

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Draft TPL-007-1

Project 2013-03 Geomagnetic Disturbance Mitigation

Standards Drafting Team

Industry Webinar

April 24, 2014

RELIABILITY | ACCOUNTABILITY



- Background and project overview
- Benchmark geomagnetic disturbance (GMD) event
- Draft standard and Implementation Plan
- Schedule
- Question and answer

Presentation posted on the project page:

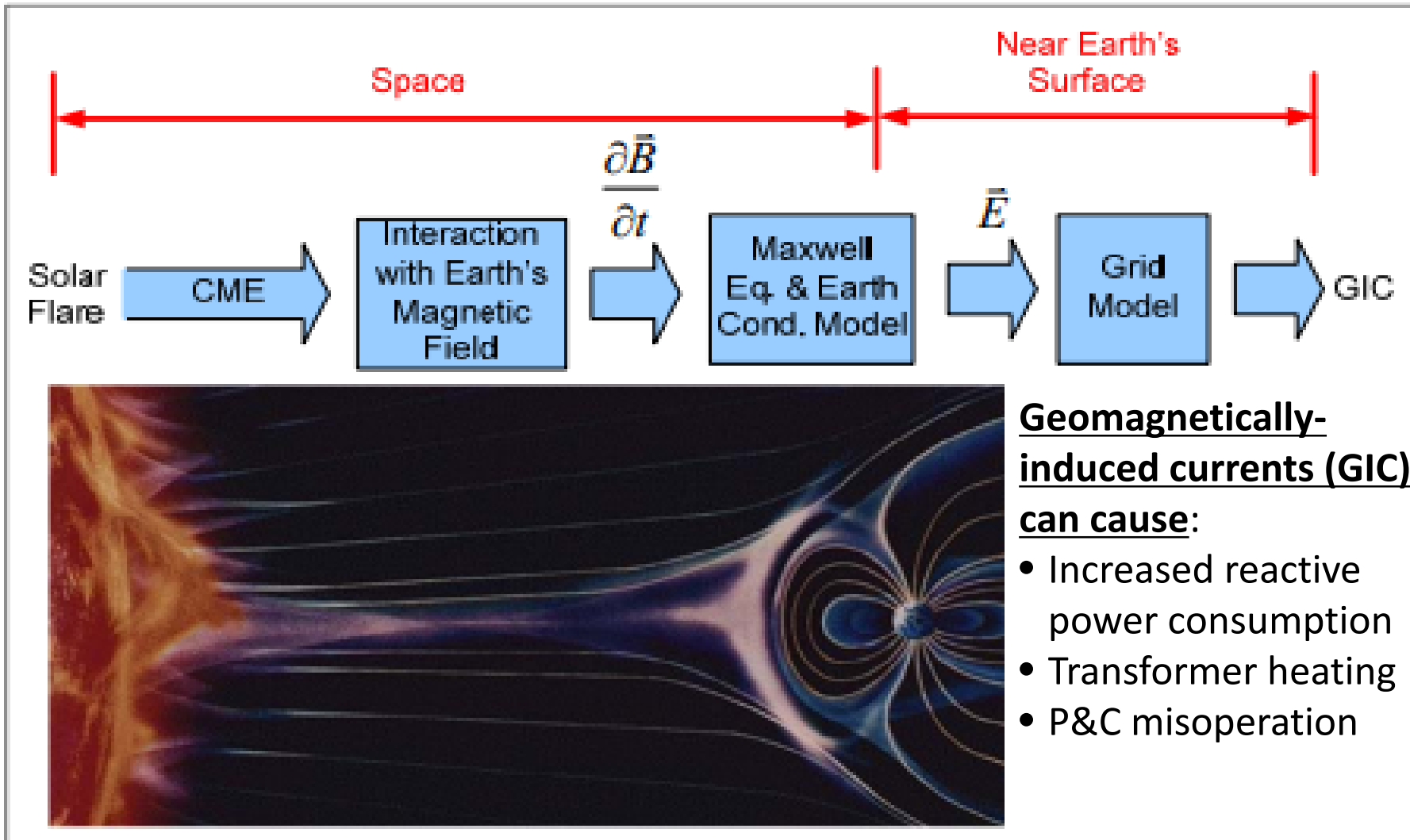
<http://www.nerc.com/pa/Stand/Pages/Geomagnetic-Disturbance-Resource.aspx>

- It is NERC's policy and practice to obey the antitrust laws to avoid all conduct that unreasonably restrains competition. This policy requires the avoidance of any conduct that violates, or that might appear to violate, the antitrust laws. Among other things, the antitrust laws forbid any agreement between or among competitors regarding prices, availability of service, product design, terms of sale, division of markets, allocation of customers or any other activity that unreasonably restrains competition.
- 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.



