UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

North American Electric Reliability Corporation	**)** **)**	**Docket No. RM15-11-000**

COMMENTS OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION IN RESPONSE TO NOTICE OF PROPOSED RULEMAKING

The North American Electric Reliability Corporation ("NERC") hereby provides comments on the Notice of Proposed Rulemaking ("NOPR") regarding proposed Reliability Standard TPL-007-1 (Transmission System Planned Performance for Geomagnetic Disturbance Events) issued by the Federal Energy Regulatory Commission's ("FERC" or "Commission") in this proceeding on May 14, 2015.[1] NERC provides these comments as the Commission-certified electric reliability organization ("ERO") responsible for the development and enforcement of mandatory Reliability Standards, including the proposed Reliability Standard TPL-007-1.[2]

In the NOPR, the Commission proposes to approve Reliability Standard TPL-007-1 submitted by NERC for approval. The Commission also proposes to approve the definition of "Geomagnetic Disturbance Vulnerability Assessment" or "GMD Vulnerability Assessment" for inclusion in the Glossary of Terms Used in NERC Reliability Standards, the Implementation Plan for proposed TPL-007-1, and the Violation Risk Factors and Violation Severity Levels associated with the proposed standard. The Commission states that the proposed Reliability

[1] Notice of Proposed Rulemaking, *Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events*, 151 FERC ¶ 61,134 (2015) ("NOPR").

[2] *N. Am. Elec. Reliability Corp.*, 116 FERC ¶ 61,062 (2006), *order on reh'g and compliance*, 117 FERC ¶ 61,126 (2006), *order on compliance*, 118 FERC ¶ 61,030 (2007), *order on clarification and reh'g*, 119 FERC ¶ 61,046 (2007), *aff'd sub nom. Alcoa Inc. v. FERC*, 564 F.3d 1342 (D.C. Cir. 2009).

Standard addresses the specific parameters for the second stage geomagnetic disturbance ("GMD") Reliability Standards as set forth in Order No. 779[3] and constitutes an important step in addressing the risks posed by GMD events to the Bulk-Power System. However, the Commission proposes to direct that NERC develop modifications to the standard to address certain areas identified by the Commission. The Commission has requested comments on its proposals.

Proposed Reliability Standard TPL-007-1 is based on the most advanced space weather and geomagnetism information available, which was obtained through NERC's collaborative work with space weather researchers at the National Aeronautics and Space Administration ("NASA"), National Oceanic and Atmosphere Administration ("NOAA"), the U.S. Geological Survey ("USGS"), and their counterparts in Canada. These organizations have world-class leadership and experience in the field, contributing vast amounts of data and rigorous analysis to establish the models and the technically supported, 1-in-100 year benchmark GMD event (referred to herein as the "Benchmark GMD Event") that underpins the standard. NERC submits additional information in response to the Commission's proposed directives and requests for comments, and respectfully requests that the Commission carefully consider this information, approve the proposed standard as filed, and decline to include the proposed directives described in the NOPR in a final rule issued in this proceeding.

I. BACKGROUND

On May 16, 2013, the Commission issued Order No. 779, directing NERC to develop a set of Reliability Standards to address GMDs in two stages. On November 14, 2013, NERC

[3] Order No. 779, *Reliability Standards for Geomagnetic Disturbances*, 143 FERC ¶ 61,147 (2013) ("Order No. 779").

submitted the first stage Reliability Standard EOP-010-1 (Geomagnetic Disturbance Operations) for Commission approval. The Commission approved EOP-010-1 in Order No. 797, issued on June 19, 2014.[4] On January 21, 2015, NERC submitted for Commission approval proposed Reliability Standard TPL-007-1, the second stage Reliability Standard contemplated by Order No. 779.[5] As discussed in detail in NERC's Petition, proposed Reliability Standard TPL-007-1 requires applicable owners and operators of the Bulk-Power System to conduct initial and on-going assessments of the potential impact of the technically supported, 1-in-100 year Benchmark GMD Event on Bulk-Power System equipment and the Bulk-Power System as a whole.[6] Additionally, the proposed standard specifies parameters for assessments that will identify impacts from this Benchmark GMD Event and requires corrective action to protect against instability, uncontrolled separation, and cascading failures of the Bulk-Power System.

On May 14, 2015, the Commission issued the NOPR proposing to approve Reliability Standard TPL-007-1. In this filing, NERC responds to the Commission's request for comments with respect to the following:

- The Commission's proposal to direct NERC to modify the Benchmark GMD Event as described in Attachment 1 to proposed Reliability Standard TPL-007-1;[7]
- The Commission's proposal to direct NERC to conduct additional research into spatial averaging, earth conductivity, and research data availability issues, establish and file a work plan for such research, and submit additional informational filings in accordance with a schedule established in the work plan;[8]

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4 Order No. 797, *Reliability Standard for Geomagnetic Disturbance Operations*, 147 FERC ¶ 61,209, *reh'g denied*, Order No. 797-A, 149 FERC ¶ 61,027 (2014) ("Order No. 797").

5 *Petition of the N. Am. Elec. Reliability Corp. for Approval of Proposed Reliability Standard TPL-007-1 Transmission System Planned Performance for Geomagnetic Disturbance Events*, Docket No. RM15-11-000 (January 21, 2015) (the "Petition").

6 *See, e.g.*, Petition at 3-4 and 15-23.

7 NOPR at P 36.

8 *Id*. at PP 39, 46.

- The Commission's proposal to direct NERC to modify Requirement R6 of proposed Reliability Standard TPL-007-1, which pertains to transformer thermal impact assessments; also, the Commission's request for comments regarding whether the required thermal impact assessments could underestimate the impact of a benchmark GMD event on a qualifying transformer;[9]

- The Commission's proposal to direct NERC to modify proposed Reliability Standard TPL-007-1 to require installation of geomagnetically-induced current ("GIC") monitors and magnetometers;[10]

- The Commission's proposal to direct NERC to modify proposed Reliability Standard TPL-007-1 to establish deadlines for developing and completing any Corrective Action Plans required by Requirement R7;[11]

- How the provision in Table 1 of the proposed standard regarding load loss and curtailment will be enforced;[12] and

- Whether the length of the phased, five-year implementation period in the proposed implementation plan could be reasonably shortened, particularly with respect to Requirements R4, R5, R6, and R7.[13]

II. COMMENTS

NERC supports the Commission's proposal to approve Reliability Standard TPL-007-1. Proposed Reliability Standard TPL-007-1 addresses the Commission's directives as set forth in Order No. 779 and represents a significant milestone in NERC's ongoing efforts to understand and address the unique reliability risks that high-impact, low-frequency GMD events pose to the Bulk-Power System.

