

161 FERC ¶ 61,048  
UNITED STATES OF AMERICA  
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Neil Chatterjee, Chairman;  
Cheryl A. LaFleur, and Robert F. Powelson.

Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events      Docket No. RM15-11-002

ORDER ON GMD RESEARCH WORK PLAN

(Issued October 19, 2017)

1. On May 30, 2017, the North American Electric Reliability Corporation (NERC) filed a geomagnetic disturbance (GMD) research work plan (GMD Work Plan) for Commission review, as directed in Order No. 830.<sup>1</sup> As discussed below, we accept the GMD Work Plan. In addition, we direct NERC to file for Commission review a final, or otherwise updated, GMD Work Plan within six months of the date of this order.

**I. Background**

**A. GMD Orders and Reliability Standard TPL-007-1**

2. In Order No. 779, the Commission directed NERC to develop and submit Reliability Standards addressing GMD events in two stages.<sup>2</sup> For the First Stage GMD Reliability Standards, NERC was directed to submit a Reliability Standard that requires owners and operators of the Bulk-Power System to develop operational procedures to

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<sup>1</sup> *Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events*, Order No. 830, 81 Fed. Reg. 67,120 (Sept. 30, 2016), 156 FERC ¶ 61,215 (2016), *reh'g denied*, Order No. 830-A, 158 FERC ¶ 61,041 (2017).

<sup>2</sup> *Reliability Standards for Geomagnetic Disturbances*, Order No. 779, 78 Fed. Reg. 30,747 (May 23, 2013), 143 FERC ¶ 61,147, *reh'g denied*, 144 FERC ¶ 61,113 (2013).

mitigate the effects of GMD events.<sup>3</sup> Order No. 779 stated that the Second Stage GMD Reliability Standards must identify one or more “benchmark GMD events” that specify what severity GMD events a responsible entity must assess for potential impacts on the Bulk-Power System. Order No. 779 also directed that, if the assessments identify potential impacts from benchmark GMD events, the Reliability Standards should require owners and operators to develop and implement a plan to protect against instability, uncontrolled separation, or cascading failures of the Bulk-Power System, caused by damage to critical or vulnerable Bulk-Power System equipment, or otherwise, as a result of a benchmark GMD event. Order No. 779 further stated that the development of this plan cannot be limited to considering operational procedures or enhanced training alone, but will, subject to the potential impacts of the benchmark GMD events identified in the assessments, contain strategies for protecting against the potential impact of GMDs based on factors such as the age, condition, technical specifications, system configuration, or location of specific equipment. Order No. 779 noted that these strategies could, for example, include automatically blocking geomagnetically-induced currents (GICs) from entering the Bulk-Power System, instituting specification requirements for new equipment, inventory management, isolating certain equipment that is not cost effective to retrofit, or a combination thereof. Order No. 779 directed NERC to submit the Second Stage GMD Reliability Standards for Commission approval within 18 months of the effective date of Order No. 779 (i.e., by January 22, 2015).

3. On January 21, 2015, NERC submitted for Commission approval Reliability Standard TPL-007-1 (Transmission System Planned Performance for Geomagnetic Disturbance Events) in response to Order No. 779. On September 22, 2016, the Commission issued Order No. 830 approving Reliability Standard TPL-007-1 but also directing NERC to develop three modifications to the Second Stage GMD Reliability Standard: (1) modify the “benchmark GMD event” definition set forth in Attachment 1 of the Reliability Standard so that the “reference peak geoelectric field amplitude” component of the definition is not based solely on spatially-averaged data; (2) develop revisions to the Reliability Standard to require applicable entities to collect and make available necessary data from GIC monitors and magnetometers to ensure a more complete set of data for planning and operational needs; and (3) develop revisions to the Reliability Standard to establish specific deadlines for the development of corrective action plans and the completion of activities called for in corrective action plans. Order No. 830 required NERC to comply with these directives by May 2018.

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<sup>3</sup> NERC submitted the First Stage GMD Reliability Standard, EOP-010-1, which the Commission approved in Order No. 797. *Reliability Standard for Geomagnetic Disturbance Operations*, Order No. 797, 79 Fed. Reg. 35,911 (June 25, 2014), 147 FERC ¶ 61,209, *reh’g denied*, Order No. 797-A, 149 FERC ¶ 61,027 (2014).