Background



- In May 2013, FERC issued Order 779 which directs NERC to submit Reliability Standards that address the impact of GMD on the reliable operation of the Bulk-Power System
 - Stage 1 – Operating Procedures
 - Stage 2 – Detailed Assessments (Planning Studies)
- Standards project 2013-03 (GMD Mitigation) began in June 2013

143 FERC ¶ 61,147
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

18 CFR Part 40

[Docket No. RM12-22-000; Order No. 779]

Reliability Standards for Geomagnetic Disturbances

(Issued May 16, 2013)

AGENCY: Federal Energy Regulatory Commission.

ACTION: Final Rule.

SUMMARY: Under section 215 of the Federal Power Act, the Federal Energy Regulatory Commission (Commission) directs the North American Electric Reliability Corporation (NERC), the Commission-certified Electric Reliability Organization, to submit to the Commission for approval proposed Reliability Standards that address the impact of geomagnetic disturbances (GMD) on the reliable operation of the Bulk-Power System. The Commission directs NERC to implement the directive in two stages. In the first stage, NERC must submit, within six months of the effective date of this Final Rule, one or more Reliability Standards that require owners and operators of the Bulk-Power System to develop and implement operational procedures to mitigate the effects of GMDs consistent with the reliable operation of the Bulk-Power System. In the second stage, NERC must submit, within 18 months of the effective date of this Final Rule, one or more Reliability Standards that require owners and operators of the Bulk-Power System to conduct initial and on-going assessments of the potential impact of benchmark GMD

Name	Registered Entity
Frank Koza (Chair)	PJM Interconnection
Randy Horton (Vice-chair)	Southern Company
Donald Atkinson	Georgia Transmission Corporation
Emanuel Bernabeu	Dominion Resource Services, Inc
Kenneth Fleischer	NextEra Energy
Luis Marti	Hydro One Networks
Antti Pulkkinen	NASA Goddard Space Flight Center
Qun Qiu	American Electric Power

- TPL-007-1 addresses directives requiring entities to assess impact of benchmark GMD events on systems and equipment
- Applies to Planning Coordinators, Transmission Planners, Transmission Owners and Generation Owners
 - Entities with grounded transformers connected ≥ 200 kV
- Planning entities are required to assess the risk of voltage collapse
 - Corrective Action Plans developed to address identified deficiencies
- Owners are required to assess thermal impact on transformers

- Informal comment period is underway through May 21, 2014 to solicit feedback on initial draft standard and related material
- Drafts posted to the project page
 - TPL-007-1 Transmission System Planned Performance During GMD
 - Implementation Plan
 - Benchmark GMD Event Description
 - Transformer Thermal Impact Assessment White Paper

Comment form:

<http://www.nerc.com/pa/Stand/Pages/Project-2013-03-Geomagnetic-Disturbance-Mitigation.aspx>

