GE
Energy Consulting

Global Power Projects

The Global Power Projects team is made up of a core group of leading technical and business experts from GE who use cross-company resources to help you solve your most difficult challenges. Our team can help you with your renewables application issues, and we also can perform grid code testing of power generation equipment and sub-synchronous torsional interaction analysis and risk mitigation. Additionally, we have expertise in power system stabilizer application issues as well as utility IT and grid modernization projects.

Renewables application issues

As renewable energy penetration grows, so do the complexities of integrating those renewables into the bulk power grid. Evolving technical and regulatory requirements around volt/var and power frequency dynamic performance and modeling make it necessary to thoroughly analyze and test wind and solar plants to help ensure they are properly designed and tuned.

The Global Power Projects team offers a package of studies and services to evaluate the electrical design and performance of wind and solar plants for a more robust grid connection that meets local codes and technical regulations. Interconnection of these plants requires special considerations, such as:

- Properly coordinating wind turbine/solar inverter and plant active and reactive power controls
- Understanding and modeling transient, dynamic and short circuit behavior of renewable generation
- Coordinating plant controls and protection

We use advanced tools, including proprietary GE software, and have extensive wind plant study experience to address these special considerations.

Benefits of the design review study

The renewable plant owner and developer benefit from this design review study package by:

- Receiving verification of plant design capabilities to meet the interconnection code
- Identifying potential concerns and getting remedial recommendations early in the requisition phase
- Obtaining report documentation to help satisfy grid operator requirements for interconnection as well as coordinated protection and control settings for the plant

If needed, you may choose to obtain plant-specific tuning, testing, and model verification of the in-service plant. Additionally, you may select special analyses to solve complex technical issues, such as multi-plant voltage regulator coordination, weak system interconnection, and evaluation of sub-synchronous control interaction or advanced dynamic modeling to meet specific regulatory requirements or overcome technical challenges.

Grid code compliance testing

Recent power system disruptions have prompted regulating agencies to more closely examine generating units' capabilities for dynamic support from a frequency and voltage/reactive power control perspective. These same realities have raised significant interest in the models of generation equipment that are used in power system planning and analysis. This has led to requirements that generating units be tested to confirm proper dynamic performance of their controls, and to update the associated dynamic model data. Testing for these purposes is now recognized as practical, having minimal intrusion on plant operations and yielding significant benefits to generating plants and to the interconnected grid.

We execute power plant dynamic performance tests, and our team of engineers has more than 100 person-years of experience in performing tests and analysis for all segments of the power generation industry. In fact, we've supported tests on nearly 1,000 generating units and renewable plants around the world, ranging in size from small diesel generating sets to large nuclear steam turbines.

Benefits of grid code compliance testing

This testing provides the industry with accurate models for use in interconnected system simulation studies, as well as practical demonstration of the units' dynamic capabilities. Our efficient execution of these tests and subsequent analyses help ensure that you secure expedient interconnection approval and remain connected to the local grid.

Turbine-generator sub-synchronous torsional interaction risk analysis, mitigation, and testing

Turbine-generators can be subject to electrical environments that react with turbine-generator shafts to produce torsional vibrations at natural frequencies. These vibrations cause cumulative fatigue damage when they exceed material fatigue limits and result in reduced component life for such parts as shafts, buckets (blades), retaining rings, and rotors. In some severe cases these adverse interactions have led to growing oscillations and damage, including twisted couplings and broken shafts.

Since the early 1970s, GE has pioneered the analysis and mitigation of torsional problems, and has offered protective relays and monitoring equipment to address these problem areas. Our current generation of torsional protection and monitoring products builds on GE's extensive experience and features digital processors, built-in monitoring, and higher reliability.

The Torsional Stress Relay (TSR) is a digital protective relay designed to continuously monitor the turbine-generator's shaft for torsional oscillations, and provide trip output contacts when shaft fatigue reaches predetermined levels. Torsional event data capture is also provided. The TSR is an updated digital version of GE's proven SMF relay, which has been applied successfully since 1976 to many turbine-generators that are exposed to risks of harmful torsional interactions.

Benefits of GE's analysis

The Global Power Projects team can evaluate and recommend protection and/or mitigation solutions for those applications at risk of sub-synchronous torsional interaction. Additionally, we have expertise in testing generator applications for sub-synchronous interaction, and we can support commissioning of mitigation solutions.

Power system stabilizer design, tuning, and testing

Excitation systems with high gain and fast response times greatly aid transient stability (synchronizing torque) but at the same time tend to reduce small signal stability (damping torque). The objective of the power system stabilizer (PSS) control is to provide a positive contribution to damping of the generator rotor angle swings, which are in a broad range of frequencies in the power system. These range from low frequency intertie modes (typically 0.1 – 1.0 Hz) to local modes (typically 1 – 2 Hz) to intra-plant modes (about 2 – 3 Hz).

PSS performance is often evaluated from the damping of the "local mode," with the generator swinging against the rest of the power system. This mode is usually at frequencies between 1 and 3 Hz. Stronger system ties and lighter loading tend to give higher local mode frequencies, and weaker ties and heavier loading tend to give lower local mode frequencies. The PSS must be designed to accommodate a wide range of system conditions that can result from different operating situations, such as out-of-service lines or varying load levels.

Proper application and tuning of the PSS require a system study to identify the best practical performance. The use of small-signal frequency-domain techniques has proved to be very effective in these studies, and the Global Power Projects team has developed simulation tools for these types of studies.

In addition to the damping of the low frequency modes, which are of primary importance, the PSS can also introduce undesirable effects at the characteristic modes of the turbine-generator mechanical torsional system. GE's position is that such interaction must be strictly limited for any applications involving GE turbine-generator designs. Filters to reduce torsional signal levels are found in GE's PSS designs, and the settings for the filters are determined from screening studies.

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GEA30587 (04/2013)