

GIC module to analyze geomagnetic disturbances on the grid

PSS®E

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 challenge

Power system planners and operators require technical tools to conduct studies to assess the impact of GIC currents in the power grid and prepare mitigation measures.

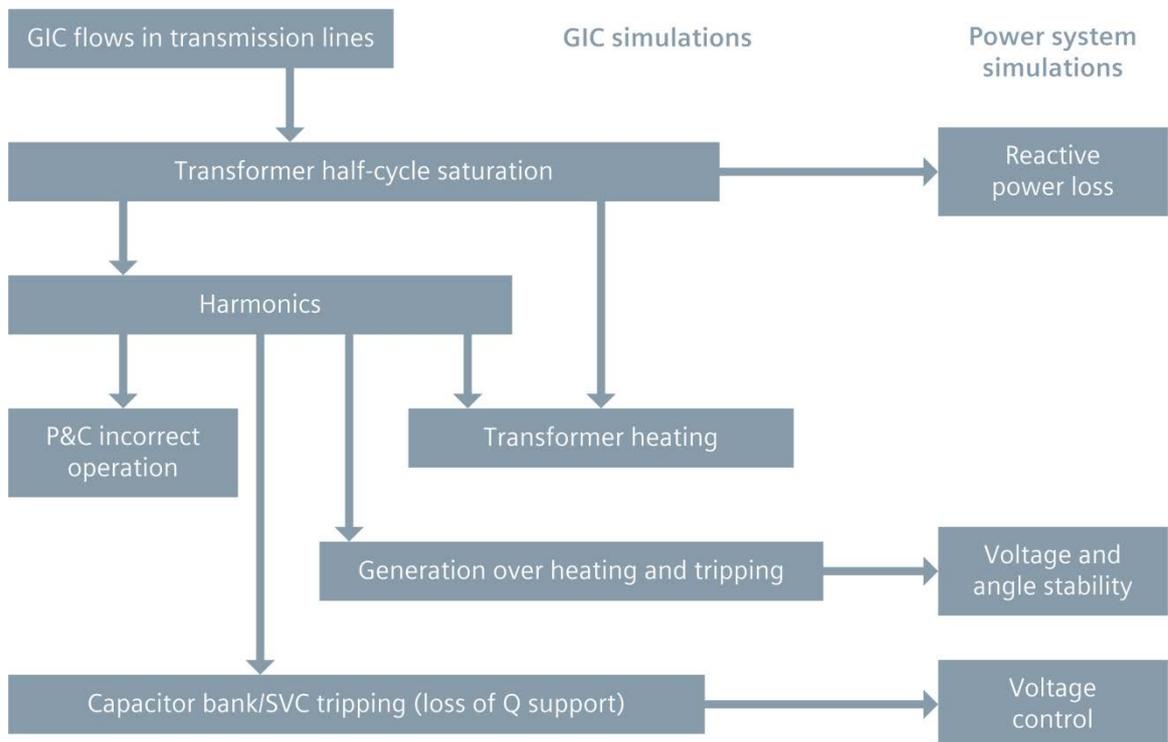


Figure 1: Potential effects of GIC on the power system grid

Our solution

PSS®E Versions 32.2 and 33.3 introduced a value-added GIC module to analyze the effects on a transmission network. The newly offered module will use the calculation method as shown in Figure 2.

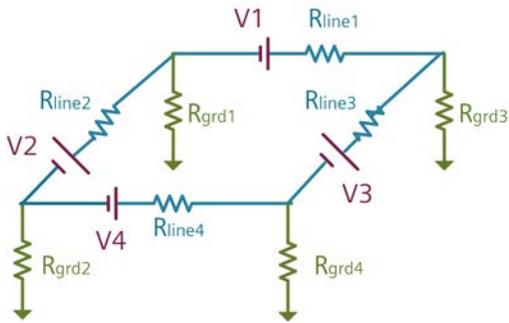


Figure 2: Method used for the GIC calculations

The method used is the Induced Voltages in Transmission Lines as voltage sources. This is the latest method of calculation recommended by NERC GMD Task Force.

In addition to the basic PSS®E power flow network data, the GIC module requires additional data that can be input through the GIC module graphical user interface (GUI) within PSS®E. This will create an auxiliary text file with an extension of *.GIC¹.

The input data required in the *.GIC file for calculations are:

- Geographic location (longitude and latitude for substations)
- Grounding resistance data for substations
- DC resistance of transformer windings
- Identification of the GIC blocking device in the grounding connection
- Transformer vector group

Optional data for transformers²

- Number of cores
- K Factor

Note: PSS®E sequence data is not required.

The results of the GIC analysis include:

- Transmission line induced DC voltages
- DC voltages at network buses and substation ground buses
- GIC flow in transmission lines, transformer windings and substation grounds
- Reactive power losses in transformers
- Substation ground and branch GIC flows
- Bus voltages

These results can be viewed either in a text report, on a network map or in a network slider diagram. The power flow case containing the output of the GIC calculation can be saved as a Saved Case (.sav) or as a PSS®E change file.

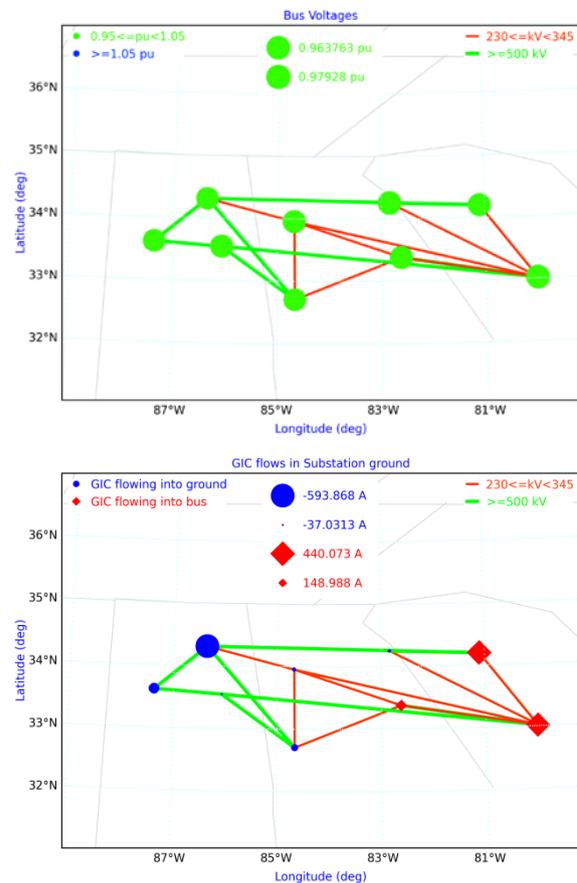


Figure 3: Effects of GIC on bus voltages and substations

For additional scenario analysis for a variety of power system network conditions and configurations, these saved files can be used in power flow, contingency and dynamics. Operational mitigation measures and equipment mitigation measures can be planned and implemented using these results.

¹ If desired, the *.GIC file can be created using any text editor, or Microsoft® Excel®.

² If not provided, default values will be used.

How to get started

For further information or to purchase the GIC Module, please contact Siemens PTI software sales at pti-software-sales.ptd@siemens.com or +1 518 395 5000.

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