Supplemental Project Notice

DISTRIBUTION SOLID-STATE TRANSFORMERS

Applications and Laboratory Evaluation

Prototype 25-kVA solid state transformer

PROJECT HIGHLIGHTS

- Evaluate the performance of SSTs
- Identify challenges associated with installing, operating, and maintaining SSTs
- Define performance requirements for SSTs
- Develop robust test protocols that enable confident selection of SSTs

Background, Objectives, and New Learnings

Over the last century, the electric distribution grid has been characterized by one-way power flow from centralized generation sources to end-users. The distribution grid is amid a profound transformation to become more flexible, resilient, and intelligent, enabling bi-directional power flow and potentially delivering both ac and dc electricity. New power electronic solid-state transformers (SSTs) are emerging as a potential technology that could transform the way the distribution grid is designed and operated. These new power electronic based transformer technologies may prove essential to enable electrification, more readily integrate distributed energy resources (DERs), and increase grid reliability and resilience.

The SST device could either be used to replace or supplement several distribution grid assets in the future, including the oil filled step down transformer, line voltage regulators, capacitor banks, and protective devices. The SST can also provide sensing and monitoring capabilities. These devices could also serve as the direct current (dc) bus interconnection point that enables bi-directional dc power flow, allowing direct dc interconnection from DERs and battery storage systems, and direct dc output to EV charging infrastructure.

Standards related to power electronic SSTs are lacking or nonexistent for distribution system applications. A need exists to develop test protocols that ensure proper operation and to demonstrate the long-term performance of these new assets. EPRI has developed rigorous third-party unbiased laboratory testing for similar technologies in the past. Using similar methodologies, the intent of this project is to develop the same robust laboratory tests that can assist utilities with specification, deployment, and life-cycle decisions.

In 2023, EPRI evaluated a novel SST design that could replace existing 25-kVA distribution transformers while also having voltage regulation capabilities. This project intends to continue exploration of potential applications and challenges of using this solid-state transformer, and potentially other designs, on the distribution grid through lab testing of device performance for different use cases and applications.

Benefits

Public benefits may include increased grid capabilities that accelerate electrification, increased safety and improved reliability, and a reduction of oil-filled devices that may pose environmental risk. Participant benefits include understanding how SSTs perform for specific applications, the development of specifications to consider when purchasing devices, and accelerating the evolution of SSTs.

Project Approach and Summary

EPRI plans to investigate potential applications and perform functionality and performance testing to help inform electric company specification and application decisions. The following tasks are proposed:

Task 1 – Applications and Challenges: Identify potential SST use cases and associated challenges or gaps that need to be addressed to allow for full scale deployment.

Task 2 – Performance Requirements Development: Develop device requirements that would be needed to perform its necessary functions for the use cases identified in Task 1.

Task 3 – Laboratory Testing: Develop a test protocol and capability to perform testing of the SSTs to evaluate the functionality and long-term performance against the requirements identified in Task 2.

Task 4 – Application and Specification Guide: Based on the learnings from Task 1-3, develop guidance to assist with the application and specification of SST on the distribution grid.

Deliverables

All participating utilities will receive regular update webcasts throughout the project, a report documenting the applications, challenges and performance requirements of SST, a report on the laboratory testing protocol and results from testing and an end of project workshop.

The non-proprietary results of this work will be incorporated into EPRI's R&D programs, and available to the public for purchase, or otherwise.

Price of Project

The price to participate is based on participant's annual distribution throughput (GWh):

- $150,000 for companies with distribution throughput greater than 50,000 GWh and
- $90,000 for all others.

Eight (8) participants are needed to complete the full scope of the project. This project qualifies for Self-Directed Funding (SDF). The project can be funded over three years.

Project Status and Schedule

The project is planned to occur over a three-year period. The project aims to commence when three (3) participants have joined.

Who Should Join

Any electric companies who would like to get a jump on understanding the applications/use of power electronic SSTs that will be applied on the distribution grid and developing performance requirements.

Contact Information

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