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the national interest*



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

## Gen3 CSP Systems and Lab Support

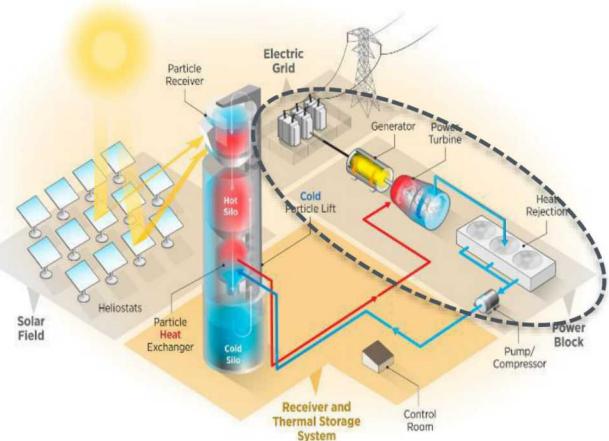
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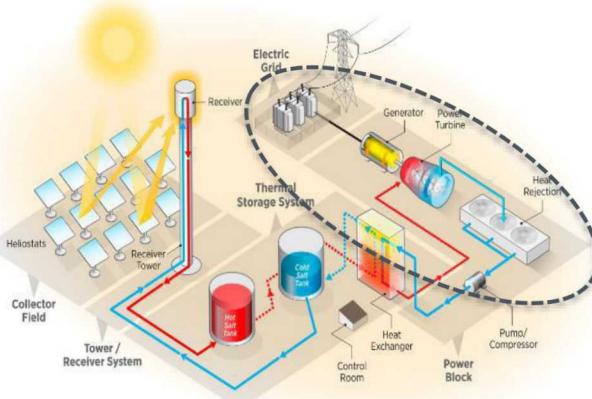
[energy.gov/solar-office](http://energy.gov/solar-office)

Matthew Carlson, R&D S&E Mechanical Engineering  
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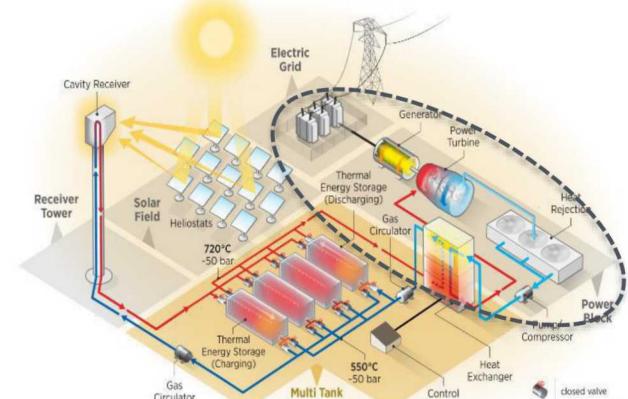
# Gen3 CSP Pathway Pilot Plant Power Block



