



TIP 25c: EPRI Geomagnetic Disturbance (GMD) Research Project

Context

In collaboration with NERC, the utility industry, and other stakeholders, EPRI is building on two decades of research in the GMD area to develop the knowledge and tools to understand, predict, and mitigate the impact of GMDs on power systems. The three-year, comprehensive, multi-deliverable project that EPRI launched in late 2011 helps the electric utility industry and other stakeholders understand, prepare for, and mitigate GMDs.

Mitigation of the most severe impacts of GMDs on the power system is expected to provide more reliable electrical service for the benefit of the public, with fewer interruptions of service and a quicker recovery from interruptions.

Description

This research effort began with definition of the GMD scenario, followed by various modeling and simulation activities. This process is followed by storm forecasting and prediction (in associated projects with NOAA and NASA), as well as system impact assessment. EPRI's focus through these tasks is on model and tool development. Mitigation measures and devices can then be defined, evaluated with appropriate simulation tools, and possibly field tested. Utilities will benefit from integrating many of these activities into their larger risk management processes. Measurement of storm parameters, geomagnetic fields, geomagnetic-induced currents (GICs), transformer impacts, and power system impacts provide data that support these activities.

An important product of this work is enhanced industry awareness of the threat, system impacts, and mitigation opportunities. The work cuts across power system planning, power system operations, asset fleet management, and risk management.

Based on the work completed to date EPRI has developed the GMD Research Action Plan. The activities are aggregated into four research areas:

- **GIC Calculation Areas:** develop an application guide for calculating GICs in bulk power systems; develop additional benchmark cases with non-uniform electric fields
- **GIC Integrated Power Flow Analysis and Models:** determine if transient stability studies are required to assess voltage stability during GMD events; provide

EMTP-RV transformer models; determine the most appropriate way to model half-cycle-saturated transformers in power flow studies; determine the correct reactive power consumption and harmonic content versus GIC using limited measurement data and EMTP simulation results.

- **System Impact Assessment:** develop transformer thermal models for planning study integration; develop an analytical tool that will implement the developed thermal models; develop an application guide to help utilities assess the vulnerability of their transformer fleet.
- **Mitigation:** use simulation results (i.e., GIC integrated power flow and EMTP) to assess the impact of GIC blocking devices on GIC flows; physically test available blocking devices in a laboratory setting; evaluate operating procedures for mitigation.

Why It Matters

The understanding developed in this project is intended to help utilities prepare for severe solar storms and to operate the grid through such events. This may improve bulk power system reliability by shortening customer interruptions as well as minimizing the risks of equipment damage.

In addition it may identify gaps in forecasting and mitigation solutions, and provide guidance on the economic feasibility of available mitigation technologies.

Goals and Objectives

This project's goals are to:

- Develop the tools and methodologies necessary for utilities to determine the potential impact of an extreme GMD event on bulk power systems.
- Identify operational techniques and other technologies available today or in the near term to mitigate equipment damage, reduce the extent of the interruption, and speed recovery.
- Identify and evaluate available technologies and those that can be developed in the longer term to reduce the impact of the geomagnetic storm as well as lower the cost of protection.

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Project Start Date: January 1, 2011

Project End Date: December 31, 2013

Reports & References (Optional)

Links (Optional)

Participating Organizations

EPRI

Funding

Total Project Cost: \$150,000

BPA Share: \$50,000

External Share: \$100,000

BPA FY2013 Budget: \$25,000

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