4. To adequately address the threats posed by GMDs, Order No. 830 further directed NERC to submit within six months of the effective date of Order No. 830 (i.e., by May 30, 2017) a GMD research work plan. The Commission identified research areas for NERC to include in the GMD research work plan, including for example: (1) analyze the area over which spatial averaging should be calculated for stability studies, including performing sensitivity analyses on squares less than 500 km per side (e.g., 100 km, 200 km); (2) analyze earth conductivity models by, for example, using metered GIC and magnetometer readings to calculate earth conductivity and using 3-D earth conductivity readings; (3) determine whether new analyses and observations support modifying the use of single station readings around the earth to adjust the spatially averaged benchmark for latitude; (4) research aspects of the required thermal impact assessments; and (5) in NERC's discretion, conduct any GMD-related research areas generally that may impact the development of new or modified GMD Reliability Standards.

### **B. GMD Work Plan**

5. On May 30, 2017, NERC filed the GMD Work Plan for Commission review in accordance with Order No. 830. NERC describes the GMD Work Plan as "preliminary" and explains that it developed the GMD Work Plan in collaboration with the Electric Power Research Institute (EPRI) and members of the NERC GMD Task Force.

6. The GMD Work Plan identifies nine GMD-related research areas: (1) further analyze spatial averaging used in the benchmark GMD event definition; (2) further analyze latitude scaling; (3) improve earth conductivity models for GIC studies; (4) study GIC field orientation for transformer thermal impact assessments; (5) further analyze 75 amperes per phase criterion used for transformer thermal impact assessments; (6) Section 1600 data request; (7) geoelectric field evaluation and calculation tool; (8) improve harmonics analysis capability; and (9) harmonic impact studies. NERC describes these research areas as being "capable of producing work product that would advance understanding of GMD events and the risks these high-impact, low frequency-events pose to the reliability of the [Bulk-Power System]." <sup>4</sup> NERC states that each research area has an expected deliverable (e.g., technical report or a publicly-available model or tool). The GMD Work Plan summarizes the nine research activities and provides an estimated time frame for completion. In its filing, NERC requests Commission guidance on how to prioritize these research areas, which "would aid in the

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<sup>4</sup> NERC Filing at 2.

development of a timetable for submitting informational filings to the Commission reporting on the results of research.”<sup>5</sup>

7. NERC states that the GMD Work Plan will require “an extensive, multi-year effort requiring scientific and technical expertise from a variety of disciplines.”<sup>6</sup> NERC cautions that it does not have the necessary expertise to complete the research in the GMD Work Plan in-house and outsourcing that work will cost an estimated \$2.72 million.<sup>7</sup> NERC maintains that organizations such as EPRI are capable of managing such a project. NERC explains that it will “work over the next several months to identify an appropriate project administration structure to drive completion of the activities in the [GMD Work Plan] in a cost-effective and efficient manner.”<sup>8</sup> NERC also states that it will conduct outreach with governmental agencies in the U.S., Europe, and Canada as well as with academia, vendors, and industry to find ways to “identify opportunities to leverage existing GMD-related work and research synergies, develop an appropriate research management structure, and identify alternative funding.”<sup>9</sup> NERC concludes by indicating that it will develop additional project details within the next six months and “commits to keep Commission staff informed of the status of these efforts.”<sup>10</sup>

8. As contemplated in Order No. 830, the Commission noticed the GMD Work Plan for public comment.<sup>11</sup> The Commission received comments from Edison Electric Institute (EEI) and David Bardin, the latter of whom submitted three sets of comments.<sup>12</sup>

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<sup>5</sup> *Id.* at 3.

<sup>6</sup> *Id.* at 2.

<sup>7</sup> NERC Filing, Attachment 1 at 21 (stating that including information technology investments, the estimated cost increases to \$3-3.5 million).

<sup>8</sup> NERC Filing at 2.

<sup>9</sup> *Id.* at 3.

<sup>10</sup> *Id.*

<sup>11</sup> Order No. 830, 156 FERC ¶ 61,215 at P 26 n.33.

<sup>12</sup> In a fourth filing Bardin requested that the Commission take notice of a document issued by the U.S. Geological Survey (USGS) stating that the President’s fiscal year 2018 budget request would defund the USGS Geomagnetism Program.

