

# NERC Geomagnetic Disturbance Standard Approved

On September 22, 2016 FERC approved NERC's TPL-007-1 standard which establishes requirements for assessing transmission system performance during benchmark geomagnetic disturbance (GMD) events. FERC also ordered that modifications be made to the standard.

Utility Planning Coordinators, Transmission Planners, Transmission Owners and Generation Owners have new mandatory responsibilities under the standard. In particular, transmission owning utilities are now required to analyze and assess the performance of their transmission systems under a GMD benchmark planning event.

This standard implements the second phase of NERC's GMD program. The first Phase is already in place in the form of mandatory standard EOP-010-1<sup>1</sup> which requires Operating Plans, Processes, and Procedures to mitigate the effect of GMD events.

With the approval of TPL-007-1, the industry now has the long awaited regulatory certainty it needs to plan and possibly modify transmission systems to withstand the [effects of geomagnetically induced currents](#) (GIC) on the transmission systems caused by coronal mass ejections from the Sun.

## Background

When GIC enters the power system, it may disrupt protection systems and negatively impact large transformers by excessive heating of internal components. During a GMD event, GIC may cause transformer hot-spot heating or damage, loss of Reactive Power sources, increased Reactive Power demand, and Misoperation(s), the combination of which may result in voltage collapse. These effects can cause power outages and lead to early failure of equipment that has a long lead time to replace or repair.

For more information, please review TRC's previously published [Regulatory Updates](#) on this topic.

## TPL-007-1

Under TPL-007-1 Transmission and Generator Owners, Planning Coordinators, and Transmission Planners must assess the vulnerability of their systems to a benchmark GMD event, described as a "one-in-100-year" event. If a utility's assessment indicates that a system does not meet the performance requirements, the utility must develop a corrective action plans addressing how it will meet the requirements.

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<sup>1</sup> For more information on the EOP-010-1 standard see:  
[http://www.nerc.com/\\_layouts/PrintStandard.aspx?standardnumber=EOP-010-1&title=Geomagnetic%20Disturbance%20Operations&jurisdiction=United%20States](http://www.nerc.com/_layouts/PrintStandard.aspx?standardnumber=EOP-010-1&title=Geomagnetic%20Disturbance%20Operations&jurisdiction=United%20States)

Utilities are required to develop system models that can be used to study transmission system performance during GMD events. They must also conduct initial and on-going vulnerability assessments of the potential impact GMD events may have on power system equipment and the power system as a whole. The assessments must account for steady state voltage during a benchmark GMD event. Utilities that do not meet the requirements to perform the analysis as called for in the standard, based on the results of their vulnerability assessments and must develop a plan to achieve the performance requirements.

## Mandatory Obligations

In this second stage of NERC's GMD regulatory program, utilities in the Planning Coordinator, Transmission Planner and Transmission Owner functions must identify benchmark GMD events and specify the magnitude of the event a utility must use for its assessment.

A vulnerability assessment<sup>2</sup> is required for transformers with a high-side, wye ground winding with terminal voltage greater than 200 kV<sup>3</sup>. If the assessments identify potential impacts, owners and operators are required to develop and implement corrective action plans to protect against instability, uncontrolled separation, or cascading failures of the BPS.

Each utility that concludes through the GMD Vulnerability Assessment that their System does not meet the performance requirements must develop a formal Corrective Action Plan. FERC has directed that the standard be changed to provide more specific requirements regarding the implementation of corrective action plans. The development of proactive strategies should be based on the age, condition, technical specifications, system configuration, and location of specific equipment.

For example, these strategies could include:

- Consideration of automatically blocking geomagnetic currents from entering the BPS;
- Instituting more stringent specifications for new equipment;
- Improved spare equipment inventory management; and

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<sup>2</sup> The study or studies shall include the following conditions:

- System On-Peak Load for at least one year within the Near-Term Transmission Planning Horizon; and
- System Off-Peak Load for at least one year within the Near-Term Transmission Planning Horizon.
- The study or studies shall be conducted based on the benchmark GMD event described in Attachment 1 of TPL-007-1 to determine whether the System meets the performance requirements in Table 1 of TPL-007-1.
- The GMD Vulnerability Assessment shall be provided within 90 calendar days of completion to the responsible utility's Reliability Coordinator, adjacent Planning Coordinators, adjacent Transmission Planners, and to any functional entity that submits a written request and has a reliability-related need.