NERC provides the following comments on the issues discussed in the NOPR.

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9 *Id.* at PP 43-44.

10 *Id*. at PP 46-49.

11 *Id.* at PP 52-53.

12 *Id.* at P 58.

13 NOPR at P 63.

A. The Benchmark GMD Event Definition

1. Spatial Averaging and the Latitude Scaling Factors

a) NOPR

In the NOPR, the Commission proposes to approve proposed Reliability Standard TPL-007-1, including the Benchmark GMD Event submitted by NERC. The Commission stated that the proposed Benchmark GMD Event is consistent with the Commission's guidance in Order No. 779 to address "the potential widespread impact of a severe GMD event, while taking into consideration the variables of geomagnetic latitude and local earth conductivity."[14]

Nevertheless, the Commission expressed concern regarding the validity of the spatial averaging technique used in developing the Benchmark GMD Event.[15] The Commission also expressed concern that a spatially-averaged geoelectric field value could underestimate the potential impacts of a GMD event within a planning area.[16] The Commission therefore proposes to direct NERC to "develop modifications to the Reliability Standard so that the reference peak geoelectric field amplitude element of the benchmark GMD event definition is not based solely on spatially-averaged data."[17] The Commission suggests that NERC could revise the standard to require assessment using two different benchmark GMD events, one using a spatially-averaged reference peak geoelectric field value and one using a non-spatially averaged value, and require entities to take "corrective actions, using engineering judgment, based on the results of both assessments."[18] The Commission also seeks comment regarding whether the Benchmark GMD

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14 *Id.* at P 32.

15 *See id.* at PP 33-34.

16 *See id.* at P 35.

17 *Id.* at P 36.

18 *Id.* at P 36.

Event definition should be modified to reduce the impact of the scaling factors used to account for differences in geomagnetic latitude.[19]

b) Comments

NERC respectfully requests that the Commission not include the proposed directives when issuing a final rule in this proceeding. The proposed Benchmark GMD Event provides a technically-justified assessment of 1-in-100 year GMD impacts, including impacts on transformers, and therefore represents a "reasonable scientific and engineering approach"[20] to identifying GMD impacts with the potential to cause instability, uncontrolled separation, or cascading failures of the Bulk-Power System. As discussed below, the spatial averaging approach used to derive the reference peak geoelectric field amplitude for the Benchmark GMD Event is technically-justified, scientifically sound, and has been published in a peer-reviewed research journal covering geomagnetism and other topics. The Benchmark GMD Event sets a high benchmark for reliability. Further, the proposed standard would not prevent applicable entities from assessing their vulnerabilities to and instituting additional mitigating measures for more severe storms based on their engineering judgment.

(1) The Spatial-Averaging Technique is a Technically-Justified, Valid Form of Assessing the Impacts of a GMD Event on the Bulk-Power System

The 1-in-100 year peak geoelectric field amplitude of the Benchmark GMD Event builds upon work conducted by the NERC GMD Task Force to develop a benchmark that supports, through the GMD Vulnerability Assessments required by proposed Reliability Standard TPL-

[19] *See* NOPR at P 37.

[20] *See id.* at P 5.

007-1, the identification of GMD impacts with the potential to cause "instability, uncontrolled separation, or cascading failures of the Bulk-Power System."[21]

In the NOPR, the Commission notes that a study cited in the 2012 GMD Interim Report[22] calculated a significantly higher reference peak geoelectric field amplitude than the reference peak geoelectric field amplitude used in the Benchmark GMD Event.[23] In the 2012 NERC GMD Interim Report, a 1-in-100 year peak geoelectric field was determined statistically from geoelectric field amplitudes calculated using 10 second IMAGE magnetometer data for the period 1993 - 2006. Individual magnetometer station data were used to predict the 1-in-100 year peak geoelectric field at a single geographic point with a reference ground conductivity equivalent to the Québec earth model at 20 V/km.[24]

The standard drafting team for proposed Reliability Standard TPL-007-1 recognized that the description in the 2012 NERC GMD Interim Report was not appropriate for the Benchmark GMD Event. This is because applying maximum point observations over an area would consistently overestimate the geoelectric field of a 1-in-100 year GMD event used in GMD analysis. The correct approach for describing a benchmark GMD event requires the use of area magnetic data to determine the 1-in-100 year peak geoelectric field. A benchmark GMD event determined in this manner could then be used to model GIC in a power system and assess the impacts using established practices, which assume a uniform geoelectric field over the area of

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[21] The Commission indicated in Order No 779 that the proposed Reliability Standard should include "Requirements whose goal is to prevent instability, uncontrolled separation, or cascading failures of the Bulk-Power System when confronted with a benchmark GMD event." Order No. 779 at P. 84. Appendix I to the Benchmark Geomagnetic Disturbance Event Description white paper (Petition Ex. D) describes how the Benchmark GMD Event was developed to support assessment of these impacts.

[22] North American Electric Reliability Corporation, *2012 Special Reliability Assessment Interim Report: Effects of Geomagnetic Disturbances on the Bulk Power System* (Feb. 2012) ("2012 NERC GMD Interim Report").

[23] NOPR at P 33 (citing 2012 NERC GMD Interim Report at 22).

[24] 2012 NERC GMD Interim Report at 22.

the power system according to GIC calculation practices.[25] Spatial averaging properly associates the "relevant spatial scales for the analyzed and applied geoelectric fields"[26] and would not distort the complexity of the potential impacts of a GMD event.[27]

The selection of a 500 km distance for determining the area of interest for magnetic observations is based on consideration of transmission systems and geomagnetic observation patterns. NERC refers the Commission to a paper describing spatial averaging and the statistical derivation of the 100-year benchmark.[28] As noted therein, the 500 km scale provides an appropriate scale "for a system-wide impact" in a transmission system. The paper also includes graphical representation of patterns of similar magnetic field measurements, in both direction and magnitude, within groups that are spread over distances of about 500 km. The authors describe areas for further research, to include "characterization of multiple different spatial scales."[29] NERC agrees that such research would provide additional modeling insights and supports further collaborative efforts between space weather researchers and electric utilities through the NERC GMD Task Force. However, the transmission system characteristics and observed magnetic data patterns provide a reasonable scientific and engineering approach for defining the Benchmark GMD Event for use with proposed Reliability Standard TPL-007-1.

