NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

EMP and GMD Risk Mitigation

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RELIABILITY | RESILIENCE | SECURITY




Vision for Mitigating GMD Impacts

- The Electric Reliability Organization sustains complementary efforts to reduce risks to the Bulk Power System from GMD:
  - Mandatory reliability standards
  - Partnerships in leading-edge research and tool development
  - Development of data collection program
- NERC works with diverse stakeholders throughout North America to carry out its vision
- Carry out the charge
  - The Department of Energy-NERC report on *High-Impact, Low- Frequency (HILF) Event Risk* (2010) analyzed rare risk scenarios
    - Cyber Attack
    - Coordinated Physical Attack
    - Geomagnetic Disturbances (GMD)

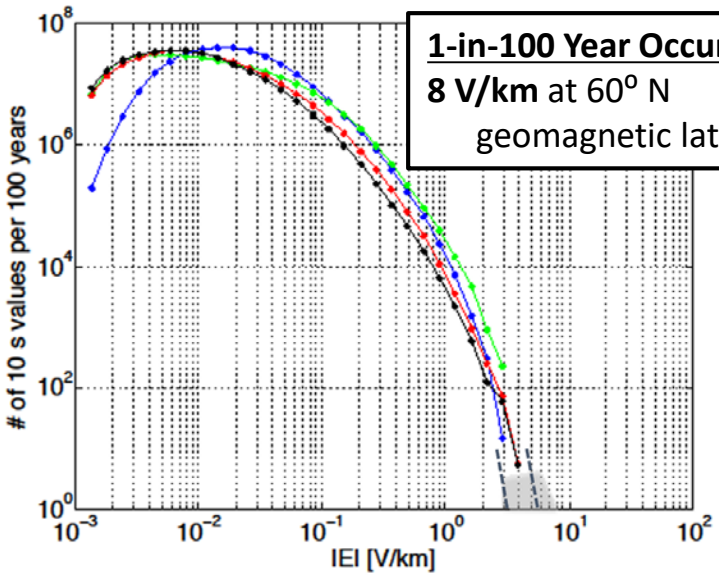
North American GMD Standards Milestones

- 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 five-year period

TPL-007-3 – Transmission System Planned Performance for Geomagnetic Disturbance Events

A. Introduction

1. **Title:** Transmission System Planned Performance for Geomagnetic Disturbance Events
2. **Number:** TPL-007-3
3. **Purpose:** Establish requirements for Transmission system planned performance during geomagnetic disturbance (GMD) events.
4. **Applicability:**
   - **4.1. Functional Entities:**
     - **4.1.1.** Planning Coordinator with a planning area that includes a Facility or Facilities specified in 4.2;
     - **4.1.2.** Transmission Planner with a planning area that includes a Facility or Facilities specified in 4.2;
     - **4.1.3.** Transmission Owner who owns a Facility or Facilities specified in 4.2; and
     - **4.1.4.** Generator Owner who owns a Facility or Facilities specified in 4.2.
   - **4.2. Facilities:**
     - **4.2.1.** Facilities that include power transformer(s) with a high side, wye-grounded winding with terminal voltage greater than 200 kV.

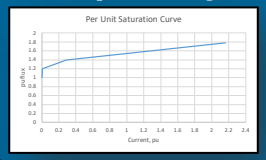


1-in-100 Year Occurrence
8 V/km at 60° N geomagnetic latitude

NERC GMD Research Plan

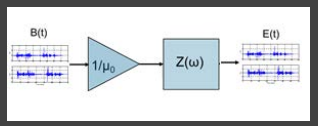
Improved Earth Conductivity Models

Improved Harmonic Analysis Capability

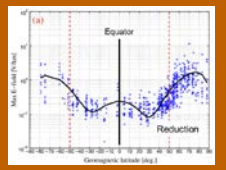


- Two-year effort began in 2017
- Tasks support TPL-007 standard
- Funded by industry and managed by EPRI
- Tools and reports available to the public at no charge

Geoelectric Field Evaluation

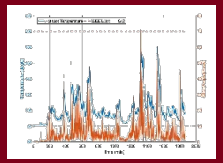


Latitude Scaling Factor



Harmonic Impacts

Transformer Thermal Impacts



Spatial Averaging

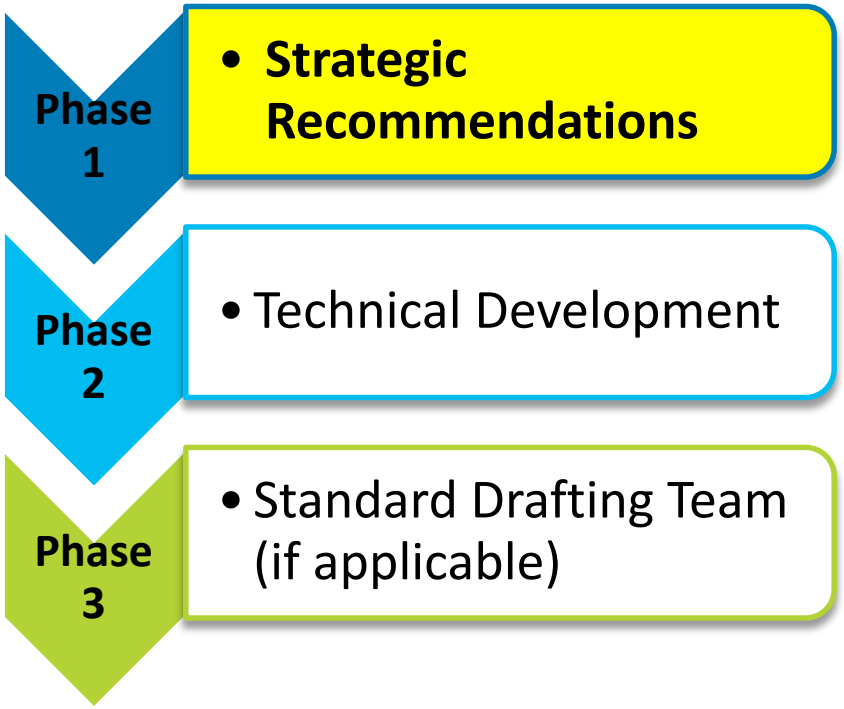
$$E_{peak} = 8 \times \alpha \times \beta \text{ (V/km)}$$

α= Geomagnetic Latitude Scaling Factors

β= Conductivity Scaling Factor

EMP Strategic Development

- **May 2019:** NERC launched a Task Force to identify reliability concerns associated with EMPs and potential methods for promoting resilience
- The Task Force is implementing a phased approach to advise NERC, regulators, and industry stakeholders on next-steps



Strategic Recommendations

- In November the Task Force will present recommendations to the NERC Board covering the following areas :
  - **Policy –** What needs to be clearly defined by the electric power industry and federal government
  - **Research –** What research is needed to prudently inform electric utilities that need to make decisions
  - **Vulnerability Assessments –** How the electric power industry applies policy and research to understand its vulnerability
  - **Mitigation Guidelines –** Fundamental suggestions and guidelines on prudent mitigation strategies
  - **Response and Recovery –** Based on the vulnerability assessments and applicable mitigation guidelines for any impacted facilities, how does a utility respond and recover

Questions and Answers