

Design and Implementation of a 1-3 MWth sCO₂ Support Loop for Gen3 CSP Primary Heat Exchangers

SAND2019-2859D

Matthew Carlson
mcarlso@sandia.gov
Sandia National Laboratories
CPS# 34151

FUNDING PROGRAM: GEN3 CSP SYSTEMS AND LAB SUPPORT

PROJECT OVERVIEW

- PI: Matthew Carlson, Sandia National Labs
- DOE funding: \$3.6M through 2020-12-31

SUMMARY STATEMENT

- **Problem statement:** All three Gen3 CSP topic 1 teams require an sCO₂ coolant system in phase 3, yet no commercial or R&D systems are readily available with sufficient capabilities.
- **Resulting solution:** Pursue a single sCO₂ system implementation satisfying FOA and topic 1 team requirements for phase 3 pilot plant operation.
- **Critical capability:** Sandia has extensive experience designing, deploying, and operating sCO₂ systems and power cycles up to 0.8 MWth and 700 °C.

KEY ACTIVITIES

Task 1: System Requirements

Coordinate requirements between Sandia and topic 1 teams and provide weightings on requirements to guide design decisions.

Task 2: System Design

Conduct preliminary and detailed design of the system including evaluations of configuration and component tradeoffs.

Task 3: Procurement

Pre-plan and execute procurement of customized, long lead time, and off-the-shelf equipment meeting requirements basis documents.

Task 4: Construction

Oversee off-site and on-site fabrication and assembly of the system including packaging for possible shipping, handling, and lifting.

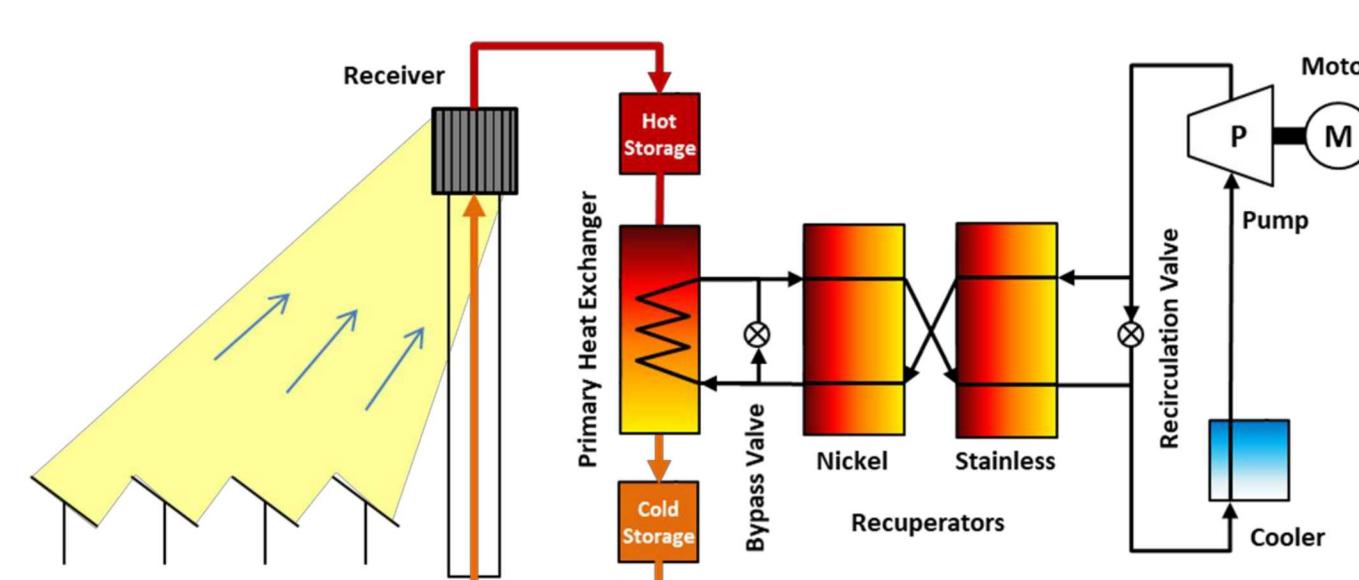
Task 5: Acceptance Testing

Perform cold-flow and heated acceptance testing to ensure system requirements have been met.

