NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Meeting Agenda

Project 2013-03 (Geomagnetic Disturbance) Standard Drafting Team

January 21, 2014 | 1:00 p.m. – 5:00 p.m. ET
January 22, 2014 | 8:00 a.m. – 5:00 p.m. ET
January 23, 2014 | 8:00 a.m. – 5:00 p.m. ET
January 24, 2014 | 8:00 a.m. – 12:00 p.m. ET

NextEra
Florida Power and Light
700 Universe Blvd
Juno Beach, FL

For remote participants:

Dial-in: 1.866.740.1260 | Access code: 6251541 | Security code: 0121
Web access: Go to www.readytalk.com and enter access code 6251541

Administrative

1. **Introduction and administrative**
2. **Safety information**
3. **Determination of quorum***
4. **NERC Antitrust Compliance Guidelines and Public Announcement***
5. **Participant conduct policy***
6. **Email list policy***
7. **Review meeting agenda and objectives**

Agenda

1. **Chair introductory remarks** - Frank Koza
2. **Discuss Benchmark GMD Event description and outline whitepaper**
3. **Develop initial draft planning standard (TPL-007-1) and VRF/VSLs**
   a. Discuss outline for supporting whitepaper
4. **Discuss Requirements for equipment vulnerability assessment**
5. **Develop initial draft Implementation Plan**

6. **Review VRF/VSL Justification**
7. **Update FERC Order No. 779 Directives Map**
8. **Draft comment form questions**
9. **Review project schedule and future meetings**
10. **Review action items**
11. **Adjourn**

*Background materials included.

Reference Material

1. **Standard Authorization Request and Stakeholder Comments for Stage 2***
2. **FERC Order No. 779***

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Antitrust Compliance Guidelines

I. General

It is NERC's policy and practice to obey the antitrust laws and to avoid all conduct that unreasonably restrains competition. This policy requires the avoidance of any conduct that violates, or that might appear to violate, the antitrust laws. Among other things, the antitrust laws forbid any agreement between or among competitors regarding prices, availability of service, product design, terms of sale, division of markets, allocation of customers or any other activity that unreasonably restrains competition.

It is the responsibility of every NERC participant and employee who may in any way affect NERC's compliance with the antitrust laws to carry out this commitment.

Antitrust laws are complex and subject to court interpretation that can vary over time and from one court to another. The purpose of these guidelines is to alert NERC participants and employees to potential antitrust problems and to set forth policies to be followed with respect to activities that may involve antitrust considerations. In some instances, the NERC policy contained in these guidelines is stricter than the applicable antitrust laws. Any NERC participant or employee who is uncertain about the legal ramifications of a particular course of conduct or who has doubts or concerns about whether NERC's antitrust compliance policy is implicated in any situation should consult NERC's General Counsel immediately.

II. Prohibited Activities

Participants in NERC activities (including those of its committees and subgroups) should refrain from the following when acting in their capacity as participants in NERC activities (e.g., at NERC meetings, conference calls and in informal discussions):

- Discussions involving pricing information, especially margin (profit) and internal cost information and participants' expectations as to their future prices or internal costs.
- Discussions of a participant's marketing strategies.
- Discussions regarding how customers and geographical areas are to be divided among competitors.
- Discussions concerning the exclusion of competitors from markets.
- Discussions concerning boycotting or group refusals to deal with competitors, vendors or suppliers.

- Any other matters that do not clearly fall within these guidelines should be reviewed with NERC's General Counsel before being discussed.

III. Activities That Are Permitted

From time to time decisions or actions of NERC (including those of its committees and subgroups) may have a negative impact on particular entities and thus in that sense adversely impact competition. Decisions and actions by NERC (including its committees and subgroups) should only be undertaken for the purpose of promoting and maintaining the reliability and adequacy of the bulk power system. If you do not have a legitimate purpose consistent with this objective for discussing a matter, please refrain from discussing the matter during NERC meetings and in other NERC-related communications.

You should also ensure that NERC procedures, including those set forth in NERC's Certificate of Incorporation, Bylaws, and Rules of Procedure are followed in conducting NERC business.

In addition, all discussions in NERC meetings and other NERC-related communications should be within the scope of the mandate for or assignment to the particular NERC committee or subgroup, as well as within the scope of the published agenda for the meeting.

No decisions should be made nor any actions taken in NERC activities for the purpose of giving an industry participant or group of participants a competitive advantage over other participants. In particular, decisions with respect to setting, revising, or assessing compliance with NERC reliability standards should not be influenced by anti-competitive motivations.

Subject to the foregoing restrictions, participants in NERC activities may discuss:

- Reliability matters relating to the bulk power system, including operation and planning matters such as establishing or revising reliability standards, special operating procedures, operating transfer capabilities, and plans for new facilities.
- Matters relating to the impact of reliability standards for the bulk power system on electricity markets, and the impact of electricity market operations on the reliability of the bulk power system.
- Proposed filings or other communications with state or federal regulatory authorities or other governmental entities.

Matters relating to the internal governance, management and operation of NERC, such as nominations for vacant committee positions, budgeting and assessments, and employment matters; and procedural matters such as planning and scheduling meetings.

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Public Announcements

REMINDER FOR USE AT BEGINNING OF MEETINGS AND CONFERENCE CALLS THAT HAVE BEEN PUBLICLY NOTICED AND ARE OPEN TO THE PUBLIC

Conference call version:
Participants are reminded that this conference call is public. The access number was posted on the NERC website and widely distributed. Speakers on the call should keep in mind that the listening audience may include members of the press and representatives of various governmental authorities, in addition to the expected participation by industry stakeholders.

Face-to-face meeting version:
Participants are reminded that this meeting is public. Notice of the meeting was posted on the NERC website and widely distributed. Participants should keep in mind that the audience may include members of the press and representatives of various governmental authorities, in addition to the expected participation by industry stakeholders.

For face-to-face meeting, with dial-in capability:
Participants are reminded that this meeting is public. Notice of the meeting was posted on the NERC website and widely distributed. The notice included the number for dial-in participation. Participants should keep in mind that the audience may include members of the press and representatives of various governmental authorities, in addition to the expected participation by industry stakeholders.

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Standards Development Process Participant Conduct Policy

I. General

To ensure that the standards development process is conducted in a responsible, timely and efficient manner, it is essential to maintain a professional and constructive work environment for all participants. Participants include, but are not limited to, members of the standard drafting team and observers.

Consistent with the NERC Rules of Procedure and the NERC Standard Processes Manual, participation in NERC's Reliability Standards development balloting and approval processes is open to all entities materially affected by NERC's Reliability Standards. In order to ensure the standards development process remains open and to facilitate the development of reliability standards in a timely manner, NERC has adopted the following Participant Conduct Policy for all participants in the standards development process.

II. Participant Conduct Policy

All participants in the standards development process must conduct themselves in a professional manner at all times. This policy includes in-person conduct and any communication, electronic or otherwise, made as a participant in the standards development process. Examples of unprofessional conduct include, but are not limited to, verbal altercations, use of abusive language, personal attacks or derogatory statements made against or directed at another participant, and frequent or patterned interruptions that disrupt the efficient conduct of a meeting or teleconference.

III. Reasonable Restrictions in Participation

If a participant does not comply with the Participant Conduct Policy, certain reasonable restrictions on participation in the standards development process may be imposed as described below.
If a NERC Standards Developer determines, by his or her own observation or by complaint of another participant, that a participant's behavior is disruptive to the orderly conduct of a meeting in progress, the NERC Standards Developer may remove the participant from a meeting. Removal by the NERC Standards Developer is limited solely to the meeting in progress and does not extend to any future meeting. Before a participant may be asked to leave the meeting, the NERC Standards Developer must first remind the participant of the obligation to conduct himself or herself in a professional manner and provide an opportunity for the participant to comply. If a participant is requested to leave a meeting by a NERC Standards Developer, the participant must cooperate fully with the request.

Similarly, if a NERC Standards Developer determines, by his or her own observation or by complaint of another participant, that a participant's behavior is disruptive to the orderly conduct of a

teleconference in progress, the NERC Standards Developer may request the participant to leave the teleconference. Removal by the NERC Standards Developer is limited solely to the teleconference in progress and does not extend to any future teleconference. Before a participant may be asked to leave the teleconference, the NERC Standards Developer must first remind the participant of the obligation to conduct himself or herself in a professional manner and provide an opportunity for the participant to comply. If a participant is requested to leave a teleconference by a NERC Standards Developer, the participant must cooperate fully with the request. Alternatively, the NERC Standards Developer may choose to terminate the teleconference.

At any time, the NERC Director of Standards, or a designee, may impose a restriction on a participant from one or more future meetings or teleconferences, a restriction on the use of any NERC-administered list server or other communication list, or such other restriction as may be reasonably necessary to maintain the orderly conduct of the standards development process. Restrictions imposed by the Director of Standards, or a designee, must be approved by the NERC General Counsel, or a designee, prior to implementation to ensure that the restriction is not unreasonable. Once approved, the restriction is binding on the participant. A restricted participant may request removal of the restriction by submitting a request in writing to the Director of Standards. The restriction will be removed at the reasonable discretion of the Director of Standards or a designee.

Any participant who has concerns about NERC's Participant Conduct Policy may contact NERC's General Counsel.

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NERC Email List Policy

NERC provides email lists, or "listservs," to NERC committees, groups, and teams to facilitate sharing information about NERC activities; including balloting, committee, working group, and drafting team work, with interested parties. All emails sent to NERC listserv addresses must be limited to topics that are directly relevant to the listserv group's assigned scope of work. NERC reserves the right to apply administrative restrictions to any listserv or its participants, without advance notice, to ensure that the resource is used in accordance with this and other NERC policies.

Prohibited activities include using NERC-provided listservs for any price-fixing, division of markets, and/or other anti-competitive behavior.[1] Recipients and participants on NERC listservs may not utilize NERC listservs for their own private purposes. This may include announcements of a personal nature, sharing of files or attachments not directly relevant to the listserv group's scope of responsibilities, and/or communication of personal views or opinions, unless those views are provided to advance the work of the listserv's group. Use of NERC's listservs is further subject to NERC's Participant Conduct Policy for the Standards Development Process.

- *Updated April 2013*

[1] Please see NERC's Antitrust Compliance Guidelines for more information about prohibited antitrust and anti-competitive behavior or practices. This policy is available at http://www.nerc.com/commondocs.php?cd=2

Project 2013-03
Geomagnetic Disturbance Mitigation
Standard Drafting Team

Chair	Frank Koza	PJM Interconnection
Vice Chair	Randy Horton	Southern Company
	Donald Atkinson	Georgia Transmission Corporation
	Emanuel Bernabeu	Dominion Resource Services, Inc
	Kenneth Fleischer	NextEra Energy
	Luis Marti	Hydro One Networks
	Antti Pulkkinen	NASA Goddard Space Flight Center
	Qun Qiu	American Electric Power
NERC Staff	Mark Olson	Standards Developer

Standards Authorization Request Form

Request to propose a new or a revision to a Reliability Standard			
Title of Proposed Standard(s):	EOP-010-1 Geomagnetic Disturbance Operations TPL-007-1 Transmission System Planned Performance During Geomagnetic Disturbances		
Date Submitted:			
SAR Requester Information			
Name:	Kenneth Donohoo, Oncor		
Organization:	Chair, Geomagnetic Disturbance Task Force		
Telephone:	NA	E-mail:	NA
SAR Type (Check as many as applicable)			
☒ New Standard ☒ Revision to existing Standard		☐ Withdrawal of existing Standard ☐ Urgent Action	

SAR Information
Purpose (Describe what the standard action will achieve in support of Bulk Electric System reliability.):
To mitigate the risk of instability, uncontrolled separation, and Cascading in the Bulk-Power System as a result of geomagnetic disturbances (GMDs) through application of Operating Procedures and strategies that address potential impacts identified in a registered entity's assessment as directed in FERC Order 779.
Industry Need (What is the industry problem this request is trying to solve?):
While the impacts of space weather are complex and depend on numerous factors, space weather has demonstrated the potential to disrupt the operation of the Bulk-Power System. A technical discussion of the effects of geomagnetic disturbances on the Bulk-Power System and recommended actions for NERC and the industry is provided in the NERC 2012 GMD Report prepared by the GMD Task Force. During a GMD event, geomagnetically-induced current (GIC) flow in transformers may cause half-cycle

SAR Information
saturation, which can increase absorption of Reactive Power, generate harmonic currents, and cause transformer hot spot heating. Harmonic currents may cause protection system Misoperation leading to the loss of Reactive Power sources. The combination of these effects from GIC can lead to voltage collapse.
Brief Description (Provide a paragraph that describes the scope of this standard action.)
The proposed project will develop requirements for registered entities to employ strategies that mitigate risks of instability, uncontrolled separation and Cascading in the Bulk-Power System caused by GMD in two stages as directed in Order 779: 1. Stage 1 standard(s) will require applicable registered entities to develop and implement Operating Procedures with predetermined and actionable steps to take prior to and during GMD events which take into account entity-specific factors that can impact the severity of GMD events in the local area. The Stage 1 standard(s) may also include associated training requirements for System Operators or development of training requirements may be deferred to Stage 2. 2. Stage 2 standard(s) will require applicable registered entities to conduct initial and on-going assessments of the potential impact of benchmark GMD events on their respective system as directed in Order 779. The Stage 2 standard(s) must identify benchmark GMD events that specify what severity GMD events applicable registered entities must assess for potential impacts. If the assessments identify potential impacts from benchmark GMD events, the Standard(s) will require the registered entity to develop and implement a plan to mitigate the risk of instability, uncontrolled separation, or Cascading as a result of benchmark GMD events.
Detailed Description (Provide a description of the proposed project with sufficient details for the standard drafting team to execute the SAR. Also provide a justification for the development or revision of the standard, including an assessment of the reliability and market interface impacts of implementing or not implementing the standard action.)
The standards development project will respond to the directives in FERC Order 779 in the timeframe required by the Order and draw upon the technical products of the GMD Task Force Phase 2 Project and other relevant information. The GMD Task Force Phase 2 Project addresses the recommendations in the 2012 GMD Report and is focused on improving the capabilities of industry to assess GMD risk and develop appropriate mitigation strategies.

SAR Information

Operating Procedures are the first stage in the Standards project to manage risks associated with GMD events with accompanying training requirements to be addressed in Stage 1 or 2 as determined by the Standards Drafting Team. Specifically, the project will require owners and operators of the Bulk-Power System to develop and implement Operating Procedures and accompanying operator training which may include:

- Procedures for acquiring and disseminating forecasting information and warning messages from the space weather forecasting community to the System Operators;
- Predetermined and actionable steps for System Operators to take prior to and during a GMD event that are tailored to the registered entity's assessment of entity-specific factors such as geography, geology, and system topology;
- Procedures to notify and coordinate with interconnected registered entities for effective action;
- Restoration procedures for applicable elements that may be impacted;
- Minimum training requirements for System Operators; and
- Criteria for discontinuing the use of Operating Procedures at the conclusion of a GMD event.

The second stage of the project will require applicable registered entities to conduct initial and periodic assessments of the risk and potential impact of benchmark GMD events to the Bulk-Power System and develop strategies to mitigate the risk of instability, uncontrolled separation, and Cascading.

- The definition of benchmark GMD events will be based on reviewed technical analysis.
- Periodic update of the assessments will be required to account for new Facilities and modifications to existing Facilities. It is expected that assessments will also consider new information and the use of new or updated tools, including new research on GMDs and the on-going work of the NERC GMD Task Force.
- The Standard(s) will require Planning Coordinators and Reliability Coordinators to review plans addressing the potential impact of benchmark GMD events in order to provide a wide-area perspective. The Standard Requirements for plans will be supported by reviewed technical analysis, with consideration of the directives in FERC Order 779.

When both stages have been completed as required by FERC Order 779, all directives in the Order will have been addressed.

Reliability Functions	
The Standard will Apply to the Following Functions (Check each one that applies.)	
☐ Regional Reliability Organization	Conducts the regional activities related to planning and operations, and coordinates activities of Responsible Entities to secure the reliability of the Bulk Electric System within the region and adjacent regions.
☒ Reliability Coordinator	Responsible for the real-time operating reliability of its Reliability Coordinator Area in coordination with its neighboring Reliability Coordinator's wide area view.
☒ Balancing Authority	Integrates resource plans ahead of time, and maintains load-interchange-resource balance within a Balancing Authority Area and supports Interconnection frequency in real time.
☐ Interchange Authority	Ensures communication of interchange transactions for reliability evaluation purposes and coordinates implementation of valid and balanced interchange schedules between Balancing Authority Areas.
☒ Planning Coordinator	Assesses the longer-term reliability of its Planning Coordinator Area.
☐ Resource Planner	Develops a >one year plan for the resource adequacy of its specific loads within a Planning Coordinator area.
☒ Transmission Planner	Develops a >one year plan for the reliability of the interconnected Bulk Electric System within its portion of the Planning Coordinator area.
☐ Transmission Service Provider	Administers the transmission tariff and provides transmission services under applicable transmission service agreements (e.g., the pro forma tariff).
☒ Transmission Owner	Owns and maintains transmission facilities.
☒ Transmission Operator	Ensures the real-time operating reliability of the transmission assets within a Transmission Operator Area.
☐ Distribution Provider	Delivers electrical energy to the End-use customer.
☒ Generator Owner	Owns and maintains generation facilities.

