

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

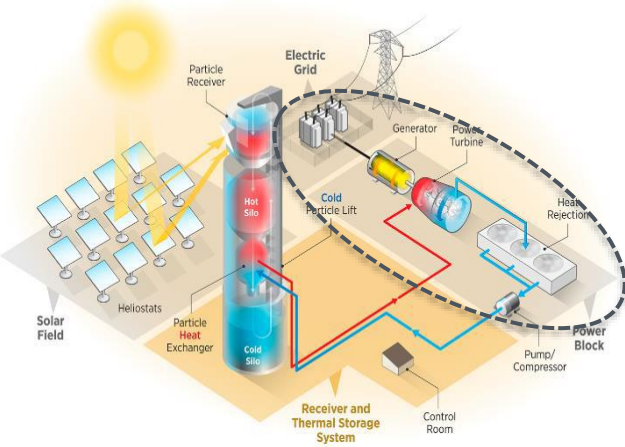
Gen3 CSP Systems and Lab Support

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND2019-2940 PE

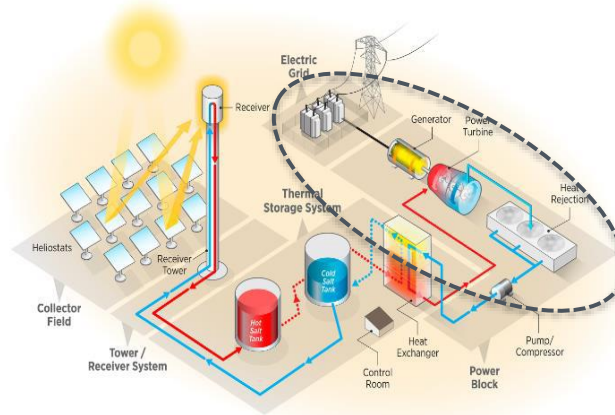
energy.gov/solar-office

Matthew Carlson, R&D S&E Mechanical Engineering
Concentrating Solar Technologies, Sandia National Labs

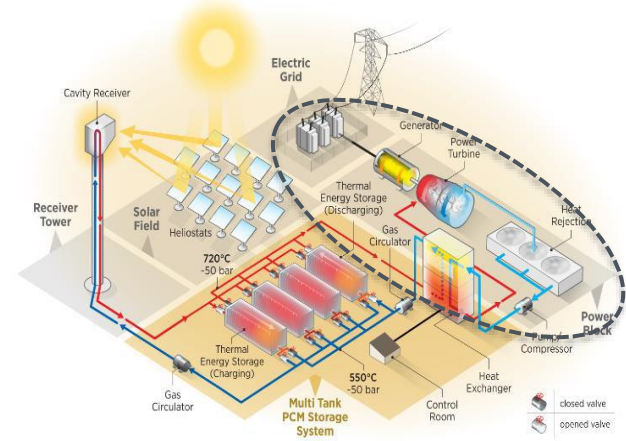
Gen3 CSP Pathway Pilot Plant Power Block



Solid



Liquid



Gas

All three pathways require a largely similar power block



Design and implement a common cooling system

1. System Requirements

- Coordinate requirements definition and provide weightings to guide design decisions.

2. System Design

- Preliminary and detailed design including evaluations of configuration and component tradeoffs.

3. Procurement

- Pre-plan and execute procurement of equipment meeting requirements basis documents.

