Solar\\_Storm\\_Risks\\_March\\_19\\_2013.pdf](http://www.resilientsocieties.org/images/Interim_Foundation_Report_on_Maine_Solar_Storm_Risks_March_19_2013.pdf)

contingency planning” was not defined but FERC did not present substantial evidence in the docket that it is unnecessary to mathematically compare assets at risk to available reserves.

Reliability standards set by NERC are subject to review by an “independent” Board of Trustees.

According to the NERC Governance Guidelines, the Board of Trustees has a Duty of Care:<sup>19</sup>

Duty of Care requires the Trustee to use the care that an ordinarily prudent person would exercise in a like position and under similar circumstances in respect to performing the functions of a member of a board of directors. This duty of care is generally thought to have two components: the time and attention devoted to the organization’s affairs (including preparation for and attendance at meetings) and the skill and judgment reflected in decisions that affect the organization.

In approving a reliability standard that did not require utilities to make sure that the megawatt capacity of reserves exceeds the megawatt capacity of assets at risk during a solar storm, the NERC Board of Trustees appears to have violated a reasonable standard of care. No reasonable person would exempt utilities from performing rudimentary mathematical calculations in support of a reliability standard to protect the life and safety of 318 million Americans.

### **7. Unreasonable Reliance upon Reliability Coordinators and Unreasonable Exemption of Balancing Authorities and Generator Operators.**

FERC erred by concluding that sixteen Reliability Coordinators could directly communicate with up to 1,500 Transmission and Generator Operators during severe GMD events with a warning time of as little as 15 minutes and that Balancing Authorities and Generator Operators should not take action on their own because of possible lack of GIC data. In support of its position, Order 797 cites the NERC Reliability Functional Model:

We are not persuaded that GMD events pose unique communication problems for reliability coordinators because a reliability coordinator may only have 15-60 minutes warning of a severe solar storm. Reliability coordinators are responsible for real-time

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<sup>19</sup> See “North American Electric Reliability Corporation Governance Guidelines” available at <http://www.nerc.com/gov/bot/Documents/Governance%20Guidelines%20-%20Approved%202.6.14.pdf>.

system reliability and often must respond quickly or even immediately to Bulk-Power System events with little or no warning.<sup>20</sup>

We checked FERC's citation of the NERC Reliability Functional Model Technical Document at page 7. This document says "The Reliability Coordinator is responsible for Real-time system reliability..." but says nothing about the ability of Reliability Coordinators to actually perform this duty during fast-moving solar storms of regional or nationwide scope. No reasonable person would accept this citation as support for FERC's position, or as "substantial evidence" required to support the FERC Order.

Because Balancing Authorities and Generator Operators are exempted from planning for GMD events under Reliability Standard EOP-010-1, the likelihood that they will reliability execute the directives of Reliability Coordinators during fast-moving and wide-area solar storms is greatly diminished. In particular, Requirement R8 of NERC Standard IRO-001-1.1 — [Reliability Coordination — Responsibilities and Authorities] allows Transmission Operators, Balancing Authorities, and Generator Operators to ignore the directives of Reliability Coordinators when such actions would "violate safety, equipment, or regulatory or statutory requirements" per Requirement R8:

"Transmission Operators, Balancing Authorities, Generator Operators, Transmission Service Providers, Load-Serving Entities, and Purchasing-Selling Entities ... shall comply with Reliability Coordinator directives unless such actions would violate safety, equipment, or regulatory or statutory requirements."

Under these circumstances, "Transmission Operator, Balancing Authority, Generator Operator, Transmission Service Provider, Load-Serving Entity, or Purchasing-Selling Entity shall immediately inform the Reliability Coordinator of the inability to perform the directive so that the Reliability Coordinator may implement alternate remedial actions."<sup>21</sup>

During a solar storm, Reliability Coordinators presumably would direct some Transmission Operators and Generator Operators to decrease load and generation to protect equipment

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<sup>20</sup> NERC, Reliability Functional Model Technical Document Version 5, at 7 (Approved May 2010), available at [http://www.nerc.com/pa/Stand/Functional%20Model%20Archive%201/FM\\_Technical\\_Document\\_V5\\_2009Dec1.pdf](http://www.nerc.com/pa/Stand/Functional%20Model%20Archive%201/FM_Technical_Document_V5_2009Dec1.pdf).)