Reliability Functions		
☒	Generator Operator	Operates generation unit(s) to provide real and Reactive Power.
☐	Purchasing-Selling Entity	Purchases or sells energy, capacity, and necessary reliability-related services as required.
☐	Market Operator	Interface point for reliability functions with commercial functions.
☐	Load-Serving Entity	Secures energy and transmission service (and reliability-related services) to serve the End-use Customer.

Reliability and Market Interface Principles		
Applicable Reliability Principles (Check all that apply).		
☒	1. Interconnected bulk power systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.	
☒	2. The frequency and voltage of interconnected bulk power systems shall be controlled within defined limits through the balancing of real and Reactive Power supply and demand.	
☒	3. Information necessary for the planning and operation of interconnected bulk power systems shall be made available to those entities responsible for planning and operating the systems reliably.	
☒	4. Plans for emergency operation and system restoration of interconnected bulk power systems shall be developed, coordinated, maintained and implemented.	
☐	5. Facilities for communication, monitoring and control shall be provided, used and maintained for the reliability of interconnected bulk power systems.	
☒	6. Personnel responsible for planning and operating interconnected bulk power systems shall be trained, qualified, and have the responsibility and authority to implement actions.	
☒	7. The security of the interconnected bulk power systems shall be assessed, monitored and maintained on a wide area basis.	
☐	8. Bulk power systems shall be protected from malicious physical or cyber attacks.	
Does the proposed Standard comply with all of the following Market Interface Principles?		Enter (yes/no)
1. A reliability standard shall not give any market participant an unfair competitive advantage.		Yes
2. A reliability standard shall neither mandate nor prohibit any specific market structure.		Yes
3. A reliability standard shall not preclude market solutions to achieving compliance		Yes

Reliability and Market Interface Principles	
with that standard.	
4. A reliability standard shall not require the public disclosure of commercially sensitive information. All market participants shall have equal opportunity to access commercially non-sensitive information that is required for compliance with reliability standards.	Yes

Related Standards	
Standard No.	Explanation
PER-005-1, R3	Training on GMD events and mitigation procedures will be added to this requirement as a specific element in required operator training unless included in a separate GMD standard.

Related SARs	
SAR ID	Explanation

Regional Variances	
Region	Explanation
ERCOT	
FRCC	
MRO	
NPCC	
RFC	
SERC	
SPP	
WECC	
The intent of the project is to develop continent-wide requirements that allow responsible entities to tailor operational procedures or strategies based on the responsible entity's assessment of entity-specific factors such as geography, geology, and system topology. However, the need for regional variances will be researched throughout the proposed project and may be supported by analysis required to develop stage 2 Standard(s).	

Consideration of Comments

Project 2013-03 Geomagnetic Disturbance Monitoring

All comments submitted may be reviewed in their original format on the project page.

Index to Questions, Comments, and Responses

1. **Do you agree that the SAR, as drafted, provides a scope within which to address the directives in Order No. 779? If not, please explain.**

Organization	Yes or No	Question 6 Comment
Electric Reliability Council of Texas, Inc.	No	If the Stage II assessment is done from a wide-area perspective, how would it work from a functional entity perspective? Other than in the ERCOT interconnection, which functional entity would be responsible at the interconnection level? No relevant functional entity has an interconnection-wide geographic scope?
PacifiCorp	No	PacifiCorp believes the use of the term "Bulk Power System" confuses the scope of the standard. PacifiCorp recommends replacing "Bulk Power System" with the term "Bulk Electric System" and adding the caveate that the voltage limitation be set at 200kv and above.
Hydro One Networks Inc.	No	Suggest adding PER-005-1, R3 in the Title of Proposed Standards(s) in this SAR. If not, how will the changes made to PER-005-1 be coordinated in conjunction with this new EOP-010-1 Standard?The disposition of IRO-005-3.1a R3 needs to be addressed in the SAR as a retirement.
Northeast Power Coordinating Council	No	Suggest adding PER-005-1, R3 in the Title of Proposed Standards(s) in this SAR. If not, how will the changes made to PER-005-1 be coordinated in conjunction with this new EOP-010-1 Standard?The disposition of IRO-005-3.1a R3 needs to be addressed in the SAR as a retirement.
Independent Electricity System Operator	No	The Stage II assessment should be done at the interconnection level, not by a patchwork of the Planning Coordinators and Transmission Planners. If analysis shows there are potential local issues, NERC should consider regional criteria or local procedures first, rather than an overly complex standard, much of which won't apply to most entities interonncetion-wide.
Ben Li Associates	No	The Stage II assessment should be done at the interconnection level, not by a patchwork of the Planning Coordinators and Transmission Planners. If analysis shows there are potential local issues, NERC should consider regional criteria or local procedures first, rather than an overly

Organization	Yes or No	Question 6 Comment
		complex standard, much of which won't apply to most entities interconnection-wide.
Oncor Electric Delivery Complany LLC	No	The Standard did not address all owners and operators of equipment associated with the FERC Order directing NERC to "submit for approval one or more Reliability Standards that require owners and operators to develop and implement operational procedures to mitigate the effects of GMDs." The Standard needs to also include Generation Owners and Operators of step-up transformers and auxillary transformers with at least one terminal at 200 kV or higher.
Oklahoma Gas & Electric	No	This SAR should not be applicable to Balancing Authorities. FERC Order No. 779 directed the ERO to develop one or more Reliability Standards that require owners and operators of the BPS to develop and implement operational procedures to mitigate the effects of GMDs. The functions of the BA center around balancing load and generation; and implementing and accounting for interchange schedules. BAs (unless they are also TOPs) do not monitor BES elements such as transformers.
Ameren	No	We believe that the scope should include initial assessments of potential impacts of GMD before a standard is drafted.
Dominion	Yes	Dominion suggests adding PER-005-1, R3 in the Title of Proposed Standards(s) in this SAR? If not, how will the changes made to PER-005-1 be coordinated in conjunction with this new EOP-010-1 Standard.
Northern California Power Agency	Yes	I like the SAR; too bad some of the language did not carry over into the implementation plan
National Rural Electric Cooperative Association (NRECA)	Yes	NRECA agrees that the SAR as drafted provides a scope to address the directives in Order No 779, but believes as explained in response to Question 5 the directives could be addressed by modifying existing standards as an alternative to developing a new standard.

Organization	Yes or No	Question 6 Comment
PJM Interconnection, L.L.C.	Yes	PJM has signed onto SERC's comments.
Northeast Utilities	Yes	SAR scope is adequate.
Pepco Holdings Inc & Affiliates	Yes	Suggest that any associated training requirements for System Operators be deferred to Stage 2.Based on what is learned from Stage 2 benchmark events, may want to revisited functional applicability of Stage 1 (i.e. EOP-010).
SPP Standards Review Group	Yes	The SAR, as well as the draft standard, refer to the BPS. Given the restrictions as proposed in the standard on transformers with high-side terminals of 200 kV and above, wouldn't the reference be more appropriate to the BES?
Tri-State Generation and Transmission Association, Inc.	Yes	Tri-State believes the SAR provides a scope to address the directives but still strongly believe that Stage 1 and Stage 2 should be in the reverse order. An assessment should be conducted to determine potential impacts from GMD events prior to developing Operating Procedures to mitigate any possible effects of GMD.
ACES Standards Collaborators	Yes	While we agree that the SAR does provide a plan to address the FERC directives, we continue to believe new standards with requirements to write specific operating plans or procedures is premature and that NERC should pursue and equally effective and efficient alternative. The electric industry is already required to have policies and procedures to manage emergency conditions through the requirements such as TOP-004-2 R6.1 and EOP-001-2 R2.2. Since the electric industry has always taken an "all hazards" approach to planning and operating the electric grid, these policies and procedures will have already considered extreme operating situations such as events that might occur during a GMD event. The electric industry's excellent response to large events such as hurricanes, blizzards, and tornadoes has proven the "all hazards" approach to planning is effective.

Organization	Yes or No	Question 6 Comment
MRO NERC Standards Review Forum (NSRF)	Yes	
SERC OC Review Group	Yes	
Florida Municipal Power Agency	Yes	
Emprimus LLC and Volkmann Consulting	Yes	
FirstEnergy	Yes	
DTE Electric	Yes	
Bonneville Power Administration	Yes	
JEA	Yes	
Salt River Project	Yes	
Western Area Power Administration	Yes	
Western Electricity Coordinating	Yes	

Organization	Yes or No	Question 6 Comment
Council		
Southern Company	Yes	
Bureau of Reclamation	Yes	
Foundation for Resilient Societies	Yes	
CenterPoint Energy	Yes	
American Electric Power	Yes	
NIPSCO	Yes	
American Transmission Company	Yes	
ReliabilityFirst	Yes	
Public Utility District No.1 of Snohomish County	Yes	
Entergy Services, Inc.	Yes	

Organization	Yes or No	Question 6 Comment
Minnkota Power Cooperative, INC.	Yes	
City of Austin dba Austin Energy	Yes	
Duke Energy	Yes	
Great River Energy	Yes	
Xcel Energy	Yes	
American Public Power Association	Yes	
Farmington Electric Utility System	Yes	

2. The SAR identifies a list of reliability functions that may be assigned responsibility for requirements in the set of standards addressed by this SAR. Do you agree with the list of proposed applicable functional entities? If no, please explain.

Organization	Yes or No	Question 7 Comment
National Rural Electric Cooperative Association (NRECA)	No	As explained in response to Question 1, NRECA does not believe it is necessary to include the Balancing Authority as an applicable entity in this standard.
Great River Energy	No	As previously stated in Q1, the Balancing Authority (BA) should not be included in the standard.
ACES Standards Collaborators	No	As stated above in question one, the Balancing Authority (BA) should not be included in the standard. Per the NERC functional model, the BA is focused on balancing load, interchange and generation and supporting system frequency while the Transmission Operator (TOP) is focused transmission flows and, in particular, controlling voltages. While the BA might have role if additional generation is committed, the role would be, in essence, to respond to TOP actions. It would be the TOP that would identify the need to commit additional generation to mitigate loading on transformers or to increase reactive support.
Northeast Utilities	No	I believe that due to the wide geographical impact of GMDs/ GICs the RRO should coordinate plans between their RCs and perhaps with other RROs.
NV Energy	No	No, as discussed in response to Q1, the BA should have no direct functional responsibility for the mitigation of GMD. This should be up to the TOP's within the BA footprint. Inclusion of the BA complicates the situation.
PacifiCorp	No	Please refer to the answer supplied for Question 1.
Idaho Power	No	Propose adding Generation Operator with any transformer with a high side terminal voltage

Organization	Yes or No	Question 7 Comment
Company		greater than 200 kV to the Applicability Functional Entities.
SPP Standards Review Group	No	The Functional Model does not assign transformer operation to the Balancing Authority yet the drafting team makes a connection between transformers and the Balancing Authority by incorporating the Balancing Authority in the Applicability Section. Why did the drafting team make this decision? Shouldn't the Balancing Authority be removed from the Applicability Section since it is concerned with balancing generation to load and not operating transformers? The Balancing Authority already has procedures to assist it whenever load or generation within its Balancing Authority Area is lost. It's reason for the loss is immaterial to the Balancing Authority, the procedures it has to cover this situation would be similar regardless of the cause. In any event, the Balancing Authority has no responsibility to mitigate issues associated with a transformer within its Balancing Authority Area. That functionality resides with the Transmission Operator.
Oncor Electric Delivery Complany LLC	No	The Standard did not address all owners and operators of equipment associated with the FERC Order directing NERC to "submit for approval one or more Reliability Standards that require owners and operators to develop and implement operational procedures to mitigate the effects of GMDs." The Standard needs to also include Generation Owners and Operators of step-up transformers and auxillary transformers with at least one terminal at 200 kV or higher.
Oklahoma Gas & Electric	No	This SAR should not be applicable to Balancing Authorities. FERC Order No. 779 directed the ERO to develop one or more Reliability Standards that require owners and operators of the BPS to develop and implement operational procedures to mitigate the effects of GMDs. The functions of the BA center around balancing load and generation; and implementing and accounting for interchange schedules. BAs (unless they are also TOPs) do not monitor BES elements such as transformers.
Tri-State Generation and Transmission	No	Tri-State believes that BAs should not be included as an applicable entity because there will be unnecessary duplication or conflict between the Balancing Authority and the Reliability Coordinator Operating Plans.

Organization	Yes or No	Question 7 Comment
Association, Inc.		
Southern Company	Yes	As stated above in our response to Question #1, we suggest that the BA should not be required to have Operating Procedures for GMD. The risks mitigated are things that the TOP monitor and can either take action themselves or instruct the BA to redispatch generation.
Entergy Services, Inc.	Yes	DP may need to be included as the 200 kV limit may include distribution equipment. The SDT should consider changing the high side terminal voltage to greater than 300 kV.
PJM Interconnection, L.L.C.	Yes	PJM has signed onto SERC's comments.
SERC OC Review Group	Yes	There is a possibility that the DP would be included because the 200 kV limit may include distribution equipment. The SDT should consider raising the “bright line” to 300 kV.
MRO NERC Standards Review Forum (NSRF)	Yes	
Pepco Holdings Inc & Affiliates	Yes	
Hydro One Networks Inc.	Yes	
Dominion	Yes	
Northeast Power Coordinating	Yes	

Organization	Yes or No	Question 7 Comment
Council		
Florida Municipal Power Agency	Yes	
Emprimus LLC and Volkmann Consulting	Yes	
FirstEnergy	Yes	
DTE Electric	Yes	
Bonneville Power Administration	Yes	
JEA	Yes	
Salt River Project	Yes	
Western Area Power Administration	Yes	
Colorado Springs Utilities	Yes	
Foundation for Resilient	Yes	

Organization	Yes or No	Question 7 Comment
Societies		
American Electric Power	Yes	
NIPSCO	Yes	
Northern California Power Agency	Yes	
American Transmission Company	Yes	
Independent Electricity System Operator	Yes	
ReliabilityFirst	Yes	
Ben Li Associates	Yes	
Public Utility District No.1 of Snohomish County	Yes	
Minnkota Power	Yes	

Organization	Yes or No	Question 7 Comment
Cooperative, INC.		
City of Austin dba Austin Energy	Yes	
Duke Energy	Yes	
Electric Reliability Council of Texas, Inc.	Yes	
Xcel Energy	Yes	
American Public Power Association	Yes	
Farmington Electric Utility System	Yes	

3. **The intent of the project is to develop continent-wide requirements that allow responsible entities to tailor operational procedures or strategies based on the responsible entity's assessment of entity-specific factors such as geography, geology, and system topology. However, the need for regional variances will be researched throughout the proposed project and may be supported by analysis required to develop stage 2 Standard(s). Are you aware of any regional variances that will be needed as a result of this project? If yes, please identify the regional variance in your comments.**

Organization	Yes or No	Question 8 Comment
Northeast Utilities	No	All regional variances should be due to geographical, geological and system design factors and should be covered by developing earth and system models.
Western Electricity Coordinating Council	No	I am not aware of any regional variances that would be needed but do have concern about entities in the far south being subject to these standard prior to studies being conducted.
Southern Company	No	No, as long as the phase 2 standards are non-prescriptive. EOP-010-1 allows entities to account for regional differences that exist in their area through the development of their plans. This methodology of accounting for regional differences through plan development needs to be continued as the phase 2 standards or standard changes are developed.
Northern California Power Agency	No	No, but not sure I understand what you are getting at. As stated above geology and soil conditions will vary from region to region
PacifiCorp	No	None other than those identified.
City of Austin dba Austin Energy	No	Not at this time. We believe, however, that due to geographic differences, entities in the ERCOT Region may request regional variances after we begin developing our approach to GMD.
PJM	No	PJM has signed onto SERC's comments.

Organization	Yes or No	Question 8 Comment
Interconnection, L.L.C.		
Entergy Services, Inc.	No	SDT should consider and ensure that entities have adequate time to conduct analyses based on the responsible entity's assessment of entity-specific factors such as geography, geology, and system topology.
Sacramento Municipal Utility District	No	SMUD is unaware of WECC any regional variance.
SPP Standards Review Group	No	While we are concerned with the intent of continent-wide requirements, if accomplished as proposed by the drafting team with flexibility provided for responsible entities to tailor their response to both stages of standard development to their risk and exposure based on their geography, geology and system topology, then regional variances may not be needed. Otherwise, regional waivers or exemptions may be appropriate.
MRO NERC Standards Review Forum (NSRF)	No	
Pepco Holdings Inc & Affiliates	No	
Dominion	No	
Oklahoma Gas & Electric	No	
Emprimus LLC and Volkmann	No	

Organization	Yes or No	Question 8 Comment
Consulting		
FirstEnergy	No	
DTE Electric	No	
Bonneville Power Administration	No	
Arizona Public Service Company	No	
American Electric Power	No	
American Transmission Company	No	
Independent Electricity System Operator	No	
Ben Li Associates	No	
Public Utility District No.1 of Snohomish	No	

Organization	Yes or No	Question 8 Comment
County		
NV Energy	No	
Oncor Electric Delivery Complany LLC	No	
Minnkota Power Cooperative, INC.	No	
Electric Reliability Council of Texas, Inc.	No	
American Public Power Association	No	
Farmington Electric Utility System	No	
ACES Standards Collaborators	Yes	(1) Because the science it unsettled at this point, it is difficult to imagine a situation with a GMD event so severe that it impacts significantly the furthest southern parts of the U.S. Thus, a regional variance is likely necessary for these areas. However, until the science is settled it is challenging to know where to draw the line for where the regional variances are needed geographically or geologically.