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25 North American Electric Reliability Corporation, *Application Guide: Computing Geomagnetically Induced Current in the Bulk Power System* at 24 (Equation 27) (Dec. 2013), *available at* http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/GIC%20Application%20Guide%202013_approved.pdf.

26 Antti Pulkkinen, Emanuel Bernabeu, Jan Eichner, Ari Viljanen, and Chigomezyo Ngwira, *Regional-Scale High-Latitude Extreme Geoelectric Fields pertaining to Geomagnetically Induced Currents*, EARTH, PLANETS AND SPACE 2015 67:93 (published Jun. 19, 2015), *available at* http://www.earth-planets-space.com/content/67/1/93 ("Pulkkinen et al. (2015)").

27 *Compare* NOPR at P 35 ("A GMD event will have a peak value in one or more location(s), and the amplitude will decline in distance from the peak. Only applying a spatially-averaged geoelectric field value across an entire planning area would distort this complexity. . . .").

28 *See* Pulkkinen et al. (2015), *supra* n. 26. The authors of this paper include both members of the TPL-007-1 standard drafting team as well as other individuals with substantial subject matter expertise.

29 *Id.* at 6.

(2) The Latitude Scaling Factors Appropriately Reflect the Impacts of GMD Events on Areas of Lower Geomagnetic Latitudes, and Modification is Not Warranted

A latitude scaling factor is provided in proposed TPL-007-1 to allow the Benchmark GMD Event to be tailored to an entity's specific geomagnetic latitude.[30] As stated in the Petition, the latitude scaling factor and the ground conductivity model scaling factor "account for differences in the intensity of a GMD event due to geographical considerations...."[31] In the NOPR, the Commission seeks comment on whether modification is warranted to reduce the impact of the latitude scaling factor "in light of studies indicating that GMD events could have pronounced effect on lower geomagnetic latitudes."[32] The Commission cites two research articles as examples of such studies.[33]

Modification of the latitude scaling factor is not technically justified, as the latitude scaling factor in proposed TPL-007-1 accurately models the reduction of induced geoelectric fields that occurs over the mid-latitude region during a 100-year GMD event scenario. The scaling factor describes the observed drop in geoelectric field that has been exhibited in analysis of major recorded geomagnetic storms. The analysis is based on ground-based magnetometer data and spacecraft observations that can determine the latitude boundary of the auroral electric current systems, which are the predominant source of severe geomagnetic disturbances.[34] The

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30 *See* Proposed Reliability Standard TPL-007-1 Attachment 1 – Calculating Geoelectric Fields for the Benchmark GMD Event (Petition Ex. A).

31 Petition at 18.

32 NOPR at P 37.

33 Cited research papers are: C.M. Ngwira et al., *Modeling Extreme 'Carrington-type' Space Weather Events using Three-dimensional Global MHD Simulations*, 119 J. OF GEOPHYSICAL RES.: SPACE PHYSICS 4472 (2014) ("Ngwira et al. (2014)") and C.T. Gaunt and G. Coetzee, *Transformer Failures in Regions Incorrectly Considered to Have Low GIC-Risk*, 2007 IEEE LAUSANNE 807 (July 2007) ("Gaunt and Coetzee (2007)").

34 *See* C. Ngwira and A. Pulkkinen et al., *Extended Study of Extreme Geoelectric Field Event Scenarios for Geomagnetically Induced Current Applications*, 11 SPACE WEATHER 121 (2013) ("Ngwira and Pulkkinen (2013)").

standard drafting team for proposed Reliability Standard TPL-007-1 determined that observational data provided a strong technical basis for the latitude scaling factors because it is well-documented in technical papers.[35]

Neither of the articles cited by the Commission in the NOPR warrants modification of the latitude scaling factor. The first article cited by the Commission in the NOPR publishes simulation results from "Carrington-type" (i.e. extreme)[36] conditions and represents a first-of-its-kind application of a suite of models to describe complex space weather interactions with earth's magnetosphere.[37] As reported in the article, the Carrington simulations produced extreme geomagnetic perturbations and implied that ground geoelectric fields could be displaced toward the equator.[38] The research was supported in part by NERC and EPRI as part of long-term efforts to understand the upper bound on geoelectric fields that can theoretically occur. However, it is important to note that these simulations and models are not yet sufficiently mature to apply their conclusions to a Reliability Standard. NERC agrees that additional research is necessary, and supports the significant research that is occurring throughout the space weather community to develop and validate models and simulation techniques. Nevertheless, inherent uncertainty exists. Furthermore, as NERC described in the Petition, proposed Reliability Standard TPL-007-1 is intended to provide adequate protection for an applicable entity's system to withstand a geomagnetic disturbance based on a 1-in-100 year GMD event design.[39] The research described

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35 *See id.* In addition, the latitude boundary behavior is described in A. Pulkkinen et al., *Generation of 100-year Geomagnetically Induced Current Scenarios*, SPACE WEATHER (2012), and Alan W.P. Thomson et al., *Quantifying Extreme Behavior in Geomagnetic Activity*, SPACE WEATHER (2011).

36 Referring to the type of conditions experienced during the Carrington Event of 1859. As described in the Petition, this event was the largest recorded GMD event, named after the British astronomer Richard Carrington. It is considered to be a 1-in-150 year GMD event. *See* Petition at n. 39 and 22.

37 *See generally* Ngwira et al. (2014).

38 Ngwira et al. (2014) at 4472.

39 *See* Petition at 16-17.

in this article is based on theoretical maximum storm conditions (i.e., more than a 1-in-100 year GMD event). When validated, the research may not be directly applicable to the proposed Reliability Standard as currently envisioned, with a 1-in-100 year GMD event design.

The second article cited in the NOPR was published in 2007 and describes transformer damage that occurred in southern Africa in 2003 and 2004. To briefly summarize the findings, after the severe GMD associated with the October 2003 "Halloween Storm", monitoring equipment detected a rapid increase in dissolved gas in some power transformers operated by Eskom, the electric utility of South Africa. Analysis of dissolved gas in oil-insulated transformers is used for preventive maintenance and fault analysis purposes and can provide information of overall transformer health. Internal inspection of the affected transformers revealed limited thermal damage to transformer insulation consistent with low levels of dissolved gas.[40] As transformer condition, loading, and construction factors can all influence the vulnerability of a transformer to levels of GIC, the results presented in this article do not lead to the conclusions that the transformer impacts were the result of abnormally high levels of GIC or that the geoelectric fields experienced in southern Africa were uncharacteristically high for this latitude during a severe GMD event.[41] Furthermore, the standard drafting team included observational data from the October 2003 "Halloween Storm" in the set of GMD events that were analyzed to determine the latitude scaling factors used in proposed TPL-007-1, and the

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[40] *See* 2012 NERC GMD Interim Report at 41-42 (citing Gaunt and Coetzee (2007)).

