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 REGARDING THE LOS ALAMOS NATIONAL LABORATORY TECHNICAL PAPER

The North American Electric Reliability Corporation ("NERC") hereby provides comments regarding the September 2015 technical paper prepared by the Los Alamos National Laboratory ("LANL") titled *Review of the GMD Benchmark Event in TPL-007-1* ("LANL Report"),[1] filed by the Foundation for Resilient Societies in the above-captioned docket on September 30, 2015.[2] NERC submits these comments as the Commission-certified electric reliability organization responsible for the development and enforcement of mandatory Reliability Standards,[3] including the proposed Reliability Standard TPL-007-1 – Transmission System Planned Performance for Geomagnetic Disturbance ("GMD") Events.

NERC welcomes the additional discussion brought about by the LANL Report and the opportunity to comment on the analysis and recommendations. NERC encourages rigorous review of all aspects of this important Reliability Standard and appreciates the U.S. Department

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[1] Los Alamos Nat'l Lab., *Review of the GMD Benchmark Event in TPL-007-1*, Report LA-UR-15-25609 (Sept. 2015).

[2] On October 2, 2015, the Federal Energy Regulatory Commission ("FERC" or the "Commission") issued a Notice Setting Comment Period, allowing interested parties 20 days to comment on the LANL Report as well as NERC's September 23, 2015 comments submitted in reply to certain other comments made in a prior public comment period.

[3] *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).

of Energy and the LANL undertaking an independent review of the benchmark GMD event developed by NERC for use with proposed TPL-007-1 ("Benchmark GMD Event").

However, NERC maintains that the proposed Benchmark GMD Event provides a scientifically sound, technically justified approach for identifying GMD impacts with the potential to cause "instability, uncontrolled separation, or cascading failures of the Bulk-Power System" in accordance with Order No. 779.[4] Therefore, NERC reiterates its request that the Commission approve the proposed standard, without modification, as just, reasonable, not unduly discriminatory or preferential, and in the public interest, consistent with the Notice of Proposed Rulemaking.[5]

I. COMMENTS

The LANL Report provides the results of a review and analysis of the proposed Benchmark GMD Event; specifically: (i) the estimate of the 1-in-100 year geoelectric field magnitude; (ii) the scaling of the Benchmark GMD Event based on geomagnetic latitude; and (iii) the effect of earth conductivity data on scaling the Benchmark GMD Event. The LANL Report identifies several concerns and makes recommendations for certain aspects of the Benchmark GMD Event to be reanalyzed.

Following careful consideration of the LANL Report, NERC maintains that the proposed Benchmark GMD Event provides a reasonable and technically-supported scientific and engineering approach to evaluating the potential impacts of a severe GMD event on reliability. NERC provides its comments on specific aspects of the LANL Report below. NERC looks

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[4] *Reliability Standards for Geomagnetic Disturbances*, Order No. 779, 143 FERC ¶ 61,147 (2013) at P 84 ("Order No. 779"), *reh'g denied*, 144 FERC ¶ 61,113 (2013).

[5] *Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events*, 151 FERC ¶ 61,134 at P 22 (2015) ("NOPR") ("Pursuant to section 215(d) of the [Federal Power Act] FPA, the Commission proposes to approve Reliability Standard TPL-007-1 as just, reasonable, not unduly discriminatory or preferential, and in the public interest.").

forward to working with the sponsor of the report, the U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability, to identify areas for further research and collaboration as part of its ongoing efforts to advance the understanding of the potential reliability impacts of severe GMD events.

A. The Reference Peak Geoelectric Field

1. LANL Report

The LANL Report analyzes the same International Monitor for Auroral Geomagnetic Effects ("IMAGE") magnetometer data set used in the development of the proposed Benchmark GMD Event; however, LANL states that its analysis of this data set has differed at each step from the analysis employed in the proposed Benchmark GMD Event in order to address certain statistical concerns that it has identified.[6] The LANL Report recommends that certain aspects of the proposed Benchmark GMD Event be reanalyzed according to LANL's recommended approach.