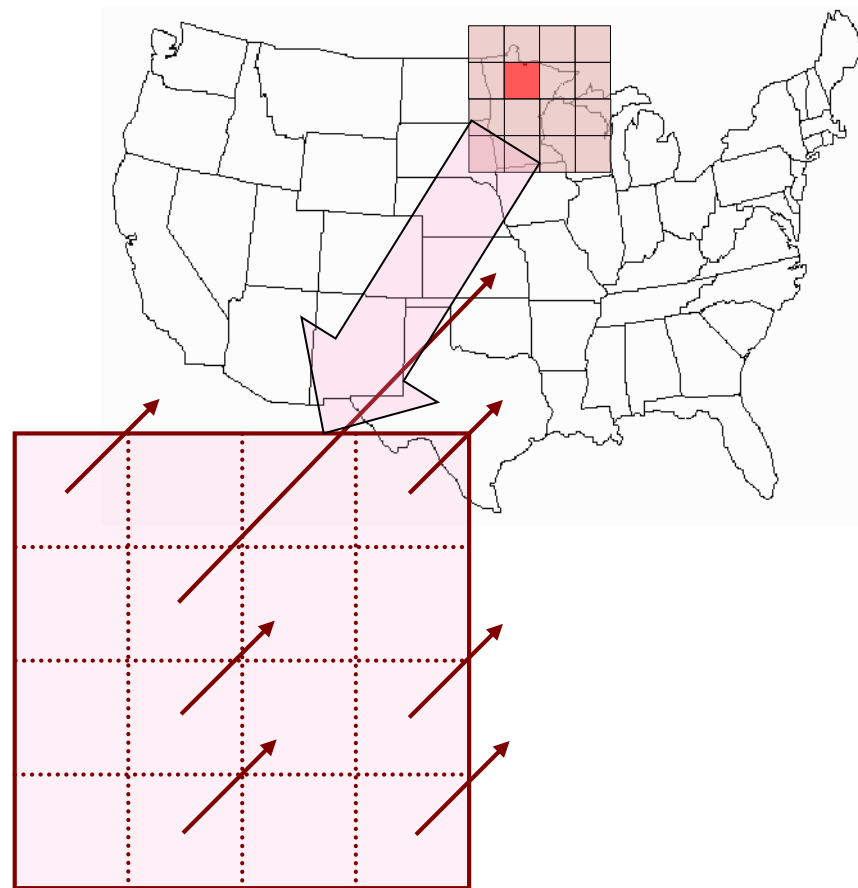


Benchmark GMD Event

- The Benchmark GMD Event is described by:
 - Reference geoelectric field amplitude
 - 1-in-100 year amplitude determined statistically from geomagnetic field measurements for a reference earth model
 - Used for GIC studies and load-flow simulations that account for transformer Reactive Power absorption
 - Reference geomagnetic field waveshape
 - March 13-14 1989 GMD event selected from recorded GMD events
 - Used for time-domain analysis on equipment such as transformer thermal impact assessment
