NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reducing GMD Risk to the North American Electric Grid

Mark Olson, Senior Engineer Reliability Assessments
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RELIABILITY | ACCOUNTABILITY

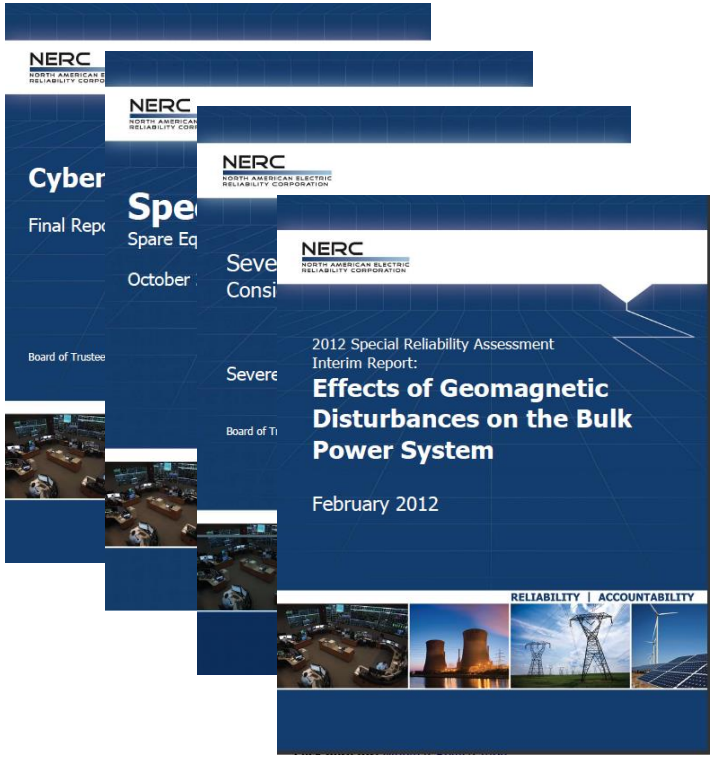



About NERC

- The mission of the NERC is to assure the effective and efficient reduction of risks to the reliability and security of the grid
- NERC has regulatory authority in the U.S. and Canada
  - Develops and enforces reliability standards
  - Annually assesses seasonal and long-term reliability
  - Monitors the transmission system
  - Educates, trains, and certifies industry personnel
- NERC is subject to oversight from the Federal Energy Regulatory Commission (FERC) and authorities in Canada

Extreme Event Risks

- The U.S. Department of Energy-NERC report on *High-Impact, Low- Frequency (HILF) Event Risk* (2010) characterized rare risk scenarios with the potential to disrupt reliable operations
  - Cyber Attack
  - Coordinated Physical Attack
  - Geomagnetic Disturbances (GMD)
- NERC 2012 GMD Report:
  - Widespread transformer damage is unlikely
  - Recommended actions for industry action



GMD Risk to the Bulk Power System

- Severe GMD Event may cause
  - Voltage Collapse (Blackout)
  - Damage to transmission system power transformers

March 13, 1989 Geomagnetic Disturbance

General Discussion (cont.)

