



Power Router for Distributing Solar in Communities (Solar Prize)

Cooperative Research and Development Final Report

CRADA Number: CRD-20-16809

NREL Technical Contact: Przemyslaw Koralewicz

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Contract No. DE-AC36-08GO28308

Technical Report
NREL/TP-5000-83684
August 2022



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Cooperative Research and Development Final Report

Report Date: August 8, 2022

In accordance with requirements set forth in the terms of the CRADA agreement, this document is the CRADA final report, including a list of subject inventions, to be forwarded to the DOE Office of Scientific and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: Switched Source LLC

CRADA Number: CRD-20-16809

CRADA Title: Power Router for Distributing Solar in Communities (Solar Prize)

Responsible Technical Contact at Alliance/National Renewable Energy Laboratory (NREL):

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Sponsoring DOE Program Office(s):

U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Technology Commercialization Office

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	NREL Shared Resources a/k/a Government In-Kind
Year 1	\$75,000.00
Year 2	\$0.00
TOTALS	\$75,000.00

Executive Summary of CRADA Work:

The American Made Solar Prize is a prize competition from the U.S. Department of Energy (DOE) that is designed to revitalize U.S. solar manufacturing. The competition aims to support the growth of U.S. solar manufacturing and reenergize American energy innovation by tapping into American's competitive spirit and the nation's unparalleled innovation ecosystem leveraging national labs, incubators, facilities and more.

Original Mod: Contractor will perform third-party testing of Participant's Phase-EQ phase balancing technology.

Modification 1: Contractor will perform third-party testing of Participant's Tie Controller feeder balancing technology. (The device under test was changed to Tie Controller due to delay in development of Phase-EQ technology. Tie Controller was already installed at the NREL Flatirons site at the beginning of this project. A Task 0 was added due to this change.)

CRADA benefit to DOE, Participant, and US Taxpayer:

- Assists laboratory in achieving programmatic scope
- Uses the laboratory's core competencies

Task Descriptions:

Participant will:

Task 1: Participant will participate in a monthly check-in with the NREL Principal Investigator. If a check-in meeting is missed two months in a row, the agreement may be cancelled by the American-Made Challenges Solar Prize team.

Task 1 Description/Results/Explanation:

Participant was involved in consistent weekly communications with the NREL Principal. All the issues and planning discussions were held leading to lack of communication gaps between NREL and the Participant.

Task 2: Participant will deliver Participant's device to be tested to NREL's Flat Irons Campus.

Task 2 Description/Results/Explanation:

In initial version of CRADA a delivery of a Participant's converter called "Phase-EQ" was planned in the scope. In Mod 1 to the CRADA a scope was changed to validation of another Participant's converter called "Tie Controller." The converter was previously installed at Flatirons Campus site using Participant's funds through TSA-18-1052 thus installation of new converter was not necessary in the scope of this CRADA project. The figure below shows Tie Controller provided by Participant and installed at Flatirons Campus. The Tie controller was interconnected to NREL's research MV infrastructure to allow electrical validation.



Figure 1: Photo of Tie Controller installed at NREL Flatirons Campus site between CGI and 5MW Dynamometer building.

Task 3: Participant will provide support through the testing process of the device as needed.

Task 3 Description/Results/Explanation:

Participant was always responsive to any support request that NREL had related to Tie Controller.

NREL will:

Provide technical advisement to include:

Task 0. NREL will support any field modifications to the equipment to make it test ready. This will include installation and maintenance support for Tie Controller sub systems, specifically HVAC and cooling systems.

Task 0 Description/Results/Explanation:

NREL supported the maintenance and readiness of Tie Controller. NREL's technicians were supporting activities related to HVAC modifications and repairs as well as electrical troubleshooting and repairs during the project. NREL was also assuring safe work environment for Switched Source personnel while on site by performing Lockout-Tagout operations.

Task 1. NREL will perform Static Points test by reaching static operating points for balancing power between two circuits.

Task 1 Description/Results/Explanation:

NREL has prepared the test environment necessary to execution of all tests requested in test plans including:

- CGI MV interconnection,
- communication infrastructure to allow for remote access for Switched Source personnel – especially needed during COVID period when access of visitors to site was restricted

Preparation to Task 1 execution took more time than expected due to lengthy debugging and testing of the Tie Controller firmware and hardware. Multiple testing sessions were scheduled during the project. During these sessions a substantial amount of NREL’s test equipment and researchers time was provided to support Switched Source personnel with troubleshooting. At the time of end of this project the converter’s firmware and hardware performance has increased exponentially however it wasn’t allowing long enough operation to perform Static Points tests specified in the test plan.

Task 2. NREL will perform Dynamic Range Test alternating from operating point to operating point to show operational range.

Task 2 Description/Results/Explanation:

Task 2 was not completed under this effort due to longer than expected development and debugging of the converter’s firmware.

Task 3: NREL will perform Thermal Test by operating the unit for extended period of time to prove critical functionality of the thermal management system.

Task 3 Description/Results/Explanation:

Task 3 was not completed under this effort due to longer than expected development and debugging of the converter’s firmware.

Task 4: NREL will perform Fault Handling Test by simulating grid faults to test system’s safety requirements and ability to disconnect/reconnect.

Task 4 Description/Results/Explanation:

Task 4 was not completed under this effort due to longer than expected development and debugging of the converter’s firmware.

Task 5: NREL will provide final report summarizing performance of tests, including any relevant metrics.

Task 5 Description/Results/Explanation:

Task 5 was not completed under this effort due to longer than expected development and debugging of the converter's firmware.

During the period of troubleshooting NREL was providing Participant with intermediate reports from troubleshooting sessions using data captured by NREL data acquisition systems.

Task 6: The Principal Investigator agrees to provide the following to DOE Office of Scientific and Technical Information (OSTI): (1) an initial abstract suitable for public release at the time the CRADA is executed; (2) a final report, within thirty (30) days upon completion or termination of this CRADA, to include a list of Subject Inventions; and (3) other scientific and technical information in any format or medium that is produced as a result of this CRADA.

Task 6 Description/Results/Explanation:

This report serves to meet this requirement for the agreement's Final Report.

Subject Inventions Listing:

None

ROI #:

None