

WECC

TPL-007-2 — Transmission System Planned Performance for Geomagnetic Disturbance (GMD) Events

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November 16, 2017

Purpose of Standard:

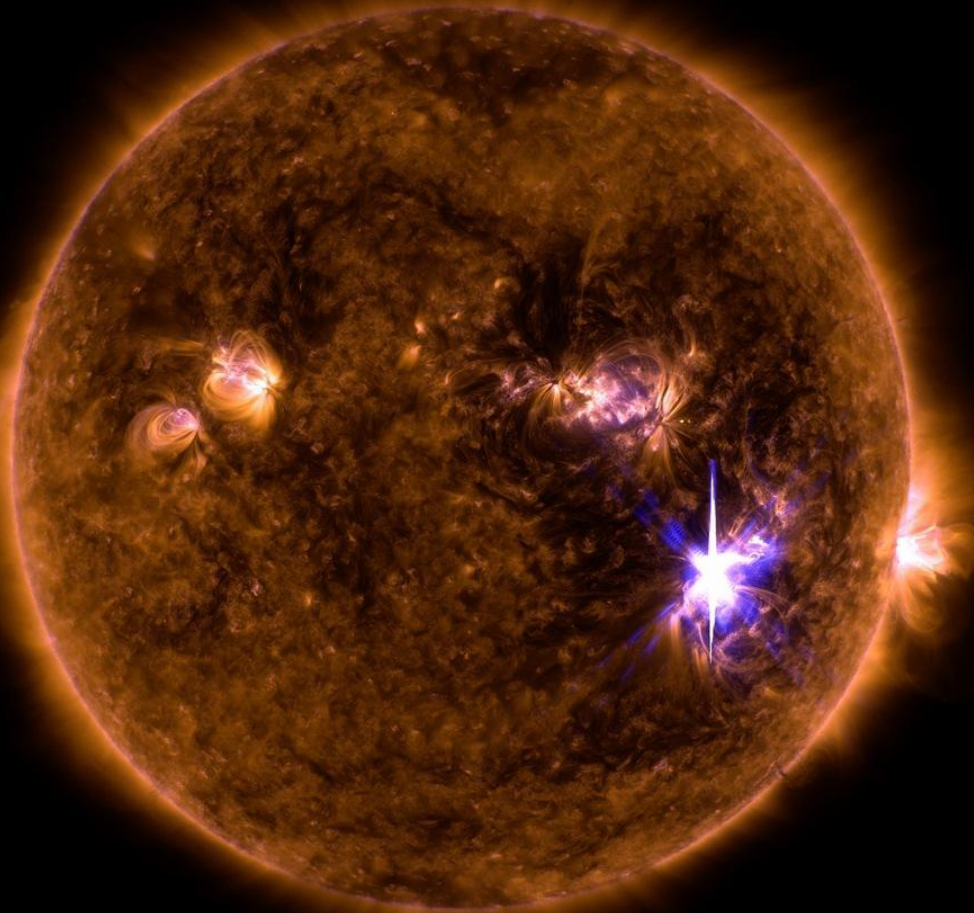
Establish requirements for transmission system planned performance during geomagnetic disturbance (GMD) events.