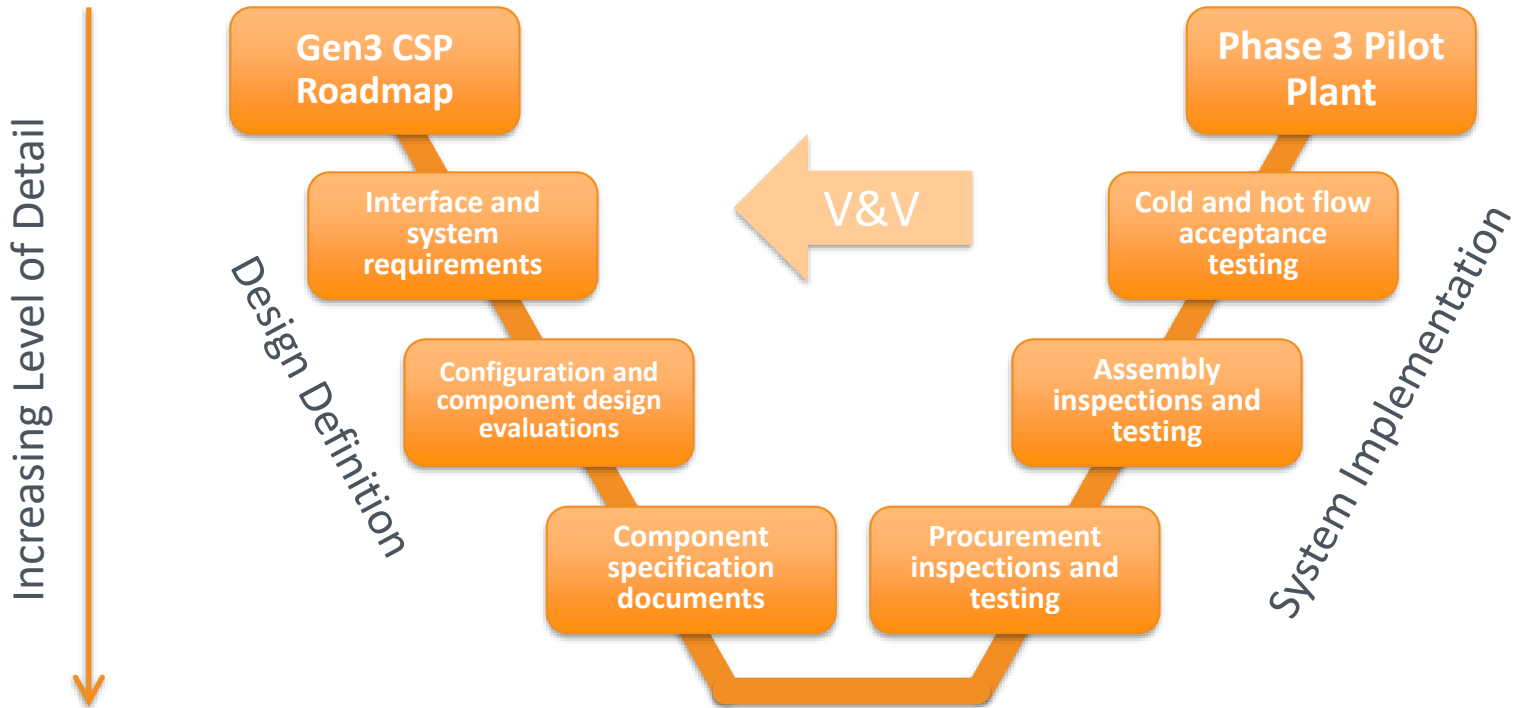
4. Construction

- Oversee fabrication and assembly including packaging.

5. Acceptance Testing

- Cold-flow and heated testing to ensure requirements are met.