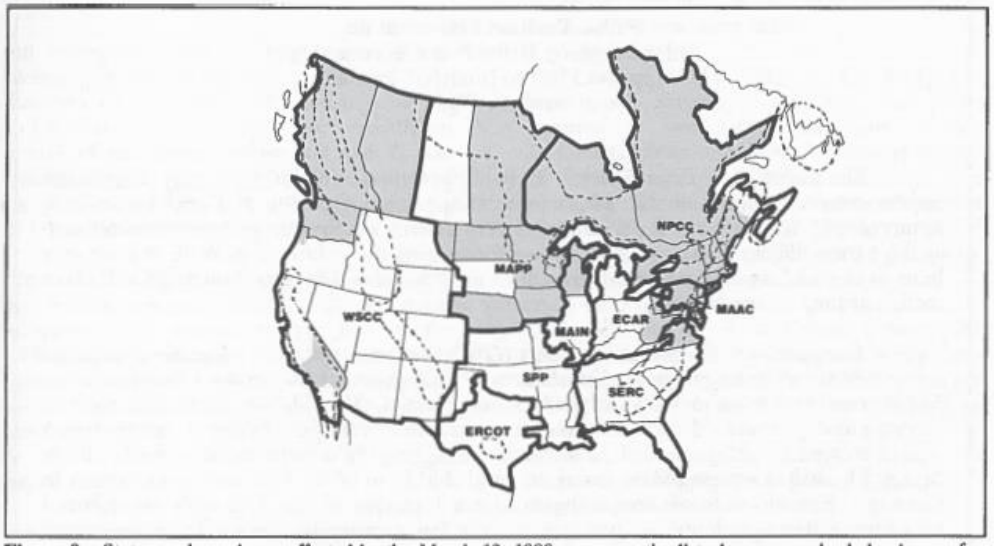
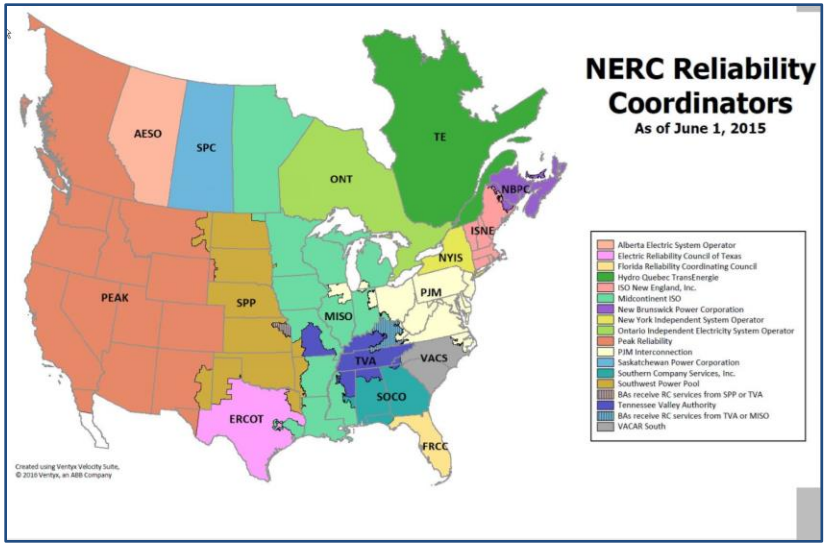


Figure 9 - *States and provinces affected by the March 13, 1989 geomagnetic disturbance are shaded. Areas of igneous rock formations also shown.*

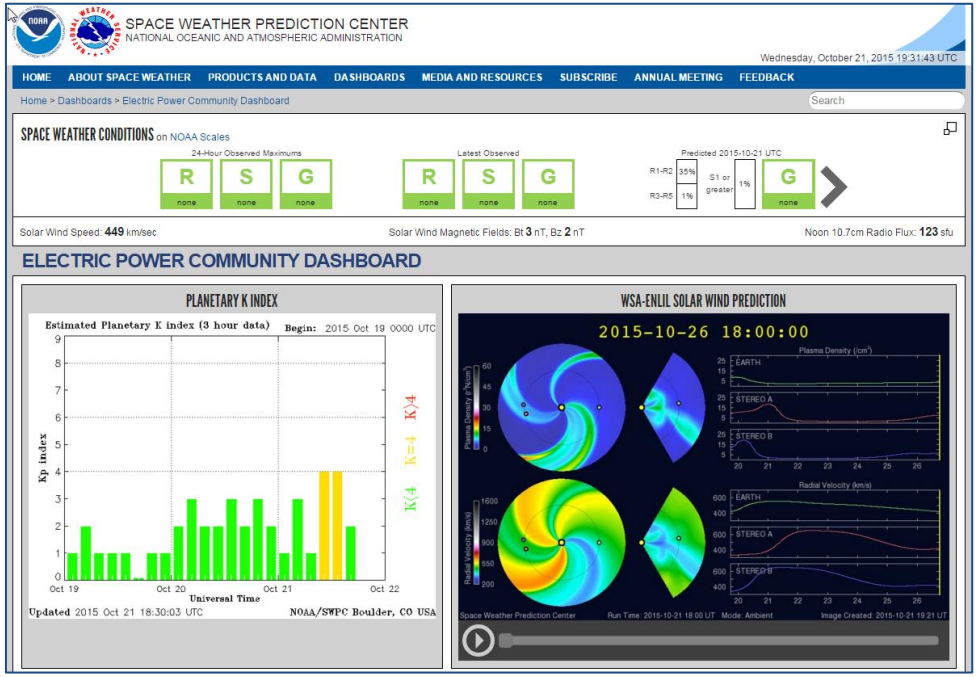
GMD Standards Extend Across North America