Reliability Issues

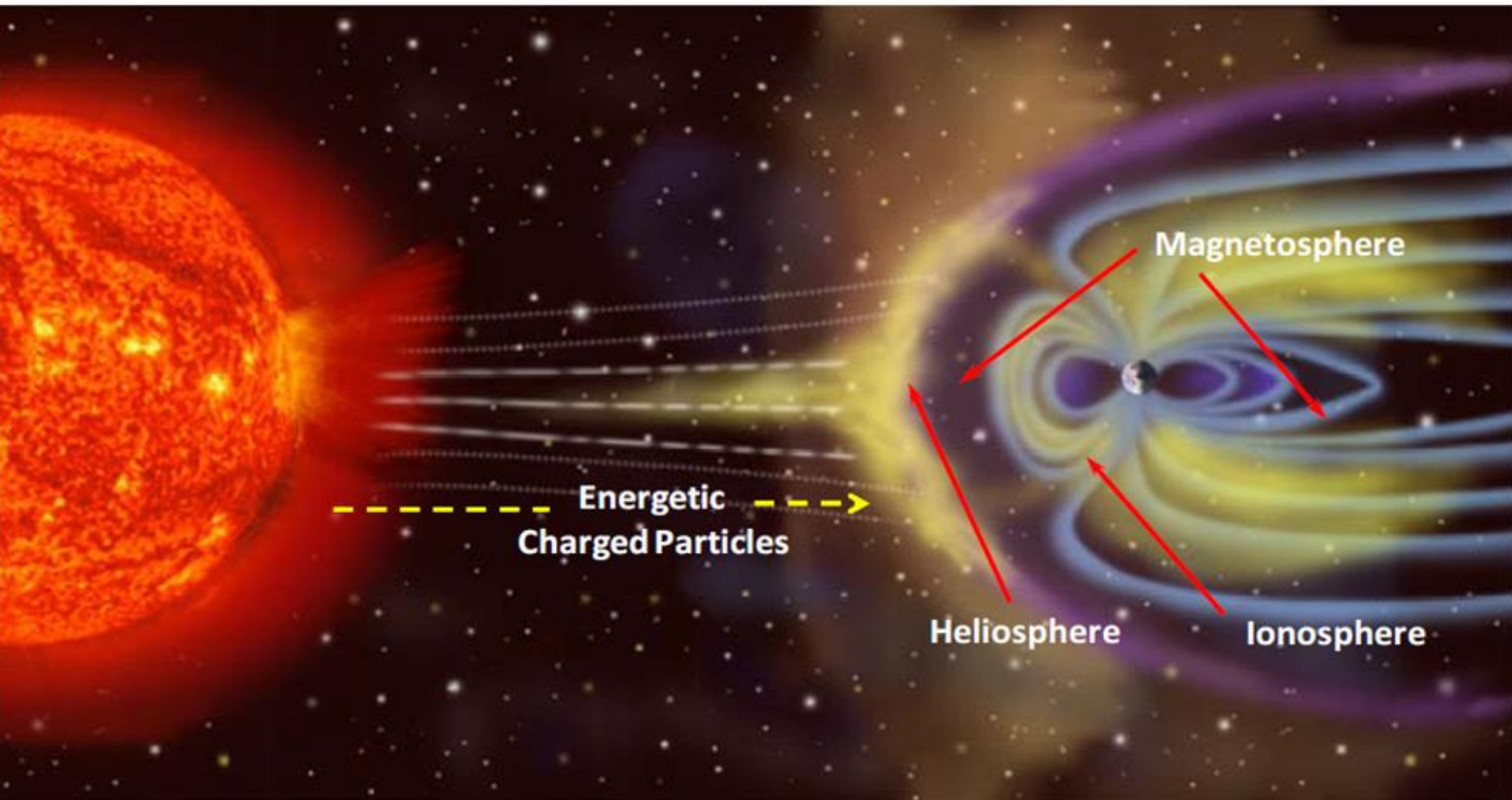
There are two reliability risks that result from the introduction of *Geomagnetic Induced Currents* to the bulk power system:

- *Damage to bulk power system assets, typically associated with transformers, and*
- *Loss of reactive power support, which could lead to voltage instability and power system collapse.*

Solar Flares



Geomagnetic Disturbance





Aurora Borealis or Northern Lights



Geomagnetic Induced Currents

- Charged particles from the coronal mass ejections (CME) interact with Earth's magnetosphere-ionosphere and produce ionospheric currents, called electrojets.
- Electrojets perturb Earth's geomagnetic field, inducing voltage potential at Earth's surface and resulting in Geomagnetic Induced Currents (GIC).