- Scaling factors for geomagnetic latitude and local earth conductivity can be used to adjust geoelectric field amplitude

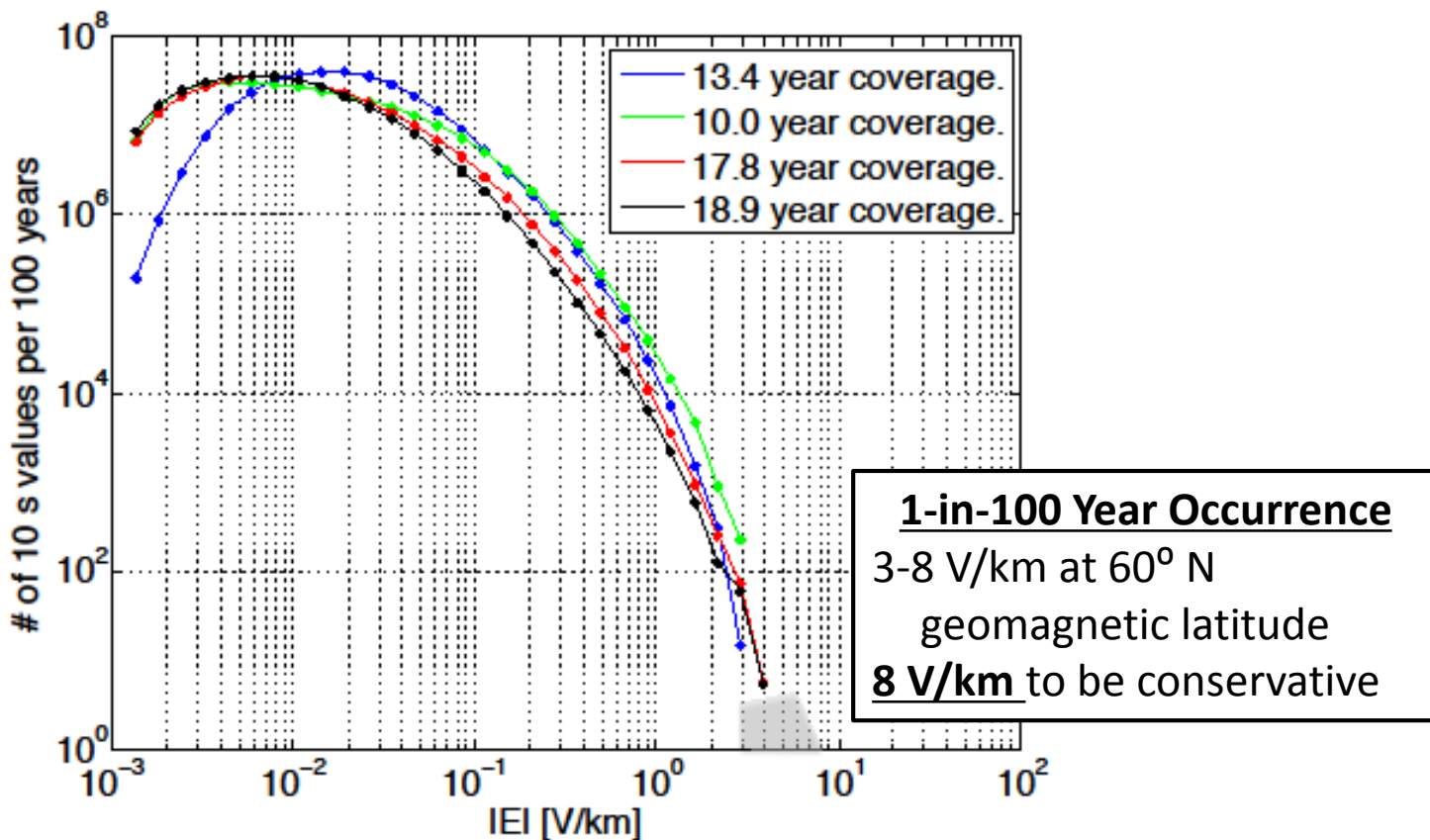
- The Benchmark GMD Event describes the design basis for GMD vulnerability assessment and planning studies
 - It defines the geoelectric field values used to compute GIC flows
- The Benchmark GMD Event takes into account known characteristics of a severe GMD event and impact on the system
 - Geomagnetic latitude
 - Earth conductivity
 - Transformer electrical response
 - Transformer thermal response
 - Geoelectric field waveshape
 - Wide-area geomagnetic phenomena