Hierarchical Approach to Definition and Review

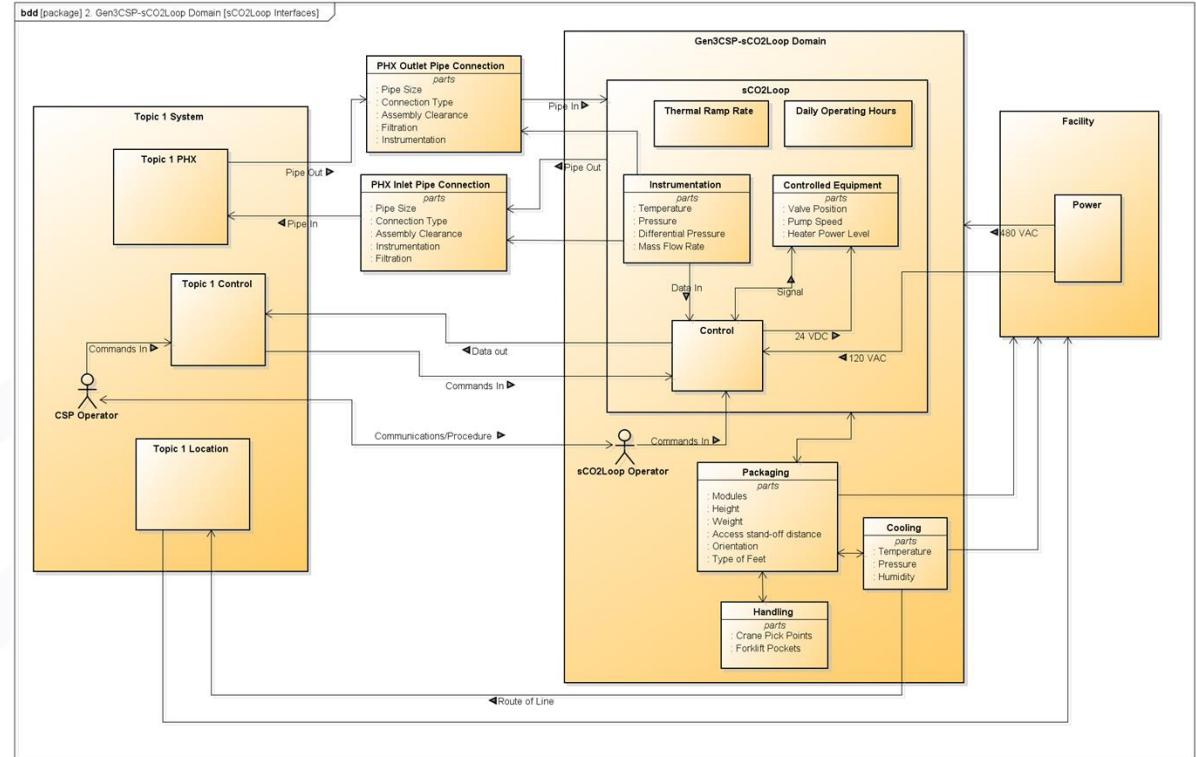


Key Requirements Specified in the FOA

Requirement	Value	Source
Operating Fluid	Carbon Dioxide	DE-FOA-0001697
PHX Outlet Pressure	250 bar	DE-FOA-0001697
PHX Outlet Temperature	715 °C	DE-FOA-0001697
Thermal Duty	≥1 MWth	DE-FOA-0001697
Operational Time	≤16 hr/day*	DE-FOA-0001697
PHX Inlet Pressure	246 bar	1.5% pressure drop
PHX Inlet Temperature	565 °C	150 °C temperature rise
Mass Flow Rate	5.3 kg/s	Derived

*6 hours of operation plus energy delivery deferred up to 10 hours

- Interfacing with
 - the PHX
 - the facility
 - the operators
 - shippers
 - installers
 - maintainers
 - future modifications