<sup>21</sup> FERC approved Standard IRO-001-1.1 on May 13, 2009. It is currently in effect, together with the exceptions from mandatory compliance as allowed and specified in Requirement R8, quoted above.

while directing other Transmission Operators and Generator Operators to increase load and generation. But those Transmission Operators and Generator Operators ordered to increase load and generation could decline to do so based on safety, equipment, regulatory, or statutory requirements—i.e., they fear for their equipment because it is shaking, growling, overheating, or otherwise showing deleterious impacts. Under this “every man for himself” regulatory regime, the result would be power shortages or even cascading outages. No reasonable person would conclude that the public interest is served by exempting Balancing Authorities and Generator Operators from both planning and execution of GMD operating procedures.

The EIS Council released a report that indicates above-average risks of regional blackouts from solar storms in high latitude nations such as Canada.<sup>22</sup> The Pacific Northwest, the upper Midwest, and New England would be dependent upon the importation from Canadian Provinces of block hydropower purchases, essential for “black start” of generating facilities after a major electric blackout. It is unreasonable and imprudent for FERC to exclude Balancing Authorities that could learn from moderate solar storms how to prepare for severe solar storms.

#### **8. Capricious Interference with Presidential Execution of Existing Emergency Powers Not Addressed in Order 797.**

Resilient Societies included in the FERC Docket RM14-1-000 a letter to the President of June 2013 (previously released by the NRC) identifying in an Appendix presidential authority to order the de-energizing of certain oil and natural gas-fired electric generating facilities under a pre-existing act of Congress.<sup>23</sup> The Executive Branch has in place a system of strategic and tactical warning of potential solar storm damage to North America. A program office of National

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<sup>22</sup> The Electric Infrastructure Council's Report, The International E-Pro Report, Washington, D.C. October 14, 2013, notes particular GMD vulnerabilities and GMD mitigation measures in higher latitude nations, at pp. 117-118.

<sup>23</sup> See Appendix 3 (in the FERC Docket), William R. Harris, “Legal Authority for the President of the United States to Order Interruption of U.S. Electric Generation and Related Electric Grid Protection during a Severe Solar Geomagnetic Storm.” Specifically, under the Power Plant and Industrial Fuel Act of 1978, 42 U.S.C. § 8374, the President has authority during an “energy supply disruption” to order the de-energizing of any oil-fired or gas-fired electric plant, about 28 percent of U.S. electric generation. Moreover, the President has authority to de-energize vulnerable energy facilities owned by the federal government, including, for example, the Bonneville Power Authority and the Tennessee Valley Authority. Combining this authority with authority of the Nuclear Regulatory Commission to order proactive de-energizing of all 102 licensed nuclear power plants, the federal government has de-energizing authority over the majority of U.S. electric generation supporting the Bulk-Power System.

Oceanic and Atmospheric Administration (NOAA) Space Weather Prediction Center maintains a “red line” communication system to the White House Situation Room. William Murtagh of the NOAA Boulder, Colorado Center projects a NOAA capability to provide strategic warning (perhaps a 90% probability) and tactical warning (perhaps 30 to 15 minutes, via the ACE satellite or its successor at the L1 LaGrange Point).

An Executive Agent of the President, perhaps the White House Office of Science and Technology, with other existing presidential authority to manage emergency communications, could order the de-energizing of those of the roughly 2,100 GSU transformers operating without hardware protection from severe GIC and vibrational hazards of those currents.

Was the White House awaiting a FERC designed system to implement operational procedures that would protect the grid from a severe solar geomagnetic storm? However inadvertently, FERC Order No. 797 interferes with, undermines, and perhaps defeats any White House capability to protect the nation’s GSU transformers in a severe solar storm. The Executive Agent for the President would require: a database as to which key transformers had hardware protection, and which had operating GIC monitors. Any action plan that would be reliably effective in a 15 to 30 minute window for execution would require as well: a system of authenticated, encrypted notifications and verifications; mandatory participation by all Generator Operators and owners of critical equipment in a program designed for rapid, reliable, emergency protection; a system to exercise and evaluate performance under emergency conditions; and visibility by other federal officials and by regional Reliability Coordinators.