[41] Indeed, manufacturer defects or transformer oil quality may have contributed to the reported transformer failures in South Africa. *See* R. Girgis and K. Vedante, *Effects of GIC on Power Transformers and Power Systems*, TRANSMISSION AND DISTRIBUTION CONFERENCE AND EXPOSITION (T&D), 2012 IEEE PES (2012), *available at* http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=6267012.

calculated geoelectric fields exhibit the characteristic drop across the middle geomagnetic latitudes.[42]

2. Work Plan for Additional GMD Research

a) NOPR

Citing the "need for more data and certainty in the knowledge and understanding of GMD events and their potential effect on the Bulk-Power System,"[43] the Commission proposes to direct NERC to conduct or oversee additional analysis on certain issues. Specifically, the Commission proposes to direct NERC to: (1) perform additional analysis regarding the sizes of squares used in the spatial averaging technique; (2) further analyze earth conductivity models; (3) determine whether new analysis supports modifying the use of single station readings around the earth to adjust the spatially-averaged benchmark for latitude; and (4) assess how to make GMD data, such as GIC monitoring and magnetometer data, available to researchers for study. The Commission proposes to direct NERC to submit a work plan within six months that would describe how it would address these issues and provide a schedule for future informational filings that would describe the results of this research and assess whether the proposed Reliability Standard continues to remain valid in light of new findings.[44]

b) Comments

NERC recognizes that the understanding of the potential impacts of GMDs on reliability is evolving, and it agrees with the Commission that continued research is necessary. The NERC GMD Task Force has provided a strong path forward based on scientific and engineering expertise, and NERC would prefer to move forward on that path, implement Reliability Standard

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42 *See* Ngwira and Pulkkinen (2013).

43 NOPR at P 38.

44 NOPR at P 39.

TPL-007-1 as proposed, and maintain flexibility in addressing new research and implementation insights through its international, collaborative research partnerships. NERC respectfully submits that this approach, as an alternative to the Commission's proposal to submit within six months of a final rule a formal work plan and informational filing schedule, would accomplish NERC's and the Commission's shared goals in advancing GMD understanding and knowledge, while providing the flexibility necessary for NERC to work effectively with its international research partners to address risks to the reliability of the North American Bulk-Power System.

Since its inception in 2011, the NERC GMD Task Force has spearheaded the focused effort to improve industry GMD awareness and mitigation capabilities. By working through an open and diverse network of international partners, including U.S. and Canadian government, utility, and public and private researchers, the NERC GMD Task Force has developed state of the art models, tools, and techniques that enable implementation of the GMD standards EOP-010-1 and proposed TPL-007-1 and support broad application of best practices in North America. NERC agrees with the Commission that continued research and analysis on GMD-related issues is appropriate. NERC commits to continue its work to advance the technical capabilities of the industry to address this high-impact, low frequency risk through these effective and collaborative international partnerships. In addition to a proactive effort to train and prepare the industry for their obligations under the GMD standards, NERC's research efforts going forward are focusing on addressing several key areas where understanding needs to progress in order to better mitigate risks to reliability.

Working with EPRI, researchers at USGS, and industry, NERC will work to improve the earth conductivity models that are a vital component to understanding the risks of GMD events in each geographic region using a variety of techniques that can be effectively implemented with

existing technology. These research efforts would be best served if NERC retains flexibility to choose its techniques and is not bound to conduct its research using pre-specified techniques that may prove to be ineffective.[45]

In addition to its efforts regarding earth conductivity models, NERC continues to partner with the United States Department of Energy, EPRI, and U.S. and Canadian utilities in transformer resiliency and in increasing the availability of thermal modeling information validated by measurement data. Further, NERC is collaborating with researchers to examine more complex GMD vulnerability issues, such as harmonics and mitigation assessment techniques, to enhance the modeling capabilities of the industry.

The NERC GMD Task Force provides an important forum for utilities and researchers to exchange relevant GMD data and information to further the body of knowledge on GMD issues relevant to the reliability of the Bulk-Power System. For example, researchers at USGS partnered with a utility to examine ground conductivity models using measured GIC data and calculated GIC values and demonstrate this capability to task force participants.[46] NERC is committed to continue this information sharing forum in response to the Commission's desire to make data available.

Further, the Commission does not need to direct NERC to analyze the validity of proposed Reliability Standard TPL-007-1 in each GMD research finding informational filing.[47]

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[45] *See, e.g.*, NOPR at P 39 (proposing to direct NERC to submit a work plan that describes how NERC plans to "further analyze earth conductivity models by, for example, using metered GIC and magnetometer readings to calculate earth conductivity and using 3-D readings.")

[46] *See* NERC GMD Task Force Meeting, November 2013. Presentation available at the NERC GMD Task Force project page at http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/Day2_all_final.pdf.

[47] *See* NOPR at P 39 ("Further, in the [informational filing] submissions, NERC should assess whether the proposed Reliability Standard remains valid in light of new information or whether revisions are appropriate.")

The new GMD standards were developed to take advantage of the emerging technical improvements that NERC is pursuing through its ongoing research efforts and partnerships with EPRI and other collaborators on the NERC GMD Task Force. Proposed Reliability Standard TPL-007-1 is performance-based, which enables applicable entities to use state-of-the-art tools and methods to accomplish the specified reliability objectives.[48] Further, NERC has processes in place to address both emerging reliability issues and maintain the technical relevance of standards. For example, NERC's Reliability Issues Steering Committee assists the NERC Board of Directors, NERC standing committees, NERC staff, regulators, Regional Entities, and industry stakeholders in establishing a common understanding of the scope, priority, and goals for the development of solutions to address nominated issues of strategic importance to Bulk-Power System reliability. In addition, NERC's standard development process provides for the periodic review of Reliability Standards such as proposed Reliability Standard TPL-007-1.[49] To maintain an effective benchmark, future reviews are expected to include additional magnetometer data and the results of further research into spatial scales (as discussed in Section II.A.1).[50] Future reviews of the proposed standard will also be informed by the knowledge and experience that is gained through full implementation of the standard over the proposed five year implementation period. NERC anticipates that applicable entities will derive important insights from fully implementing proposed Reliability Standard TPL-007-1, and that full implementation of the standard will provide NERC with the opportunity to obtain a more complete, overall assessment of potential GMD impacts on the reliability of the Bulk-Power System. NERC's

[48] *See* Petition at 41.

