U.S. Department of Energy CSP Program Review

Advanced High Temperature Trough Collector Development

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Overview

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Project Objectives

Engineer, procure and construct a more efficient collector loop at the SEGS V plant at Kramer Junction.

Validate the predicted performance of the HelioTrough demonstration loop.

Perform detailed engineering to modify the collector for operation with a molten salt HTF.

In the future, potentially modify the loop to operate with a molten salt HTF.

Overview of Project Schedule

Date	Description
February 2008	Start of Phase 1: Molten Salt Feasibility Study
November 2008	Start of Phase 2: Detailed engineering of VP-1 Reference Loop
September 2009	HelioTrough collector erection in Kramer Junction
December 11, 2009	First start-up of loop
January 2010	Start of Phase 3: Field validation
April 2010	Tracking parameter optimization, twist measurements, temperature sensors calibration
May 2010	First differential pressure measurements
May 2010	Improvement of tracking optimization
July 2010	Performance evaluation
February 2011	Contact potential vendors to supply components for a molten salt heat transfer fluid
March 2011	Meet with vendors - component prototypes potentially available by the end of 2011.
April 2011	Completed BoP P&ID, Loop P&ID, PFD and Function Description for a MS-HelioTrough reference loop.

Phase 3 - Current Phase of Project

Phase 3 is the field validation of the HelioTrough loop & detailed engineering to modify the collector for salt service.

Sub Tasks

3.1 Performance and operational tests

3.2 Evaluation report.

3.3 Development of new salt components

3.4 Detailed engineering of advanced HTF balance of plant (BOP)

3.5 Detailed engineering of HelioTrough-MS reference loop modification

3.6 Cost evaluation of modifications

3.7 Re-evaluation of cost comparisons

Milestone:

Complete the detailed engineering of the component modifications necessary for salt operation is an important milestone.

CRITICAL MILESTONE [GO/NO-GO DECISION] 3

The critical Milestone 3.2 is successful conclusion of the HelioTrough-VP1 reference loop test period. Detailed performance modelling, including evaluation of data covering all sun angles of incidence is required.

Project Impact on Performance Improvement and Cost Reduction

HelioTrough collector was built on high precision laser aligned jigs which allowed for simple and easy collector assembly and resulted in high optical efficiency.

The HelioTrough collector has a larger aperture (6.77 m) and HCE tube diameter (89 mm). These improvements allow for a smaller solar field design with a larger thermal output. A smaller solar field means less header pipe, HTF volume and auxiliary consumption – all which lowers capital costs.

Smaller and more efficient solar fields means less hardware and associated capital costs.

Capital cost reduction is critical to establish and maintain CSP as an integral element of the utility-scale power mix.

Technical Accomplishments

In December 2009, completed construction of a single HelioTrough loop (40 collectors) and fully integrated with the SEGS V solar field.

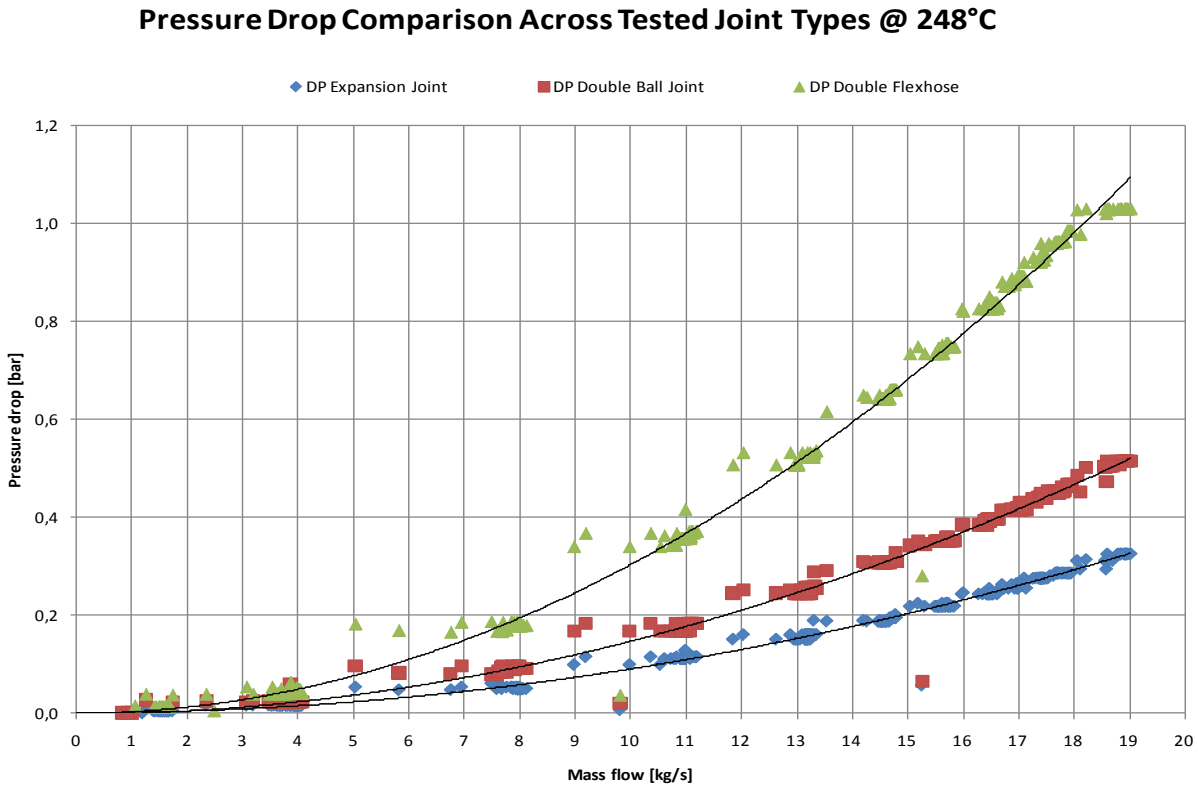
Optical design goals were fully achieved with intercept factors of 98.9 – 99.1% for 89.9 mm diameter HCE