## II. Discussion

9. As discussed below, the Commission accepts the GMD Work Plan submitted by NERC. In addition, the Commission: (1) directs NERC to file for Commission review a final, or otherwise updated, GMD Work Plan within six months of the date of this order and in the interim continue to communicate with Commission staff on NERC's progress; (2) reiterates the directive in Order No. 830 that the GMD Work Plan should evaluate the present reliance on single station readings for the purpose of geomagnetic scaling; (3) as requested by NERC, provides guidance on what research tasks should receive priority in the GMD Work Plan; and (4) addresses other issues, including those raised in the comments.

### A. Submission of Final GMD Work Plan

10. The GMD Work Plan constitutes a substantial research effort by NERC. Although it lacks significant details, the preliminary GMD Work Plan provided the Commission with useful information on NERC's progress. In addition, submission of the preliminary GMD Work Plan afforded the public an opportunity to review and comment on NERC's plan while also allowing NERC an opportunity to ask for the Commission's guidance on NERC's plan.

11. In acknowledging that the submitted GMD Work Plan is preliminary, NERC committed to completing detailed planning work within six months of the filing date of the preliminary GMD Work Plan and to keeping Commission staff apprised of the status of its efforts in the interim. The Commission accepts NERC's proposal. The next version of the GMD Work Plan should be specific, particularly with respect to the content and timing of the deliverables for each research task, and address any direction or guidance in this order.

12. Accordingly, the Commission directs NERC to file a final, or otherwise updated, GMD Work Plan within six months of the date of this order. As with the present filing, the next version of the GMD Work Plan submitted by NERC will be noticed for comment and addressed by Commission order.

### B. Reliance on Single Station Readings for Latitude Scaling

13. In Order No. 830, the Commission directed that the GMD research work plan should "determine whether new analyses and observations support modifying the use of single station readings around the earth to adjust the spatially averaged benchmark for latitude."<sup>13</sup> Although the second research area in the GMD Work Plan addresses further analysis of latitude scaling, the GMD Work Plan does not appear directly to address

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<sup>13</sup> Order No. 830, 156 FERC ¶ 61,215 at P 26.

reevaluating reliance on single station readings when adjusting for latitude. We reiterate that this reevaluation must be included in the final GMD Work Plan.

### **C. Prioritization of Research Tasks in GMD Work Plan**

14. The Commission recognizes that the scope of the GMD research directed in Order No. 830 will likely require NERC to prioritize its efforts. Accordingly, in response to NERC's request for guidance on how to prioritize the research tasks in the GMD Work Plan, the Commission provides the following guidance.

15. The Commission believes that Task 3 (Improve Earth Conductivity Models for GIC Studies) should receive first priority because of the importance of improved earth conductivity models to completing the GMD Vulnerability Assessments required in Reliability Standard TPL-007-1 accurately. Tasks 8 (Improve Harmonics Analysis Capability) and 9 (Harmonics Impact Studies) should receive second priority because the synergistic effects of harmonics during GMD events are not well understood and, as noted by the NERC GMD Task Force, harmonics were a root cause of the 1989 Québec GMD blackout.<sup>14</sup> The Commission believes that third priority should be given to Task 4 (Study GIC Field Orientation for Transformer Thermal Impact Assessments) because such work is necessary to complete Transformer Thermal Impact Assessments effectively because failure to consider orientation of the field may result in inaccurate impact studies. While important areas of research, Tasks 1 (Further Analyze Spatial Averaging Used in the Benchmark GMD Event) and 2 (Further Analyze Latitude Scaling) should receive fourth priority and Tasks 5 (Further Analyze the 75 Ampere Per Phase Criterion Used for Transformer Thermal Impact Assessments) and 7 (Goelectric Field Evaluation and Calculation Tool) fifth priority.<sup>15</sup>

16. Finally, we do not include Task 6 (Section 1600 Data Request) in our discussion above. This task, unlike the other GMD Work Plan tasks, is not a research project. Rather, its focus is on “develop[ing] the necessary guidance and technical guidelines to support a request for data or information under Section 1600 of the NERC Rules of Procedure...”<sup>16</sup> As explained in Order No. 830, the Commission believes that “additional collection and disclosure of GIC monitoring and magnetometer data is

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<sup>14</sup> NERC, *2012 Special Reliability Assessment Interim Report: Effects of Geomagnetic Disturbances on the Bulk Power System* at 6 (2012), <http://www.nerc.com/files/2012GMD.pdf>.