- May 2013 – NERC began development of two GMD standards
- April 2015 – GMD Operations standard became effective
- January 2017 – GMD Vulnerability Assessment standard became effective
  - Requirements implemented over a 5-year period



EOP-010-1: Operating Procedures

- Requires grid operators to have procedures for mitigating GMD impacts
  - Increased situational awareness
  - System posturing
  - Reconfiguration
- Operators receive alerts from space weather prediction center



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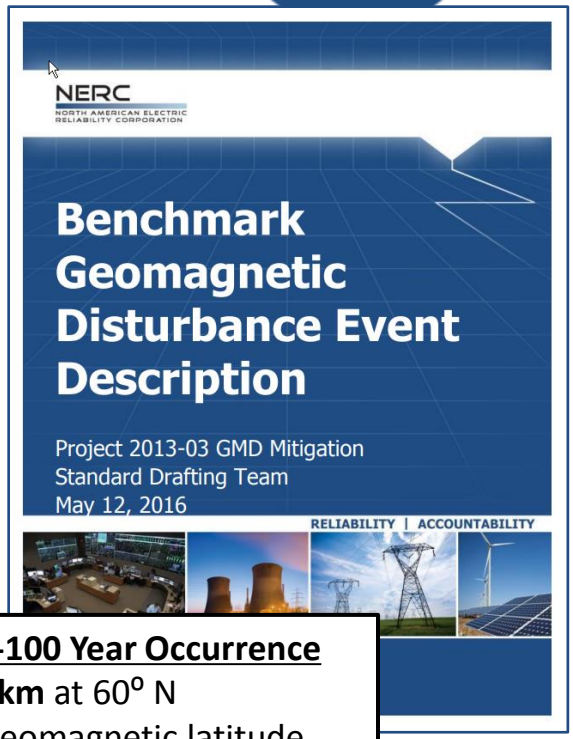
TPL-007-1: GMD Assessments

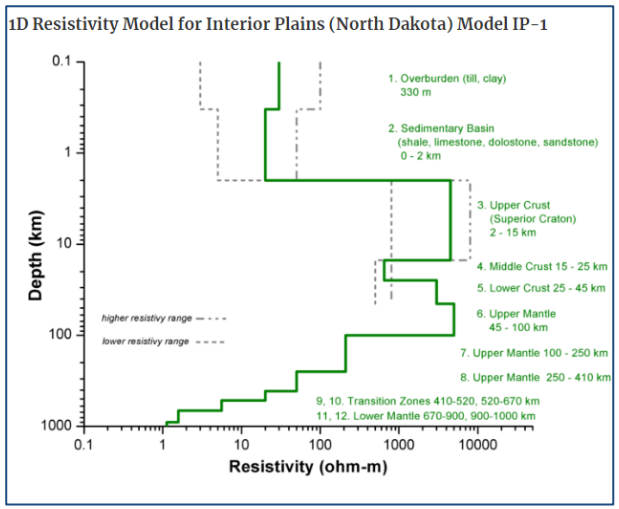
- Requires grid planners and asset owners to assess and mitigate risks of voltage collapse and equipment damage from GMD