FERC Order No. 797 excludes Generator Operators and Balancing Authorities from mandatory participation; reduces incentives to install and operate GIC monitors; and makes it impractical and perhaps impossible for the President of the United States to exercise existing statutory and constitutional authority to protect the nation from a severe solar storm under existing Article II powers and specific statutory authorities. By creating unnecessary and unsupported barriers

to exercise of existing emergency powers of the President, FERC is exceeding its regulatory authority.<sup>24</sup>

**9. Interference with Statutory Authority of the Secretary of Energy to Order Temporary Interconnection of Electric Generation and Transmission Facilities.**

FERC Order No. 797, by excluding Generator Operators and Balancing Authorities, and by failing to require GIC monitors at Bulk-Power System generating facilities, undermines the ability of the Secretary of Energy to provide for prompt, temporary interconnection of generating facilities and/or transmission networks. This authority is not the authority to protect by disconnection, but the power to restore power by reconnection, or by a temporary interconnection that did not previously exist. When the Congress transferred powers of the Federal Power Commission to FERC, it was careful to retain emergency interconnection authority in the Secretary of Energy, and not vest that authority in FERC.<sup>25</sup> Under Section 202(c) of the Federal Power Act, the Secretary of Energy in an emergency existing by reason of a shortage of electric energy may require temporary connection of generating facilities or transmission facilities.<sup>26</sup> FERC Order No. 797, by excluding Generator Operators from mandatory participation in “operating procedures” to mitigate solar geomagnetic storms, and by avoiding a mandate for cost-effective GIC monitoring at GSU transformers and key interconnections in the transmission networks of the Bulk-Power System, creates barriers to effective use by the Secretary of Energy of pre-existing emergency interconnection authority. The loss of visibility by regional Reliability Coordinators of conditions at generating facilities, and the disinclination of Generator Operators to plan for mitigation opportunities, now that they are relieved of liability by FERC Order No. 797, makes it more difficult for an Energy Secretary to identify key interconnection needs to restore the grid after a severe blackout. FERC has failed to analyze the foreseeable impacts of its Order 797: if there are fewer incentives for GIC monitoring and less widespread knowledge of the state of health of high

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<sup>24</sup> “The responsibilities of a reviewing court” includes determining “whether the Commission’s order, read in light of the relevant facts and the Commission’s broad regulatory duties, abused or exceeded its authority...” Further, a reviewing court must “decide whether each of the order’s essential elements is supported by substantial evidence.” *Permian Basin Area Rate Cases*, 390 U.S. 747 at 791-92 (1968).

<sup>25</sup> See 42 U.S.C. § 7171(a)(1)(B).

<sup>26</sup> 16 U.S.C. § 824a(c).

voltage transformers, these uncertainties may foreseeably delay action to restore grid operability via Section 202(c) interconnection authority.

#### **10. Interference with Fulfillment of the Safety Objectives of the Nuclear Regulatory Commission.**

In Order No. 797, the Commission exempted nuclear power plants licensed by the Nuclear Regulatory Commission from participation in operating procedures proposed in FERC Order No. 797. Resilient Societies, in its comments, supported this exemption in anticipation of proactive requirements for impacted nuclear power plants to de-energize in advance of anticipated impacts of severe solar GMD events. In a previous FERC Technical Conference of April 30, 2012, FERC received testimony of an NRC nuclear engineer that standard safety procedures encouraged protection of NRC-licensed power plants by shutdown or “scramming” these facilities, while control systems could assure safe shutdown.<sup>27</sup> The shutdown of some or all 102 NRC-licensed nuclear power plants in anticipation of a severe GMD event could by itself cause grid instability. Nuclear facilities generate 17 to 19 percent of annual U.S. electric grid net generation. What FERC has failed to do in Order No. 797 is to analyze the foreseeable impact of NRC preemptive shutdown of nuclear power plants on needs of the Bulk-Power System to assure “black start” capabilities essential to protect nuclear power plants and their spent fuel pools from Fukushima-type consequences. With all or most nuclear power plants in shutdown mode during a severe GMD event, FERC’s reliability standards for geomagnetic disturbances must protect “black start” resources so they can bring back nuclear operations in time to safeguard radioactive materials at these NRC-licensed sites. Hence, FERC should have analyzed the need to protect Generator Operator sites, first with mandatory GIC monitoring for transformers, and second, by assuring that standards for hardware protection will cause the protection of sufficient generating and transmission facilities to assure reliable “black start” for all nuclear generating facilities. Order No. 797 fails to take into account the extra burden and extra need for GMD visibility and GMD protection, once NRC facilities are anticipated to shut

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<sup>27</sup> The text of NRC staff testimony on April 30, 2012 is available in FERC Docket AD12-13-000.

down in a severe GMD event.<sup>28</sup> These indirect risks of FERC Order 797 require analysis and rebalancing of regulatory standards.