Organization	Yes or No	Question 8 Comment
Colorado Springs Utilities	Yes	1. Variances are absolutely going to be necessary based on geography, geology, and system topology.
National Rural Electric Cooperative Association (NRECA)	Yes	As explained in response to Question 1, it is important that any standard that is developed addressed regional geographic differences associated with the impacts of GMD in the requirements of the standard. Present data does not support that the potential for equipment damage resulting in a GMD event is the same for a cooperative in the Northeast and a cooperative in the Southeast.
Duke Energy	Yes	Duke Energy believes that due to regional variances, GMD procedures should vary based on GMD severity levels and kV thresholds.
Florida Municipal Power Agency	Yes	Florida is not susceptible to high GIC due to latitude and geology. At minimum, the applicability of the stadnrd ought to change based on geography and geology, e.g., maybe Florida's applicability is only for > 400 kV or not applicabile at all.
NIPSCO	Yes	If the geological conditions and system configuration are such that damaging magintudes of GIC do not exist and there is no history of GIC induced damage or misoperation in the TOP's service area, it should not be required to have plans specifically for GMD events.
Great River Energy	Yes	See ACES Comment for question 8.
Tri-State Generation and Transmission Association, Inc.	Yes	The assessments from each region will likely provide different results due to the varying geography, geology and location. A continent-wide standard will not properly or efficiently address the potential risks brought by geomagnetically induced currents. Tri-State believes that NERC should issue an alert to have the different Regional Entities review and develop regional standards, guidelines or other criteria to mitigate the possible effects of geomagnetic disturbances rather than develop a "fill in the blank" standard.
Hydro One	Yes	The flexibility in the plan design takes into account locational differences, which are

Organization	Yes or No	Question 8 Comment
Networks Inc.		geographically and geologically based. There is no basis for differences due to regional entity boundaries.
Northeast Power Coordinating Council	Yes	The flexibility in the plan design takes into account locational differences, which are geographically and geologically based. There is no basis for differences due to regional entity boundaries.
LCRA Transmission Services Corp	Yes	The standard and SAR as drafted do not address differences in geography, geology or system topology variances. For example because of its southern latitude, the ERCOT region is over 10 times less likely to be impacted by a GMD occurrence than northern regions of the country and 100 times less than regions of Canada. The cost and effort of prevention measures should be in line with the potential risks.
Salt River Project	Yes	
Western Area Power Administration	Yes	
Foundation for Resilient Societies	Yes	
ReliabilityFirst	Yes	
SERC OC Review Group		The industry is developing the necessary procedures, processes and analysis tools to support the GMD standard. As these technologies evolve the industry will make modifications to address those changes. SDT should consider and ensure that entities have adequate time to conduct analyses based on the responsible entity's assessment of entity-specific factors such

Organization	Yes or No	Question 8 Comment
		as geography, geology, and system topology.

4. **Are you aware of any business practice that will be needed or that will need to be modified as a result of this project? If yes, please identify the business practice in your comments.**

Organization	Yes or No	Question 9 Comment
PJM Interconnection, L.L.C.	No	PJM has signed onto SERC's comments.
Great River Energy	No	The drafting team needs to consider the impacts to smaller entites. Smaller entities have limited resources especially when considering hardening transformers against GMD events. A cost benefit analysis should be considered when weighing the reliability gains versus the costs of hardening the electric system.
Pepco Holdings Inc & Affiliates	No	
Dominion	No	
Oklahoma Gas & Electric	No	
Florida Municipal Power Agency	No	
FirstEnergy	No	
DTE Electric	No	
Bonneville Power	No	

Organization	Yes or No	Question 9 Comment
Administration		
JEA	No	
Arizona Public Service Company	No	
Western Electricity Coordinating Council	No	
Southern Company	No	
NIPSCO	No	
American Transmission Company	No	
Independent Electricity System Operator	No	
ReliabilityFirst	No	
Public Utility District No.1 of Snohomish	No	

Organization	Yes or No	Question 9 Comment
County		
NV Energy	No	
Oncor Electric Delivery Complany LLC	No	
City of Austin dba Austin Energy	No	
Electric Reliability Council of Texas, Inc.	No	
Sacramento Municipal Utility District	No	
American Public Power Association	No	
Farmington Electric Utility System	No	
Salt River Project	Yes	Depending on how the Reliability Coordinator writes the plan and procedures there could be an impact to elements of the BES that are jointly owned, mainly regarding contractual

Organization	Yes or No	Question 9 Comment
		requirements.
Foundation for Resilient Societies	Yes	For effective operating procedures implemented through regional balancing authorities, improved near-real-time GIC monitoring will be needed for all GSU transformers, SVC equipment, and major generating equipment at risk in severe solar storms. Regional balancing authorities will require improved near-real-time monitoring to prepare and protect ready reserves. Communications must be designed to operate even during severe solar storms. Regional balancing authorities will need to be in contact with the White House Situation Room and federal command centers elsewhere.
Emprimus LLC and Volkmann Consulting	Yes	GIC mitigation systems should be excluded from the SPS definition.
Duke Energy	Yes	If a TOP's GMD procedure includes the curtailment of transactions to mitigate a potential GMD event, then the modification of a TOP(s)/TSP(s) business practices may be required.
MRO NERC Standards Review Forum (NSRF)	Yes	MISO has business practice manuals (BPMs) that may require modifications.
Minnkota Power Cooperative, INC.	Yes	MISO has business practice manuals (BPMs) that may require modifications.
Northern California Power Agency	Yes	Operating procedures that address compliance with IRO-005-3 R3 will need to be modified and new procedure to show compliance with EOP-010-1 will need to be developed.

Organization	Yes or No	Question 9 Comment
Northeast Power Coordinating Council	Yes	Studies, control room practices and monitoring all will be needed. These are business practice changes and have a cost which should be considered in this Standard's development. It should be.
Tri-State Generation and Transmission Association, Inc.	Yes	The NERC IRO-005-3.1a Requirement 3 may need to be retired and incorporated into the new standard(s). The WECC Geo-Magnetic Disturbance Reporting procedure, which meets the above NERC requirement, may also need to be modified. It is extremely difficult to determine whether internal business practices will need to be adapted prior to assessments being performed to identify potential impacts of GMD events. The final GMD Operating Plan(s) developed by the Reliability Coordinator and Balancing Authorities, which have not been developed, could also impact internal business practices.
American Electric Power	Yes	The SAR indicates that there may be changes to additional standards eventually proposed as a result of Stage 2 project efforts. There is no mention of any specific modifications or additional requirements related to the sharing of GMD-related modeling information. A library of GIC models capturing various system conditions will eventually be necessary. There should be a similar coordinated effort in developing such a GIC model library as the MMWG that develops power flow and stability models on an annual basis.
Ben Li Associates	Yes	There is a possibility that the procedure of one RC could end up causing redispatch or reconfiguration in a TOP or BA area or another RC area. There is also a need to address the mechanism for cost recovery, particularly when the problem could be mitigated locally through upgrades. The cost recovery for redispatch and/or upgrades to BES facilities needamong affected entities.
Northeast Utilities	Yes	This project will require the conducting of detailed equipment analyses, and in the longer term regional earth conductivity and system modelling in order to determine impact of GMD/ GIC on equipment and systems.Monitoring and IndicationsKey parameters must be identified for control center monitoring (GIC, reactive reserves, harmonics, MVAR, etc.) and SCADA displays will have to be designed for operator use . Currently a project is underway to install

Organization	Yes or No	Question 9 Comment
		GIC monitoring on selected transformers and to track the magnitude of GIC/ harmonics with GMD incidence (via Kp provided by SWPC). The impact on equipment of deviation from normal of these indications must be known, as well as actions recommended by the transmission owner. Once this is provided, the displays mentioned above can be designed.Procedure DevelopmentOnce displays are developed as discussed above, a procedure will need to be developed to address requirements of EOP-010-1 R3. Currently in New England only the northern LCCs and ISO-NE have GMD procedures. These are of a general nature and may not be sufficient, but they will serve as a starting point for drafting operating procedures. (This presupposes that parameters for System Operator monitoring have been identified, provided to the control room, displays developed and the importance of the readings determined by the Transmission Owner.) The standard requires the RC to coordinate TOP procedures. This may result in a process similar to that for coordinating system restoration plans.TrainingOnce a new procedure is developed and displays are created, a task analysis will need to take place to identify required changes to the company specific Reliability Related Task list and required modifications to the training program.This will involve development and delivery of additional classroom training and evaluation instruments, development and administering of Job Performance Measures for newly identified Reliability Related Tasks and development, delivery and evaluation of crew simulator scenarios.
ACES Standards Collaborators	Yes	This standard will impact multiple business practices within the industry regarding budgetary issues. The cost of hardening transformers to withstand severe GMD events does not justify the reliability gains. This is especially true for smaller entities with limited resources.
SPP Standards Review Group	Yes	We foresee the need for a study/modeling group similar to the MWG which would assemble the appropriate data base upon which collaborated studies, similar to the interregional transfer capability studies being done today, would be conducted. The results of those studies would then also be made available to any responsible entity for purposes of GMD assessment.
Hydro One	Yes	

Organization	Yes or No	Question 9 Comment
Networks Inc.		
Western Area Power Administration	Yes	

5. If you have any other comments on this SAR that you haven't already mentioned above, please provide them here.

Organization	Question 10 Comment
Northeast Utilities	1.) Training requirements should be added to PER-005. Any required training should be added to the applicable GMD standard(s) (e.g. EOP-010-1.) 2.) The requirement to have the stage 2 standard done and in effect within 18 months is reasonable, however there should be adequate time within the resulting standard for entities to conduct the required earth/ system studies and alalyze them. Adequate time is also important due to the need to coordinate mitigation efforts across areas to ensure other entities are not adversely impacted by your organizations actions.
American Electric Power	AEP is voting negative on this draft, but can foresee voting in the affirmative if the issues and concerns expressed in this response are addressed in future versions of the draft.
El Paso Electric Company	EPE generally supports stage 1 of Project 2013-03: Geomagnetic Disturbance Mitigation. EPE is concerned with the short implementation period of six calendar months following applicable regulatory approval and would like to see a 1 yearlong implementation period instead.
Foundation for Resilient Societies	For concerns of the Foundation for Resilient Societies, see our website at www.resilientsocieties.org. A case study of Maine and ISO-New England utilizing recently revised operating procedures documents our concern that regional "ready reserves" in a severe geomagnetic storm are likely to be inadequate due to a combination of vulnerable long distance HVDC transmission lines, a record of SVC "trips" during only moderate solar storms, and unprotected generating equipment in New England, where high GICs are recorded.
Great River Energy	GMD events cover a wide area and multiple entities. Planning Coordinators (PC) are the ones that should be conducting the initial assessments with recommendations to the individual entities. The scope of these studies are much broader than individual entites.

Organization	Question 10 Comment
American Transmission Company	If the need for mitigation is identified, ATC believes that it is important to coordinate the response and installation of identified mitigations between GOs and TOs.
MRO NERC Standards Review Forum (NSRF)	If the need for mitigation is identified, it is important to coordinate the response and installation of identified mitigations between GOs and TOs.
Los Angeles Department of Water and Power	LADWP does not currently have a comment on this question.
Los Angeles Department of Water and Power	LADWP does not currently have a response for this question.
LCRA Transmission Services Corp	no comment
Northern California Power Agency	No further comments
Colorado Springs Utilities	None
Minnkota Power Cooperative, INC.	See NSRF's Comments
SERC OC Review Group	Thank you for the opportunity to comment.Disclaimer: The comments expressed herein represent a consensus of the views of the above named members of the SERC OC Review Group only and should not be construed as the position of the SERC Reliability Corporation, or its board or its officers.
ACES Standards Collaborators	The SAR discusses additional training requirements that ultimately will impact system operators. System operators already have a heavy training load from mandatory training required to meet the PER requirements (i.e. 32 hours of emergency operations training) to the training requirements to maintain NERC certification (i.e. 200 hours every three years for an RC). We would advise the drafting team to be careful to not overburden the system operators with additional training requirements that could distract them from doing their

Organization	Question 10 Comment
	job of maintaining system reliability.
Northeast Power Coordinating Council	The Standard is a reasonable response to the FERC Directives.When EOP-010-1 becomes effective IRO-005-3a Requirement R3 becomes redundant and should be removed. This information should be added to the "Related Standards" section of the SAR.
Salt River Project	We believe the standard needs to address shared elements of the BES. The exposure at one end of a shared element may be more significant than at the remote end. NERC and the Reliability Coordinator need to provide direction when this type of situation occurs.
Oklahoma Gas & Electric	While we understand the good intentions of FERC in Order No. 779, we feel that industry's time would be better spent pursuing Reliability initiatives that were focused on more pressing, well-documented threats to reliability, particularly as it relates to entities that are located in more southerly regions of the continent.

END OF REPORT

143 FERC ¶ 61,147

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

18 CFR Part 40

[Docket No. RM12-22-000; Order No. 779]

Reliability Standards for Geomagnetic Disturbances

(Issued May 16, 2013)

AGENCY: Federal Energy Regulatory Commission.

ACTION: Final Rule.

SUMMARY: Under section 215 of the Federal Power Act, the Federal Energy Regulatory Commission (Commission) directs the North American Electric Reliability Corporation (NERC), the Commission-certified Electric Reliability Organization, to submit to the Commission for approval proposed Reliability Standards that address the impact of geomagnetic disturbances (GMD) on the reliable operation of the Bulk-Power System. The Commission directs NERC to implement the directive in two stages. In the first stage, NERC must submit, within six months of the effective date of this Final Rule, one or more Reliability Standards that require owners and operators of the Bulk-Power System to develop and implement operational procedures to mitigate the effects of GMDs consistent with the reliable operation of the Bulk-Power System. In the second stage, NERC must submit, within 18 months of the effective date of this Final Rule, one or more Reliability Standards that require owners and operators of the Bulk-Power System to conduct initial and on-going assessments of the potential impact of benchmark GMD

events on Bulk-Power System equipment and the Bulk-Power System as a whole. The Second Stage GMD Reliability Standards must identify benchmark GMD events that specify what severity GMD events a responsible entity must assess for potential impacts on the Bulk-Power System. 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. 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. These strategies could, for example, include automatically blocking geomagnetically induced currents 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.

EFFECTIVE DATE: This rule will become effective **[INSERT DATE 60 days after publication in the FEDERAL REGISTER].**

FOR FURTHER INFORMATION CONTACT:

Regis Binder (Technical Information)
Office of Electric Reliability
Division of Reliability Standards and Security
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426
(301) 665-1601
Regis.Binder@ferc.gov

Matthew Vlissides (Legal Information)
Office of the General Counsel
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426
(202) 502-8408
Matthew.Vlissides@ferc.gov

SUPPLEMENTARY INFORMATION:

143 FERC ¶ 61,147
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Jon Wellinghoff, Chairman;
Philip D. Moeller, John R. Norris,
Cheryl A. LaFleur, and Tony Clark.

Reliability Standards for Geomagnetic Disturbances Docket No. RM12-22-000

Order No. 779

FINAL RULE

(Issued May 16, 2013)

1. Pursuant to section 215(d)(5) of the Federal Power Act (FPA),[1] the Commission directs the North American Electric Reliability Corporation (NERC), the Commission-certified Electric Reliability Organization (ERO), to submit for approval Reliability Standards (GMD Reliability Standards) that address the risks posed by geomagnetic disturbances (GMD) to the reliable operation of the Bulk-Power System.

2. The Commission directs NERC to implement the directive in two stages. In the first stage, NERC must submit, within six months of the effective date of this Final Rule, one or more Reliability Standards that require owners and operators of the Bulk-Power System to develop and implement operational procedures to mitigate the effects of GMDs consistent with the reliable operation of the Bulk-Power System. In the second stage,

[1] 16 U.S.C. 824o(d)(5) (2006).

NERC must submit, within 18 months of the effective date of this Final Rule, one or more Reliability Standards that require owners and operators of the Bulk-Power System to conduct initial and on-going assessments of the potential impact of benchmark GMD events on Bulk-Power System equipment and the Bulk-Power System as a whole. The Second Stage GMD Reliability Standards must identify "benchmark GMD events" that specify what severity GMD events a responsible entity must assess for potential impacts on the Bulk-Power System. The benchmark GMD events must be technically justified because the benchmark GMD events will define the scope of the Second Stage GMD Reliability Standards (i.e., responsible entities should not be required to assess GMD events more severe than the benchmark GMD events). 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. The plan cannot be limited to considering operational procedures or enhanced training alone. Rather, the plan must, 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. 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. The Reliability Standards 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. Given that the scientific understanding of GMDs is still evolving, we recognize that Reliability Standards cannot be expected to protect against all GMD-induced outages.