Technical Accomplishment






Performance Results component tests



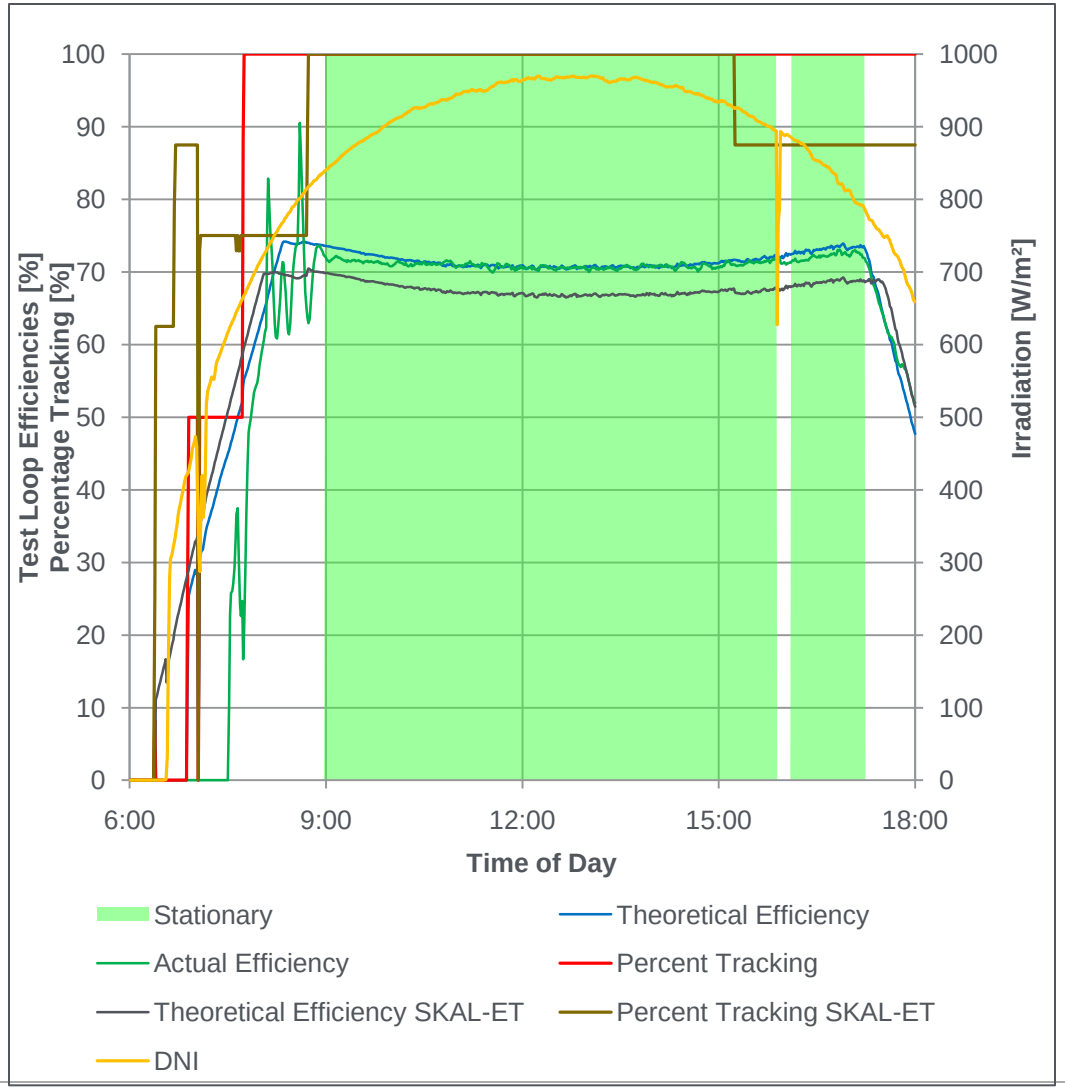
The HelioTrough loop measures pressure drop across ball joint, expansion joint and flex hose assemblies.