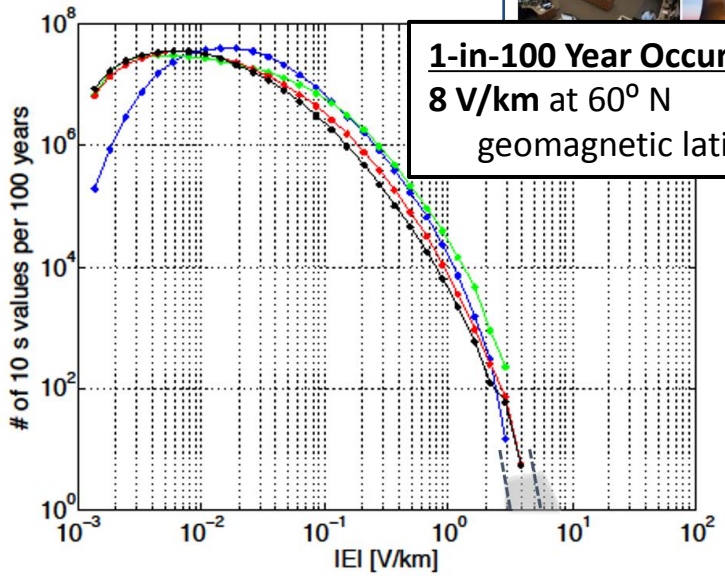
- Components of TPL-007-1
  - Benchmark GMD event
  - GMD Vulnerability Assessment
  - Corrective Action Plan (CAP)

Benchmark GMD Event

- Magnetometer data used to estimate a 1-in-100 year GMD event
- Entities tailor the benchmark to their system area
  - Geomagnetic latitude and earth conductivity factors







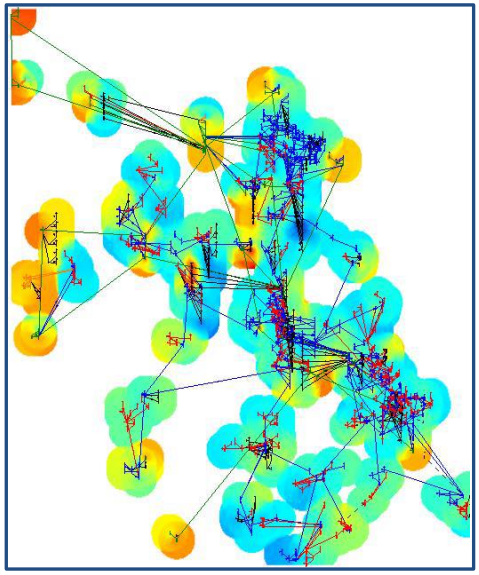
1-in-100 Year Occurrence
8 V/km at 60° N geomagnetic latitude

GMD Vulnerability Assessment

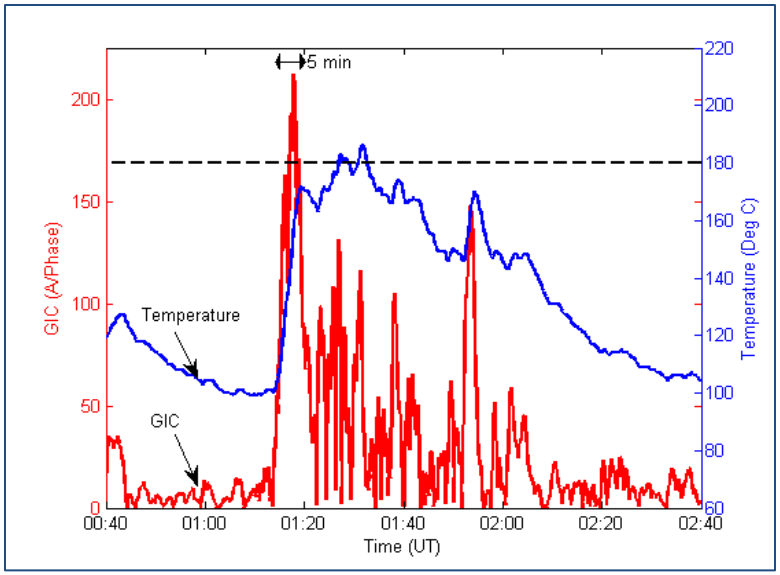
- Documented evaluation of potential susceptibility to voltage collapse, Cascading, or localized damage of equipment due to geomagnetic disturbances
- Requirements are contained in TPL-007-1