**Solid**



**Liquid**



**Gas**

All three pathways require a largely similar power block



Design and implement a common cooling system

# Breakdown of Work Activities

## 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.

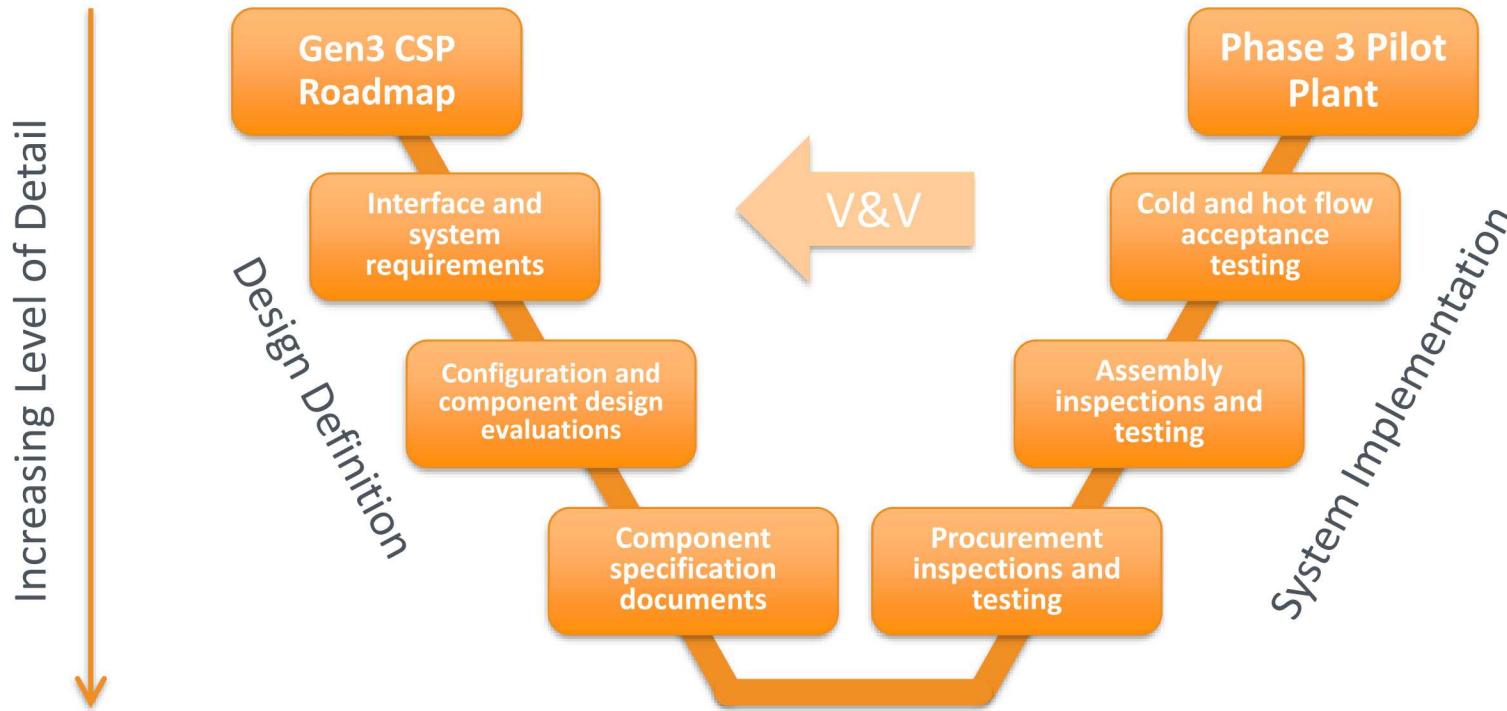