### **11. Viable Two-Way Communications Not Supported by Substantial Evidence in the Docket.**

FERC erred by assuming that there would be reliable and prompt two-way communications between Reliability Coordinators and Generator Operators immediately before and during severe solar storms. FERC has noted that space-based communication systems may be impaired during a severe solar storm.<sup>29</sup> The EMP Commission Report of April 2008, Chapter 2 “Electric Power”, provides additional evidence that communication systems are at risk during severe solar weather because the E3 pulse of a man-made EMP event approximates a GMD event.<sup>30</sup> There is not substantial evidence in the Docket records preceding FERC Orders 779 and 797 that there will be reliable two-way communications between the 16 regional Reliability Coordinator centers and other critical grid entities. Without reliable two-way communications, the regional Reliability Coordinators are likely to fail as the primary sources of mitigation instructions. Even if two-way communications exist, or are restored, lack of visibility as to conditions at Generator Operator sites argues for devolution of primary responsibility to mitigate GMD storms from the regional Reliability Coordinators to Generator Operators. Even Generator Operators without GIC monitors on-site may be able to hear clanging, growling, vibrations, and the other audio indicators of equipment distressed by vibrational impacts of solar GMD events. Even without the prudent and cost-effective installation of GIC monitors, they will know if their GSU transformers, or generator rotors, or stators are at risk. FERC needs to include Generator Operators in operating procedures, and FERC needs to require a system of devolutionary responsibility in the event that reliable communications and regional visibility are no longer

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<sup>28</sup> We concede that the NRC has back fitting authority under its existing statutory authorities. Under Title 42 U.S.C. § 2011 et seq. the NRC may require backfitting for essential safety requirements without accounting for economic costs. However, the NRC can apply cost-benefit analysis for various risk reduction initiatives. See *Union of Concerned Scientists v. NRC*, 824 F.2d 108 (1987). So the NRC could mandate retrofit installation of neutral ground blocking equipment at every GSU transformer under NRC license authority. However, the NRC may be reluctant to place a burden upon nuclear licensees, when FERC declines to place a comparable burden on non-nuclear generating facilities.

<sup>29</sup> FERC cited GMD impacts on communications in FERC Order No. 779 (May 2013), Para. 6, citing an Oak Ridge National Laboratory Report (1991).

<sup>30</sup> See “Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack; Critical National Infrastructures,” April 2008 at page 43.

valid assumptions. Without a primary role for Generator Operators and greater visibility via GIC monitors, FERC is asking the American electric customers to depend upon an impractical system that is likely to fail just when it is needed.

**12. Unlawful Deference to NERC on a Matter Regarding Competition and FERC's Failure to Address Comment on Anti-Competitive Barriers in Order No. 797.**

FERC erred by deferring to NERC on allegations of anti-competitive rulemaking; and by creating barriers to competition to deliver higher reliability electric transmission services. Through Order No. 797, FERC effectively grants Generator Operators a shield against financial liability for failure to participate in GMD operating procedures. Representatives of Generator Operators in the NERC Standards Committee and the NERC RISC Committee advocated eliminating GIC monitoring as a potential mandatory standard. The Generator Operator representatives were successful. FERC has not required a GIC monitoring equipment standard, and Generator Operators have no present duty to know what geomagnetic storms do to critical equipment at their facilities. The direct foreseeable effects are to discourage purchase of hardware protective equipment for GMD, and to discourage installation of GIC monitors at all GSU transformers and other GMD-impacted equipment. The indirect impact of these barriers to solar storm protection is to render difficult or impossible the competition by one or more transmission companies that may wish to compete to provide higher standards of grid reliability.<sup>31</sup>

A transmission company that seeks to provide higher reliability transmission services during adverse solar weather is impaired by Generator Operators that opt not to block the entry of GICs into the bulk transmission system via their GSU transformers. Unprotected transformers not only place the transformers at risk; they facilitate the injection of GICs and resulting reactive power demands into the bulk transmission system. In this light, FERC's Order No. 797 has created barriers to competition among transmission companies that would like to protect

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<sup>31</sup> FERC Order No. 672 expressly considered the potential role of improved reliability as a significant source of marketplace competition. Resilient Societies in the Docket preceding FERC Order 797 quoted CenterPoint Energy's comments in the Order 672 Docket, encouraging FERC to design reliability standards that encourage competitive initiatives to provide higher reliability services.

against GMD events but that also need to incentivize Generator Operators to also purchase GIC blocking equipment. FERC Order No. 797 does just the opposite: it rationalizes failing to install GIC monitors at generator-operator sites; it discourages Generator Operator participation in operating procedures; and it discourages purchase of GMD blocking equipment, which is most unlikely without prior installation of GIC monitoring equipment. It is a violation of Section 215 of the Energy Policy Act and of the policies embedded in FERC Order No. 672 to prohibit FERC from giving weight to NERC proposals that adversely impact competition in electric markets. FERC has failed to analyze the barriers to competition, thereby primarily benefitting Generator Operators and Generator Owners, and violating FERC's Order No. 672.