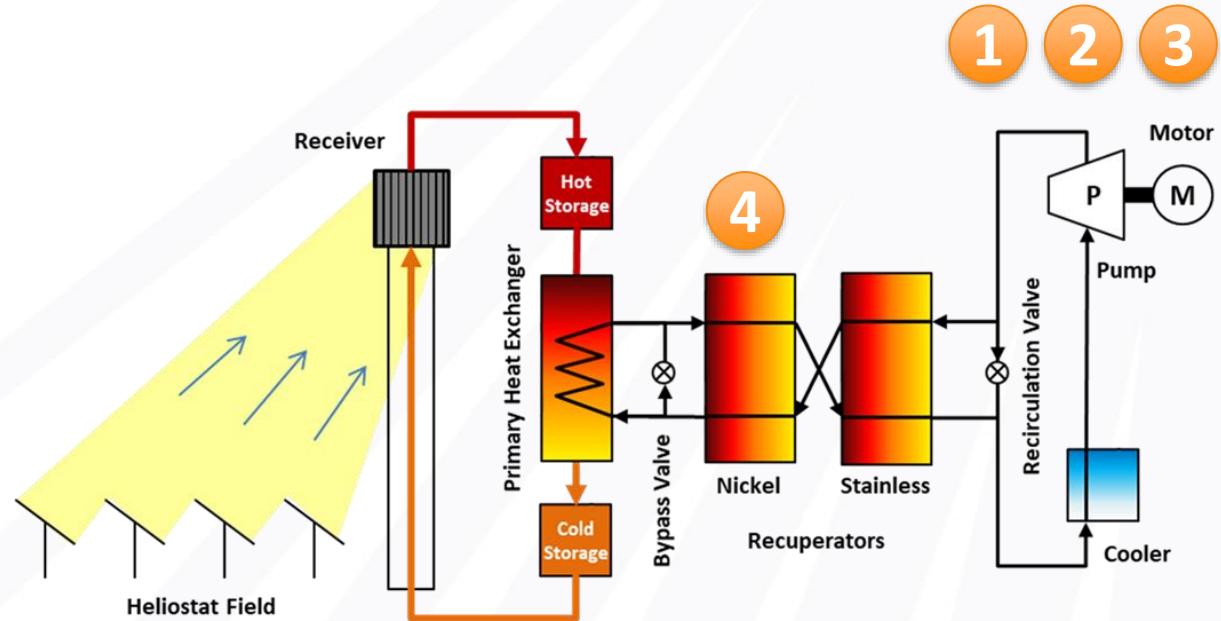


Other Requirements Finalized in Q2

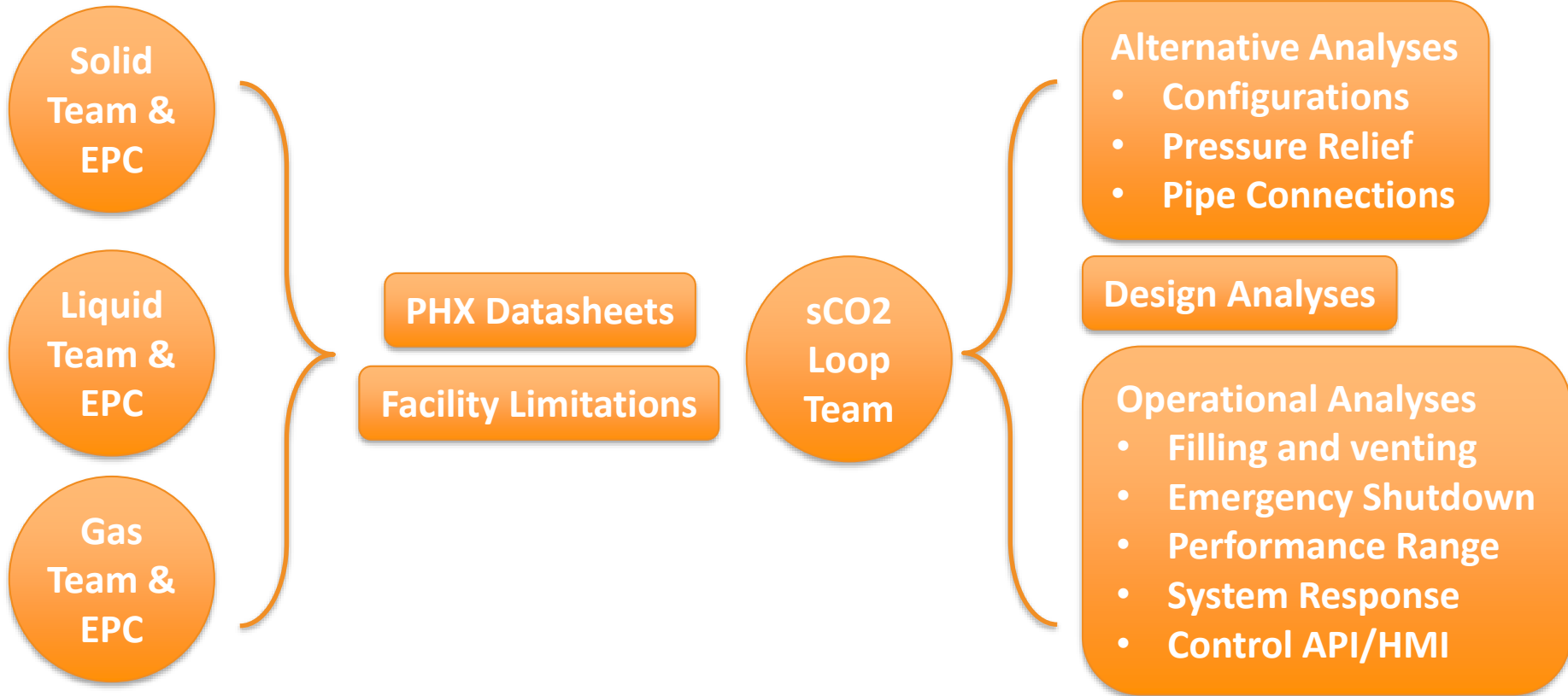
Category	Type	Key Source
PHX Outlet Conditions	Performance	DE-FOA-0001697
Operational Time	Performance	DE-FOA-0001697
Thermal Duty	Performance	DE-FOA-0001697
PHX Inlet Conditions	Operational	Topic 1 Teams
Transient Performance	Operational	Topic 1 Teams
System MAWP/MDMT	Design	Sandia SMEs
Plumbing Connections	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