## 4. Construction

- 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



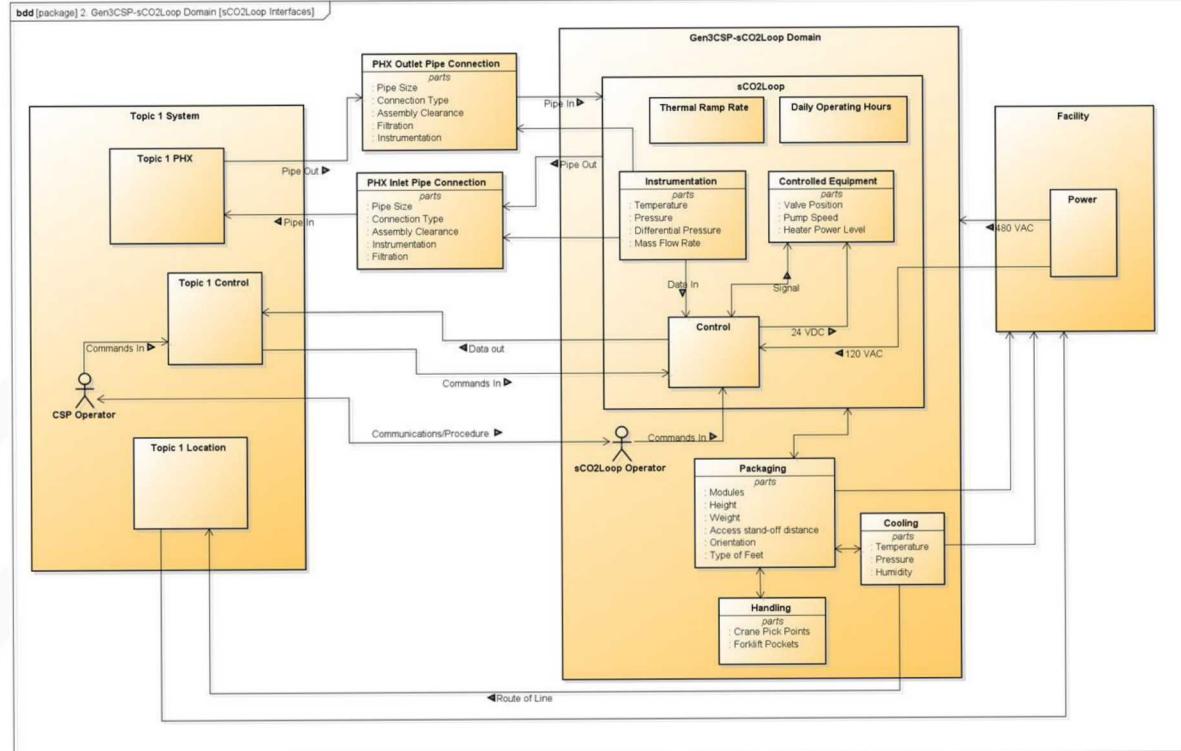
# Key Requirements Specified in the FOA

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	$\geq 1$ MWth	DE-FOA-0001697
Operational Time	$\leq 16$ 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

