

Electric Distribution R&D Peer Review 2006 Project Summary

YOUR ORGANIZATION:	Distributed Utility Associates
PROJECT TITLE:	The Distributed Utility Integration Test (DUIT)
PRESENTERS:	Susan Horgan
FY 2005 FUNDING:	\$438,000
FY 2006 FUNDING:	\$62,000
START/COMPLETION DATES:	6/04-6/08

Overall Project Purpose and Objectives

The Distributed Utility Integration Test (DUIT) Project, is a thorough test of the issues raised and value of co-location and integration of diverse distributed generation and storage technologies into the electric distribution system. Several distributed generation and storage technologies are installed within electrical interaction proximity of each other to allow for their aggregate benefits and operational issues to become evident. The project focuses on the identification of issues, and measurement and analysis of the interactions between units and the distribution system rather than the operation of any single innovative distributed generation technology and storage component.

The goals of the DUIT project are to prove the feasibility and operational limits, if any, and to define metrics to quantify the benefits of the integration of diverse distributed generation and storage technologies in a distribution system; and to provide a testing ground for observing and measuring the beneficial and/or detrimental interactions among the distributed technologies on the distribution system and to make the results of such credible activities publicly available.

Achieving these goals requires a project that will entail full-scale multi-megawatt implementation, testing and demonstration of distributed generation technologies in an actual utility installation. The DUIT project provides the necessary proof needed to demonstrate that traditional and emerging technologies can all work together seamlessly, and without adverse consequences to either the distribution system or the user, to provide the desired mixture of benefits (to multiple stakeholders) resulting from the use of a combination of the various technologies. The DUIT test provides evidence for in the use of distributed generation and storage as reliable energy resources to improve system operation and lower the cost of electric service for all customers, whether owned or operated by utilities, customers, or third parties.

Interactions between multiple DER's are largely unpredictable under currently existing and available knowledge, due to limited operating experience to date. By examining current and emerging technologies under various operational concepts to properly integrate diverse distributed resources, this project will provide new insights into grid support issues and will suggest innovative system protection design concepts.

Phase II of this program began in 2005. This phase calls for testing multiple and diverse distributed resources on distribution and utilization systems. To date the second phase has emphasized only a small segment of the total amount of testing to be done and has included testing of anti-islanding schemes and protection with disparate, diverse DER sources. The Phase II partial funding to date has been provided by the California Energy Commission, PG&E, and a number of DER manufacturers and integrators.

The scope of this subcontract is for the continuation of the Phase II work. Funding under this subcontract will be used to: clarify the objectives, including identification of the specific tests to be performed and the specific modifications that will be required, of the DUIT testing beyond the initial islanding testing on radial systems completed to date, and to begin the same process for network testing. Upgrade the 21 kV distribution voltage test infrastructure at the existing test site, expand the data analysis to test multiple units in multiple bays, install additional distributed resources and to perform the prioritized tests in anti-islanding.

FY 2005 and FY 2006 Results and Accomplishments:

Published the NETWORK DISTRIBUTION SYSTEMS BACKGROUND AND ISSUES RELATED TO THE INTERCONNECTION OF DISTRIBUTED RESOURCES document, these efforts were incorporated into Massachusetts, California, New York and IEEE processes.

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PG&E developed the scope and the cost estimate to upgrade the DUIT facility to 7MVA. The upgrade of two new feeders includes: A new 21 kV feeder (2103) to be run and terminated on the existing low voltage structure at *TES substation*. Run and install new feeder (2103) on to existing low profile 21 kV steel structure. Upgrade the relays for CB 2100/2 with a new GE L90 & SEL 351 relay. The second feeder will be added to the existing switchgear in *Research sub* and ran to TES. Install a new 21 kV 1200 A CC breaker and feeder in cell 1 of the existing switchgear. Other equipment associated with the new breaker will be a GE L90 & SEL 351 relays, and a D20C1 I/O board. In addition to the scope a fiber optic cable will be run from Research sub to TES sub for direct-trip feature on the GE L90 relay.

Completed the installation and acceptance testing of the capstone microturbines. The units are rated at 60kW and 30kW. The facility also installed a 100kW flywheel storage unit consisting of seven flywheels and one 500kW battery unit in coordination with the California Energy Storage and DOE storage programs.

Completed test sequences 13-15 involving small group tests for single phase multiple unit tests with more than one type of inverter. Each test sequence includes 33%, 66% and 100% power ratings with +5% to -5% variations in reactive loads in 1% intervals. Test sequences 16 to 23 were completed. Sequence 16 -22 were tests that documented the interactions of single phase inverters with the genset. The sequences are a progress from testing an individual inverter with the engine then proceeding to two inverters of the same type with the engine. Were results varied the progression of inverters was increased from one to two. Sequence seventeen required four inverters and sequence 22 required ten. Each test sequence includes 33%, 66% and 100% power ratings with +5% to -5% variations in reactive loads in 1% intervals. Sequence 23-24 investigated the interactions between the three phase inverters and the genset. These tests were completed with the Cummins genset. Test sequence #23 is complete. This completes the engine and inverter testing as originally planned. However, we did take have the opportunity to test the Diesel and the 3 phase inverter(s) at various Q's. Though this was not part of the primary test plan sequence. The results from the 3 phase testing strongly indicated that repeating the test sequence with a very low Q was necessary. It was also important to conduct this testing before the engine was removed. The genset was removed and will be replaced with a larger unit that includes a standardized interconnection.

FY 2007 Plans and Expectations:

- Develop network test protocols
- Complete 7MVA upgrade
- Install additional DR
- Publish multiple unit single phase unintentional islanding results
- Complete remainder of anti-islanding tests
- Coordinate and develop a facility modeling plan with National Resources Canada

Public/Private Partnerships: The Phase II partial funding in FY06 date has been primarily provided by the California Energy Commission, PG&E, and a number of DER manufacturers.

Beacon Power—flywheel and inverter manufacturer	Sandia—storage collaborator
Capstone Turbine—microturbine manufacturer	San Francisco PUC-policy advisor
California Energy Commission Pier program—primary funder	SMA—inverter manufacturer
Consolidated Edison—network partner	SMUD—equipment donor
Cummins—engine manufacturer	Solar Turbines—policy advisor
Distributed Utility Associates—project leader	Underwriters Labs-testing collaborator
EPRI—technology transfer partner	Xantrex—inverter manufacturer
NREL/DOE —primary funder	ZBB—battery manufacturer
PG&E—facility host	