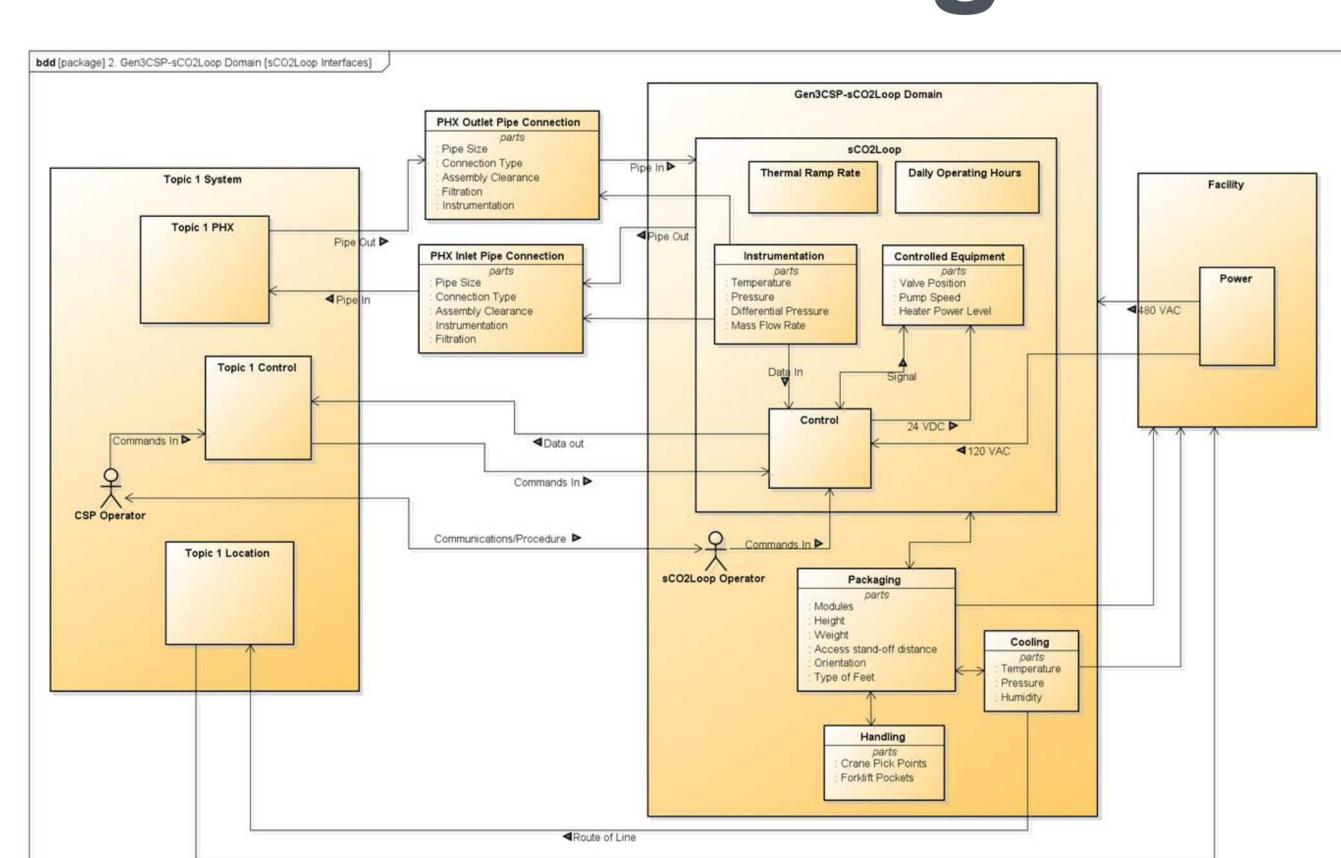
KEY OUTCOMES AND IMPACT

- Fix primary heat exchanger interface requirements for topic 1 team designs
- Systems engineering breakdown of sCO₂ loop design considerations including:
 - Design analyses
 - Alternatives analyses
 - Operational analyses
- Turnkey 1-3 MWth sCO₂ cooling system