<sup>3</sup> The GIC application guide is available at:

[http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/GIC%20Application%20Guide%202013\\_approved.pdf](http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/GIC%20Application%20Guide%202013_approved.pdf)

- Isolating certain equipment that is not cost effective to retrofit.

Utilities will need to review existing procedures or develop and implement new procedures in order to maintain compliance. Critical areas of attention include:

- System configuration
- Modeling and analysis
- Monitoring and measurement
- Mitigation planning

NERC continues to support the industry with technical guidance in order to comply with the approved standard. NERC is also raising awareness about the impact of GMD on the power system through information exchange and focused training for industry, researchers and policymakers.

## FERC Directives Request Additional Changes in the Future

Given the limited historical geomagnetic data and because scientific understanding of GDM is still evolving, FERC directed NERC to conduct further research on specific GMD issues. NERC is to submit a work plan and, subsequently, one or more informational filings that address specific GMD-related research areas.

The FERC Order also requires new data collection and sharing to support ongoing research efforts in this field.

There are three directives to NERC for additional changes to the TPL-007-1 standard.

1. NERC must modify the benchmark GMD event” definition so that the reference peak geoelectric field amplitude component of the definition is not based solely on spatially-averaged data.
2. NERC must develop revisions to TPL-007-1 to require utilities to collect and make available necessary data from geomagnetically-induced current monitors and magnetometers to ensure a more complete set of data for planning and operational needs.
3. NERC must develop revisions to TPL-007-1 to establish specific deadlines for the development of corrective action plans and the completion of activities called for in corrective action plans.

## Implementation

The draft final rule requires NERC to comply with the directives within 18 months of the effective date of the final rule. The proposed changes do not alter the implementation of the approved standard. The implementation plan for the standard calls for implementation of the requirements over a five year period and provides time for:

- Utilities to develop the required simulation models.
- Sequencing of assessments of thermal impact on transformers dependent upon GIC flow calculation results
- Development of viable Corrective Action Plans, which may require utilities to develop, perform, and validate new or modified studies, assessments, procedures

## Modeling Expertise Can Support Success

There is a great deal of modeling called for in the standard which may be unfamiliar to your current staff. NERC has promoted the development of models for the earth conductivity paths through the NERC GMD Task Force<sup>4</sup>. A number of documents associated with the development of the standard are available from NERC. TRC has been closely following the modeling issues that were extensively deliberated during the technical conference and during the FERC consideration of the standard. Our experts can assist your staff with the analysis and development of corrective actions plans called for in the standard.

## Resources

- [FERC Order – Approval of TPL-007-1F](#)
- [TPL-007-1 Standard](#)
- [TPL-007-1 Implementation Plan](#)
- [NERC GMD Planning Guide](#)
- [TRC Regulatory Update on FERC GMD Standard Deliberations 10-15-2015](#)
- [TRC System Studies & Planning Support Services](#)

## About Us

TRC's Power Delivery Engineers provide full service transmission planning, consulting and construction management for utilities, municipalities and industry. Comprised of over 1,000 personnel, many of whom are experienced utility engineers, our project teams know how to plan, design, and install facilities that meet a client's financial, technical, and scheduling goals.

*This regulatory update is a service to our utility clients, helping keep you informed of issues that impact your reliability risk and business goals.*

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<sup>4</sup> NERC's GMD Task Force related materials can be found at this link: [http://www.nerc.com/comm/PC/Pages/Geomagnetic-Disturbance-Task-Force-\(GMDTF\)-2013.aspx](http://www.nerc.com/comm/PC/Pages/Geomagnetic-Disturbance-Task-Force-(GMDTF)-2013.aspx)