3. We take this action based on the potentially severe, wide-spread impact on the reliable operation of the Bulk-Power System that can be caused by GMD events and the absence of existing Reliability Standards to address GMD events. We are not directing the ERO to include any specific Requirements in the GMD Reliability Standards nor are we pre-judging what the ERO eventually submits for approval. Instead, in this Final Rule, we identify issues that should be considered in the NERC standards development process. We expect NERC to explain how the proposed GMD Reliability Standards address these issues when the Reliability Standards are submitted for Commission approval.

I. Background

A. Section 215 and Mandatory Reliability Standards

4. Section 215 of the FPA requires the Commission to certify an ERO to develop mandatory and enforceable Reliability Standards, subject to Commission review and

approval.[2] Once approved, the Reliability Standards may be enforced in the United States by the ERO, subject to Commission oversight, or by the Commission independently.

5. Pursuant to FPA section 215(d)(5), the Commission has the authority, upon its own motion or upon complaint, to order the ERO to submit to the Commission a proposed Reliability Standard or a modification to a Reliability Standard that addresses a specific matter if the Commission considers such a new or modified Reliability Standard appropriate to carry out section 215 of the FPA.[3]

B. Geomagnetic Disturbances

6. A GMD, caused by solar events, results in distortions to the earth's magnetic field, can be of varying intensity, and has in the past impacted the operation of pipelines, communications systems, and electric power systems.[4] The interaction of the earth's magnetic field and solar events can cause low frequency GICs to flow along the surface of the earth and in the oceans. Reliability issues arise when GICs enter the Bulk-Power System from the earth. Because many Bulk-Power System transformers are grounded, the GIC appears as electrical current to the Bulk-Power System and flows through the

[2] 16 U.S.C. 824o (2006).

[3] 16 U.S.C. 824o(d)(5); 18 CFR 39.5(f) (2012).

[4] Oak Ridge National Laboratory, Electric Utility Industry Experience with Geomagnetic Disturbances at xiii (1991), *available at* http://www.ornl.gov/~webworks/cpr/v823/rpt/51089.pdf.

ground connection and conductors, such as transformers and transmission lines.[5] GICs can cause "half-cycle saturation" of high-voltage Bulk-Power System transformers, which can lead to increased consumption of reactive power and creation of disruptive harmonics that can cause the sudden collapse of the Bulk-Power System.[6] Further, half-cycle saturation from GICs can potentially damage Bulk-Power System transformers because of overheating.[7]

C. Studies of GMD Events on the Bulk-Power System

7. The impact of GMDs on the Bulk-Power System has been evaluated in several government-sponsored studies and NERC reports. The EMP Commission issued reports assessing the threat to the United States from Electromagnetic Pulse (EMP) attack in 2004 and 2008, which also addressed the effects of geomagnetic storms on the electric power infrastructure.[8] The National Research Council of the National Academies issued

[5] North American Electric Reliability Corp., *2012 Special Reliability Assessment Interim Report: Effects of Geomagnetic Disturbances on the Bulk Power System* at ii (February 2012) (*NERC Interim GMD Report*), *available at* http://www.nerc.com/files/2012GMD.pdf.

[6] *Id.* at iii-iv.

[7] *Id.*

[8] These reports are accessible at the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack website at http://www.empcommission.org/.

a report addressing the impact of severe space weather events in 2008.[9] The Oak Ridge National Laboratory issued a series of reports on the effects of electromagnetic pulses on the Bulk-Power System in January 2010.[10] NERC issued the HILF Report on high-impact, low-frequency risks to the Bulk-Power System in June 2010.[11]

8. In November 2010, NERC endorsed the creation of a GMD Task Force to "develop a technical white paper describing the evaluation of scenarios of potential GMD impacts, identifying key bulk power system parameters under those scenario conditions, and evaluating potential reliability implications of these incidents."[12] The NERC GMD Task Force was formed in early 2011.[13] In February 2012, the NERC GMD Task Force issued the NERC Interim GMD Report evaluating the effects of GMDs on the Bulk-Power System.

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[9] National Research Council of the National Academies, Severe Space Weather Events—Understanding Societal and Economic Impacts: A Workshop Report at 4 (2008) (NAS Workshop Report), *available at* http://www.nap.edu/catalog/12507.html.

[10] Oak Ridge National Laboratory, *FERC EMP-GIC Metatech Reports 319-324* (January 2010) (collectively, *Oak Ridge Study*), *available at* http://www.ornl.gov/sci/ees/etsd/pes/ferc_emp_gic.shtml.

[11] The HILF Report was prepared by NERC, Department of Energy, and a steering committee comprised of industry and risk experts and was approved by the NERC Board of Trustees on May 17, 2010. North American Electric Reliability Corp., *High-Impact, Low-Frequency Event Risk to the North American Bulk Power System*, at 2 (June 2010) (*HILF Report*), *available at* http://www.nerc.com/files/HILF.pdf).

[12] NERC, Board of Trustees Minutes, Exhibit J, at 1 (Nov. 4, 2010), *available at* http://www.nerc.com/docs/docs/bot/BOT-1110m-open-complete.pdf.

[13] NERC Comments at 2 n.4.

9. The Commission held a Technical Conference on April 30, 2012 to discuss the risks posed by GMDs to the reliable operation of the Bulk-Power System.[14] Several panelists indicated at the Technical Conference that severe GMD events could potentially compromise the reliable operation of the Bulk-Power System, with some noting as an example the GMD-induced disruption of the Hydro-Québec grid in 1989.[15] Some commenters, however, expressed concern with developing Reliability Standards to address GMD events at this time.[16]

D. Notice of Proposed Rulemaking

10. On October 18, 2012, the Commission issued a Notice of Proposed Rulemaking (NOPR) pursuant to FPA section 215(d) proposing to direct that NERC submit to the Commission for approval proposed Reliability Standards that address the risks posed by

[14] Written statements presented at the Technical Conference, post-Technical Conference comments, and Technical Conference transcript are accessible through the Commission's eLibrary document retrieval system in Docket No. AD12-13-000.

[15] NOPR, 141 FERC ¶ 61,045 at P 3 (citing Statement of Scott Pugh, U.S. Department of Homeland Security at 2 (citing 1989 Hydro-Québec blackout); Statement of Frank Koza, PJM Interconnection, L.L.C. at 1 ("The combination of half-cycle transformer saturation and increased reactive power consumption can lead to voltage collapse and blackouts if not properly managed."); Statement of John Kappenman at 8 ("The bulk power system is the nation's most important critical infrastructure and unlike other threats, a severe geomagnetic storms [sic] can impose a near simultaneous nationwide crippling threat to this vital infrastructure."); Statement of Gerry Cauley, NERC at 1 ("Previous examples, such as the 1989 event in Hydro Québec demonstrate that severe solar storms represent a serious risk that can challenge the reliability of the bulk power system.")).

[16] *See, e.g.*, Statement of Steven Naumann, EEI at 5 ("Until [system-wide] studies are completed, it is premature to determine whether NERC should advance development of mandatory requirements to address GMD related-issues.").

GMDs to the reliable operation of the Bulk-Power System.[17] The NOPR stated that the proposal was based on government-sponsored studies and NERC studies indicating that GMD events can have an adverse, wide-area impact on the reliable operation of the Bulk-Power System.[18] The NOPR stated that GMD vulnerabilities are not adequately addressed in the Reliability Standards and that this constitutes a reliability gap because GMD events can cause the Bulk-Power System to collapse suddenly and can potentially damage equipment on the Bulk-Power System.

11. The NOPR proposed to direct NERC to develop GMD Reliability Standards in two stages. Regarding the first stage, NERC would submit one or more proposed Reliability Standards that require owners and operators of the Bulk-Power System to develop and implement operational procedures to mitigate the effects of GMDs consistent with the reliable operation of the Bulk-Power System. The NOPR proposed that NERC would submit these First Stage GMD Reliability Standards within 90 days of the effective date of a final rule in this proceeding. The NOPR, while not proposing to direct a specific implementation plan, encouraged a 90-day implementation period following Commission approval of the First Stage GMD Reliability Standards.

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[17] *Reliability Standards for Geomagnetic Disturbances*, Notice of Proposed Rulemaking, 77 FR 64,935 (Oct. 24, 2012), 141 FERC ¶ 61,045 (2012) (NOPR).

[18] NOPR, 141 FERC ¶ 61,045 at P 2 (citing *NERC Interim GMD Report* at 85; *HILF Report* at 68; *Oak Ridge Study*).

12. The NOPR proposed to accept aspects of the "Initial Actions" plan set forth in NERC's May 21, 2012 post-Technical Conference comments, in which NERC stated that it would "identify facilities most at-risk from severe geomagnetic disturbance" and "conduct wide-area geomagnetic disturbance vulnerability assessment."[19] In the NOPR, the Commission stated that it agreed with NERC that critical Bulk-Power System facilities should be evaluated for GMD vulnerability and, as part of the "Initial Actions," special attention should be given to Bulk-Power System facilities that provide service to critical and priority loads. The NOPR proposed that NERC would conduct these "Initial Actions" simultaneously with the development of the First Stage GMD Reliability Standards.

13. Regarding the second stage, the NOPR proposed that, within six months of the effective date of a final rule in this proceeding, NERC would file one or more proposed Reliability Standards that require owners and operators of the Bulk-Power System to conduct initial and on-going assessments of the potential impact of GMDs on Bulk-Power System equipment and the Bulk-Power System as a whole. The NOPR stated that, based on those assessments, the Reliability Standards would require owners and operators to develop and implement a plan so that instability, uncontrolled separation, or cascading failures of the Bulk-Power System, caused by damage to critical or vulnerable Bulk-Power System equipment, or otherwise, will not occur as a result of a GMD. The NOPR

[19] NERC May 21, 2012 Comments at 8-9.

stated that the plan could not be limited to operational procedures or enhanced training alone, but should, subject to the needs identified in the assessments, contain strategies for protecting against the potential impact of GMDs based on factors such as the age, condition, technical specifications, or location of specific equipment. The NOPR further stated that these strategies could include automatically blocking GICs from entering the Bulk-Power System, instituting specification requirements for new equipment, inventory management, and isolating certain equipment that is not cost effective to retrofit. Without proposing a specific implementation period, the NOPR stated that the Second Stage GMD Reliability Standards would likely need to be implemented in phases, focusing first on the most critical Bulk-Power System assets.

14. In response to the NOPR, interested entities filed 62 comments. We address below the issues raised in the comments.[20] The Appendix to this Final Rule lists the entities that filed comments to the NOPR.[21]

[20] Some comments raised issues not addressed in the NOPR, including cost recovery for compliance with the GMD Reliability Standards; the risks posed to the Bulk-Power System by electromagnetic pulses; the organization and conduct of the NERC GMD Task Force; terrorism; and cybersecurity. Issues outside the scope of the NOPR are not addressed in this Final Rule. However, nothing precludes entities from seeking cost recovery if needed.

[21] A document submitted by the Nuclear Regulatory Commission (NRC) was erroneously included in the Commission's eLibrary system in this rulemaking docket and was subsequently removed. The NRC document did not influence the determinations in this Final Rule.

II. Discussion

15. As discussed below, the Commission finds that the existing Reliability Standards do not adequately address the risks posed by GMDs to the reliable operation of the Bulk-Power System. In its NOPR comments, NERC states that "[a]s a high-impact, low-frequency event, GMDs pose a unique threat to Bulk-Power System reliability, and NERC is committed to working with stakeholders and the Commission to address these challenges consistent with its responsibilities as the ERO."[22] Accordingly, pursuant to section 215(d)(5) of the FPA, the Commission directs the ERO to develop and submit for approval Reliability Standards that address the potentially severe, wide-spread impact of GMD events on the reliable operation of the Bulk-Power System.[23]

16. We issue this directive recognizing, as we did in the NOPR, that there is an ongoing debate as to the likely effect of GMDs on the reliable operation of the Bulk-Power System. As discussed below, the NOPR comments reflect these differing views, with some comments supporting the NERC Interim GMD Report's conclusion that the worst-case GMD scenario is "voltage instability and subsequent voltage collapse,"[24] while other comments endorse the Oak Ridge Study's conclusion that a severe GMD

[22] NERC Comments at 3.

[23] We do not necessarily require NERC to develop and submit entirely new Reliability Standards. NERC could develop and submit revisions to existing Reliability Standards. In addition, as stated in the NOPR, facilities and equipment falling outside of our jurisdiction would not be subject to the proposed GMD Reliability Standards. NOPR, 141 FERC ¶ 61,045 at P 27 n.49.

[24] NERC Interim GMD Report at 69.

event could put Bulk-Power System transformers at risk for failure or permanent damage.[25] As we stated in the NOPR, and affirm here, "[w]hile the conclusions of these reports differ significantly, our proposed action is warranted by even the lesser consequence of a projected widespread blackout without long-term, significant damage to the Bulk-Power System. Taking steps to prevent such blackouts is consistent with maintaining the reliable operation of the Bulk-Power System."[26]

17. In directing the ERO to submit Reliability Standards that address the potential impact of GMD events on the reliable operation of the Bulk-Power System, we are not directing NERC to include specific Requirements or otherwise pre-judging what the ERO eventually proposes. In addition, we are not directing the ERO to develop GMD Reliability Standards that are "one-size-fits-all," a concern expressed in the comments.[27] Instead, in this final rule we identify issues that should be considered in the NERC standards development process. We expect NERC to develop GMD Reliability

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[25] Oak Ridge National Laboratory, *Electromagnetic Pulse: Effects on the U.S. Power Grid: Meta-R-319* at page 1-14, Tables 4-1, 4-2, 4-3 (discussing at-risk transformers) (January 2010) (*Oak Ridge Study 319 Report*), *available at* http://www.ornl.gov/sci/ees/etsd/pes/pubs/ferc_Meta-R-319.pdf.

[26] NOPR, 141 FERC ¶ 61,045 at P 5 (citing 16 U.S.C. 824o(a)(4)).

[27] *See*, *e.g.*, NERC Comments at 4; EIS Comments at 3; Bonneville Comments at 3; NV Energy Comments at 4. Rather than adopt a "one-size-fits-all" approach, the NOPR stated that the Oak Ridge Study identified several variables that determine the severity of GMD events, including: (1) location and strength of the underlying solar event; (2) ground conductivity in the affected locations (i.e., the geology of the location); (3) orientation of the transmission lines; (4) length of transmission lines; and (5) grid construction. NOPR at P 14 (citing *Oak Ridge Study 319 Report* at page 2-5).

Standards that address these issues and, when these Reliability Standards are submitted to the Commission for approval, to explain in the accompanying petition how the issues are addressed in the proposed GMD Reliability Standards.[28]

18. Because of concerns raised in the comments regarding the proposed schedule for developing and submitting the GMD Reliability Standards, we adjust the schedule in the NOPR to allow more time. Accordingly, we set a six-month deadline from the effective date of this Final Rule for NERC to submit the First Stage GMD Reliability Standards and suggest a six-month implementation period for the First Stage GMD Reliability Standards following Commission approval. We set an 18-month deadline from the effective date of this Final Rule for NERC to submit the Second Stage GMD Reliability Standards, and direct NERC to propose an implementation period.

19. Below we address the comments regarding: (1) the Commission's authority to direct the ERO to develop and submit GMD Reliability Standards under FPA section 215(d)(5); (2) the content of the First Stage GMD Reliability Standards and the schedule for submitting and implementing the Reliability Standards; (3) the "Initial Actions" GMD vulnerability assessments; and (4) the content of the Second Stage GMD Reliability Standards and the schedule for submitting and implementing those Reliability Standards.

[28] In its comments, NERC encourages the Commission to permit Commission staff to actively participate in the NERC standards development process. NERC Comments at 8. Consistent with the Commission's current practice, Commission staff will participate as an observer in the development of the GMD Reliability Standards.

A. Commission Authority to Direct the ERO to Develop GMD Reliability Standards under FPA Section 215(d)(5)

NOPR

20. The NOPR stated that GMD vulnerabilities are not adequately addressed in the existing Reliability Standards.[29] The NOPR stated that this constitutes a reliability gap because GMD events can cause the Bulk-Power System to collapse suddenly and can potentially damage the Bulk-Power System.[30] In order to carry out section 215 of the FPA, the NOPR proposed to direct NERC to develop and submit for approval Reliability Standards that address the potentially severe, wide-spread impact of GMD events on the reliable operation of the Bulk-Power System.

Comments

21. NERC states that it "supports the Commission's exercise of its authority pursuant to Section 215(d)(5) in the NOPR and the due weight given to NERC's technical expertise with respect to the content of the proposed Reliability Standards. The NOPR explicitly does not propose to require NERC or owners or operators of the Bulk-Power System to adopt any particular operational procedures or a particular solution in the

[29] NOPR, 141 FERC ¶ 61,045 at P 4 (citing NERC Reliability Standard IRO-005-3a (Reliability Coordination — Current Day Operations), Requirement R3, as the only existing Requirement that discusses GMDs).

[30] NOPR, 141 FERC ¶ 61,045 at PP 4-5.

second stage Reliability Standards to address GMDs. NERC submits that this approach is consistent with Section 215(d)(2) of the Federal Power Act."[31]

22. ELCON states that the NOPR does not establish why the GMD Reliability Standards are "appropriate to carry out [section 215]," as required under FPA section 215(d)(5).[32] ELCON states that the "NOPR does not give sufficient recognition to the key unresolved technical issues, including the lack of consensus about the nature and potential impacts of GMD events and the absence of tools for modeling or addressing the effects of geomagnetic induced currents."[33] Accordingly, ELCON states that "a final rule would not be supportable as an exercise of the Commission's authority under Section 215(d)(5)."[34] The Trade Associations state that "[w]hile FERC has authority under Section 215(d)(5) to direct the ERO to develop a mandatory standard on a specific matter, the specific matter that is the subject of this NOPR, GIC levels caused by strong GMD events, does not have a strong scientific or technical consensus upon which to develop standards."[35] NARUC states that the NOPR "does not provide sufficient cost

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[31] NERC Comments at 7.