- Storm-time geoelectric fields are spatially complex which can bias statistical analysis
 - Localized e-field enhancements occur in small (~100 km) regions
- Benchmark analysis examined spatially-averaged data to address wide-area GMD effects



**Illustration of Localized
Geoelectric Field Enhancement**

Reference Geoelectric Field Amplitude



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

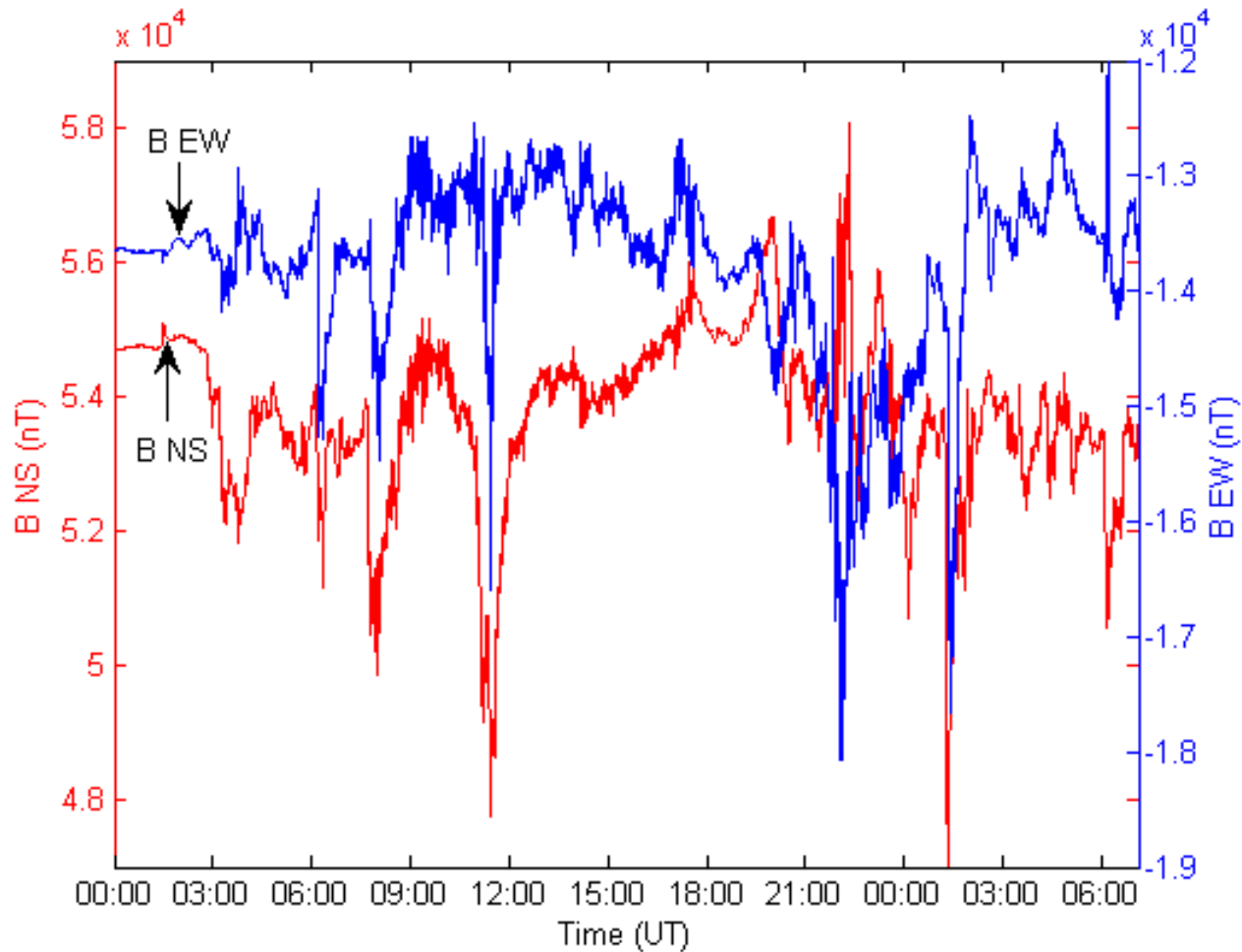
$$E_{\text{peak}} = 8 \times \alpha \times \beta \text{ (in V/km)}$$

where,

- E_{peak} = Benchmark geoelectric field amplitude at System location
- α = Factor adjustment for geomagnetic latitude
- β = Factor adjustment for regional Earth conductivity model

8 V/km is a statistically-determined 1-in-100 year peak geoelectric field amplitude at reference location (60° N geomagnetic latitude, resistive ground model)

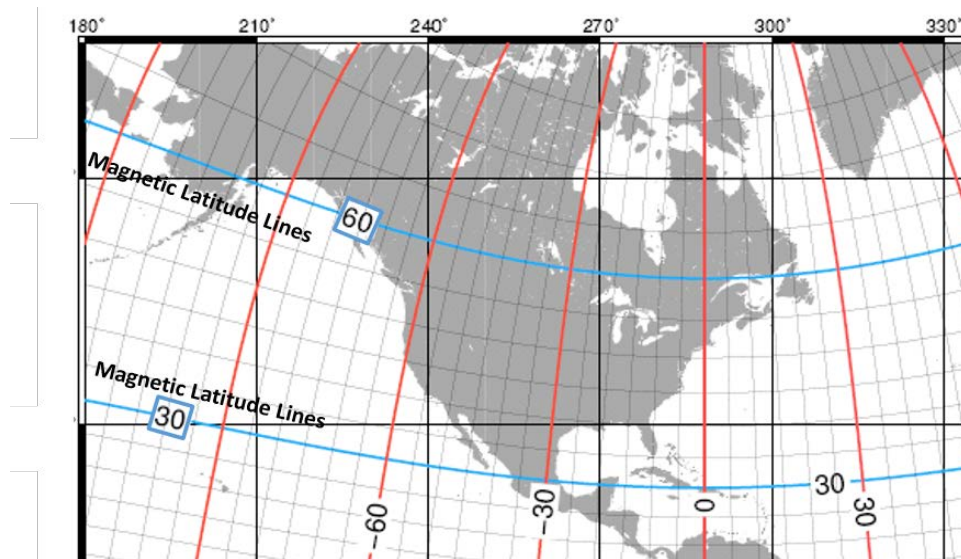
- Selected after analyzing recorded GMD events
 - March 13-14, 1989 from Natural Resources Canada (NRCan) observations
 - 2003 Halloween storm (Nurmijarvi and Memanbetsu observations)
 - NERC Interim Report reference storm
- NRCan Ottawa observatory 10-second data for March 1989 event selected
 - Provides conservative results for transformer thermal analysis



Benchmark geomagnetic field waveshape. Red Bn (Northward), Blue Be (Eastward).