# Systems Engineering to Expand Requirements

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

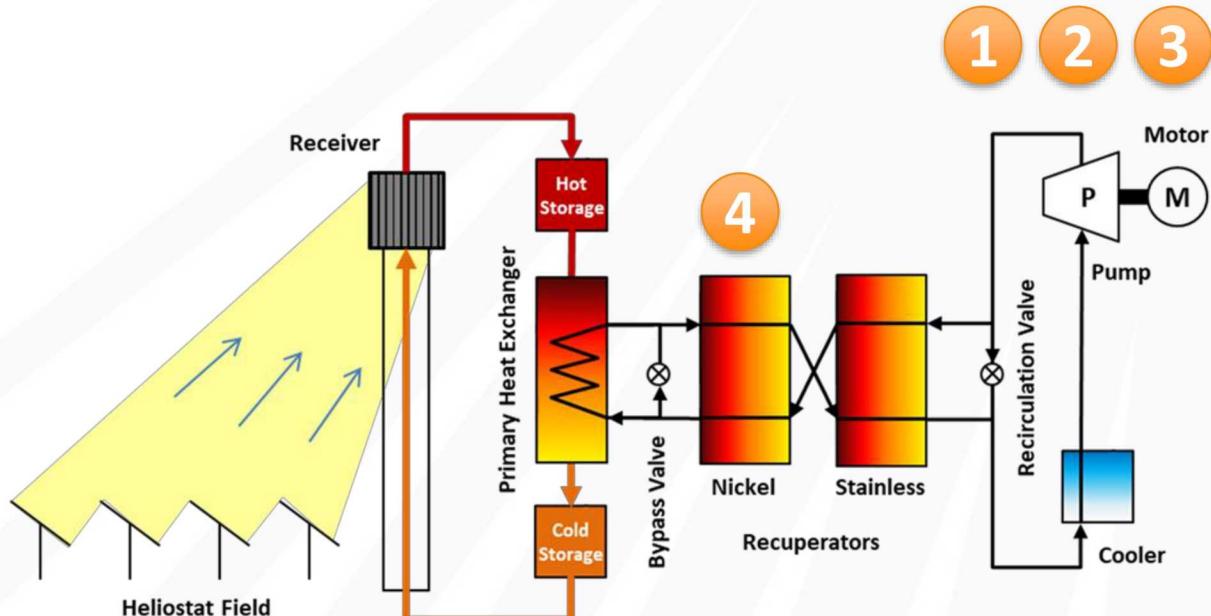


# Other Requirements Finalized in Q2

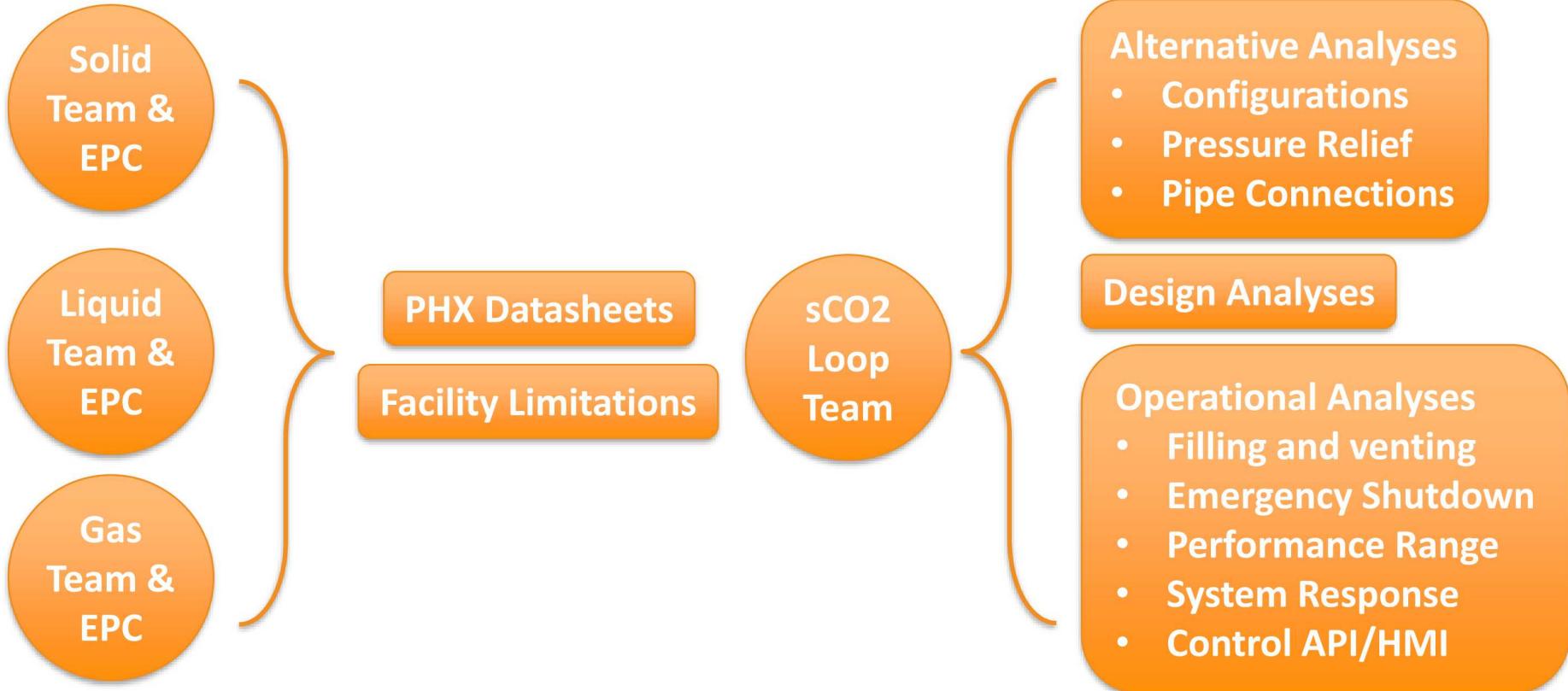
Category	Type	Key Source
PHX Outlet Conditions	Performance	DE-FOA-0001697
Operational Time	Performance	DE-FOA-0001697
Thermal Duty	Performance	DE-FOA-0001697
PHX Inlet Conditions	Operational	Topic 1 Teams
Transient Performance	Operational	Topic 1 Teams
System MAWP/MDMT	Design	Sandia SMEs
Plumbing Connections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



# sCO<sub>2</sub> PHX Coolant System for Any Pathway