[32] 16 U.S.C. 824o(d)(5) ("The Commission, upon its own motion or complaint may order the Electric Reliability Organization to submit to the Commission a proposed reliability standard or a modification to a reliability standard that addresses a specific matter if the Commission considers such a new or modified reliability standard appropriate to carry out this section.").

[33] ELCON Comments at 4-5.

[34] *Id.* at 5.

[35] Trade Associations Comments at 25.

benefit or technical evidence to justify a directive to NERC to set GMD Reliability Standards at this time."[36] Other commenters, without explicitly addressing the Commission's authority to direct the ERO to develop GMD Reliability Standards, state that there is an insufficient technical basis for the NERC standards development process.[37]

Commission Determination

23. The Commission finds that the directives in this Final Rule are a valid exercise of the Commission's authority under FPA section 215(d)(5). The plain language of the statute authorizes the Commission to order the development of a Reliability Standard that "addresses a specific matter if the Commission considers such a new or modified reliability standard appropriate to carry out this section."[38]

24. We determine that addressing the specific matter of GMDs and their impact on the reliable operation of the Bulk-Power System is appropriate to carry out FPA section 215. As the NOPR stated, while there is an ongoing debate as to how a severe GMD event will most likely impact the Bulk-Power System, there is a general consensus that GMD events

[36] NARUC Comments at 3.

[37] *See*, *e.g.*, Duke Comments at 2-4; CenterPoint Comments at 3.

[38] 16 U.S.C. 824o(d)(5).

can cause wide-spread blackouts due to voltage instability and subsequent voltage collapse, thus disrupting the reliable operation of the Bulk-Power System.[39]

25. FPA section 215 defines "reliability standard" as a "requirement … to provide for reliable operation of the bulk-power system."[40] FPA section 215 defines "reliable operation" to mean "operating the elements of the bulk-power system within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance, including a cybersecurity incident, or unanticipated failure of system elements."[41] Because there is a general consensus that GMD events can cause "voltage instability and subsequent voltage collapse," thus affecting the reliable operation of the Bulk-Power System, the Commission finds that GMDs are valid subject matter for Reliability Standards development. In addition, as the Trade Associations' comments

[39] *See*, *e.g.*, Trade Associations Comments at 51 ("The 1989 Hydro Quebec Blackout, is often used in the ORNL/Metatech Report to assert that wide spread collapse and permanent equipment damage is a likely outcome of a severe GMD event. Although the Trade Associations agree that both are potential risks of a severe GMD event, the Trade Association find the conclusions of the GMD Task Force, which states that 'the most likely worst-case system impacts from a severe GMD event and corresponding GIC flow is voltage instability caused by a significant loss of reactive power support,' to be more credible and based on the scientific facts."); PJM Comments at 3 ("[T]here is no question that severe space weather has the potential to create serious problems for the Bulk-Power System."); ITC Comments at 2 ("ITC believes that the risk to the bulk power system from GMD is a significant concern that should be addressed.").

[40] 16 U.S.C. 824o(a)(3).

[41] *Id.* at 824o(a)(4).

acknowledge, the Reliability Standards currently do not expressly require responsible entities to mitigate the risks posed by GMDs to the Bulk-Power System.[42] Therefore, we believe that it is appropriate to direct NERC to submit new or modified Reliability Standards that address GMDs pursuant to FPA section 215(d)(5).

26. We reject the assertion that a lack of technical or scientific consensus regarding some issues associated with GMDs deprives the Commission of the statutory authority to order the development of revised or new Reliability Standards. While the Commission must have a reasonable basis for its actions, section 215(d)(5) does not require the Commission to certify the existence of a consensus before it can require the ERO to develop a Reliability Standard. Instead, the statute specifically vests the Commission with the discretion to determine when a new Reliability Standard is necessary.[43] In any event, the lack of consensus in this case pertains to the most likely impact of a severe GMD event and the appropriate measures to take in mitigation. There is general

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[42] Trade Associations Comments at 25 ("[T]he Trade Associations acknowledge that NERC Reliability Standards do not expressly require steps for mitigating the effects of GMD events.").

[43] 16 U.S.C. 824o(d)(5); *see also Transmission Relay Loadability Reliability Standard*, 134 FERC ¶ 61,127, at P 25 (2011) (explaining that under section 215(d)(5) "the Commission, and not just the ERO, has the responsibility and authority to identify 'specific matters' that it considers appropriate to carry out section 215. Section 215 establishes a paradigm by which both the Commission and the ERO are responsible for identifying reliability gaps—the ERO through its Reliability Standards development process, where it can independently identify areas of concern and develop Standards to address them; and the Commission through its review of proposed Reliability Standards and authority to direct modifications or new Standards that address specific issues necessary to effectuate the purposes of section 215.").

agreement that GMD events can cause wide-spread blackouts due to voltage instability and subsequent voltage collapse, thus disrupting the reliable operation of the Bulk-Power System.[44] In fact, such blackouts have occurred.[45] Requiring Reliability Standards to protect against these risks is well within the Commission's authority. Moreover, the NERC standards development process will be the vehicle for working through the technical complexities associated with addressing the risks of GMD events on the Bulk-Power System.[46] This is consistent with the NERC Standards Process Manual, which states that the NERC standards development process is designed to "build and document consensus for each Reliability Standard, both with regard to the need and justification for the Reliability Standard and the content of the Reliability Standard."[47]

27. Some comments contend that the NOPR proposed to direct NERC to develop GMD Reliability Standards containing overly prescriptive Requirements in too short an

[44] *See supra* n.39.

[45] *See* NERC Interim GMD Report at i (citing 1989 Hydro-Québec blackout).

[46] The NERC GMD Task Force has already developed operational procedure templates for certain functional entities. *See* NERC GMD Task Force Geomagnetic Disturbance Operating Procedure Template: Transmission Operator, *available at* http://www.nerc.com/docs/pc/gmdtf/Template _TOP.pdf; NERC GMD Task Force Geomagnetic Disturbance Operating Procedure Template: Generator Operator, *available at* http://www.nerc.com/docs/pc/gmdtf/Template_GOP.pdf. We expect that the NERC standards development process will consider the NERC GMD Task Force's work as a resource.

[47] NERC Rules of Procedure, Appendix 3A (Standards Process Manual) (Effective January 31, 2012) at 4.

amount of time.[48] Moreover, those comments state that the NOPR relied on underlying studies that, the comments assert, are flawed or unreliable.[49] However, as NERC recognizes in its NOPR comments, the NOPR explicitly stated that it was not directing the ERO to include any specific Requirements or otherwise pre-judging what the ERO eventually submits for approval.[50] In this Final Rule, we direct the ERO to consider issues in the NERC standards development process, but we do not direct the content of the Reliability Standards or pre-judge what NERC ultimately proposes. As for the timing of the submission and implementation of the GMD Reliability Standards, we address that concern by modifying the schedule in the NOPR to give NERC more time to develop and submit the Reliability Standards. With respect to the commenters' criticism of the studies cited in the NOPR, we recognize the divergent views.[51] However, as stated above, our directive to develop GMD Reliability Standards is justified even under the conclusion in

[48] *See, e.g.*, ELCON Comments at 7-14; CenterPoint Comments at 2.

[49] *See, e.g.*, Trade Associations Comments at 19.

[50] NOPR, 141 FERC ¶ 61,045 at P 17.

[51] While some commenters criticize the Oak Ridge Study's conclusions regarding the possible damaging effects of GMDs to Bulk-Power System components, the NOPR stated that the NERC-approved HILF Report also found that "[t]ransformers experience excessive levels of internal heating brought on by stray flux when GICs cause the transformer's magnetic core to saturate, forcing magnetic flux to flow outside the normal core steel magnetic circuit. Previous well documented cases have noted heating failures that caused melting and burn-through of large-amperage copper windings and leads in these transformers (Figure 9)." NOPR, 141 FERC ¶ 61,045 at 13 n.33 (citing *HILF Report* at 70).

the NERC GMD Interim Report, with which the Trade Associations "strongly agree," that a GMD event could result in "voltage instability and subsequent voltage collapse."[52]

28. Finally, while we disagree that FPA section 215(d)(5) (the specific subsection we rely on in this proceeding) requires a particular cost-benefit showing in order to direct the development of revised or new Reliability Standards, the Commission is cognizant of the potential costs of GMD Reliability Standards. As we explain and clarify in this final rule, the Commission is not directing the content of the GMD Reliability Standards that must be submitted, and with respect to the Second Stage GMD Reliability Standards, is not mandating the use of any particular technologies (such as automatic blocking) to address the potential impact of benchmark GMD events. We expect that NERC and industry will consider the costs and benefits of particular mitigation measures as NERC develops the technically-justified Second Stage GMD Reliability Standards.

B. First Stage GMD Reliability Standards

29. As discussed below, the Commission directs that, within six months of the effective date of this Final Rule, NERC submit for approval one or more Reliability Standards that require owners and operators of the Bulk-Power System to develop and implement operational procedures to mitigate the effects of GMDs consistent with the reliable operation of the Bulk-Power System. We address below the comments regarding

[52] NERC Interim GMD Report at 69; Trade Associations Comments at 17-18.

the content of the First Stage GMD Reliability Standards and the schedule for submitting and implementing the First Stage GMD Reliability Standards.

1. Content of First Stage GMD Reliability Standards

NOPR

30. The NOPR proposed to direct NERC to submit one or more Reliability Standards requiring owners and operators of the Bulk-Power System to develop and implement operational procedures to mitigate the effects of GMDs consistent with the reliable operation of the Bulk-Power System. The NOPR stated that the proposed Reliability Standards should not necessarily specify what operational procedures must be adopted, but the ERO should give owners and operators of the Bulk-Power System guidance as to what procedures have been or are expected to be effective in mitigating the effects of GMDs consistent with the reliable operation of the Bulk-Power System. The NOPR also stated that the proposed Reliability Standards should address the coordination of operational procedures among responsible entities across regions. The NOPR further stated that, because there is potential for equipment damage resulting from a GMD event, the proposed Reliability Standards should also address operational procedures for restoring GMD-impacted portions of the Bulk-Power System that take into account the potential for equipment that is damaged or out-of-service for an extended period of time. The NOPR also proposed that, following implementation, NERC would provide periodic reports assessing the effectiveness of operational procedures in mitigating the effects of GMD events and periodically review the required operational procedures and recommend to owners and operators that they incorporate lessons-learned and new research findings.

Comments

31. NERC and several commenters generally support the development of Reliability Standards requiring owners and operators to develop and implement operational procedures to address GMDs.[53] Some commenters state that certain entities have already implemented operational procedures to address GMDs, and some commenters stress the importance of combining operational procedures with monitoring and situational awareness.[54] Other commenters express concern with relying on operational procedures alone to address GMDs.[55]

32. NERC states that it supports the development of operational procedures because "[t]raining and education programs on the nature of the threat [of GMDs] will allow Bulk-Power System Operators to more rapidly identify areas for improvement and take actions when necessary."[56] NERC states, however, that its ability to assess and report on the effectiveness of operational procedures is constrained because of the limitations with monitoring and forecasting GMD events. NERC states that, if the Commission requires NERC to submit periodic reports, as proposed in the NOPR, the reports should be

[53] *See*, *e.g.*, NERC Comments at 9; Joint ISOs/RTOs Comments at 4; PJM Comments at 3; APS Comments at 3; Exelon Comments at 4; Bonneville Comments at 3; ITC Comments at 6; PPL Companies Comments at 2; Pa PUC Comments at 3; SCE Comments at 3-4; and IESO Comments at 6.

[54] *See*, *e.g.*, IESO Comments at 6; Exelon Comments 4-5.

[55] *See*, *e.g.*, Comments of Congressman Franks at 1-2; IESO Comments at 8-9; and EIS Comments at 5.

[56] NERC Comments at 9.

submitted no more frequently than annually and, in part to conserve ERO resources, that the reporting obligation should expire upon implementation of the Second Stage GMD Reliability Standards. NERC also states that the emergence of new forecasting capabilities is vital to improving early warning and understanding of potential GMD effects and will directly impact the development of operational procedures. NERC states that relying on the "K-Index,"[57] which NERC describes as the most familiar means of characterizing the severity of geomagnetic storms, is problematic because of the associated "uncertainties and inaccuracies." NERC states that the K-Index "cannot be used as an automatic triggering event for specific required actions because operational procedures need flexibility to account for actual operating conditions and the ability to adjust accordingly."[58]

33. Commenters that oppose Reliability Standards requiring the development and implementation of operational procedures state that Reliability Standards are premature because the science of GMDs is not fully understood and more study is needed before Reliability Standards can be developed.[59] Accordingly, commenters state that the NERC

[57] "K index" is defined as "a 3-hourly quasi-logarithmic local index of geomagnetic activity relative to an assumed quiet-day curve for the recording site. Range is from 0 (quiet) to 9 (severely disturbed)." Space Weather Prediction Center, *Glossary of Solar-Terrestrial Terms*, *available at* http://www.swpc.noaa.gov/info/glossary.html#k.

[58] NERC Comments at 11.

[59] *See, e.g.*, Trade Associations Comments at 4-5; NARUC Comments at 5-6; ELCON Comments at 2; SPP Parties Comments at 3; CenterPoint Comments at 5; Dominion Comments at 4; Duke Comments at 2-3; and KCP&L Comments at 2.

GMD Task Force should be allowed to finish its work, which includes evaluating the need for GMD Reliability Standards, before the Commission directs NERC to develop Reliability Standards. Commenters also state that requiring operational procedures prematurely (e.g., before responsible entities have conducted GMD vulnerability assessments) may harm reliability because operational procedures can have unintended consequences that adversely affect the Bulk-Power System.[60]

34. Some commenters opposed to requiring operational procedures state that they could support the use of operational procedures under certain conditions. The Trade Associations state that they could support requiring operational procedures if the Commission determines that they are necessary.[61] Dominion states that it could support, as an interim step, having NERC gather current industry practices regarding GMD operational procedures and issue a best practices operating guideline within 90 days.[62] SPP Parties state that the Commission should encourage NERC to issue, before the next

[60] CenterPoint Comments at 7.

[61] Trade Associations Comments at 5-6 ("If the Commission finds it must direct NERC to develop a standard or standards to address the impact of GMDs on the [Bulk-Power System], the Trade Associations support the Commission's stage one proposal to require NERC to file one or more standards which would require grid owners and operators to develop and implement operations procedures that would mitigate GMD effects.").

[62] Dominion Comments at 4.

solar peak in June 2013, a "reliability guideline" to assist owners and operators of Bulk-Power System facilities to address GMD threats to the Bulk-Power System.[63]

35. Commenters generally agree that operational procedures, if required, should be developed by responsible entities and not by NERC, although some commenters state that NERC could develop best practices to assist responsible entities.[64] Commenters state that the Reliability Standards should not have Requirements that treat responsible entities the same ("one-size-fits-all") because responsible entities, due to geography, geology or other variables, may be more or less likely to experience the effects of GMDs. Commenters state that the operational procedures should be developed by responsible entities based on factors such as the entity's geographic location and the structural make-up of the entity's Bulk-Power System components. Commenters also state that operational procedures should not have the unintended effect of adversely impacting the Bulk-Power System. Commenters further state that the Reliability Standards should be

[63] SPP Parties Comments at 4. As discussed below, the NERC GMD Task Force provided guidance to registered entities in the NERC Interim GMD Report by identifying possible operational procedures in response to GMD events. NERC Interim GMD Report at 80-81. In addition, NERC issued an Industry Advisory Alert on May 10, 2011 entitled "Preparing for Geo-Magnetic Disturbances." NERC, Industry Advisory: Preparing for Geo-Magnetic Disturbance (May 10, 2011), *available at* http://www.nerc.com/fileUploads/File/Events%20Analysis/A-2011-05-10-01_GMD_FINAL.pdf.

[64] NERC Comments at 6; AEP Comments at 4-5; ELCON Comments at 13; SPP Parties Comments at 5; IESO Comments at 11; Consumers Comments at 4; and Duke Comments at 5.

clear as to which functional entities are responsible for compliance and that the assignment of responsibilities should be consistent with NERC's functional model.

Commission Determination

36. The Commission directs NERC to submit, within six months of the effective date of this Final Rule, one or more Reliability Standards requiring owners and operators of the Bulk-Power System to develop and implement operational procedures to mitigate the effects of GMDs consistent with the reliable operation of the Bulk-Power System. As we stated in the NOPR, "operational procedures, while not a complete solution, constitute[] an important first step to addressing the GMD reliability gap because they can be implemented relatively quickly."[65] Operational procedures may help alleviate abnormal system conditions due to transformer absorption of reactive power during GMD events, helping to stabilize system voltage swings, and may potentially isolate some equipment from being damaged or misoperated.