Among other things, the LANL Report recommends that the Benchmark GMD Event be "reanalyzed with consideration for the time correlations between IMAGE magnetometer samples (or other datasets) to develop a statistically meaningful definition of an independent GMD event."[7] As observed in the LANL Report, "[t]he physics of the electrojet during a GMD event creates time correlations in the resulting geo-magnetic and geo-electric fields."[8] The report states that such correlations could create biases in statistical analysis because data that are counted as

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6 These differences are summarized on page 6 of the LANL Report.

7 LANL Report at 7.

8 *Id.* at 4.

independent and discrete events are actually related to other events in the data set; as a result, these events may be over-counted and skew the analysis.[9]

Using its recommended, alternative approach, LANL calculates a 1-in-100 year peak geoelectric field value of 13.2 V/km (average), with a range of 8.4 V/km to 16.6 V/km, compared to the proposed Benchmark GMD Event value of 8 V/km.[10]

2. NERC Comments

NERC offers two observations of the analysis contained in the LANL Report. First, as NERC explained in its prior filings in this proceeding, the proposed Benchmark GMD Event was developed using a technically-justified approach that uses area magnetic field data to determine the 1-in-100 year peak geoelectric field.[11] An important distinction between the proposed Benchmark GMD Event and other estimates of a 1-in-100 year GMD event, including the estimate presented in the LANL Report, is the consideration given to regional scales appropriate for the Bulk-Power System.

The 1-in-100 year peak geoelectric field values in the LANL Report are calculated from individual station data, rather than area magnetic field data. Like other estimates of 1-in-100 year peak geoelectric fields for single geographic points, the results are higher than the proposed Benchmark GMD Event. However, and as discussed more fully in NERC's NOPR Comments, applying a single-point maximum geoelectric field over the entire area of a power system would

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9 *See id.*

10 *Id.* at 7.

11 *See, e.g.*, *Comments of the North American Electric Reliability Corporation in Response to Proposed Rulemaking*, Docket. No. RM15-11-000 (July 27, 2015) at 7-8 ("NERC's NOPR Comments"). For a description of the technical basis for this approach, *see* 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 (2015), *available at* http://www.earth-planets-space.com/content/67/1/93.

consistently overestimate geomagnetically induced currents ("GICs") above the levels expected from a 1-in-100 year GMD event.[12] As a result, GMD Vulnerability Assessments would be unduly pessimistic, representing conditions more extreme than a 1-in-100 year GMD event. NERC and industry, through the standards development process, determined that an appropriately defined 1-in-100 year GMD event was a conservative planning criterion that would address the risks from a GMD event on the order of the March 1989 event and reasonably protect against more extreme events.[13]

In contrast to the LANL estimated 1-in-100 year event, the proposed Benchmark GMD Event makes use of area magnetic field data to determine the 1-in-100 year peak geoelectric field magnitude. In doing so, GIC calculations derived from the Benchmark GMD Event would not be biased by observed, temporary, and localized peak geoelectric fields at individual geographic points. Instead, GMD Vulnerability Assessments based on the Benchmark GMD Event would realistically identify potential instability, uncontrolled separation, and cascading in the Bulk-Power System caused by a 1-in-100 year GMD event, consistent with the Commission's guidance in Order No. 779.

Second, the proposed Benchmark GMD Event addresses the concerns described in the LANL Report of statistical bias caused by time correlated data. The development of the proposed Benchmark GMD Event included extreme value analysis to determine the 95% confidence bound of the 1-in-100 year peak geoelectric field.[14] The extreme value analysis was performed

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12 *See* NERC's NOPR Comments at 7.

13 *See Petition of the North American Electric Reliability Corporation for Approval of Proposed Reliability Standard TPL-007-1 Transmission System Planned Performance for Geomagnetic Disturbance Events,* Docket No. RM15-11-000 (Jan. 21, 2015) at 16 (the "Petition").