GMD Vulnerability Assessment Process

Model Benchmark GIC → Study system voltage collapse and transformer thermal risks → Identify corrective action needs



Voltage Assessment

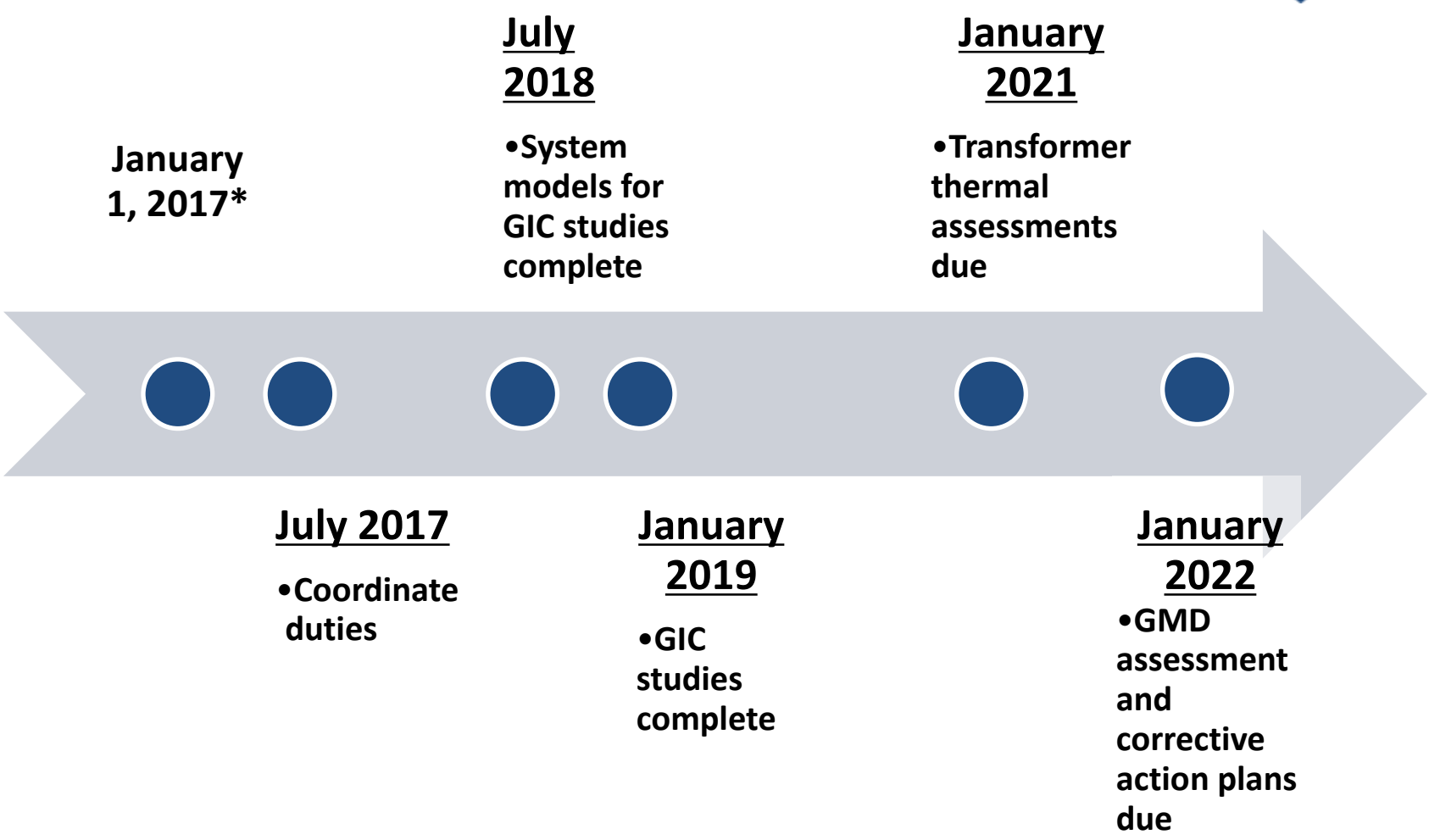


Transformer Thermal Simulation

Corrective Action Plans (CAP)

- TPL-007 requires CAP when the GMD Vulnerability Assessment indicates system performance requirements are not met
- Options include
  - Hardening the system
  - Installing monitors
  - Operating procedures

TPL-007 Implementation Plan



January 1, 2017 is the day FERC Order No. 830 became effective

Revisions to TPL-007

- NERC recently completed revisions to TPL-007
  - Enhance the benchmark GMD event
  - Require entities to collect GMD data
  - Establish deadlines for Corrective Action Plans (CAPs)

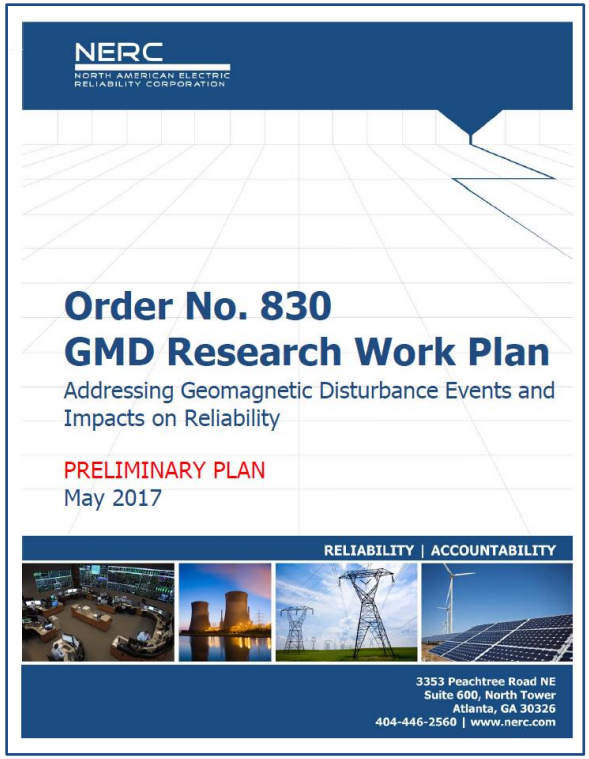
- Revisions filed in January 2018 and pending regulatory approval

GMD Research

Research Initiatives

- NERC launched two-year research plan with Electric Power Research Institute:
  - Continued analysis on benchmark GMD event
  - Improving earth conductivity models
  - Further analysis on transformer vulnerability
  - Development of additional tools for industry

- NERC will make reports available to the public and provide opportunity for comment



GMD Task Force

- NERC GMD Task Force collaborates with researchers, agencies and utilities across North America
  - Electric Power Research Institute
  - North American Transmission Forum
  - NASA, Canadian Space Agency
  - U.S. Geological Survey, Natural Resources Canada
  - U.S. Space Weather Prediction Center
  - U.S. National Labs
  - Utilities from all regions in North America
- Focused on improving tools for planners and operators to manage GMD impacts

GMD Data Collection

- Order No. 830 includes directives for collecting data to "improve our collective understanding" of GMD risk
  - Includes GIC and magnetometer data
  - NERC is to make data available to the public
- NERC proposes collecting data from owners with GIC monitors
  - Collect during all GMD Events K-7 and greater
- Public comment period was conducted January-March 2018

Questions and Answers