- Determination of α scaling factors described in NERC GMD TF Application Guide for Computing GIC
- Table provided in TPL-007-1 Attachment 1 and Benchmark white paper

1.0 at 60° N	Juneau; Winnipeg; Churchill Falls, NL
0.3 at 50° N	New York ; St Louis; Salt Lake City
0.1 at 40° N	Jacksonville; New Orleans; Tucson



Geomagnetic Latitude Chart

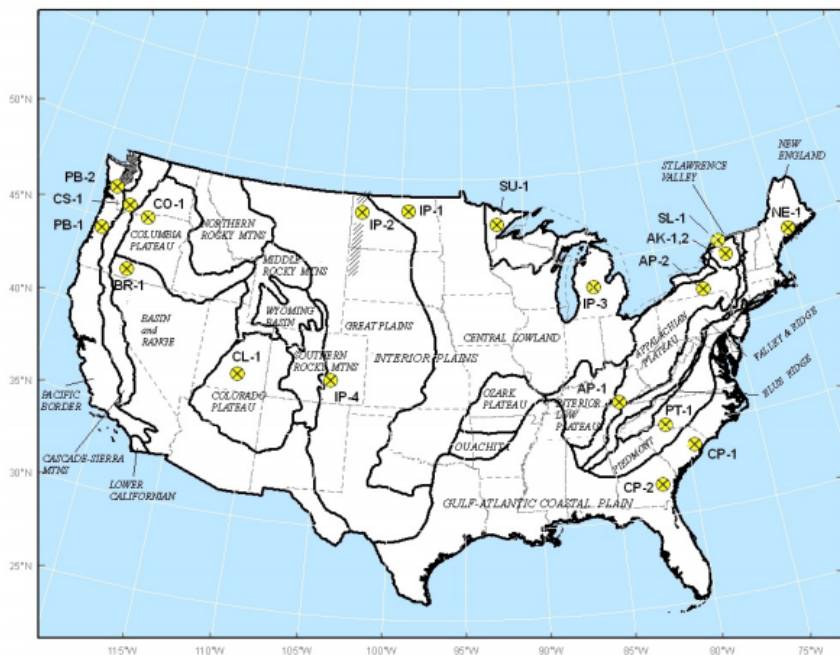
Earth conductivity model factor (β)