[49] Section 13 of NERC Standard Processes manual, *Process for Conducting Periodic Reviews of Reliability Standards*, governs Reliability Standards reviews and directs that each Reliability Standard be reviewed at least once every 10 years.

[50] *See* Petition at 41.

processes provide the proper fora to determine whether the proposed standard remains valid as written, or whether implementation insights and new research developments provide a basis for revising the standard. Commission staff is able to participate in these processes and monitor progress and awareness of data and research results.

For the reasons described above, the Commission's proposal to direct NERC to study specific GMD issues and submit a work plan within six months of the effective date of a final rule in this proceeding that would describe how NERC would address these areas and when it would report its findings is not needed to ensure ongoing research in GMD related areas. NERC is addressing key areas affecting reliability and is committed to continuing these efforts and keeping Commission staff apprised of the results. However, in addition to being unnecessary to achieve the desired results, the Commission's proposed directive poses practical challenges as well. The understanding of GMD impacts on reliability is evolving, and NERC's collaborative international research partnerships will need flexibility in order to continue to develop sound, verified, and actionable results in the areas most important to reliability. Given the effectiveness of these efforts to date, reliability would be best served by continuing this approach, rather than by binding NERC to a specific and inflexible research plan and report schedule to be determined six months (or even a year) following the effective date of a final rule in this proceeding.

NERC reiterates its commitment to continue its collaborative efforts to improve the understanding of GMD impacts on reliability and to work with the Commission and stakeholders to address the concerns raised in the NOPR through these ongoing efforts. In light of NERC's commitments and ongoing collaborative efforts, NERC respectfully requests that the Commission decline to include the proposed directive in a final rule issued in this proceeding.

B. Transformer Thermal Impact Assessment

1. NOPR

In the NOPR, the Commission proposes to direct NERC to modify the proposed standard to require applicable entities to apply spatially-averaged and non-spatially averaged peak geoelectric field values, or some equally and efficient alternative, when conducting thermal impact assessments pursuant to Requirement R6.[51] Additionally, the Commission seeks comment from NERC "as to why qualifying transformers are not assessed for thermal impacts using the maximum GIC-orientation" and whether this could result in assessments that "underestimate the impact of a benchmark GMD event on a qualifying transformer."[52]

2. Comments

The Benchmark GMD Event appropriately addresses the potential widespread impact of a severe GMD event consistent with the Commission's guidance in Order No. 779. Technical justification does not exist to support a modification of the transformer thermal assessment requirements in proposed TPL-007-1 to identify transformers that are potentially at-risk in a localized area from a high-impact, low-frequency GMD event. As described above, use of the Benchmark GMD Event will result in GIC calculations that are appropriately scaled for system-wide assessments because the field data is characterized over a generally equivalent area. Additionally, analysis performed by the standard drafting team of the impact of localized enhanced geoelectric fields on the GIC levels in transformers indicates that relatively few transformers in the system are affected.[53] Thus, the thermal assessment requirements in proposed

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51 NOPR at P 43.

52 *Id.* at P 44.

53 Benchmark Geomagnetic Disturbance Event Description white paper (Petition Ex. D) at 15.

TPL-007-1 appropriately address the risks of instability, uncontrolled separation, and cascading caused by damage to transformers from the Benchmark GMD Event.

Requirement R5 of proposed Reliability Standard TPL-007-1 specifies GIC flow information to "support various methods for performing transformer thermal impact assessments."[54] Methods described in the Transformer Thermal Impact Assessment White Paper provide technically-justified approaches to assess thermal vulnerability of transformers to the Benchmark GMD Event.[55] In some methods, the effective GIC time series specified by proposed Requirement R5 Part 5.2 is used to perform a detailed thermal impact assessment of the Benchmark GMD Event according to technical guidance. A transformer thermal response simulation, for example, can be performed using the calculated effective GIC time series that would be produced in the system during a Benchmark GMD Event.[56]

The Commission seeks comment "as to why qualifying transformers are not assessed for thermal impacts using the maximum GIC-producing orientation."[57] For clarity, NERC notes that the thermal impact assessment approach described in supporting technical guidance uses the magnitude of the maximum GIC-producing orientation for each transformer in the system as determined through steady-state GIC analysis.[58] In the thermal assessment process, the time-varying orientation of the Benchmark GMD Event is defined by the benchmark geomagnetic field waveshape. This waveshape, which specifies time-varying magnitude and orientation of the geomagnetic field, is based on recorded magnetic field observations from the March 1989 GMD

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54 Petition at 29.

55 *See generally* Transformer Thermal Impact Assessment White Paper (Petition Ex. E).

56 *See id.* at 5.

57 NOPR at P 44.

58 Transformer Thermal Impact Assessment White Paper (Petition Ex. E) at 6.

event.[59] For thermal assessments, the benchmark geomagnetic field waveshape is scaled to match 1-in-100 year peak geoelectric field intensities. The waveshape of the March 1989 GMD event is shown to provide "generally conservative results when performing thermal analysis of power transformers."[60] The orientation of the geomagnetic field varies widely and continuously during a GMD event. At any point in time any given transformer would be aligned with the maximum GIC-producing orientation for only a few minutes. In the context of transformer hot spot heating with time constants in the order of tens of minutes, alignment with any particular orientation for a few minutes at a particular point in time is not a driving concern.[61]

NERC maintains that the approach taken for assessing thermal impact in qualifying transformers is justified for addressing the potential impact of a 1-in-100 year GMD event as part of a GMD Vulnerability Assessment. The GIC flow information provided in Requirement R5 is derived from the Benchmark GMD Event and accounts for the magnitude and duration of the GIC that system transformers could see during a severe GMD event.

