NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Acciona Solar Technology Performance Evaluation

Cooperative Research and Development Final Report

CRADA Number: CRD-10-384

NREL Technical Contact: Mark S. Mehos

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Cooperative Research and Development Final Report

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

CRADA Number: CRD-10-384

CRADA Title: Acciona Solar Technology Performance Evaluation

Parties to the Agreement: Acciona Solar Power, Inc.

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	NREL Shared Resources
Year 1	$ 70,000.00
Year 2	$ 70,000.00
Year 3	$ 40,000.00
Year 4	$ 35,000
TOTALS	$ 215,000.00

Abstract of CRADA work:

Under this agreement, NREL will work with Acciona to conduct joint testing, evaluation, and data collection related to Acciona's solar technologies and systems. This work includes, but is not limited to, testing and evaluation of solar component and system technologies, data collection and monitoring, performance evaluation, reliability testing, and analysis. This work will be conducted at Acciona's Nevada Solar One (NSO) power plant and NREL test facilities.

Specific projects will be developed on a task order basis. Each task order will identify the name of the project and deliverables to be produced under the task order. Each task order will delineate an estimated completion date based on a project's schedule. Any reports developed under this CRADA must be reviewed by both NREL and Acciona and approved by each organization prior to publication of results or documents.

Summary of Research Results:

Three specific tasks were negotiated with Acciona Solar Power. These tasks included 1) optical characterization of solar collector assemblies installed at NSO, 2) thermal characterization of heat collection elements installed at the site, and 3) validation of performance acceptance test guidelines based on data collected at the site with an emphasis on assessing the solar field reflectivity necessary as input to such guidelines.

A description of the activities and procedures are provided within this summary. Specific data collected from the site is considered proprietary under the agreement negotiated within the CRADA and therefore is not provided in this report.

Task 1: Optical Characterization of NSO Solar Collector Assemblies: Under this task, NREL worked with Acciona to characterize the optical and thermal performance of existing solar collector assemblies (SCAs) installed at Acciona's NSO plant. As part of this task, the following items were addressed:

- NREL worked with Acciona to develop a test plan for collecting and analyzing SCA optical characterization data
- NREL transported optical characterization equipment to and from the NSO site
- NREL worked with Acciona to collect data at the NSO site
- NREL analyzed the data collected from the site and provided a final report to Acciona.

Summary of Accomplishments: NREL staff travelled to Nevada to perform Video Hartmann Scanning Optical Tester (VSHOT) testing on several SCA's at Acciona's NSO site.[1] Several representative assemblies were characterized for their ability to accurately concentrate sunlight, a trait which was quantified by providing an intercept factor figure of merit. Such a characterization can identify small or gross misalignments of the SCA which may result in reduced thermal performance. The purpose of this trip was to baseline operational SCAs after several years of successful plant operation. NREL provided a confidential report to Acciona describing the performance of each SCA tested in terms of the RMS deviation of SCA cross sections compared to a perfect parabola as well as the calculated intercept factor (using a ray trace analysis) based on the collected data.

Task 2: Receiver Heat Loss Characterization: Under this task, NREL characterized the heat loss from all of the heat collection elements (HCEs) currently installed at Acciona's NSO plant using NREL's infrared imaging platform. NREL delivered a report cataloging the glass envelop temperature and associated heat loss for each HCE and estimated the heat loss compared to as new HCEs at the site. As part of this task, the following items were addressed:

- NREL worked with Acciona to development of a test plan for collecting and analyzing HCE heat loss data
- NREL transport our Thermal Scout IR imagining equipment to the NSO plant site in preparation for subsequent testing
- NREL staff collected HCE thermal image data from collectors installed at the NSO site
- NREL analyzed the data collected from the site and provided a final report to Acciona.

Summary of Accomplishments: NREL's Thermal Socut[2] was used to characterize all four collector subfields at Nevada Solar One consisting of approximately 20,000 heat collection elements. The system was able to baseline the performance of each of the receivers over a period of five days. A confidential summary report describing the number of "hot" HCEs, and "cold" HCEs indicating the current status of performance of each receiver was provided to Acciona at the end of the task.

Task 3: Data Collection for Use in Validation of Performance Test Guidelines: Under this task, NREL collected data in support of development of a test methodology for verifying the performance of parabolic trough solar fields as an element of a solar field acceptance test. Within this task an effort was made to develop a mirror reflectance model suitable for CSP applications as well as a general procedure to measure the average mirror reflectance of a solar field. The mirror reflectance model can be used to characterize different types of mirror materials and can be directly used to perform optical performance

[1] See http://www.nrel.gov/docs/fy11osti/48482.pdf for a description of the VSHOT systems.
[2] See http://www.nrel.gov/docs/fy13osti/57336.pdf for a description of NREL's Thermal Scout.

evaluation of solar collectors. The proposed procedure for average solar field reflectance measurements includes a baseline comprehensive measurement and individual factor measurements: the former allows a comprehensive survey of mirror reflectance across the entire solar field, and the latter provides correcting factors for selected individual factors to further improve the accuracy of the baseline measurements.

Summary of Accomplishments: A detailed test case implementing the general procedure was applied to the NSO plant and validated the mirror reflectance model and average reflectance measurement procedure. Data collected under the effort was report to Acciona under a confidential report. However, a generalized description of the model and summary of data collected at the site has been submitted for publication in the Journal of Solar Energy.[3]

Subject Inventions Listing:

None

Report Date:

November 3, 2013

Responsible Technical Contact at Alliance/NREL

Mark S. Mehos

This document contains NO confidential, protectable, or proprietary information.

[3] Zhu, G., Kearney, D., and Mehos, M.,