0.81 Atlantic Coastal (CP-1)

0.27 Columbia Plateau (CO-1)

0.67 British Columbia (BC)

0.79 Prairies



Based on information from US Geological Survey (USGS) and NRCAN



TPL-007-1

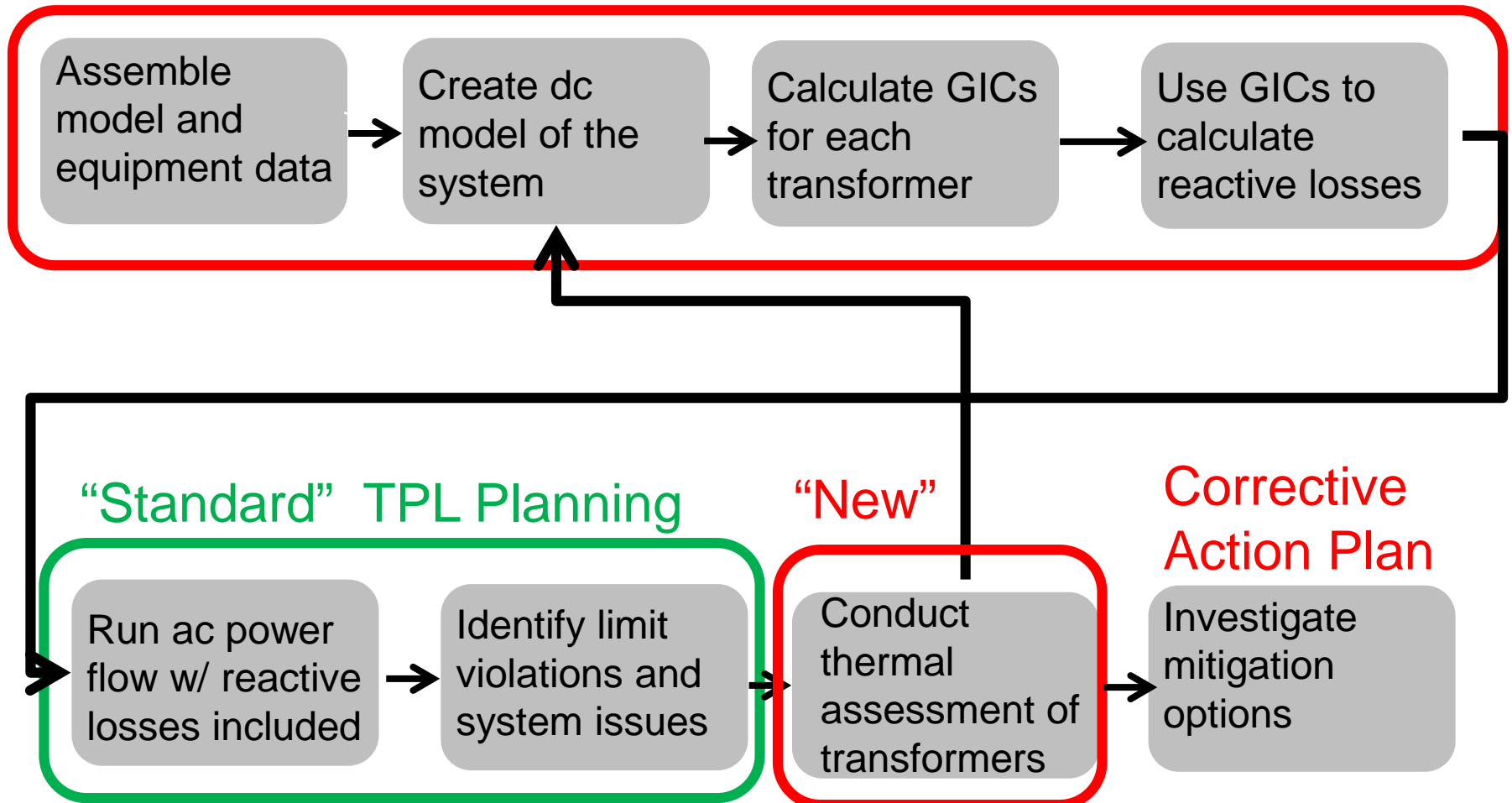
- Require a GMD Vulnerability Assessment of the system for its ability to withstand a Benchmark GMD Event without wide area blackout, voltage collapse, or damage to transformers

Applicability: PCs,TPs, TOs, GOs

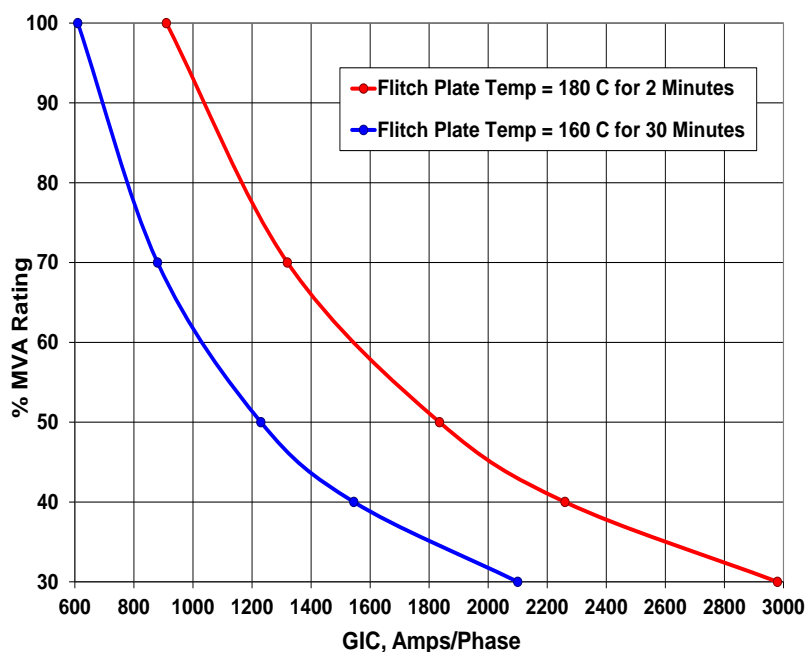
- Need system models— dc (GIC calculation) and ac (power flow)
 - Transformer information — internal winding resistance
 - Substation grounding information
- Studies that may be necessary to perform a GMD assessment:
 - Transformer GIC impact (Reactive Power and Thermal)
 - Power flow System studies
 - Impact of harmonics on Reactive Power compensation devices