DC Ground Currents

- Long man-made conducting paths, such as transmission lines, metallic pipelines, cables and railways, can act as “antennae.”
- This action can allow small DC currents to enter and exit the power system at transformer grounds, disrupt the normal operation of the power system and, in some cases, cause damage to equipment.

Applicability

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;

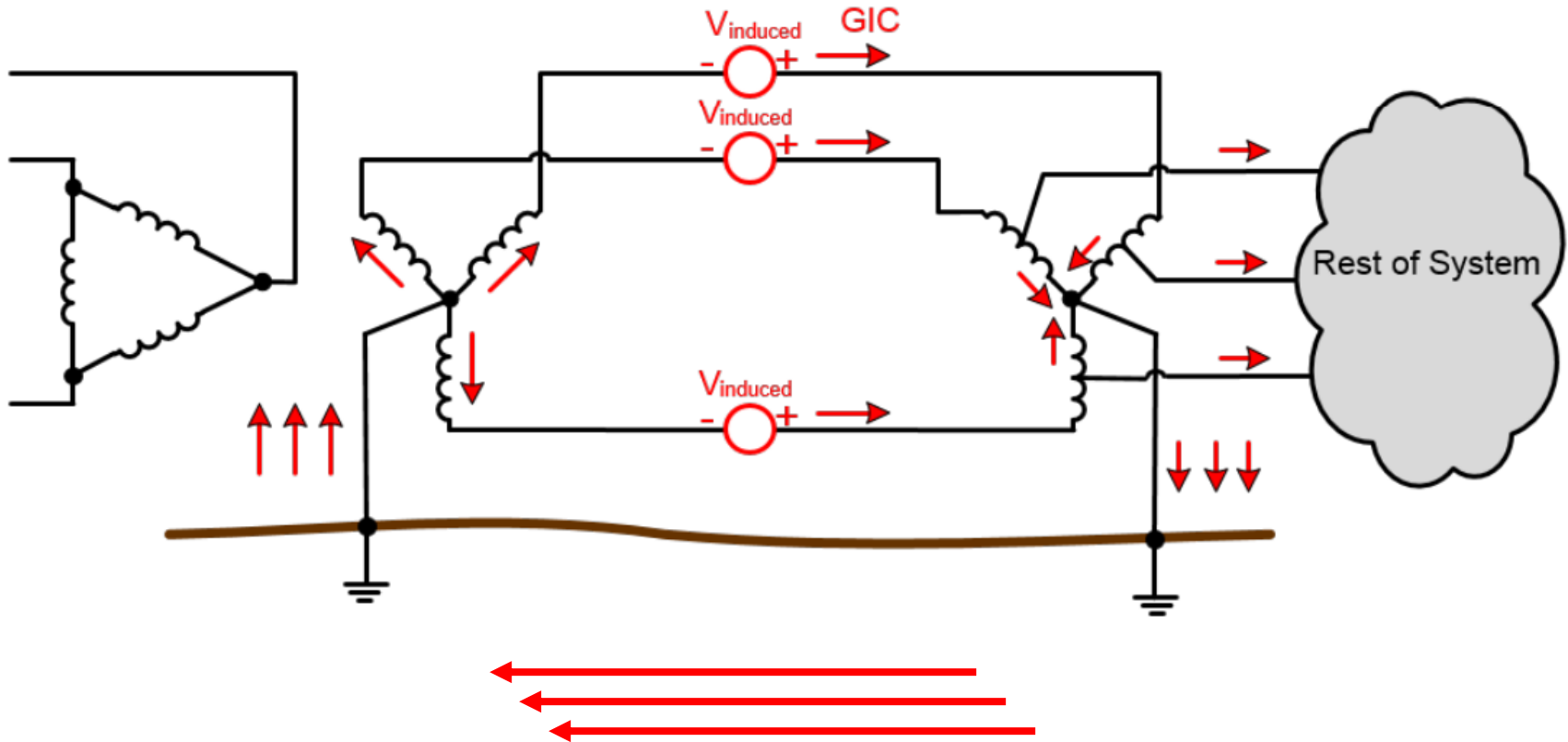
4.1.3 **Transmission Owner** who owns a Facility or Facilities specified in 4.2;

4.1.4 **Generator Owner** who owns a Facility or Facilities specified in 4.2.