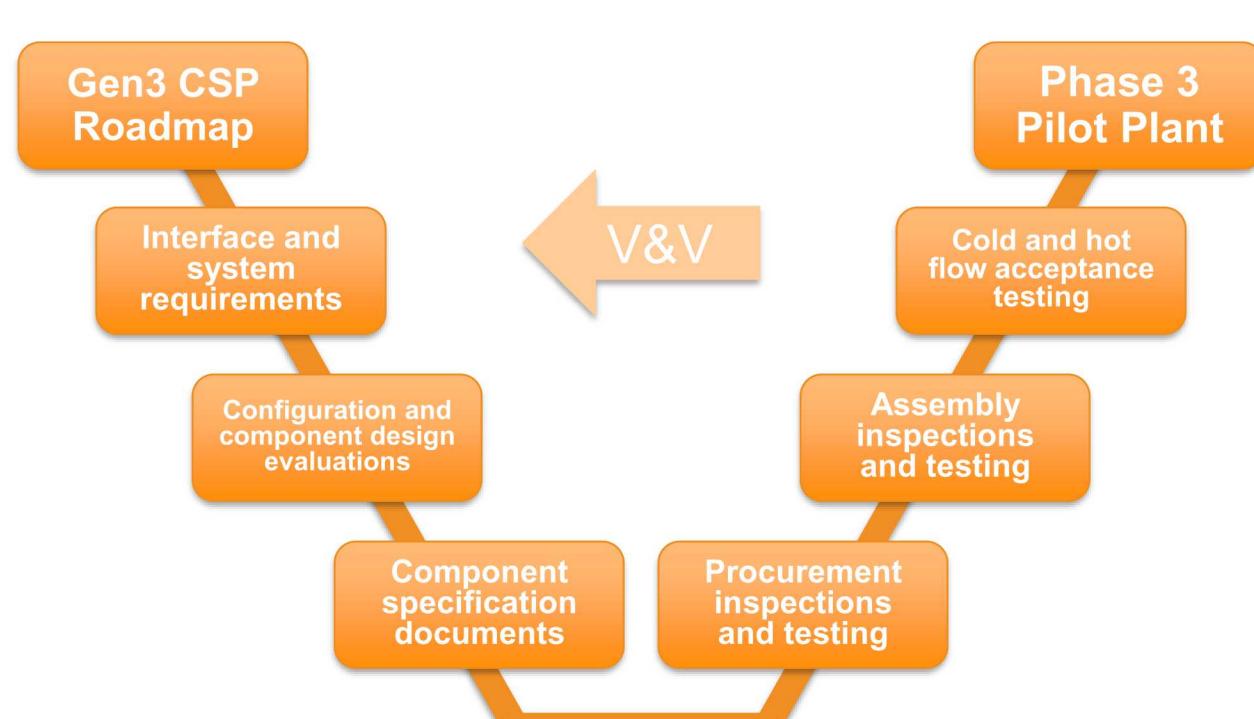
Process Flow Diagram



Interface Diagram



Support Loop Lifecycle



Key Requirements

Category	Type	Key Source
PHX Outlet Conditions	Performance	DE-FOA-0001697
Operational Time	Performance	DE-FOA-0001697
Thermal Duty	Performance	DE-FOA-0001697
PHX Inlet Conditions	Operational	Topic 1 Teams
Transient Performance	Operational	Topic 1 Teams
System MAWP/MDMT	Design	Sandia SMEs
Plumbing Connections	Interfacing	Topic 1 Team EPCs
Electrical Connections	Interfacing	Topic 1 Team EPCs
Footprint, Height, Weight	Physical Constraints	Topic 1 Team EPCs
Forklift/Crane/Shipping	Handling/Shipping	Topic 1 Team EPCs
Replaceable Components	Adaptability	Topic 1 Teams