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Compliance solutions for Geomagnetic Disturbance mitigation

NERC-TPL-007

At a glance

Geomagnetic Disturbances (GMDs) occur when solar energetic particles from the sun migrate to the earth. These auroral electrojets cause short-term variations in the earth's magnetic field. The changes in earth's magnetic field create an electric field over the surface of the affected region, which in turn induces voltages in high-voltage transmission lines.

The induced voltages in transmission lines cause Geomagnetically Induced Currents (GICs) to flow if there is a closed path for currents to circulate.

These closed paths in the electrical grid typically exist in the transformer grounding connections. GICs are low frequency currents (below 1 Hz). Their flow through transformers result in half-cycle saturation leading to increased VAR losses and harmonic distortion that may lead to voltage stability problems.

The goal of the North American Electric Reliability Corporation (NERC) Reliability Standards is to protect and maintain the reliability of the North American Bulk Electrical System (BES). NERC's Transmission Planning (TPL) standards

establish transmission system planning performance requirements within the planning horizon to develop a BES that will operate reliably over a broad spectrum of System conditions and following a wide range of probable Contingencies.¹

NERC TPL-007 establishes reliability requirements for assessing transmission system planned performance during a GMD event.

¹ www.nerc.com

Applicability

- *Planning Coordinator / Transmission Planner* with an area that includes a power transformer with a high side, wye-grounded winding connected at 200 kV or higher
- *Transmission Owner / Generation Owner* who owns a power transformer(s) with a high side, wye-grounded winding connected at 200 kV or higher

Requirements and measures

There are seven notable requirements outline in this standard, with the results of Requirements R1 through R5 determine the applicability of the remaining requirements.

- **Requirement R1** requires that each Planning Coordinator, in conjunction with its Transmission Planner(s), identify the individual and joint responsibilities of each for maintaining models and performing the necessary study work to complete GMD Vulnerability Assessment(s).
- **Requirement R2** mandates that each entity identified in Requirement R1 maintain System models and GIC System models of the applicable planning area for completion of GMD Vulnerability Assessment(s).
- **Requirement R3** requires that each entity demonstrate availability of the criteria for acceptable System steady state voltage performance.
- **Requirement R4** mandates the completion of a GMD Vulnerability Assessment of the Near-Term Transmission Planning Horizon, once every 60 calendar months. The assessment results will be used to determine whether the System meets specific performance requirements outlined in the Standard.
- **Requirement R5** mandates that each entity provide GIC flow information to each Transmission Owner and Generator Owner that owns an applicable BES power transformer. With this information, each Transmission Owner and Generator Owner is required by Requirement R6 to conduct a thermal impact assessment for its solely and jointly owned applicable BES power transformers where the maximum effective GIC value provided is 75 A per phase or greater.

- **Requirement R7** requires that each responsible entity that concludes, as a result of the GMD Vulnerability Assessment, that their System does not meet performance requirements must develop a corresponding Corrective Action Plan that identifies actions necessary to mitigate the impacts and meet performance requirements.

Our solution

Power system planners and operators will require technical tools and/or consultative services to conduct studies to assess the impact of GIC currents in the power grid and prepare mitigation measures. Siemens PTI's comprehensive expertise in power system planning allows us the ability to offer both consulting solutions, as well as software tools, specifically tailored to the client's particular needs in regards to compliance with NERC TPL-007.

The experts at Siemens PTI are globally renowned for their in-depth knowledge built over decades of experience. By contributing actively to national and international committees and bodies, such as the NERC Reliability Standards Committee and IEEE Standards Working Groups, our consultants have an active role in shaping the future of technical developments and standards. Having this deep understanding allows for Siemens PTI to provide recommendations and alternative missing data or other challenges that may arise during a GMD Vulnerability Assessment.

North American transmission owners seeking a timely, cost effective and proven solution can leverage Siemens PTI's vast industry expertise, from planning through operations, to comply with the TPL-007 reliability standard with a customized solution that fits their needs.

How to get started

For further information, please contact Siemens PTI consulting sales at pti-consulting.ptd@siemens.com or +1 518 395 5000.

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