14 *See id.* at 17.

on a data set consisting of daily maximum geoelectric field amplitudes.[15] Because the maximums are daily values, the analysis is not biased by short time correlations as described in the LANL Report. Results of the extreme value analysis indicate that the proposed Benchmark GMD Event peak geoelectric field is above the 95% confidence bound for a 1-in-100 year event.[16]

B. Latitude Scaling Factor

1. LANL Report

The LANL Report also analyzed the proposed Benchmark GMD Event latitude scaling factor used to tailor the GMD Vulnerability Assessments to entity-specific locations. Observing that there is significant uncertainty in latitude scaling because there are no recorded storms the size of the Benchmark GMD Event, the report concluded that a physical model is needed to derive scaling factors from the available historical data. The LANL Report recommends adding a factor-of-two margin to the scaling factors used in the proposed standard for conservatism until such time as a model is developed.[17]

2. NERC Comments

The latitude scaling factor in proposed Reliability Standard TPL-007-1 accurately models the drop in geoelectric field that has been exhibited in analysis of major recorded geomagnetic storms.[18] While the events in this data set are not equivalent size to the Benchmark GMD Event, they capture the maximum observed shift in the latitude boundary of the auroral electric current

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15 Petition, Ex. D (White Paper on GMD Benchmark Event Description) at 11.

16 *Id.* at 13. Derived from extreme value analysis, the upper limit of the 95% confidence interval for a 100-year return level is 5.77 V/km.

17 LANL Report at 12.

18 *See* NERC's NOPR Comments at 9.

systems that drive severe GMDs.[19] The scaling factors represent the maximum expansion of the auroral electric current systems observed for major storms since the late 1980s.

NERC is committed to advancing the understanding of the reliability risks posed by severe GMDs and will continue to pursue modeling enhancements for assessing GMD impacts. NERC supports the Commission's objectives for continued research[20] and agrees that future research should examine latitude scaling of geoelectric fields by assessing additional data and information. This effort could include development of models to further "extrapolate the small to moderate disturbance data currently in the historical record to disturbances as large as the TPL-007-1 Benchmark [GMD] Event," as suggested in the LANL Report.[21] However, while physical models may be able to provide additional insights in the future, the currently-available recorded data provides a strong technical basis for approval of the proposed TPL-007-1 Reliability Standard.

C. Earth Conductivity

1. LANL Report

The LANL Report observes that proposed Reliability Standard TPL-007-1 includes several possible approaches for adapting the Benchmark GMD Event to a local area using models for earth conductivity. Noting that "[m]ore work needs to be done to generate better-defined Earth layer conductivity data sources" for use in the proposed standard, the report

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19 *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). Table 1 on page 2 describes the auroral expansion of the major recorded storms.

20 *See* NOPR at P 39.

21 *See* LANL Report at 12.

recommends that that the standard should use the worst-case earth conductivity configurations where specific detailed data is not known.[22]

2. NERC Comments

The proposed Benchmark GMD Event includes default scaling factors for earth conductivity based on publicly-available earth models.[23] Some of the earth models contain ranges of conductivity values in some layers, rather than distinct conductivity values, due to complexities in the Earth's composition. The earth conductivity scaling factors used in proposed TPL-007-1 are based on the analysis and "assigned value" that lies within these ranges based on the geophysical analysis described in a 2012 study by the Electric Power Research Institute.[24]

NERC agrees that more research into earth conductivity models is needed, and is working with research partners and industry to enhance these models in the future.[25] However, NERC maintains that the scaling factors contained in the proposed Benchmark GMD Event are derived from technically justified models resulting from peer-reviewed research and currently available information. This strong technical justification supports approval of the proposed TPL-007-1 Reliability Standard as written.

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22 *Id.* at 15-16.

23 *See* Petition at 19.

24 Electric Power Research Institute, *One-Dimensional Earth Resistivity Models for Selected Areas of Continental United States & Alaska*, Product ID 1026430 Technical Update (Dec. 2012), *available at* http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001026430.

25 For a discussion of NERC's ongoing collaborative research efforts, *see* NERC's NOPR Comments at 13.

II. CONCLUSION

NERC respectfully requests that the Commission consider these comments and approve the proposed TPL-007-1 Reliability Standard as just, reasonable, not unduly discriminatory or preferential, and in the public interest.

Respectfully submitted,

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Date: October 22, 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 22nd day of October, 2015.

/s/ Lauren A. Perotti

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