<sup>15</sup> Work on Task 5, step 2 (determine the effects of short-term harmonic currents) could be undertaken as part of Tasks 8 and 9.<sup>15</sup>

<sup>16</sup> NERC Filing at 11-12.

necessary to improve our collective understanding of the threats posed by GMD events.”<sup>17</sup> This data collection and distribution is critical not only to efforts that might be undertaken in support of the GMD research plan, but efforts elsewhere in government, industry, and academia. This effort is essential to our continued understanding of GMD and its effects on the Bulk-Power System, and NERC should complete this effort as expeditiously as possible.

#### **D. Review of GMD Work Plan Deliverables**

17. In its filing, NERC states that it “contemplates that the final deliverable for each Task would be subject to technical and scientific review through the NERC GMD Task Force, engaging outside researchers as necessary.”<sup>18</sup> NERC explains that the GMD Task Force “includes participants from U.S. and Canadian government space weather researchers, representatives from the manufacturer and vendor community, and subject matter experts from both within and outside the electric power industry.”<sup>19</sup> Because the research tasks set forth in Order No. 830 and the GMD Work Plan implicate various scientific disciplines, the Commission encourages wide participation in the development of the GMD Work Plan deliverables. The Commission also expects NERC to afford interested entities an opportunity to comment on GMD Work Plan deliverables before they are filed with the Commission.

#### **E. Other Issues**

18. EEI states that research in the GMD Work Plan should be pursued but “the significant scope and scale of this work and therefore how this research will be funded is a substantive concern.”<sup>20</sup> EEI contends that implementing the GMD Work Plan “would extend NERC’s authority from developing, modifying, and enforcing the Reliability Standards to implementing research in support of future modifications to the standards ... Reliability Standards to this point have been based on existing and known reliability practices and have not required new research to develop such practices, except for [in the case of Reliability Standard FAC-003-2 (Transmission Vegetation Management)].”<sup>21</sup> EEI states that to “avoid setting a precedent,” the Commission should “coordinate with

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<sup>17</sup> Order No. 830, 156 FERC ¶ 61,215 at P 88.

<sup>18</sup> NERC Filing at 7.

<sup>19</sup> *Id.* at n.9.

<sup>20</sup> EEI Comment at 2.

<sup>21</sup> *Id.* at 3.

NERC to explore the funding issue with the Department of Energy to determine if a cost share arrangement could be leveraged to fund this research ... [and] prioritize the research activities such as Task 1 and 3 to limit the scope and scale of the research.”<sup>22</sup>

19. EEI did not seek rehearing of this aspect of Order No. 830. Accordingly, to the extent EEI now requests rehearing of this issue, the request is untimely.<sup>23</sup> Even so, in 2013, the Commission approved NERC’s proposed criteria for determining what activities fall within the scope of section 215 of the Federal Power Act. The Commission, *inter alia*, determined that “information gathering, collection and analysis activities to obtain information reasonably necessary in Reliability Standards development, including for purposes of identifying areas in which new Reliability Standards could be developed ... [or] existing Reliability Standards could be revised” falls within the scope of section 215.<sup>24</sup> Moreover, as EEI concedes, the GMD work plan is not wholly unprecedented, as the Commission directed NERC to conduct research on Reliability Standard FAC-003-2 regarding minimum clearance distances between vegetation and transmission lines.<sup>25</sup> That research was ultimately performed for NERC under contract by EPRI.<sup>26</sup> Nevertheless, the Commission is amenable to prioritizing NERC’s research efforts, as discussed above, and having NERC pursue cost sharing or savings opportunities. However, we note that such efforts should not delay completion of this critical research.

20. In his first set of comments, Bardin states that the GMD Work Plan does not address completion of a three-dimensional magnetotelluric survey of the United States or the development of a “comprehensive magnetometer network.”<sup>27</sup> Bardin also maintains that NERC can “compel EPRI and others to make magnetometer data freely accessible by

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<sup>22</sup> *Id.*

<sup>23</sup> 16 U.S.C. § 8251(a) (2012); 18 C.F.R. § 385.713(b) (2017) (“A request for rehearing by a party must be filed not later than 30 days after issuance of any final decision or other final order in a proceeding.”).