C. Installation of GMD Monitoring Devices

1. NOPR

The Commission proposes to direct NERC to modify the proposed standard to require installation of monitoring equipment, such as GIC monitors and magnetometers, "to the extent there are any gaps in existing GIC monitoring and magnetometer networks, which will ensure a

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[59] Benchmark GMD Event Description (Petition Ex. D) at 6. For more information about the March 1989 GMD event, *see* Petition at 16 and 2012 NERC Interim GMD Report at i.

[60] *Id.*

[61] By contrast, it is appropriate to consider the orientation for maximum GIC in the context of half-cycle saturation and subsequent reactive power absorption, where a few minutes is practically steady-state for the power system. *See* NERC GMD Task Force, *Geomagnetic Disturbance Planning Guide* (Dec. 2013) at 6, *available at* http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/GMD%20Planning%20Guide_approved.pdf ("GMD Planning Guide").

more complete set of data for planning and operational needs."[62] In the Petition, NERC stated that installation of GIC monitoring devices may be part of an entity's corrective action plan developed to achieve specified performance during a benchmark GMD event.[63] In the NOPR, the Commission stated that, "rather than wait to install necessary monitoring devices as part of a corrective action plan, GIC and magnetometer data should be collected by applicable entities at the outset" at locations identified by NERC.[64] To identify these locations, NERC, as part of a work plan informational filing, would be directed to: (i) identify the number and location of existing monitoring devices; and (ii) assess whether there are GIC monitors and magnetometers in enough locations to "provide adequate analytical validation and situational awareness."[65] NERC would also be required to "assess how to make GMD data (e.g., GIC monitoring and magnetometer data) available to researchers for study" in its work plan.[66] In the alternative, the Commission seeks comment on whether NERC itself should be responsible for installing additional magnetometers while affected entities would be responsible for installing additional GIC monitors.[67]

2. Comments

NERC respectfully requests that the Commission decline to include the proposed directive for NERC to modify proposed Reliability Standard TPL-007-1 to require the installation of GMD monitoring equipment in a final rule issued in this proceeding. The Commission's proposed directive is not needed to ensure adequate data is available for

62 NOPR at P 46.
63 Petition at 32.
64 NOPR at P 48.
65 *Id.* at PP 46, 48.
66 *Id.* at P 39.
67 *Id.* at P 46.

reliability-related purposes, because proposed Reliability Standard TPL-007-1 supports effective GMD monitoring programs, and additional efforts are planned or underway to ensure adequate data for reliability purposes. This includes addressing the concerns identified by the Commission in the NOPR, such as ensuring a more complete set of data for operational and planning needs, analytical validation, and situational awareness. Further, the Commission's proposed directive poses numerous implementation challenges at this early stage. GMD monitoring capabilities and technical information have not yet reached a level of maturity to support application in a Reliability Standard, and not all applicable entities have developed the comprehensive understanding of system vulnerabilities that would be needed to deploy GMD monitoring devices for the greatest reliability benefit. Therefore, the current approach represents an effective and practical way to obtain improved GMD information for operational and planning needs.

a) The Proposed Reliability Standard Supports Effective GMD Monitoring Programs

While installation of GIC monitoring devices could be part of a mitigation strategy required by proposed TPL-007-1 as stated in the Petition,[68] NERC agrees with the Commission that GMD monitoring and data acquisition should not be limited to an applicable entity's Corrective Action Plan. For instance, GIC data may be used by an entity for situational awareness purposes or to provide validation of GMD Vulnerability Assessment information.

Proposed Reliability Standard TPL-007-1 and the related technical guidance support grid monitoring enhancement. For example, the technical guidance for GMD planning advises that "the placement of monitors is influenced by a number of vulnerability factors, including system topology, local geology, transformer type, etc."[69] The GMD Vulnerability Assessments required

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68 *See* Petition at 13.

69 2012 NERC GMD Interim Report at 71.

by the proposed Reliability Standard will systematically determine these vulnerability factors to identify system and equipment issues which may need to be monitored for operator situational awareness. Technical guidance for development of effective operating procedures further advises that GMD Vulnerability Assessment studies are needed to determine where to place GIC monitors for operator decision making.[70] Additionally, the studies conducted during the GMD Vulnerability Assessment process will determine the expected values of GIC and other system parameters during GMD events, information which will support validation efforts.

Requirements for communicating impacts identified through the GMD Vulnerability Assessments are clearly established by proposed Reliability Standard TPL-007-1, promoting a high level of situational awareness among operating entities during GMD events. Shared information would include locations of GIC monitors and "thresholds for action" based on the results of studies.[71] Requirement R4 Part 4.3 specifies that the GMD Vulnerability Assessment must be provided to the responsible entity's Reliability Coordinator, among other entities, within 90 calendar days of completion of the assessment. Similarly, Requirement R7 Part 7.3 specifies that a Corrective Action Plan must be provided to the responsible entity's Reliability Coordinator, among other entities, within 90 calendar days of completion. This transfer of information supports situational awareness and the development of effective GMD operating plans and procedures which are required by the first-stage GMD Reliability Standard, EOP-010-1 - Geomagnetic Disturbance Operations.[72]

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70 *See id.* at 79 (11.3 Information Needed for Decision-Making).

71 *Id*.

72 Under EOP-010-1, applicable entities are required to have coordinated GMD operating plans and procedures to mitigate the effects of GMD events on reliable operations. Rather than imposing prescriptive requirements, EOP-010-1 provides flexibility for tailored operating procedures based on the applicable entity's assessment of entity-specific factors, such as geography, geology, and system topology in accordance with Commission guidance in Order No. 779. *See* Order No. 779 at P 38 ("the Reliability Standards, rather than include

NERC anticipates that the continent-wide implementation of proposed TPL-007-1 would further promote entity-initiated GIC monitor installations and data acquisition as applicable entities address system and equipment impacts identified through the GMD Vulnerability Assessment process. The growth trend in GIC monitors that results from implementation of proposed TPL-007-1 is expected to support the timely and effective development of expanded GIC information for planning and operational needs.

b) Additional Efforts are Underway to Expand GMD Monitoring Programs to Ensure Adequate Data for Reliability Needs

As described above, the proposed Reliability Standard supports effective GMD monitoring programs, and efforts are already underway to expand GMD monitoring capabilities. Through these efforts, NERC and industry should effectively address the concerns noted by the Commission in the NOPR, including ensuring a more complete set of data for operational and planning needs and supporting analytical validation and situational awareness. In light of these efforts, the Commission's proposed directive to modify the standard to require installation of GMD monitoring devices is unnecessary.