37. It is not premature for NERC to begin developing Reliability Standards requiring owners and operators of the Bulk-Power System to develop and implement operational procedures. The comments reflect that some entities have implemented operational

[65] NOPR, 141 FERC ¶ 61,045 at P 18 n.38 (citing NERC Interim GMD Report at 79 ("Operating procedures are the quickest way to put in place actions that can mitigate the adverse effects of GIC on system reliability … Both system operating and transmission owner organizations need to have appropriate procedures and training in place.")).

procedures to mitigate the impacts of GMDs.[66] In addition, the NERC Interim GMD Report identifies examples of operational procedures to mitigate GMD events including: reduction of equipment loading (e.g., by starting off-line generation), unloading the reactive load of operating generation, reductions of system voltage, and system and/or equipment isolation through reconfiguration of the transmission system.[67] In addition, the NERC GMD Task Force has developed operational procedure templates for certain functional entities. Given the work of the NERC GMD Task Force and recognizing that some operational procedures are already in place, we conclude that it is not premature for NERC to develop Reliability Standards that require operational procedures.

38. The Commission is not directing NERC to develop Reliability Standards that include specific operational procedures. Instead, as proposed in the NOPR, the Reliability Standards should include a mechanism that requires responsible entities to develop and implement operational procedures because owners and operators of the Bulk-Power System are most familiar with their own equipment and system configurations. In addition, we do not expect that owners and operators of the Bulk-Power System will necessarily develop and implement the same operational procedures. Instead, the Reliability Standards, rather than include "one-size-fits-all" Requirements, should allow responsible entities to tailor their operational procedures based on the

[66] *See*, *e.g.*, IESO Comments at 5; Exelon Comments at 5; CEA Comments at 6-7; Dominion Comments at 5; Trade Associations Comments at 26.

[67] NERC Interim GMD Report at 80-81.

responsible entity's assessment of entity-specific factors, such as geography, geology, and system topology, identified in the Reliability Standards. In addition, as we stated in the NOPR, the coordination of operational procedures across regions is an important issue that should be considered in the NERC standards development process.[68] The coordination of operational procedures across regions and data sharing might be overseen by planning coordinators or another functional entity with a wide-area perspective.[69] The NERC standards development process, as stated in the NOPR, should also consider operational procedures for restoring GMD-impacted portions of the Bulk-Power System that take into account the potential for damaged equipment that could be de-rated or out-of-service for an extended period of time.

39. While responsible entities will develop and implement operational procedures, NERC can support their efforts, for example, by identifying and sharing operational procedures found to be the most effective. NERC should also periodically survey the responsible entities' operational procedures, offer recommendations based on lessons-learned and new research findings, and re-evaluate whether modification to the Reliability Standards is warranted. Based on these surveys, NERC should produce

[68] NOPR, 141 FERC ¶ 61,045 at 20 (citing NERC Interim GMD Report at 79 ("The [operating] procedures of these organizations need to be coordinated with each other and with their neighboring organizations.")).

[69] In NERC's May 21, 2012 post-Technical Conference comments, NERC stated that planning coordinators will conduct the wide-area analyses as part of the "Initial Actions" assessments, discussed below. NERC May 21, 2012 Comments at 9. LADWP proposes that reliability coordinators coordinate these efforts. LADWP Comments at 5.

periodic reports assessing the effectiveness of operational procedures. We take no position in this Final Rule on the content, frequency, or duration of such surveys, recommendations, or reports because we believe that those issues, in the first instance, should be addressed as part of the NERC standards development process.

40. We take no position in this Final Rule with respect to NERC's concerns regarding overreliance on the K-Index to trigger operational procedures. Technical issues regarding the development and implementation of operational procedures should be, in the first instance, considered in the NERC standards development process. Likewise, we take no position in this Final Rule on which functional entities should be responsible under the Reliability Standards because we believe that those issues, in the first instance, should be addressed as part of the NERC standards development process.

2. Schedule for Submitting and Implementing First Stage GMD Reliability Standards

NOPR

41. The NOPR proposed that NERC submit the First Stage GMD Reliability Standards to the Commission for approval within 90 days of the effective date of a final rule in this proceeding. The NOPR also proposed a suggested 90-day implementation period following Commission approval of the First Stage GMD Reliability Standards.

Comments

42. NERC states that "[w]hile the implementation plan proposed for the completion of the first stage Reliability Standards is aggressive, NERC is committed to meeting

whatever implementation targets are established by the Commission."[70] Other commenters support adoption of the proposed 90-day filing deadline for the First Stage GMD Reliability Standards.[71]

43. Other commenters state that the proposed 90-day deadline for filing the First Stage GMD Reliability Standards does not allow enough time to develop a Reliability Standard using the NERC standards development process.[72] ITC proposes a six-month deadline for developing and submitting the First Stage GMD Reliability Standards and a six-month implementation period following Commission approval. LADWP suggests an eight-month deadline for submitting the First Stage GMD Reliability Standards and a six-month implementation period. Joint ISOs/RTOs propose a one-year deadline for developing and submitting the First Stage GMD Reliability Standards, with the Commission directing NERC to develop an implementation schedule once NERC has a better idea of the degree of coordination that will be needed between the different functional entities. CenterPoint states that "two years of study and review are needed to develop GMD Reliability Standards" and proposes "a region-based phased implementation schedule."[73] Exelon recommends having the ERO propose a filing

[70] NERC Comments at 9.

[71] *See*, *e.g.*, SENS Comments at 4; Foundation Comments at 19.

[72] *See*, *e.g.*, ITC Comments at 3; LADWP Comments at 8-9; Joint ISOs/RTOs Comments at 14; Consumers Energy Comments at 2-3; AEP Comments at 4.

[73] CenterPoint Comments at 16-17.

deadline.[74] The Trade Associations recommend that the Commission not suggest an implementation period, but the Trade Associations state that it is their preliminary view that operational procedures could be implemented in six months.[75]

Commission Determination

44. We support the prompt development of mandatory and enforceable Reliability Standards that require owners and operators to implement operational procedures to afford some level of protection to the Bulk-Power System against GMD events. In its comments, NERC commits to meeting the 90-day deadline proposed in the NOPR. However, based on the concerns raised in other comments, we modify the schedule in the NOPR and direct NERC to submit proposed First Stage GMD Reliability Standards within six months of the effective date of this Final Rule.

45. While a six-month deadline may not be as long as some commenters propose, it strikes a balance by affording NERC a reasonable amount of time to develop the Reliability Standards and having Reliability Standards in place in the near term. As we stated in the NOPR, the Commission expects that NERC and owners and operators of the Bulk-Power System will draw on industry's experience with existing operational procedures to expedite the NERC standards development process. This should help

[74] Exelon Comments at 14.

[75] Trade Associations Comments at 22.

establish the First Stage GMD Reliability Standards quickly to afford some level of protection to the Bulk-Power System against GMD events.

46. With respect to the suggested 90-day implementation period proposed in the NOPR, we modify the proposal and suggest a six-month implementation period. Given our expectation that the Reliability Standards proposed by NERC will require responsible entities to develop and implement operational procedures and to coordinate such efforts, it is appropriate to afford more time for implementation. We take no position in this Final R ule on the details of the implementation plan. The details of the implementation plan should be addressed, in the first instance, in the NERC standards development process.

C. "Initial Actions" GMD Vulnerability Assessments

NOPR

47. The NOPR proposed to accept aspects of the "Initial Actions" detailed in NERC's May 21, 2012 post-Technical Conference comments. The NOPR stated that NERC proposed to "identify facilities most at-risk from severe geomagnetic disturbance" and "conduct wide-area geomagnetic disturbance vulnerability assessment."[76] The NOPR agreed with NERC that critical Bulk-Power System facilities should be evaluated for GMD vulnerability and, as part of the "Initial Actions," that special attention should be

[76] NERC May 21, 2012 Comments at 8-9.

given to Bulk-Power System facilities that provide service to critical and priority loads.[77] The NOPR proposed that NERC would conduct these "Initial Actions" in parallel with the development and implementation of the First Stage GMD Reliability Standards.

Comments

48. NERC states that it agrees that an assessment is necessary to identify and classify the at-risk population of transformers, and NERC clarifies that asset owners will conduct the "Initial Actions" assessments. The Trade Associations agree that owners and operators of the Bulk-Power System should perform individual assessments, while planning authorities should perform system-wide assessments.

49. The Trade Associations support identification of at-risk facilities but caution that the assessment will require new tools, including improved modeling of GICs; improvements in area and regional power flow modeling; and benchmarking of models against actual GICs. Bonneville also states that, while an assessment needs to be done, the tools and models required to perform such an assessment currently do not exist. Bonneville anticipates the availability of "adequate tools for use in developing limited assessments of risk indexed against the magnitude of GIC flow through individual

[77] NOPR, 141 FERC ¶ 61,045 at P 22 (citing NERC, *Severe Impact Resilience: Considerations and Recommendations* at 26 (Accepted by NERC Board of Trustees on May 9, 2012), *available at* http://www.nerc.com/docs/oc/sirtf/SIRTF_Final_May_9_2012-Board_Accepted.pdf.).

transformers and possibly even reactive demand under GIC condition by the end of 2013."[78]

50. Duke states that the "Initial Actions" assessments should identify critical Bulk-Power System facilities but that "[e]xpanding the effort to include identification and protection for all critical and priority loads is too extensive an activity to be completed simultaneously with the first stage GMD Reliability Standards."[79] Exelon states that the NOPR defines critical facilities in a confusing manner because the NOPR references "critical and priority" loads, which Exelon states generally relate to the distribution system and not to specific Bulk-Power System facilities. Exelon states that NERC has set out a methodology for determining what equipment it considers critical and a methodology to identify "at-risk" equipment based on peer-reviewed research. Exelon recommends that NERC and responsible entities rely on their technical expertise to define what is critical equipment. Exelon also states that the time frames in the NOPR for completing the "Initial Actions" assessments is unrealistic because Exelon believes that the NOPR proposed to require completion of the assessments 90 days after the Commission approves the First Stage GMD Reliability Standards.[80] CenterPoint states

[78] Bonneville Comments at 5.

[79] Duke Comments at 5-6.

[80] Exelon Comments at 7 n.20.

that vulnerability assessments should be made on a "regional basis" with the regions most vulnerable to GMDs assessed first.

Commission Determination

51. The Commission accepts the proposal in NERC's May 21, 2012 post-Technical Conference comments and directs NERC to "identify facilities most at-risk from severe geomagnetic disturbance" and "conduct wide-area geomagnetic disturbance vulnerability assessment" as well as give special attention to those Bulk-Power System facilities that provide service to critical and priority loads.[81] As noted in NERC's comments, owners and operators of the Bulk-Power System, as opposed to NERC, will perform the assessments and special attention will be given to evaluating critical transformers (e.g., step-up transformers at large generating facilities).[82] We agree with the Trade Associations that system-wide assessments could be conducted by planning authorities,

[81] NERC Comments at 8-9 ("As the first step in identifying the risk of geomagnetic disturbance to the bulk power system, NERC intends to complete a system-wide vulnerability assessment … special attention will be given to the evaluation of critical transformers, such as generator step-up units at large generating facilities … a high level review will be conducted to identify and classify the at-risk population based on existing peer-reviewed research. This assessment will be based on a high level screening approach that will include transformer design, condition, geology and geomagnetic location.").

[82] The NERC Rules of Procedure permit NERC to seek such information from registered entities. NERC Rules of Procedures, Section 1601 (effective January 31, 2012) ("Within the United States, NERC and Regional Entities may request data or information that is necessary to meet their obligations under Section 215 of the Federal Power Act, as authorized by Section 39.2(d) of the Commission's regulations, 18 C.F.R. § 39.2(d).").

or another functional entity with a wide-area perspective, in coordination with owners and operators of the Bulk-Power System.[83] NERC should oversee these efforts and provide responsible entities with a methodology for identifying "at-risk" Bulk-Power System components and "critical and priority loads" that need to be analyzed in the "Initial Actions."

52. Some commenters state that tools do not exist for conducting the "Initial Actions" assessments. As a result, the commenters assert that the schedule for completing the "Initial Actions" assessments is unrealistic because the commenters believe that the NOPR proposed to require the completion of such assessments by the filing date or implementation date of the First Stage GMD Reliability Standards. We clarify that the "Initial Actions" assessments do no need to be completed by the filing date or implementation date of the First Stage GMD Reliability Standards. The NOPR only proposed that the "Initial Actions" assessments should *begin* immediately (i.e., simultaneous with the development of the First Stage GMD Reliability Standards). Thus, the "Initial Actions" assessments provide a head start for analyzing the most at-risk and critical facilities before the Second Stage GMD Reliability Standards become effective and could be used to assist in performing the GMD vulnerability assessments required in the Second Stage GMD Reliability Standards. Further, to the extent that owners and

[83] The accuracy of wide-area assessments will depend on the data provided by owners and operators of the Bulk-Power System.

operators of the Bulk-Power System have already begun to identify facilities most at-risk from severe GMD events, those assessments should help to inform the "Initial Actions" assessments required by this final rule.

53. In NERC's May 21, 2012 post Technical Conference comments, NERC stated that all of its proposed "Initial Actions" would take 18-24 months to complete.[84] The June 2012 GMD Task Force Phase 2 Scope and Project Plan estimated that "improve[d] tools for industry planners to develop GMD mitigation strategies" would be completed within 12-36 months, depending on the task, and "improve[d] tools for system operators to manage GMD impacts" would be completed within 12-24 months.[85] Adjusting the deadline for submission of the Second Stage GMD Reliability Standards to 18 months allows time to identify facilities most at-risk from severe geomagnetic disturbance and to conduct wide-area geomagnetic disturbance vulnerability assessment, with special attention being given to those Bulk-Power System facilities that provide service to critical and priority loads, before the effective date of the Second Stage GMD Reliability Standards.[86]

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[84] NERC May 21, 2012 Comments at 8.

[85] NERC, GMD Task Force Phase 2 Scope and Project Plan (June 2012), *available at* http://www.nerc.com/docs/pc/gmdtf/GMD_Phase_2_Project_Plan_APPROVED.pdf.

[86] The rulemaking following submission of the Second Stage GMD Reliability Standards 18 months from the effective date of this Final Rule is likely to take several months, and a multi-phased implementation period is likely to follow the effective date of a final rule approving the Second Stage GMD Reliability Standards.

D. Second Stage GMD Reliability Standards

54. As discussed below, the Commission adopts the NOPR proposal, with modifications, to direct NERC to submit Second Stage GMD Reliability Standards. We direct NERC to submit for approval, one or more Reliability Standards that require owners and operators of the Bulk-Power System to conduct initial and on-going assessments of the potential impact of benchmark GMD events on Bulk-Power System equipment and the Bulk-Power System as a whole. The Second Stage GMD Reliability Standard must identify what severity GMD events (i.e., benchmark GMD events) that responsible entities will have to assess for potential impacts on the Bulk-Power System. If the assessments identify potential impacts from benchmark GMD events, owners and operators must 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. Owners and operators of the Bulk-Power System cannot limit their plans to considering operational procedures or enhanced training alone, but must, subject to the vulnerabilities identified in the assessments, contain strategies for protecting against the potential impact of the benchmark GMD events based on factors such as the age, condition, technical specifications, system configuration, or location of specific equipment. These strategies could, for example, include automatically blocking GICs from entering the Bulk-Power System, instituting specification requirements for new equipment, inventory management, and isolating certain equipment that is not cost

effective to retrofit, or a combination thereof. These Reliability Standards should be submitted within 18 months of the effective date of this Final Rule.

55. In the discussion below, we address the comments on the GMD vulnerability assessments, the plans for addressing identified vulnerabilities, and the schedule for submitting and implementing the Second Stage GMD Reliability Standards.

1. GMD Vulnerability Assessments

NOPR

56. The NOPR proposed to direct NERC to file one or more Reliability Standards that require owners and operators of the Bulk-Power System to conduct initial and on-going assessments of the potential impact of GMDs on Bulk-Power System equipment and the Bulk-Power System as a whole. The NOPR stated that the Reliability Standards would require owners and operators to develop and implement plans based on the needs identified in the assessments.

57. The NOPR proposed to direct the ERO to consider the following parameters as it develops the Second Stage GMD Reliability Standards.

58. First, the Commission proposed that the Reliability Standards should contain uniform evaluation criteria for owners and operators to follow when conducting their assessments.

59. Second, the NOPR stated that the assessments should, through studies and simulations, evaluate the primary and secondary effects of GICs on Bulk-Power System

transformers, including the effects of GICs originating from and passing to other regions.[87]

60. Third, the NOPR asserted that the assessments should evaluate the effects of GICs on other Bulk-Power System equipment, system operations, and system stability, including the anticipated loss of critical or vulnerable devices or elements resulting from GIC-related issues.[88]

61. Fourth, in conjunction with assessments by owners and operators of their own Bulk-Power System components, the Commission stated that wide-area or Regional assessments of GIC impacts should be performed. The NOPR noted that a severe GMD event can cause simultaneous stresses at multiple locations on the Bulk-Power System, potentially resulting in a multiple-outage event.[89] In predicting GIC flows, it is necessary to take into consideration the network topology as an integrated whole (i.e., on a wide-area basis).[90]

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[87] The NOPR described damage to Bulk-Power System components as a primary effect of GICs and production of harmonics that are not present during normal Bulk-Power System operation and increased transformer absorption of reactive power as secondary effects of GICs. NOPR, 141 FERC ¶ 61,045 at P 13.

