

# **GMD News and Observer** Your View into EPRI Research on Geomagnetic Disturbance Vulnerabilities, Impacts, and Mitigation



#### EXECUTIVE UPDATE

Welcome to the sixth issue of our newsletter, *GMD News and Observer*. Published approximately quarterly, this newsletter provides progress reports and insights for the industry on the geomagnetic disturbance (GMD) area. This issue provides updates on a NERC effort to develop a GMD Planning Application Guide, as well as EPRI efforts to advance research on GMD scenarios and GIC calculation methods.

Previous issues of this newsletter can be downloaded from epri.com (Issue 1: ID# 1025857; Issue 2: ID#1025858; Issue 3: ID#1025859; Issue 4: ID#3002000847; and Issue 5: ID#3002000848). In subsequent issues, we will discuss emerging research on GMDs and proposed mitigation plans by various industry leaders.

EPRI plans to continue its research on GMDs through 2014. We are continuing our outreach to utilities that can make available high-voltage transformers for GIC transformer testing and modeling. Ideally we can initiate discussions early in the procurement phase, so that we can insert additional thermocouples into the transformer during construction. We would then make arrangements with the manufacturer to test the transformer, and compare the results with existing industry models.

We welcome your feedback.

Best regards, Rich Lordan Senior Technical Executive <u>rilordan@epri.com</u>, (650) 855-2435

## **NERC GMD Planning Application Guide**

Models and tools for evaluating potential bulk power system impacts associated with severe GMDs are advancing at a rapid pace. However, the assessments do not necessarily fall within the standard repertoire of planning studies. Recognizing the need in this area, EPRI's GMD research imitative is supplying both research and engineering expertise in support of developing a set of GMD-related guidelines that are being produced by the NERC GMD Task Force. These documents will provide both general guidelines as well as non-traditional issues power engineers need to consider when performing GMD-related studies.

The four guideline documents being produced are:

- **Transformer Modeling Guide** which summarizes the transformer models that are available for GMD planning studies
- **GIC Application Guide,** which provides the theoretical background for calculating geomagnetically induced currents (GIC) and underlying assumptions used in modern GMD simulation tools
- **Operating Guide**, which provides guidance on the operating procedures that can be used in the management of a GMD event
- **Planning Application Guide,** which provides guidance and non-traditional considerations for performing GMD-related assessment studies.

The Planning Application Guide, targeted for release later in 2013, has a central role in the GMD guidelines set as it employs both the GIC calculation and transformer modeling in the prescribed studies as well as supplies guidance on the assessments needed to inform potential operating procedures.

The guide begins by providing an overview of GMD-related planning including descriptions of the types of studies that are employed, as well as a discussion on the current state-of-the-art of GMD analysis tools and models. Next, assessment methods and considerations for evaluating potential impacts to the system during an extreme event are presented. Additionally, methods to evaluate potential thermal impacts to transformers and other system asset impacts are offered. Finally, the guide provides approaches to integrate system and equipment assessments in order to determine mitigation measures based on defined criteria.

For more information, contact Mark Olson, Standards Developer, NERC, 404-446-9760, <u>mark.olson@nerc.net</u>.

# **EPRI Continues GIC Scenario Research**

EPRI has recently completed two companion studies that continue its research on geomagnetically induced current (GIC) scenarios.

In 2012, EPRI carried out a study of extreme geomagnetic storm and GIC scenarios. The developed scenarios were derived as a function of different ground conductivity structures and geomagnetic latitudes and can be used directly in further power engineering analyses to assess the risk space weather poses on high-voltage transmission systems. This work used two representative ground conductivity models for resistive and conductive conditions. To better tailor the extreme storm and geoelectric field scenarios to various continental US conditions, EPRI recently completed a new study that fully integrates 20 new US Geological Survey (USGS) ground conductivity models.

EPRI also continued its studies to further understanding of the theoretical extreme geoelectric fields. EPRI used state-of-the-art large-scale magnetospheric simulations at the NASA Goddard Space Flight Center (GSFC) to explore the theoretical limits of geoelectric field amplitudes and the location of the geomagnetic latitude threshold. This research was conducted using hypothetical Carrington-type and observed extreme coronal mass ejection (CME) events to better understand the geophysical and GIC implications of extreme interplanetary transients. This study used the new USGS ground conductivity models mentioned above.

EPRI is publishing results of this work later in 2013 in report 3002000819. This work is being performed by the Space Weather Laboratory at GSFC and the Catholic University of America. It will contribute valuable information to the NERC GMD Drafting team because this team may propose benchmark storm scenarios for various North American regions to assess their vulnerability. Although the research represents the most advanced information on the topic, additional research may be required before benchmark storm scenarios can be made with confidence.

# **EPRI Advances Methods of Calculating GICs**

EPRI has also recently completed work on improved methods of calculating GICs. In one line of research, EPRI has developed comprehensive documentation of ways to calculate electric fields to determine GICs. EPRI is publishing these methods in report 3002002149 by the end of 2013.

In a related line of research, EPRI has assessed the impact of using uniform (rather than non-uniform) geology assumptions on GIC calculations. In particular, a recently completed EPRI study examined the impact of land mass boundary conditions (i.e., the impact on GIC calculations of coastlines). Lateral changes in conductivity, such as at a coastline, can produce local distortions of the electric field (see Figure 1). The EPRI report describes a two-dimensional forward modeling code and applies it to an example to illustrate how the conductivity contrast between the sea and the land influences the geoelectric fields produced at the coast.

Natural Resources Canada conducted both of these lines of research for EPRI.



## Figure 1

Electric field values, Ey (mV/km) across the coast for Bx = 1nT (Frequency = 0.032 Hz, Period = 30 sec). Seawater depth = 328 ft (100 m). Source: Natural Resources Canada

#### EVENTS, NEWS, AND RESOURCES

# **EPRI and NATF Conducts GMD Summit**

On September 24-25, 2013, EPRI and the North American Transmission Forum (NATF) conducted a GMD Summit at EPRI's offices in Charlotte, North Carolina. The Summit provided a non-public forum for information sharing and discussion of the practical aspects of preparing for a GMD event (studies, monitoring, operations, mitigation, etc.). Attended by approximately 50 industry representatives, the Summit identified topics that require additional future focus and/or work efforts.

# SUNBURST Monitoring System Update

EPRI conducted an update of the SUNBURST monitoring system on October 16, 2013. In September and early October 2013, four new SUNBURST nodes were installed – at the Tennessee Valley Authority (TVA), MidAmerican Energy, and Kansas City Power & Light. Four additional utilities each intend to install an additional SUNBURST node in 2013, including Southern California Edison, Duke Energy, the Salt River Project and FirstEnergy Corp. TVA plans to install additional nodes later in 2013 and in 2014.

# **Upcoming Events**

The following GMD-related events are planned:

- SUNBURST Annual Meeting, early December 2013, Washington DC (date TBD)
- NERC Geomagnetic Disturbance Task Force meeting, Atlanta, November 13-15, 2013
- The next monthly GMD progress conference call will be held November 8, 2013 (1-2pm, EST, 10-11am PST).

## **Opportunities for Participation**

To find out about opportunities to participate in EPRI GMD research, please contact EPRI Senior Technical Executive Rich Lordan, rilordan@epri.com, (650) 855-2435.

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#### **Electric Power Research Institute**

3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA 800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

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