EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Substation Seismic Studies

Substation equipment damage from an earthquake.

- **Offer data to engineers to specify adequate seismic requirements for substation equipment**
- **Provide testing procedures to engineers to help with qualifying substation equipment**
- **Research ways to potentially improve the survivability of substation equipment and minimize damage during earthquakes**

Background, Objectives, and New Learning

Substation Seismic Studies project was initiated in 2000. IEEE Standard 693, *Recommended Practice for Seismic Design of Substations* is used by electric power utilities to qualify substation equipment for seismic movements. Deficiencies were deemed to exist in the original standard, and information was unavailable for dynamic response to better analyze equipment, and/or permit their evaluation in cases of limited configuration changes, such as insulator substitution. Several utilities, including representatives who had participated in the IEEE 693 Working Group, worked with EPRI to start a collaborative project to address deficiencies in the standard.

The project has been addressing perceived deficiencies in the standard, and filling knowledge gaps in the industry, by performing tests in the laboratory and analyzing the results. These tests are intended to gather dynamic response information that may be used to better analyze the equipment, and permit their evaluation in case of limited configuration changes, such as insulator substitution. Equipment qualified using the recommended practice are expected to perform acceptably under reasonably anticipated strong ground motion events.

The knowledge gained from this project is intended to seismically qualify substation equipment using IEEE Standard 693.

Benefits

The project addresses perceived deficiencies in the existing standard used to evaluate performance of substation equipment. These evaluations are meant to help qualified products to have higher probability of surviving earthquakes. As a result of this research and development, it is expected that repairs of damaged equipment, and duration of power interruptions, will be reduced. These enhancements may improve the reliability, safety, and affordability of electric power supplies.

Project Approach and Summary

Testing is usually performed at facilities as directed by EPRI, with input from the participants. Project management and technical services are also provided by EPRI.

Each year since the project started, EPRI has been selecting equipment to be tested, and then establishing equipment support structure specifications, vibration test requirements, electrical equipment specifications, and test specifications. EPRI then usually prepares a Request for Proposal, and issues it to equipment manufacturers and research laboratories for selection to participate in the project.

Once this step is completed, a test plan is usually created in conjunction with the testing laboratory and the equipment manufacturer, after which the lab performs tests of one or more pieces of equipment, under the direction of EPRI. The manufacturer and the testing laboratory then prepare

documentation for the equipment following IEEE 693 requirements, and EPRI usually prepares a project report describing the project.

Each sample is expected to undergo tests required by IEEE 693-2005, with modifications as determined by EPRI. In general, the input motions, instrumentation, test sequences, functional tests, and other requirements specified by the referenced standard are used.

Testing is usually started at the Moderate Required Response Spectrum (RRS) level, and then the High RRS level. If lower level tests are completed, and there is reasonable assurance that higher level tests can be achieved, tests up to the High-Performance Level (PL) of IEEE 693 may be performed. Failure of a test article beyond the RRS level(s) is usually not deemed as a failure of a qualification test, provided that the test equipment met all qualification requirements at the lower level.

Deliverables

The unique deliverables are determined on an annual basis. For the past several years, equipment seismic qualification reports, and EPRI technical reports, have been published.

Price of Project

The price to participate in this project is $30,000 per year. This project qualifies for self-directed and/or tailored collaboration funding.

Project Status and Schedule

The project was initiated in 2000, and continues to generate timely, useful, and valuable research results until today.

Who Should Join

Power utilities who own substations, especially those in areas which are prone to earthquakes.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

Technical Contact

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