[88] The Oak Ridge Study assessment included GMD modeling, simulation and review of storm impacts, power grid GIC flows and reactive power demands, transformer heating and risk of potential damage to transformers. *See generally Oak Ridge Study 319 Report*.

[89] *Oak Ridge Study 319 Report* at pages A1-1, A1-2.

[90] *Id.* at page 1-17.

62. Fifth, the NOPR proposed that the assessments should be periodically updated, taking into account new facilities, modifications to existing facilities, and new information, including new research on GMDs, to determine whether there are resulting changes in GMD impacts that require modifications to Bulk-Power System mitigation schemes.

Comments

63. NERC and several commenters generally support requiring GMD vulnerability assessments.[91] NERC states that it supports the NOPR's approach of requiring owners and operators of the Bulk-Power System to conduct vulnerability assessments to determine how critical or vulnerable Bulk-Power System components react to simulated GICs of varying intensities. NERC also states that it appreciates the NOPR's recognition of the need to incorporate new information and research given that the science of GMDs is still evolving.

64. Many commenters that oppose the Second Stage GMD Reliability Standards at this time state that available methods of performing vulnerability assessments are crude and unrefined.[92] For example, the Trade Associations state that using existing tools "would be asking industry to make assessments … and apply solutions at a point when these tools are incapable of doing so without creating risks to reliability that could be

[91] *See*, *e.g.*, NERC Comments at 14 Joint ISOs/RTOs Comments at 19; PJM Comments at 3; Pa PUC Comments at 3-4; AEP Comments at 2.

[92] *See*, *e.g.*, Trade Associations Comments at 30; Exelon Comments at 8.

greater than any known risk resulting from a severe GMD event."[93] Commenters state that assessments should only be required after the necessary tools and methodologies have been developed and validated and the NERC GMD Task Force has completed its work.

65. Some commenters state that requiring all owners and operators to base their vulnerability assessments on uniform evaluation criteria would not be realistic due to the widely varying geology and geomagnetic latitudes within which the Bulk-Power System is planned and operated.

66. Some commenters state that the Commission should specify the severity of the GMD to assess and plan, although the commenters do not agree on a specific severity.[94] ITC states that it "believes that there should be a clear engineering benchmark for transmission owner and operators to plan for GMD in a prudent fashion (e.g., a 1 in 100 year GMD event)."[95] EIS states that, because the science of GMDs is inexact, an event twice as large as the largest expected GMD should be used as a safety margin.[96] Other commenters state that establishing a benchmark GMD event is problematic because there is no consensus storm scenario.

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[93] Trade Associations Comments at 4.

[94] *See*, *e.g.*, CEA Comments at 4-5; ITC Comments at 4.

[95] ITC Comments at 4.

[96] EIS Comments at 4.

Commission Determination

67. We direct NERC, within 18 months of the effective date of this final rule, to submit for approval one or more Reliability Standards that require owners and operators of the Bulk-Power System to conduct initial and on-going vulnerability assessments of the potential impact of benchmark GMD events on Bulk-Power System equipment and the Bulk-Power System as a whole. We agree with commenters that the Second Stage GMD Reliability Standards should specify what severity GMD events (i.e., benchmark GMD events) responsible entities must assess for potential impacts on the Bulk-Power System. However, the Commission declines to specify the severity of the storm or otherwise define the characteristics of these benchmark GMD events in this Final Rule. Rather, NERC, through its standards development process, should identify the benchmark GMD events that responsible entities would have to assess.[97] Each responsible entity under the Second Stage GMD Reliability Standards would then be required to assess its vulnerability to the benchmark GMD events consistent with the five assessment parameters identified in the NOPR and adopted in this Final Rule.[98] The NERC standards development process should consider tasking planning coordinators, or

[97] Similar work is already being done in Phase 2 of the NERC GMD Task Force Plan. The GMD Task Force Phase 2 Scope and Project Plan states that the NERC GMD Task Force will "refine and improve a set of defined reference storms (most severe occurrence in a 100-year time horizon) and support ongoing research to identify the maximum theoretical GMD." GMD Task Force Phase 2 Scope and Project Plan at 5.

[98] NOPR, 141 FERC ¶ 61,045 at PP 28-32.

another functional entity with a wide-area perspective, to coordinate assessments across Regions under the Second Stage GMD Reliability Standards to ensure consistency and regional effectiveness.

68. The comments that oppose requiring assessments stress that there is a substantial amount of work being done by the NERC GMD Task Force and industry to develop and validate tools, models, and data to perform the vulnerability assessments. We recognize that the tools for assessing GMD vulnerabilities are not fully mature. To address this concern, NERC should consider developing Reliability Standards that can incorporate improvements in the scientific understanding of GMDs. When developing the Second Stage GMD Reliability Standards implementation schedule, NERC should consider the availability of validated tools, models, and data necessary to comply with the Requirements.

69. Some tools currently exist and others are expected to be available when the Second Stage GMD Reliability Standards become effective. For example, NERC states in its comments that, while only one component of developing a comprehensive understanding of the effects of GMDs on the Bulk-Power System, NERC and the Electric Power Research Institute have developed a vulnerability assessment tool that calculates expected GIC levels and has released the tool in an open-source code.[99] In addition,

[99] NERC Comments at 13. As noted at the April 30, 2012 Technical Conference, John Kappenman stated that his investigations are based on mathematical models regarding the impacts of GMDs on the Bulk-Power System. *See, e.g.*, April 30, 2012 Prepared Testimony of John G. Kappenman at 1.

NERC stated in its May 12, 2012 post-Technical Conference comments that NERC expects to complete several "Mid-Term Actions" within 12 to 36 months relating to the development of GMD assessment tools. These "Mid-Term Actions" include: (1) refining probabilistic geomagnetic disturbance storm scenarios; (2) performing comprehensive tests of transformers to GIC; (3) increasing GIC monitoring locations across North America; and (4) developing analytical tools for system planners and operators to reliably manage geomagnetic disturbance impacts.[100] The 18-month deadline to submit the Second Stage GMD Reliability Standards (i.e., early-2015) falls within NERC's 12 to 36 month window for completion of the "Mid-Term Actions." Moreover, it is likely that the implementation date of the Second Stage GMD Reliability Standards will be after the completion of the "Mid-Term Actions." As a result, responsible entities will likely have additional tools available to conduct GMD vulnerability assessments once the Second Stage GMD Reliability Standards become effective. In any event, as we explain above, NERC should consider the availability of validated tools, models, and data as it develops an implementation schedule for the Second Stage GMD Reliability Standards.

70. In response to commenters who note that entities may have different vulnerabilities to GMD events based on their geographic location and geology, we emphasize that the vulnerability assessments in the Second Stage GMD Reliability

[100] NERC May 12, 2012 Comments at 10-12.

Standards should not assume that all owners and operators of the Bulk-Power System are the same. However, we disagree with commenters that it is not realistic to base vulnerability assessments on uniform evaluation criteria.[101] We clarify that the NOPR did not intend to require responsible entities to use uniform values when assessing their GMD vulnerabilities. Instead, the vulnerability assessments would be based on uniform criteria (e.g., geographic location and geology) but the values for such criteria would be entity-specific.

71. In drafting the Second Stage GMD Reliability Standards, NERC should identify what severity GMD events (i.e., benchmark GMD events) responsible entities will have to assess, and NERC should technically support its choice. The benchmark GMD events should be based on factors that may include, but are not limited to, varying severity of the GMD (i.e., the rate of change in the GMDs magnetic fields), duration, geographic footprint of the GMD, how the GMD's intensity varies with latitude, system configuration, and the orientation of the magnetic fields produced by the GMD.[102] We recognize that there is currently no consensus on benchmark GMD events, and the Commission does not identify specific benchmark GMD events for NERC to adopt.

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[101] NOPR, 141 FERC ¶ 61,045 at P 27.

[102] NERC Interim GMD Report at 82 ("The first step is to develop a handful of scenarios and the associated probability of each (e.g., severe storm – once in 100 years; serious storm once in 10 years)."). The Commission recognizes that this is not an exhaustive list and additional factors may be added as new information becomes available.

Instead, this issue should be considered in the NERC standards development process so that any benchmark GMD events proposed by NERC have a strong technical basis.

2. Plans to Address Identified GMD Vulnerabilities

NOPR

72. The NOPR proposed to direct the ERO to develop Reliability Standards that require owners and operators of the Bulk-Power System to develop and implement a plan, based on the results of the GMD vulnerability assessments, so that instability, uncontrolled separation, or cascading failures of the Bulk-Power System, caused by damage to critical or vulnerable Bulk-Power System equipment, or otherwise, will not occur as a result of a GMD. The NOPR did not propose to require a particular solution in the Second Stage GMD Reliability Standards to address identified vulnerabilities. However, the NOPR stated that it expected that some assessments will demonstrate that automatic blocking is necessary in some instances.

73. The NOPR stated that automatic blocking measures address the two major concerns with relying exclusively on operational procedures to mitigate GMDs (i.e., the short period of time to react to a GMD event and operational procedures may not prevent damage to Bulk-Power System equipment). The NOPR stated that automatic blocking can prevent the flow of GICs through power transformers and the Bulk-Power System.[103] The NOPR further stated that eliminating GICs in transformers prevents transformer core

[103] NOPR, 141 FERC ¶ 61,045 at P 34 (citing NERC Interim GMD Report at 73).

saturation and, thus, mitigates or prevents the effects of GMDs on the Bulk-Power System (i.e., transformer overheating, reactive power absorption, and harmonic generation). The NOPR did not propose to direct the ERO to require a particular automatic blocking technology, where blocking is deemed necessary. Instead, the Commission proposed to direct the ERO to identify in the Reliability Standards what would constitute appropriate automatic blocking measures. In defining what is an appropriate blocking measure, the NOPR stated that the ERO should address: (1) its feasibility and effectiveness; and (2) its ability to operate without adversely impacting the reliable operation of the Bulk-Power System. The NOPR also proposed that the Reliability Standards should include a means by which the ERO can verify that selected blocking measures are appropriate.

74. The NOPR stated that, while not a means for blocking GICs, another possible option is to improve the "withstand" capability of Bulk-Power System components, which refers to a component's ability to withstand stresses imposed by GICs before suffering damage.[104] The NOPR stated that the ERO should consider whether the reliability goals of the proposed Reliability Standards can be achieved by a combination of automatic protection measures, including, for example, some combination of automatic blocking and improved "withstand" capability.

[104] NOPR, 141 FERC ¶ 61,045 at P 36 (citing NERC Interim GMD Report at 67).

Comments

75. NERC states that the Second Stage GMD Reliability Standards should be technology-neutral and should not require dedicated blocking devices or other specific equipment. NERC further states that it is currently unable to verify whether a specific blocking device is appropriate.

76. A majority of commenters state that blocking devices need further study and that the Commission should clarify that the Second Stage GMD Reliability Standards will not require responsible entities to install blocking devices or require installation of any particular type of mitigation.[105] Bonneville, for example, states that the "capability to perform studies that include transformer thermal models needed for developing appropriate mitigation plans and blocking strategies will likely not be available for use until the end of the 2014 at the earliest."[106] Commenters also express concern with the statement in the NOPR that plans for addressing GMD vulnerabilities cannot be limited to operational procedures or enhanced training alone because the commenters understand this language to require the installation of automatic blocking devices. PJM requests that the Reliability Standards explicitly state that equipment owners, not system operators, are the responsible entities.[107]

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[105] *See*, *e.g.*, Trade Associations Comments at 32; Joint ISOs/RTOs Comments at 18; Bonneville Comments at 7; Exelon Comments at 11-12.

[106] Bonneville Comments at 6.

[107] PJM Comments at 4-5.

77. Some commenters state that the Second Stage GMD Reliability Standard should not require responsible entities to implement a plan that prevents cascading failures but instead support a Reliability Standard that allows NERC to determine the appropriate mix between prevention and timely restoration of the Bulk-Power System. Commenters also express concern with the language in the NOPR that, under the Second Stage GMD Reliability Standards, responsible entities would be required to "develop and implement a plan so that instability, uncontrolled separation, or cascading failures of the Bulk-Power System, caused by damage to critical or vulnerable Bulk-Power System equipment, or otherwise, will not occur as a result of a GMD." Commenters state that such a standard imposes strict liability on responsible entities and is inconsistent with the unpredictable and uncontrolled nature of GMD events.

78. Other commenters express support for hardening elements of the Bulk-Power System as an option to protect against GMD events.[108] Some of these commenters state that operational procedures alone do not prevent the flow of GICs through Bulk-Power System elements; instead, operational procedures are intended to prevent the Bulk-Power System from collapsing, which exposes equipment to GICs for longer periods. EIS states that a combination of operational procedures and hardware is needed to protect the Bulk-Power System. Foundation states that relying on operational procedures alone, based on warnings from space weather observations, renders the Advanced Composition Explorer

[108] *See*, *e.g.*, Pa PUC Comments at 4; Bonneville Comments at 7.

satellite, which gives details about an approaching GMD, a single point of failure in protecting the Bulk-Power System. Commenters also state that the benefits afforded by operational procedures are unpredictable because the state of the Bulk-Power System (e.g., load, available generation, unplanned equipment outages) at the time of a GMD event cannot be known in advance.

Commission Determination

79. We direct NERC, within 18 months of the effective date of this Final Rule, to submit for approval one or more Reliability Standards that, assuming the assessments identify potential impacts from a benchmark GMD event, require owners and operators of the Bulk-Power System 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. Owners and operators of the Bulk-Power System cannot limit their plans to considering operational procedures or enhanced training, but must, subject to the vulnerabilities identified in the assessments, contain strategies for protecting against the potential impact of any benchmark GMD event based on factors such as the age, condition, technical specifications, system configuration, or location of specific equipment. These strategies could, for example, include automatically blocking GICs from entering the Bulk-Power System, instituting specification requirements for new equipment, inventory management, and isolating certain equipment that is not cost effective to retrofit, or a combination thereof.

80. A major concern raised in the comments is that the NOPR proposed to require responsible entities to utilize automatic blocking devices. However, the NOPR explicitly stated that it did not propose to require a particular solution in the Second Stage GMD Reliability Standards to address GMD vulnerabilities. The NOPR only stated that it expected that some assessments will demonstrate that automatic blocking is necessary in some instances. While the NOPR proposed to provide guidance with respect to the use and evaluation of automatic blocking devices, the NOPR did not propose to require the use of automatic blocking devices.

81. In this Final Rule, we do not direct the ERO to develop Reliability Standards that require the use of automatic blocking devices or any specific technology. We agree with NERC that the Reliability Standards should be technology-neutral.[109] Instead, the Second Stage GMD Reliability Standards should require owners and operators of the Bulk-Power System 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. In the NOPR, we identified a non-exhaustive list of possible automatic measures for doing so, including automatically blocking GICs from entering the Bulk-Power System, instituting specification requirements for new

[109] NERC Comments at 4.

equipment, inventory management, and isolating certain equipment that is not cost effective to retrofit.

82. As with the First Stage GMD Reliability Standards, the responsible entities should perform vulnerability assessments of their own systems and develop the plans for mitigating any identified vulnerabilities. We take no position in this Final Rule on which functional entities should be responsible for compliance under the Second Stage GMD Reliability Standards. However, the NERC standards development process should consider tasking planning coordinators, or another functional entity with a wide-area perspective, to coordinate mitigation plans across Regions under the Second Stage GMD Reliability Standards to ensure consistency and regional effectiveness. We clarify that if a responsible entity performs the required GMD vulnerability assessments and finds no potential GMD impacts, no plan is required under the Second Stage GMD Reliability Standards.[110]

83. The NOPR stated that if a responsible entity identifies GMD vulnerabilities, then the plan cannot be limited to operational procedures or enhanced training alone. Some commenters interpreted this to mean that a responsible entity could never rely on operational procedures alone. We clarify that if the GMD vulnerability assessments in the Second Stage GMD Reliability Standards identify potential GMD impacts, while the development of the required mitigation plan cannot be limited to considering operational

[110] NOPR, 141 FERC ¶ 61,045 at P 16 n.37.

procedures or enhanced training alone, operational procedures and enhanced training may be sufficient if that is verified by the vulnerability assessments.

84. The Second Stage GMD Reliability Standards should not impose "strict liability" on responsible entities for failure to ensure the reliable operation of the Bulk-Power System in the face of a GMD event of unforeseen severity, as some commenters fear. The NOPR proposed to require owners and operators to develop and implement a plan so that instability, uncontrolled separation, or cascading failures of the Bulk-Power System, caused by damage to critical or vulnerable Bulk-Power System equipment, or otherwise, will not occur as a result of a GMD.[111] While this language is taken directly from the definition of "reliable operation" in FPA section 215(a)(4), and similar language is found in the Requirements of other Reliability Standards, we clarify that owners and operators should be required 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. The goal of the NERC standards development process should be to propose Reliability Standards that ensure the reliable operation of the Bulk-

[111] 16 U.S.C. 824o(a)(4) ("The term 'reliable operation' means operating the elements of the bulk-power system within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance, including a cybersecurity incident, or unanticipated failure of system elements.").