“New” Planning Steps

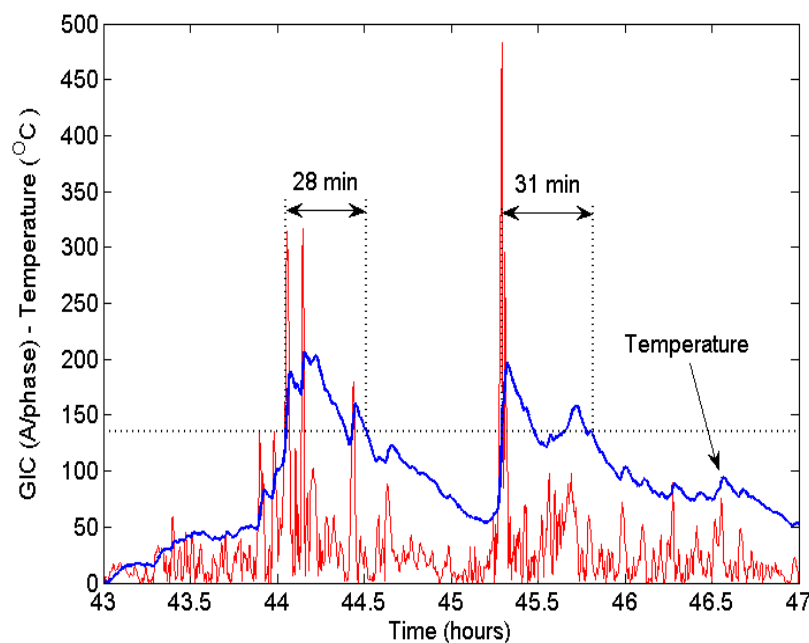
GIC Calculation is now available on most power system analysis software



- Consult manufacturer or IEEE Std C57.91 for temperature limits
- Assessment approaches:



Transformer manufacturer capability curves



Thermal response simulation

- A phased implementation over a four-year period is proposed for TPL-007-1 to provide adequate time for:
 - Model development
 - Sequencing of assessments (System GIC studies and transformer thermal impact assessments)
 - Development of Corrective Action Plans, if necessary



Project Schedule

- Informal comment period: April 22–May 21, 2014
- Technical Conference: May 20, 2014 | 8:30 a.m.– 4:00 p.m.
 - NERC Atlanta and webinar
 - Details and registration information to follow
- Drafting team will meet in early June to consider comments and revise drafts
- Initial comment and ballot beginning in June 2014
- NERC Board of Trustees adoption by November 2014

- Project page: <http://www.nerc.com/pa/Stand/Pages/Project-2013-03-Geomagnetic-Disturbance-Mitigation.aspx>

Program Areas & Departments > Standards > Project 2013-03 Geomagnetic Disturbance Mitigation

Project 2013-03 Geomagnetic Disturbance Mitigation

Related Files

Draft	Action	Dates
<p>Draft 1</p> <p>Stage 2 Standard</p> <p>TPL-007-1</p> <p>Implementation Plan</p> <p>Supporting Materials</p> <p>Unofficial Comment Form (Word)</p> <p>Benchmark GMD Event White Paper</p> <p>Transformer Thermal Impact Assessment White Paper</p>	<p>Comment Period</p> <p>Info>></p> <p>Submit Comments>></p>	<p>04/22/14 - 05/21/14</p>

- GMD TF Page: [http://www.nerc.com/comm/PC/Pages/Geomagnetic-Disturbance-Task-Force-\(GMDTF\)-2013.aspx](http://www.nerc.com/comm/PC/Pages/Geomagnetic-Disturbance-Task-Force-(GMDTF)-2013.aspx)
- Application Guide: Computing GIC in the Bulk-Power System
http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/GIC%20Application%20Guide%202013_approved.pdf
- GMD Planning Guide:
http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%202013/GMD%20Planning%20Guide_approved.pdf



Questions and Answers

Send questions by chat