Draft TPL-007-1
Project 2013-03 Geomagnetic Disturbance (GMD) Mitigation

Standard Drafting Team
Industry Webinar
June 26, 2014
• Summary of changes to TPL-007-1
• Comments on benchmark GMD event
• Overview of GMD assessment process
• Next steps
• Question and answer

Presentation posted on the project page:
http://www.nerc.com/pa/Stand/Pages/Geomagnetic-Disturbance-Resource.aspx
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• It is the responsibility of every NERC participant and employee who may in any way affect NERC's compliance with the antitrust laws to carry out this commitment.
• Participants are reminded that this meeting is public. Notice of the meeting was posted on the NERC website and widely distributed. Participants should keep in mind that the audience may include members of the press and representatives of various governmental authorities, in addition to the expected participation by industry stakeholders.
Potential Impacts on the Power System

Geomagnetically-induced currents (GIC) can cause:
- Increased reactive power consumption
- Transformer heating
- Protection System misoperation
• Requires a **GMD Vulnerability Assessment** of the system for its ability to withstand a Benchmark GMD Event without causing a wide area blackout, voltage collapse, or damage to transformers, once every five years.
  - **Applicability:** Planning Coordinators, Transmission Planners

• Requires a **Transformer thermal impact assessment** to ensure that all high-side, wye grounded transformers connected at 200kV or higher will not overheat based on the Benchmark GMD Event
  - **Applicability:** Generator Owners, Transmission Owners
Changes Made to the Draft Standard

- Reordered the requirements
  - Comments indicated some confusion as to the order in which the requirements would be executed
- Established a floor of 15 Amperes (A) for Transformer Thermal Assessment
  - If calculated GIC is 15A or less, no further transformer thermal analysis is required
  - Technical justification: Continuous 15A exposure does not result in temperatures of concern, based on transformer testing
- Revised Implementation Plan
  - Moved earlier implementation steps (determine responsibilities, build models)
  - Maintained 4 year timeline to develop Corrective Action Plan
• Include Reliability Coordinators (RC) as an applicable entity
  ▪ But, RCs included as a recipient of the analyses for information and for situational awareness

• Establish an exemption for lower latitude systems
  ▪ Benchmark definition includes adjustment factors for earth conductivity and geomagnetic latitude, but assessment is required
  ▪ Technical justification not available at this point

• Change the benchmark GMD event geoelectric field magnitude
Comments on the GMD Benchmark

• Benchmark geoelectric field is too low
  ▪ Earlier work by GMD Task Force had peak fields of 20 V/km or more
  ▪ “Spatial averaging” technique is not documented in peer-reviewed technical papers

• Benchmark geoelectric field is too high
  ▪ Statistical analysis calculates to a field of 5.8 V/km
  ▪ Visual extrapolation implies a field of 3-8 V/km (why not 3 V/km or 5.8 V/km?)
GMD Benchmark Geoelectric Field

\[ E_{\text{peak}} = E_{\text{benchmark}} \times \alpha \times \beta \text{ (in V/km)} \]

where,

\[ E_{\text{peak}} = \text{Benchmark geoelectric field magnitude at System location} \]

\[ E_{\text{benchmark}} = \text{Benchmark geoelectric field magnitude at reference location (60° N geomagnetic latitude, resistive ground model)} \]

\[ \alpha = \text{Factor adjustment for geomagnetic latitude} \]

\[ \beta = \text{Factor adjustment for regional earth conductivity model} \]
Reference Geoelectric Field Amplitude

Statistical occurrence of spatially averaged high-latitude geoelectric field amplitudes from IMAGE magnetometer data (1993 – 2013)

1-in-100 Year Occurrence
3-8 V/km at 60° N geomagnetic latitude
8 V/km to be conservative
Response to the Benchmark Comments

- Statistical analyses (GMD Task Force and standards project) are based on the same data
- Spatial averaging of geomagnetic observation data is appropriate for assessing wide-area impacts
- Benchmark is conservatively “high” to provide for margin, given the uncertainties associated with these types of calculations
Integrated View of the GMD Assessment Process

Geomagnetic Field

Earth Conductivity Model

B(t)

dc System Model

E(t)

Transformer Model (Electrical)

GIC

Power Flow Analysis

vars

Bus Voltages
Line Loading & var Reserves

Assessment Criteria

Operating Procedures and Mitigation Measures (if needed)

Failed

Pass

Potential Mitigation Measures

Temp(t)

Hot Spot Temp

Transformer Model (Thermal)

GIC(t)
Implementation Plan

Date of Approval

60 Days
- R1
- Identify Responsibilities

14 Months
- R2
- System Models

18 Months
- R5
- GIC Flow Information

36 Months
- R6
- Thermal Assessment

48 Months
- R3, R4, and R7
- GMD Assessment
- Corrective Action Plan
Next Steps

- Formal Comment and Initial Ballot—June 13 – July 30, 2014
  - Technical Conference July 17, 2014
- SDT reviews ballot results and comments—August, 2014
- Post for a second ballot—August, 2014
- Seek NERC Board adoption at November meeting
- File with FERC by January 2015
**Project page:**  [http://www.nerc.com/pa/Stand/Pages/Project-2013-03-Geomagnetic-Disturbance-Mitigation.aspx](http://www.nerc.com/pa/Stand/Pages/Project-2013-03-Geomagnetic-Disturbance-Mitigation.aspx)

### Project 2013-03 Geomagnetic Disturbance Mitigation

#### Related Files

<table>
<thead>
<tr>
<th>Draft 2</th>
<th>Action</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 2 Standard</strong></td>
<td>Ballot and Non-Binding Poll</td>
<td>07/21/14 – 07/30/14</td>
</tr>
<tr>
<td>TPL-007-1 Clean</td>
<td>Info&gt;&gt;</td>
<td></td>
</tr>
<tr>
<td>Clean</td>
<td>Vote&gt;&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Implementation Plan</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean</td>
<td>Info&gt;&gt;</td>
<td></td>
</tr>
<tr>
<td>Redline to Last Posted</td>
<td>Vote&gt;&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Supporting Materials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unofficial Comment Form (Word)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Benchmark GMD Event White Paper</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean</td>
<td>Info&gt;&gt;</td>
<td></td>
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<tr>
<td>Redline to Last Posted</td>
<td>Vote&gt;&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Transformer Thermal Impact Assessment White Paper</strong></td>
<td></td>
<td></td>
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<tr>
<td>Clean</td>
<td>Info&gt;&gt;</td>
<td></td>
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<tr>
<td>Redline to Last Posted</td>
<td>Submit Comments&gt;&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>Thermal Screening Criterion white paper</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Common Questions and Responses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Join Ballot Pool&gt;&gt;</strong></td>
<td></td>
<td>06/13/14 – 07/14/14</td>
</tr>
</tbody>
</table>
Questions and Answers

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