To date, a number of entities have installed GIC monitors, either through the EPRI's collaborative SUNBURST program or independently. The EPRI SUNBURST network currently operates over 40 GIC monitoring nodes, providing near real-time GIC data to participating members.[73] NERC also notes that there are NERC registered entities that have installed GIC

'one-size-fits-all' Requirements, should allow responsible entities to tailor their operational procedures based on the responsible entity's assessment of entity-specific factors, such as geography, geology, and system topology, identified in the Reliability Standards."). For Transmission Operators, these procedures must include "System Operator actions to be initiated based on predetermined conditions" such as space weather information, or other data including GIC monitoring information if available. EOP-010-1 R3.2. Reliability Coordinators are required by EOP-010-1 R1 to have a GMD Operating Plan that "coordinates GMD Operating Procedures or Operating Processes within its Reliability Coordinator Area" and to review the GMD operating procedures of Transmission Operators.

[73] EPRI, *SUNBURST Network for Geomagnetic Currents* (abstract) (June 2011), *available at*: http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001023278&Mode=download.

monitors independently to address their needs for GIC data. One example is PJM's use of GIC monitoring to trigger operating procedures, which was noted by the Commission in the NOPR.[74] These GIC monitoring activities have been initiated by entities to address their operational or planning needs, and through collaborative forums such as the NERC GMD Task Force and the EPRI SUNBURST program, they can also be an important resource for broader validation and situational awareness purposes.

In addition to GIC monitoring devices, the Commission proposes to direct NERC to modify the proposed Reliability Standard to require the installation of magnetometers or, in the alternative, install such magnetometers itself.[75] NERC agrees that accurate magnetic field information is necessary to support validation of models used in GMD Vulnerability Assessments because magnetic data is used to calculate the geoelectric fields that produce GICs during a GMD event. However, the proposed directive is not needed to support model validation, because collaborative research efforts are underway that would effectively address these concerns.

Collaborative research efforts to support model validation may include the addition of magnetometers where necessary to augment the existing network of magnetometers operated through USGS observatories in the contiguous United States. As discussed above, earth conductivity model research and validation is included in NERC's work plan with EPRI and other research partners.[76] One possible approach is to use modeled and collected GIC data along with magnetometer data from USGS observatories or other sources to assess the validity of ground models in a utility's area. With support from the U.S. Department of Energy, EPRI has

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74 NOPR at P 47.

75 NOPR at P 46.

76 *See supra* Section II.A.2.

completed installation of a magnetometer in the northeast region of United States to augment data feeds from USGS sites into the SUNBURST network. These efforts, and any additional magnetometer installations that are undertaken through NERC's collaborative research efforts, would provide effective support for validating models with magnetometer data.

The GMD monitoring efforts described above complement each other to support the expanded flow of GMD data and information for research and entity-specific reliability purposes. In light of these efforts, the Commission's proposed directive to modify the proposed standard to require the installation of GMD monitoring devices is not needed to ensure adequate data for operations and planning, situational awareness, and model validation purposes.

c) Practical Considerations Weigh against Requiring Monitoring through the Proposed Reliability Standard

The Commission proposes to direct NERC to modify proposed Reliability Standard TPL-007-1 to require the installation of GMD monitoring equipment so that GIC and magnetometer data can be collected "at the outset".[77] While there is nothing in the proposed standard that would prevent an entity from installing the proposed GMD monitoring equipment, a mandatory requirement to install GMD monitoring devices would pose significant implementation challenges. Further, such a requirement would not be well-aligned with the purpose of a NERC planning standard.

GMD monitoring capabilities and technical information have not yet reached a level of maturity to support application in a Reliability Standard. In order to deploy GIC monitors effectively, applicable entities must first develop an understanding of their needs and vulnerabilities. The GMD Vulnerability Assessment process provides a systematic approach for

[77] NOPR at P 48.

developing the information that applicable entities would need to determine where additional devices are necessary to "provide adequate analytical validation and situational awareness."[78] Correspondingly, the GMD Vulnerability Assessments will be integral to the process of identifying gaps in existing GMD monitoring networks and selecting the locations where additional devices would provide the greatest benefit to reliability. Under the proposed implementation plan, the information necessary for effective deployment of additional GIC monitoring devices would be developed over a five-year period. Therefore, it would be premature to require the installation of GIC monitoring devices in selected locations "at the outset," before the information needed to develop meaningful and technically justified installation criteria is available.

Further, as described in the preceding section, entity initiatives and ongoing collaborative research efforts are currently underway or expected that will expand existing GIC monitor and magnetometer networks. The proposed Reliability Standard, along with these initiatives and collaborative research efforts, will support the development of GMD monitoring and would address the Commission's concerns in a more effective manner than would be possible in a mandatory Reliability Standard at this early stage.

Lastly, NERC notes that a requirement mandating the installation of GMD monitoring devices for situational awareness purposes would be outside the scope of a planning standard

[78] *See* NOPR at P 48.

generally,[79] and would also be incongruous with the purpose and intent of proposed Reliability Standard TPL-007-1.[80]

For these reasons, NERC respectfully requests that the Commission refrain from including the proposed directive relating to the mandatory installation of GMD monitoring equipment in a final rule issued in this proceeding.

D. Corrective Action Plan Deadlines

1. NOPR

The Commission proposes to direct NERC to revise proposed Reliability Standard TPL-007-1 to include deadlines for developing and completing any Corrective Action Plans for mitigating identified vulnerabilities under Requirement R7. Specifically, the Commission proposes to direct NERC to establish: (1) a one-year deadline for developing Corrective Action Plans following the completion of the GMD Vulnerability Assessment; (2) a two-year deadline for completing mitigation measures in Corrective Action Plans that do not involve installing equipment; and (3) a four-year deadline for completing mitigation measures in Corrective Action Plans involving equipment installation.[81]

2. Comments

NERC does not object to the Commission's proposal to establish a one-year deadline for developing a Corrective Action Plan, but does not believe such a deadline is needed. The requirements for the GMD Vulnerability Assessment and the Corrective Action Plan go into

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[79] As described by the Commission in Order No. 693, the Transmission Planning (TPL) standards "are intended to ensure that the transmission system is *planned* and *designed* to meet an appropriate and specific set of reliability criteria." *Mandatory Reliability Standards for the Bulk-Power System*, Order No. 693, FERC Stats. & Regs. ¶ 31,242 at P 1683 (2007) (emphasis added), *order on reh'g*, Order No. 693–A, 120 FERC ¶ 61,053 (2007).