Power System in response to identified benchmark GMD events.[112] Identifying robust and technically justified benchmark GMD events in the Reliability Standards, that the Bulk-Power System is required to withstand (i.e., continue "reliable operation"), addresses the concern that responsible entities might otherwise be required to prevent instability, uncontrolled separation, or cascading failures of the Bulk-Power System when confronted with GMD events of unforeseen severity. In addition, the Reliability Standards 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. Given that the scientific understanding of GMDs is still evolving, we recognize that Reliability Standards cannot be expected to protect against all GMD-induced outages.

85. In the NOPR, we proposed to direct the ERO to identify what would constitute appropriate automatic blocking measures. The NOPR stated that, in defining what is an appropriate blocking measure, the ERO should address: (1) feasibility and effectiveness; and (2) ability to operate without adversely impacting the reliable operation of the Bulk-Power System. The comments reflect that certain entities have implemented automatic blocking measures, but the comments also reflect concerns with the unintended effects of automatic blocking measures and the uncertainties surrounding automatic blocking

[112] *See, e.g.*, Reliability Standard TOP-004-2, Requirement R2 ("Each Transmission Operator shall operate so that instability, uncontrolled separation, or cascading outages will not occur as a result of the most severe single contingency.").

measures.[113] We do not require the use of automatic blocking measures in the Second Stage GMD Reliability Standards. However, given that some responsible entities have or may choose automatic blocking measures, the NERC standards development process should consider how to verify that selected blocking measures are effective and consistent with the reliable operation of the Bulk-Power System.

86. The NOPR stated that another possible mitigation option is to improve the "withstand" capability of Bulk-Power System components. The NOPR stated that the "withstand" capability refers to a component's ability to withstand stresses imposed by GICs before suffering damage. While responsible entities will decide how to mitigate GMD vulnerabilities on their systems, the NERC standards development process should consider how the reliability goals of the proposed Reliability Standards can be achieved by a combination of automatic measures including, for example, some combination of blocking, improved "withstand" capability, instituting specification requirements for new equipment, inventory management, and isolating certain equipment that is not cost effective to retrofit. As with the First Stage GMD Reliability Standards, NERC can identify and disseminate to responsible entities the measures or the combination of measures adequate to maintain the reliable operation of the Bulk-Power System against the potential GMD impacts identified in the assessments.

[113] CEA Comments at 10; Bonneville Comments at 7; Dominion Comments at 7; CenterPoint Comments at 12-13; Exelon Comments at 11-12.

3. Schedule for Submitting and Implementing Second Stage GMD Reliability Standards

NOPR

87. The NOPR proposed a six-month deadline to submit the Second Stage GMD Reliability Standards to the Commission. However, the NOPR did not propose to direct or suggest an implementation schedule for the Second Stage GMD Reliability Standards. Instead, the NOPR stated that the Reliability Standards would likely require an extended, multi-phase implementation period given the time needed to conduct the required assessments and the time and cost of installing any required automatic protection measures. The NOPR stated that it would be appropriate for the Second Stage GMD Reliability Standards to include an implementation schedule that requires owners and operators of the Bulk-Power System to prioritize implementation so that components considered vital to the reliable operation of the Bulk-Power System are protected in the earliest phase of the implementation plan.

Comments

88. NERC states that "[w]hile the implementation proposed for the completion of the second stage Reliability Standards is aggressive, NERC is committed to meeting whatever implementation targets are established by the Commission in the final rule."[114]

[114] NERC Comments at 13.

Other commenters support adoption of the proposed six-month filing deadline for the Second Stage GMD Reliability Standards.[115]

89. Some commenters, including those supporting the Second Stage GMD Reliability Standards, express concern with the six-month deadline proposed in the NOPR because six months does not allow enough time to address the complex issues raised by the proposed Reliability Standards.[116] Joint ISOs/RTOs propose a one-year development and filing deadline.[117] Idaho Power proposes an 18-month deadline for submitting the Reliability Standards and a three-year, multi-phased implementation period.[118] Exelon recommends that NERC should propose a filing deadline.[119]

90. Commenters opposing the Second Stage GMD Reliability Standards state that the development of Second Stage GMD Reliability Standards should be delayed given the need for further research into GMDs and the continuing work of the NERC GMD Task Force.

Commission Determination

91. In its comments, NERC commits to meeting the six-month submission deadline proposed in the NOPR. However, based on the concerns raised in the comments, we

[115] *See, e.g.*, Foundation Comments at 19.

[116] *See, e.g.*, LADWP Comments at 5; Joint ISOs/RTOs Comments 24-25.

[117] Joint ISOs/RTOs Comments at 24.

[118] Idaho Power Comments at 2.

[119] Exelon Comments at 14.

modify the schedule in the NOPR and direct NERC to submit the proposed Second Stage GMD Reliability Standards within 18 months of the effective date of this Final Rule. While NERC should propose an implementation plan, we do not direct or suggest a specific implementation plan. As stated in the NOPR, in a proposed implementation plan, we expect that NERC will consider a multi-phased approach that requires owners and operators of the Bulk-Power System to prioritize implementation so that components considered vital to the reliable operation of the Bulk-Power System are protected first. We also expect, as discussed above, that the implementation plan will take into account the availability of validated tools, models, and data that are necessary for responsible entities to perform the required GMD vulnerability assessments.

III. Information Collection Statement

92. The Office of Management and Budget (OMB) regulations require approval of certain information collection requirements imposed by agency rules. Upon approval of a collection(s) of information, OMB will assign an OMB control number and an expiration date. Respondents subject to the filing requirements of an agency rule will not be penalized for failing to respond to these collections of information unless the collections of information display a valid OMB control number. The Paperwork Reduction Act (PRA) requires each federal agency to seek and obtain OMB approval before undertaking a collection of information directed to ten or more persons, or contained in a rule of general applicability.

93. The Commission is submitting these reporting requirements to OMB for its review and approval under section 3507(d) of the PRA. The Commission solicited comments on

the Commission's need for this information, whether the information will have practical utility, ways to enhance the quality, utility, and clarity of the information to be collected, and any suggested methods for minimizing the respondent's burden, including the use of automated information techniques. The Commission received no comments on the burden and cost information contained in the NOPR.

94. The Public Reporting Burden and cost related to the proposed rule in Docket RM12-22-000 are covered by, and already included in, the existing FERC-725, Certification of Electric Reliability Organization; Procedures for Electric Reliability (OMB Control No. 1902-0225). FERC-725 includes the ERO's overall responsibility for developing Reliability Standards, such as the Reliability Standards for Geomagnetic Disturbances.

95. Internal review: The Commission has reviewed the proposed changes and has determined that the changes are necessary to ensure the reliability and integrity of the Nation's Bulk-Power System.

96. Interested persons may obtain information on the reporting requirements by contacting: Federal Energy Regulatory Commission, 888 First Street, NE, Washington, DC 20426 [Attention: Ellen Brown, Office of the Executive Director, e-mail: DataClearance@ferc.gov, Phone: (202) 502-8663, fax: (202) 273-0873]. Comments on the requirements of this rule may also be sent to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503 [Attention: Desk Officer for the Federal Energy Regulatory Commission]. For security reasons, comments should be sent by e-mail to OMB at oira_submission@omb.eop.gov. Please reference

OMB Control No. 1902-0225, FERC-725 and the docket number of this proposed rulemaking in your submission.

IV. Environmental Analysis

97. The Commission is required to prepare an Environmental Assessment or an Environmental Impact Statement for any action that may have a significant adverse effect on the human environment.[120] The Commission has categorically excluded certain actions from this requirement as not having a significant effect on the human environment. Included in the exclusion are rules that are clarifying, corrective, or procedural or that do not substantially change the effect of the regulations being amended.[121] The actions proposed here fall within this categorical exclusion in the Commission's regulations.[122]

[120] *Regulations Implementing the National Environmental Policy Act of 1969*, Order No 486, 52 FR 47897 (Dec. 17, 1987), FERC Stats. & Regs. Preambles 1986-1990 ¶ 30,783 (1987).

[121] 18 CFR 380.4(a)(2)(ii).

[122] Only one commenter, SENS, addressed the NOPR's Environmental Analysis proposal. SENS requested that the Commission "include an environmental impact assessment of GMD-induced power outage on the approximately 104 nuclear power plants in the United States if the proposed rules are *not* enacted." SENS Comments at 5 (emphasis in original). The request in this comment is moot in light of the Commission's directive in this Final Rule that the ERO develop and submit for approval proposed GMD Reliability Standards.

V. Regulatory Flexibility Act

98. The Regulatory Flexibility Act of 1980 (RFA)[123] generally requires a description and analysis of proposed rules that will have significant economic impact on a substantial number of small entities. The RFA mandates consideration of regulatory alternatives that accomplish the stated objectives of a proposed rule and that minimize any significant economic impact on a substantial number of small entities. The Small Business Administration's (SBA) Office of Size Standards develops the numerical definition of a small business.[124] The SBA has established a size standard for electric utilities, stating that a firm is small if, including its affiliates, it is primarily engaged in the transmission, generation and/or distribution of electric energy for sale and its total electric output for the preceding twelve months did not exceed four million megawatt hours.[125]

99. The NOPR stated that, by proposing only to direct NERC, the Commission-certified ERO, to develop GMD Reliability Standards, the proposal would not have a significant or substantial impact on entities other than NERC. The NOPR stated that the ERO develops and files with the Commission for approval Reliability Standards affecting the Bulk-Power System, which represents: (a) a total electricity demand of 830 gigawatts (830,000 megawatts) and (b) more than $1 trillion worth of assets. Therefore, the NOPR certified that the proposal will not have a significant economic impact on a substantial

[123] 5 U.S.C. 601-612.

[124] 13 CFR 121.101.

[125] 13 CFR 121.201, Sector 22, Utilities & n.1.

number of small entities. The NOPR further stated that any Reliability Standards proposed by NERC in compliance with this rulemaking will be considered by the Commission in future proceedings and that, as part of any future proceedings, the Commission will make determinations pertaining to the Regulatory Flexibility Act based on the content of the Reliability Standards proposed by NERC.

100. The Commission received one comment addressing the Regulatory Flexibility Act certification in the NOPR.

Comments

101. APPA, NRECA, and TAPS state that the GMD Reliability Standards could result in significant adverse regulatory impacts on many small utilities. APPA, NRECA and TAPS state that, while it might be premature for the Commission to engage in a full RFA analysis at this stage, putting off an RFA analysis will make it more difficult to perform an analysis in the future. APPA, NRECA and TAPS state that the Commission should at least gather the necessary facts in the comment phase of this rulemaking so that it can develop a record on the universe of small entities that could be affected by NERC Reliability Standards addressing GMDs and possible ways to mitigate any adverse impacts of such Reliability Standards. APPA, NRECA and TAPS encourage the Commission to host a "technical conference, convene[] a panel of small utility representatives, or undertake some other comparable outreach effort to solicit information

from the small entities that may be affected by the contemplated GMD reliability standards." [126]

Commission Determination

102. The Commission certifies that this final rule will not have a significant economic impact on a substantial number of small entities. We affirm the reasoning in the NOPR that, in only directing the ERO to develop and submit for approval GMD Reliability Standards, this Final Rule only applies to NERC, which, as discussed above, is not a small entity. APPA, NRECA and TAPS concede that it would be premature to conduct a full Regulatory Flexibility Analysis at this time, but they state that it could be more difficult to conduct such an analysis in the future. We disagree because the Commission cannot assess the economic impact on small entities of the GMD Reliability Standards at this time since they have not been developed or submitted for approval by NERC. Such an analysis, at this time, would be purely speculative. As we stated in the NOPR, the GMD Reliability Standards proposed by NERC in compliance with this Final Rule will be considered by the Commission in future rulemakings. As part of those rulemakings, the Commission will make determinations pertaining to the Regulatory Flexibility Act based on the content of the Reliability Standards proposed by NERC. While the Commission declines to conduct the types of outreach suggested by APPA, NRECA, and TAPS at this time, APPA, NRECA and TAPS should participate in the standards

[126] APPA, NRECA, and TAPS Comments at 6.

development process as NERC develops the Reliability Standards required by this Final Rule to ensure that their views are taken into account. In addition, the Commission welcomes any informal discussions on these issues as NERC develops the Reliability Standards required by this final rule.

VI. Document Availability

103. In addition to publishing the full text of this document in the Federal Register, the Commission provides all interested persons an opportunity to view and/or print the contents of this document via the Internet through the Commission's Home Page (http://www.ferc.gov) and in the Commission's Public Reference Room during normal business hours (8:30 am to 5:00 pm Eastern time) at 888 First Street, NE, Room 2A, Washington DC 20426.

104. From the Commission's Home Page on the Internet, this information is available on eLibrary. The full text of this document is available on eLibrary in PDF and Microsoft Word format for viewing, printing, and/or downloading. To access this document in eLibrary, type the docket number excluding the last three digits of this document in the docket number field.

105. User assistance is available for eLibrary and the Commission's website during normal business hours from the Commission's Online Support at (202) 502-6652 (toll free at 1-866-208-3676) or email at ferconlinesupport@ferc.gov, or the Public Reference Room at (202) 502-8371, TTY (202) 502-8659. E-mail the Public Reference Room at public.referenceroom@ferc.gov.

VII. Effective Date and Congressional Notification

106. These regulations are effective **[60 days after publication in the FEDERAL REGISTER]**. The Commission has determined, with the concurrence of the Administrator of the Office of Information and Regulatory Affairs of OMB, that this rule is not a "major rule" as defined in section 351 of the Small Business Regulatory Enforcement Fairness Act of 1996.

By the Commission.

(S E A L)

Nathaniel J. Davis, Sr.,
Deputy Secretary.

Appendix
Commenters

Abbreviation	Commenter
Alcoa	Alcoa Inc. and Alcoa Power Generating Inc.
AFS	Advanced Fusion Systems
AEP	American Electric Power Service Corporation
APS	Arizona Public Service Company
Ayers	Cynthia E. Ayers
George Baker	George H. Baker III, Ph. D
Joel Baker	Joel E. Baker
Bequette	William Bequette
Bowen	Dwane M. Bowen
Boyd	David A. Boyd
Bonneville	Bonneville Power Administration
CEA	Canadian Electricity Association
CenterPoint	CenterPoint Energy Houston Electric, LLC
Clinic	Samuelson-Glushko Technology Law and Policy Clinic, University of Colorado Law School
Congressman Franks	Congressman Trent Franks
Consumers Energy	Consumers Energy Company
Dominion	Dominion Resources Services, Inc.
Duke	Duke Energy Corporation
EEI	Edison Electric Institute
EIS	Electric Infrastructure Security Council
ELCON	Electricity Consumers Resource Council
Emprimus	Emprimus LLC
EPSA	Electric Power Supply Association
Exelon	Exelon Corporation
Foundation	Foundation for Resilient Societies
FPL	Florida Power & Light Company
Frauman	Roger Frauman
Greenhill	John Greenhill
Idaho Power	Idaho Power Company
IESO	Independent Electricity Operator and Hydro One Networks, Inc.
ITC	International Transmission Company
Joint ISOs/RTOs	Alberta Electric System Operator, California Independent System Operator, Electric Reliability Council of Texas, Independent Electricity System Operator of Ontario, Inc., ISO New England Inc., Midwest Independent Transmission System Operator, Inc., New York Independent System

	Operator, Inc., and Southwest Power Pool (SPP)
Johnson	Amanda Johnson
Kappenman	John Kappenman, Storm Analysis Consultants
KCP&L	Kansas City Power & Light Company and KCP&L Greater Missouri Operations Company
Koenig	Roger L. Koenig, Michigan State University
Kristen	Steven F. Kristen
LADWP	City of Los Angeles Department of Water and Power
Leggett	Nickolaus Leggett
Lloyd's	Lloyd's
Lund	John Curtis Lund
Manto	Charles L. Manto
Mitsubishi Electric	Mitsubishi Electric Power Products, Inc.
NARUC	National Association of Regulatory Utility Commissioners
NERC	North American Electric Reliability Corporation
NV Energy	Nevada Power Company and Sierra Pacific Power Company
Pa PUC	Pennsylvania Public Utility Commission
Phoenix	Phoenix Electric Corp.
PJM	PJM Interconnection, L.L.C.
PPL Companies	Louisville Gas and Electric Company and Kentucky Utilities Company, Lower Mount Bethel Energy, LLC, PPL Brunner Island, LLC, PPL Electric Utilities Corporation, PPL EnergyPlus, LLC, PPL Ironwood, LLC, PPL Martins Creek, LLC, PPL Montana, LLC, PPL Montour, LLC, and PPL Susquehanna LLC
Orquin	Alberto Ramirez Orquin, PhD
Ruckriegle	Heidi Ruckriegle
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric
SENS	Stored Energy Systems LLC
SmartSenseCom	SmartSenseCom, Inc.
SPP Parties	AEP, City of Coffeyville, Kansas, City of Independence, Missouri, Oklahoma Municipal Power Authority, SPP, Southwester Power Administration, Westar Energy, Inc., and Western Farmers Electric Cooperative
Stolov	Jerome J. Stolov
TAPS	Transmission Access Policy Study Group
Trade Associations	American Public Power Association (APPA), Edison Electric Institute, Large Public Power Council, National Rural Electric Cooperative Association (NRECA)
Wallenmeyer	William Wallenmeyer

Document Content(s)