<sup>24</sup> *North American Electric Reliability Corp.*, 143 FERC ¶ 61,052, at P 33 (2013).

<sup>25</sup> *Revisions to Reliability Standard for Transmission Vegetation Management*, Order No. 777, 142 FERC ¶ 61,208, at P 3 (2013).

<sup>26</sup> *North American Electric Reliability Corp.*, Docket No. RD16-4-000 (2016) (delegated letter order approving Reliability Standard FAC-003-4 (Transmission Vegetation Management)).

<sup>27</sup> June 16, 2017 Bardin Comments.

exercising NERC authority under NERC's own Rules.”<sup>28</sup> Bardin also questions NERC's plan to develop further the details of the preliminary GMD Work Plan over the next six months because the delay could “interrupt[] momentum.”<sup>29</sup> In his second set of comments, Bardin poses a series of questions, addressed to NERC, meant to clarify the section of the GMD Work Plan (Task 6) devoted to data collection under Section 1600 of the NERC Rules of Procedure. In his third set of comments, Bardin states that the Commission should ask NERC how it will address “challenges ... as to collection of data as well as validation of models and testing of hypotheses” and how NERC will learn about new research results and disseminate such information to industry.”<sup>30</sup>

21. In response to Bardin's first set of comments, we note that Order No. 830 did not direct NERC to complete three-dimensional magnetotelluric surveys of the United States as part of the GMD research work plan, and therefore find that requiring such a plan is beyond the scope of Order No. 830's requirements. However, we support efforts to complete such a survey, and appreciate the work being done by the United States Geological Survey's geomagnetism program, which provides important data and research that support broader GMD efforts. With respect to developing a “comprehensive magnetometer network,” NERC will address this issue as part of the directed revisions to Reliability Standard TPL-007-1. Specifically, Order No. 830 directed NERC to modify Reliability Standard TPL-007-1 to require the collection of necessary GIC monitoring and magnetometer data and to make such data publicly available, which could be achieved by leveraging existing magnetometers or, if necessary, installing new magnetometers.

22. As for Bardin's comment regarding compelling magnetometer data from EPRI, Order No. 830-A stated that NERC cannot compel EPRI to provide data to NERC because EPRI is not subject to the Commission's jurisdiction.<sup>31</sup> Instead, Order No. 830 directed NERC to gather data from users, owners, and operators of the Bulk-Power System through a Section 1600 data request under the NERC Rules of Procedure and through the reporting requirements in the future version of Reliability Standard TPL-007-1. We reiterate the importance of that data collection effort and note that, while we cannot compel EPRI to provide data to NERC, we encourage EPRI to do so on a voluntary basis to further support GMD research efforts. We also disagree with the contention that additional time to finalize the GMD Work Plan might adversely

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<sup>28</sup> *Id.* at 3.

<sup>29</sup> *Id.*

<sup>30</sup> June 23, 2017 Bardin Comments at 1.

<sup>31</sup> Order No. 830-A, 158 FERC ¶ 61,041 at P 26 n.25.

impact NERC's research activities. As discussed above, NERC's efforts in preparing and submitting the preliminary GMD Work Plan, while incomplete, provided the Commission with useful information. In Order No. 830, the Commission recognized that NERC might require additional time to complete the GMD Work Plan.<sup>32</sup> We find in this instance that additional time to finalize details of the GMD Work Plan is reasonable.

23. Bardin's second and third sets of comments generally seek clarification from NERC regarding elements of the GMD Work Plan. We encourage NERC to consider these questions in the first instance when preparing the final, or otherwise updated, GMD Work Plan.

The Commission orders:

(A) The Commission accepts the preliminary GMD Work Plan, as discussed in the body of this order.

(B) The Commission directs NERC to submit a final, or otherwise updated, GMD Work Plan within six months of the date of this order, as discussed in the body of this order.

By the Commission.

( S E A L )

Nathaniel J. Davis, Sr.,  
Deputy Secretary.

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<sup>32</sup> Order No. 830, 156 FERC ¶ 61,215 at P 81 ("An extension of time to submit the GMD research work plan may be available if six months proves to be insufficient.").