[80] The stated purpose of proposed Reliability Standard TPL-007-1 is to "establish requirements for Transmission system planned performance during geomagnetic disturbance (GMD) events."

[81] NOPR at PP 52-54.

effect at the same time under the proposed implementation plan (five years following regulatory approval). NERC expects that applicable entities would determine necessary corrective actions as part of their GMD Vulnerability Assessments for the initial assessment as well as subsequent assessments.

With respect to the completion of mitigation measures contained in the Corrective Action Plans, NERC expresses the following concerns. NERC agrees that applicable entities need to take reasonably prompt measures to remediate vulnerabilities identified through GMD Vulnerability Assessments. Requirement R7 requires applicable entities to develop an effective plan, and the timing of mitigation measures is a part of that plan. Provided that they are mitigating vulnerabilities in the interim, applicable entities should be encouraged to pursue better, longer-term solutions. The problem with establishing completion deadlines at this stage is that equipment-based mitigation measures for GMDs are still in development, and realistic timelines for their completion and implementation have not yet been established. NERC is concerned that the Commission's proposed directive could have the unintended effect of encouraging applicable entities to pursue operating procedure mitigation measures at the expense of equipment measures, and thereby forestall the development of an entire category of potential solutions.

Nevertheless, should the Commission determine that a directive to develop Corrective Action Plan completion deadlines is necessary at this time, NERC respectfully requests that it be afforded the flexibility to develop requirements that will allow for the modification or extension of completion deadlines, in light of the fact that there is there is little industry experience with certain GMD mitigation solutions.

E. Minimization of Load Loss and Curtailment

1. NOPR

The Commission seeks comment that explains how the provision in Table 1 regarding load loss and curtailment ("Load loss or curtailment of Firm Transmission Service should be minimized") will be enforced.[82]

2. Comments

The section in Table 1 titled "Steady State Performance Footnotes" provides details to be used by applicable entities in evaluating system performance for the GMD planning event. Note 3 in TPL-007-1 is generally modeled on similar language in approved Reliability Standard TPL-001-4 (Transmission System Planning Performance Requirements). For example, Table 1, note 9 of approved TPL-001-4 provides, in part, that "an objective of the planning process should be to minimize the likelihood and magnitude of interruption of Firm Transmission Service following Contingency events." However, proposed TPL-007-1 Table 1 does not include additional load loss performance criteria used in normal contingency planning because such criteria may not be applicable to GMD Vulnerability Assessments of the impact from a 1-in-100 year GMD event. [83]

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82 NOPR at P 57-58.

83 For example, TPL-001-4 Table 1, note 12 states:

> An objective of the planning process is to minimize the likelihood and magnitude of Non-Consequential Load Loss following planning events. In limited circumstances, Non-Consequential Load Loss may be needed throughout the planning horizon to ensure that [Bulk Electric System] BES performance requirements are met. However, when Non-Consequential Load Loss is utilized under footnote 12 within the Near-Term Transmission Planning Horizon to address BES performance requirements, such interruption is limited to circumstances where the Non-Consequential Load Loss meets the conditions shown in Attachment 1. In no case can the planned Non-Consequential Load Loss under footnote 12 exceed 75 MW for US registered entities. The amount of planned Non-Consequential Load Loss for a non-US Registered Entity should be implemented in a manner that is consistent with, or under the direction of, the applicable governmental authority or its agency in the non-US jurisdiction.

Enforcement of TPL-007-1 Requirement R4 would include an evaluation of whether the system meets the Steady State performance requirements of Table 1 which are aimed at protecting against instability, uncontrolled separation, and Cascading.[84] "Minimization" in the context of TPL-007-1 means that planned Load loss or curtailments are not to exceed amounts necessary to prevent voltage collapse.

F. Implementation Plan and Effective Dates

1. NOPR

The Commission proposes to approve the phased, five-year implementation plan for proposed Reliability Standard TPL-007-1. However, the Commission seeks comment as to "whether the length of the implementation plan, particularly with respect to Requirements R4, R5, R6, and R7, could be reasonably shortened."[85]

2. Comments

NERC submits that the length of the implementation plan is appropriate and commensurate with the requirements of the proposed standard. Industry has provided projections on the time required for obtaining validated tools, models, and data necessary for conducting GMD Vulnerability Assessments through the standard development process.[86] Initially, the standard drafting team proposed a four year implementation plan. However, the team received a number of comments expressing concern with the proposed four-year length and determined that

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84 TPL-007-1 Table 1 – Steady State Planning Events provides for the following Steady State performance:

a. Voltage collapse, Cascading and uncontrolled islanding shall not occur.

b. Generation loss is acceptable as a consequence of the planning event.

c. Planned System adjustments such as Transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Facility Ratings.

85 NOPR at P 63.

86 *See generally* Summary of Development History and Complete Record of Development (Petition Ex, I).

a five year length was more appropriate.[87] The phased implementation plan has been tailored accordingly and reflects a realistic timeline for expecting owners and operators to perform GMD Vulnerability Assessments. As the GMD Vulnerability Assessments will be performed once every five years, it is especially important that applicable entities have ample time to provide the necessary training and education on the use of new modeling tools to ensure their successful implementation.

[87] *See, e.g.*, Comments of ACES Standards Collaborators, Consideration of Comments Posted August 27, 2014 at 74 ("We believe the overall timeline of four years is too short and burdensome for entities. With limited resources, software, and industry knowledge in this area, it will take entities time to construct the proper data models and conduct these new studies correctly. For smaller entities with limited staff and financial resources, this effort will be a significant challenge."). *See also* Comments of Northeast Power Coordinating Council submitted during the informal comment period ending May 21, 2014 ("This Implementation Plan is highly dependent on the availability of time study tools. Please make sure that sufficient delay for tool development is considered and that stages are postponed accordingly. Given the newness of the science and assumptions, it is possible that more time than four years may be needed."). Comments are available in the Complete Record of Development (Petition Ex. I).

III. Conclusion

For the reasons set forth above, NERC respectfully requests that the Commission accept these comments for consideration.

Respectfully submitted,

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Date: July 27, 2015

CERTIFICATE OF SERVICE

I hereby certify that I have served a copy of the foregoing document upon all parties listed on the official service list compiled by the Secretary in this proceeding. Dated at Washington, D.C. this 27th day of July, 2015.

/s/ Lauren A. Perotti

Lauren A. Perotti

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