4.2. Facilities:

Facilities that include power transformer(s) with a high side, wye-grounded winding with terminal voltage greater than 200 kV.

GIC Flow in a Simplified Power System



Geomagnetically-Induced Current (Ground Current)

Affect on System Reliability

The flow of these DC currents in transformer windings can lead to increased transformer hotspot heating, and reactive power absorption – each of which can affect system reliability.

WECC Planners working with TPs and PAs

Developing “two” data sets.

The Geomagnetic Induced Current (“GIC”) data essentially goes on top of the standard power flow data.

The GIC data is dependent on a power flow case.

The data is not covered by the MOD-032 process primarily because GIC is all DC analysis.

WECC Planning Department...

Working with General Electric to create a GIC Model:

- Developing a Western Interconnection-wide Geomagnetic Induced Current (“GIC”) model that can be used by NERC registered entities to perform the assessments specified in TPL-007.
- Model will help determine the data quality of GIC information provided by WECC, identify appropriate data if essential data is missing, and help develop data checks and automate corrections.

WECC Planning Department...

- Train WECC in the use of GIC simulation tools
- Perform an assessment of the GIC flows in the Western Interconnection-wide GIC model.

The Western Interconnection-wide GIC model will be used by NERC registered entities to perform the assessments specified in NERC Reliability Standard TPL-007-1, Requirement R4.

Update on TPL-007-2....

On September 22, 2016, FERC issued Order No. 830 approving Reliability Standard TPL-007-1 and its associated five-year Implementation Plan.

In the Order, FERC also directed NERC to develop certain modifications to the standard. FERC established a deadline of 18 months from the effective date of Order No. 830 for completing the revisions, which is May 2018.

Modifications to TPL-007-1

- Modify the benchmark GMD event definition used for GMD Vulnerability Assessments;
- Make related modifications to requirements pertaining to transformer thermal impact assessments;
- Require collection of GMD-related data. NERC is directed to make data available; and
- **Require deadlines for Corrective Action Plans and GMD mitigating actions.**

TPL-007-2

A standard drafting team (SDT) was appointed in December 2016 to develop revisions to TPL-007-1 addressing the above directives.

So...TPL-007-2 has been created and addresses the FERC directives.

Final ballot was on October 30, 2017.

Corrective Action Plans (R7)

- When the responsible entity concludes through a benchmark GMD Vulnerability Assessment that its system does not meet the performance requirements for the steady state planning benchmark GMD event contained in Table 1 of the standard, it shall have evidence of a corrective action plan (CAP) including timetable for implementing selected actions.

Corrective Action Plans (R7)

In Order No. 830, FERC directed revisions to TPL-007-1 such that CAPs are developed within one year from the completion of GMD Vulnerability Assessments. FERC also directed an *establishment of implementation deadlines* after the completion of the CAP as follows:

- Two years for non-hardware mitigation; and
- Four years for hardware mitigation.

If the required deadline cannot be met, the implementing entities would be required to report to the RC and adjacent PCs and TPs within 90 days and provide basic update reports on an annual basis until completed.

Reference Documents

- *NERC Geomagnetic Disturbance Planning Guide*
http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%20013/GMD%20Planning%20Guide_approved.pdf
- *Transformer Modeling Guide*
<https://www.aeso.ca/assets/linkfiles/4040.002-Rev02-Transformer-Modelling-Guide.pdf>
- *Application Guide for Computing Geomagnetically-Induced Current (GIC) in the Bulk-Power System*
http://www.nerc.com/comm/PC/Geomagnetic%20Disturbance%20Task%20Force%20GMDTF%20013/GIC%20Application%20Guide%202013_approved.pdf



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