Prospectively letting NERC set an unrealistically low benchmark standard for a solar storm – NERC is currently proposing only 8 volts per kilometer, at or below the actual data recorded during moderate solar storms – will most likely lead to further barriers to install hardware protection at generation facilities. So the Stage 1 and Stage 2 reliability standards will foreseeably discourage and delay protection of the Bulk-Power System from severe solar geomagnetic disturbances. The result would be an anticompetitive standard that would shift risks from Generator Operators to society at large, and that would discourage higher levels of reliability within transmission companies.

**13. FERC Order No. 797 Fails to Recognize That Complexity and Unpredictability of Operating Procedures Requires That Failover Operating Procedures Should Vest in Generator-Operators and Their Facilities and Transmission Operators and Their Facilities.**

Professor-Emeritus George Baker, teaching on critical infrastructure at James Madison University for over 14 years and formerly a manager for setting of military specifications at the Department of Defense, submitted comments on Docket RM14-1-00 on the unpredictability of events, and uncertainties in complex modeling of solar storm impacts.<sup>32</sup> In Order 797, FERC acknowledged the concerns raised by Dr. Baker, but failed to analyze the consequences of reduced predictability and reduced visibility during severe solar storms. If the 16 regional

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<sup>32</sup> Dr. Baker is a Director of the Foundation for Resilient Societies.

Reliability Coordinators are likely to have impaired visibility of conditions at the generating facilities and transmission operators in their area of responsibility, and of conditions in adjoining regional Reliability Coordinator areas of responsibility, it would be prudent for FERC's GMD operating procedures to include provisions for failover responsibilities vesting in Generator Operators and Transmission Operators in their area. If the nation is to protect its GSU transformers – a dubious proposition under FERC Order No. 797 as proposed – the procedures for GMD operational mitigation should include failover responsibilities at every Generator-Operator above some criticality thresholds such as megawatt capacity. If threat visibility is impaired, if communications are impaired, if a cyber-attack is timed to coincide with a severe solar storm, it would be prudent for FERC reliability standards for GMD events to include provisions for failover responsibilities by Generator Operators, and by Transmission Operators.

Generator Operators will have the best chance to protect their GSU transformers and other critical equipment. And by participation, Generator Operators may accelerate installation of hardware protections that are a surer remedy for severe solar GMD events. Instead, FERC Order No. 797 assumes that unexpected outcomes do not matter, and that regional Reliability Coordinators can solve all the problems that need to be solved. This assumption is unreasonable, discriminatory, not supported by substantial evidence, and not in the public interest.

## **Request for Rehearing**

For each of the issues presented and for the reasons provided, Resilient Societies respectfully requests that FERC schedule a rehearing on the inadequacies and opportunities to improve FERC Order No. 797 and NERC Reliability Standard EOP-010-1.

## **Requests for Remand**

Resilient Societies requests that FERC remand to NERC modifications of the GMD Operating Procedure Standard to include:

1. Specific operational requirements such as the operator actions in the NERC templates for GMD operating procedures.
2. A planning requirement that would mandate Reliability Coordinators, Balancing Authorities, and Transmission Operators to mathematically compare the megawatt capacity of assets at risk during solar storms to megawatt capacity of reserve resources.
3. Applicability of the standard to NERC registered entities with networks within the definition of the Bulk Electric System.
4. Required GIC monitoring equipment at high voltage transformers and other critical equipment supporting the Bulk Power System;
5. Mandatory reporting of GIC data to regional Reliability Coordinators, Balancing Authorities, and Transmission Operators;
6. Mandatory planning and participation in GMD operating procedures by Generator Operators and Balancing Authorities;
7. Mandatory exercises, unscheduled drills, order authentication validation, and coordination with representatives of the Executive Office of the President, the Secretary of Energy, and the Nuclear Regulatory Commission to assure a coordinated, cooperative and effective system of anticipation and response to geomagnetic disturbance events; and
8. A system of external review and audit for geomagnetic disturbance plans developed by applicable entities.

## Conclusion

Without rehearing, reconsideration, and remand, FERC Order 779 will leave the Bulk Power System more vulnerable to severe GMD hazards than if FERC had issued no Order for GMD Operating Procedures whatsoever. Through Order No. 779, FERC's Commissioners enabled a promising initiative to protect the electric grid from severe solar storms. The Commission has an opportunity and the nation has a need for the Commission to revise its Order No. 797 and to refocus NERC so the Commission's objectives can be achieved.

Respectfully submitted by:



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For the

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