Process Flow Diagram and Key Alternatives

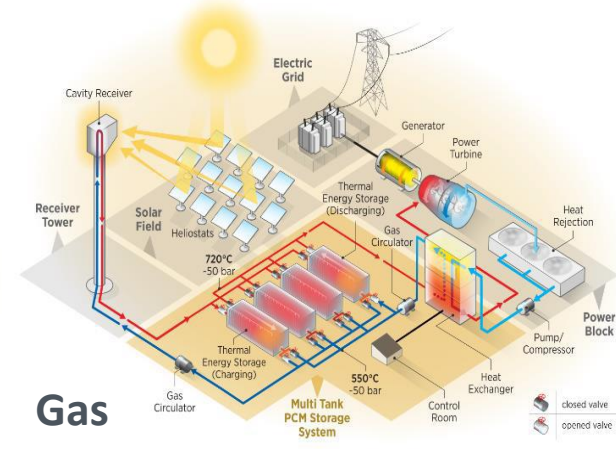
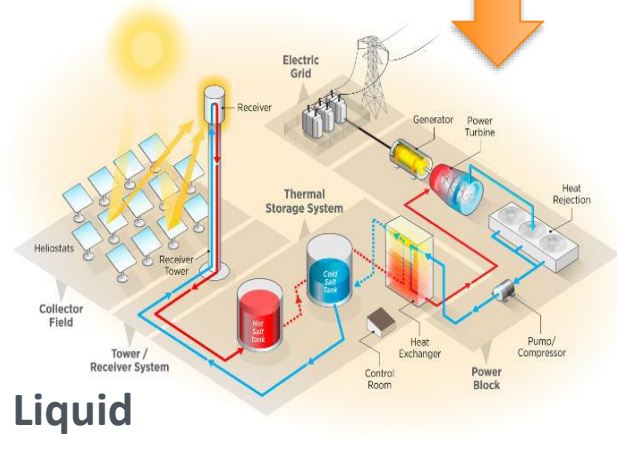
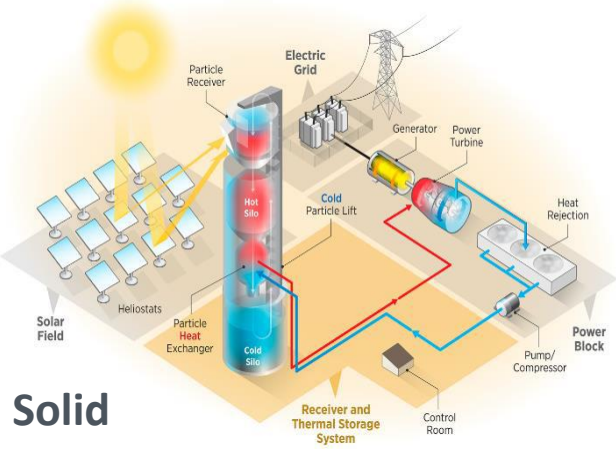
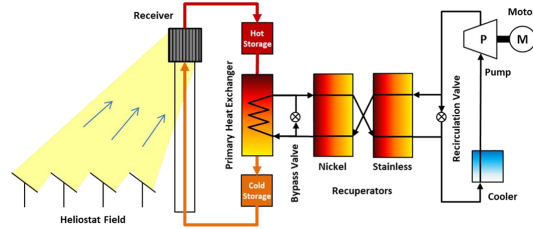
1. Blowdown vs. recirculation
2. Liquid pumping vs. gas compression
3. Low-temp vs. high-temp compression
4. High-temp recuperation vs. preheating and after-cooling



Interactions for Requirements Definition



sCO₂ PHX Coolant System for Any Pathway



closed valve
opened valve