Results indicate the pressure drop is lowest across the expansion joint assembly.

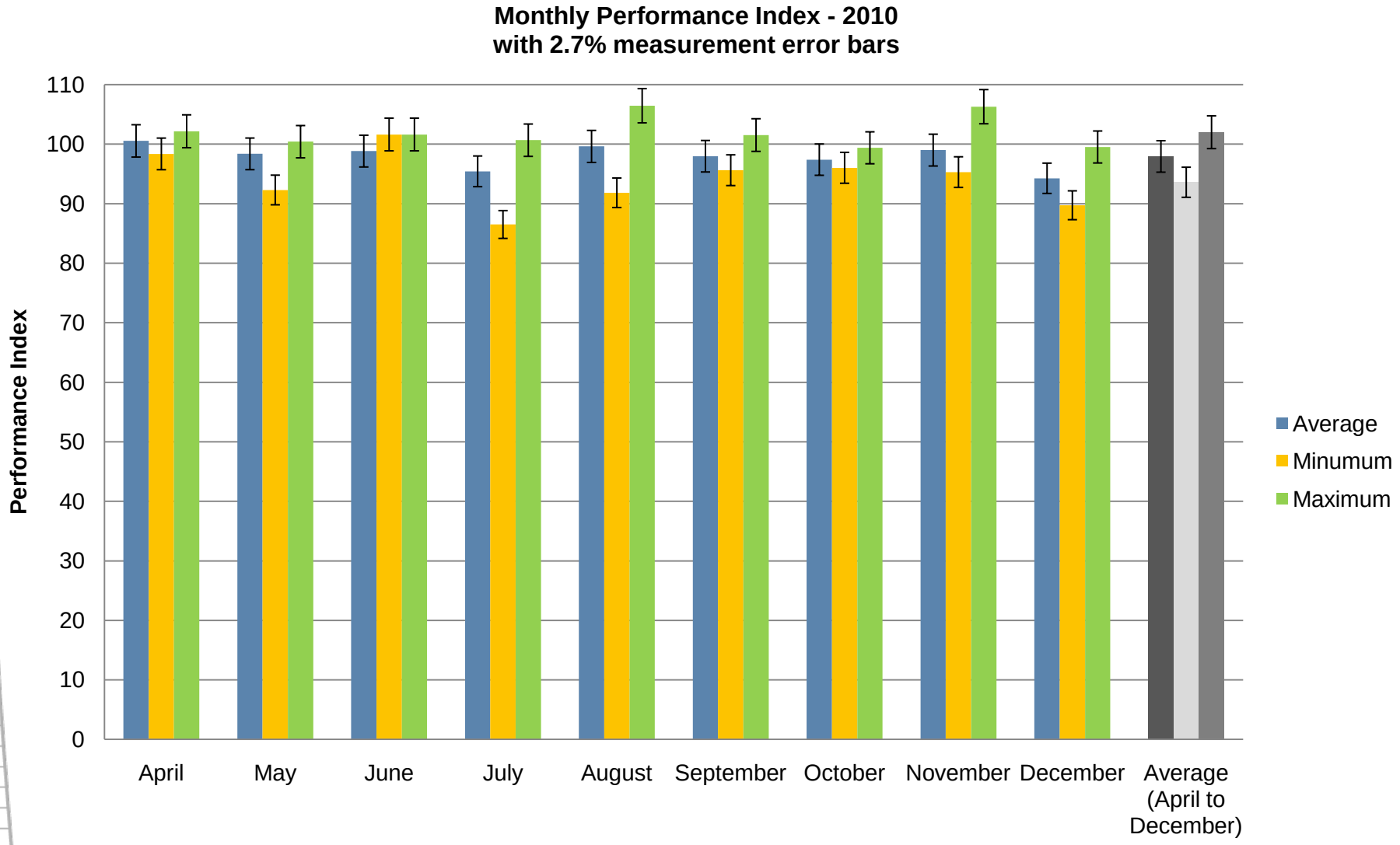
Performance Results
HelioTrough & Skal-ET Comparison

On April 26, 2010, the theoretical efficiency of the HelioTrough loop is 5.1% higher than the demonstration SKAL-ET loop.

The increased efficiency of the HelioTrough compared to the Skal-ET can be contributed to a more accurate collector geometry and assembly process.



Performance Results
Performance Index



Significant Challenges to Date

Availability of components suitable for a molten salt heat transfer fluid.

Vendors have expressed interest in developing components and could potentially have prototypes available in a couple months, but the lack of qualified components is a challenge.

The heat transfer from molten salt to synthetic oil at temperatures above 400°C entails risks. Exothermic reactions could occur if salt and oil mix. Intermediate heat transfer cycles or safety heat exchangers are very costly at the high temperatures.

Future Work

Continue to gather and evaluate performance data for the HelioTrough loop

Continue working with suppliers to develop components suitable for operation with a molten salt heat transfer fluid.

Continue engineering for a molten salt demonstration loop

Evaluate the costs associated with the MS-HelioTrough loop conversion

Q & A