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SOLAR ENERGY TECHNOLOGIES OFFICE

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NNSA National Nuclear Security Administration

SETO CSP Program Summit 2019

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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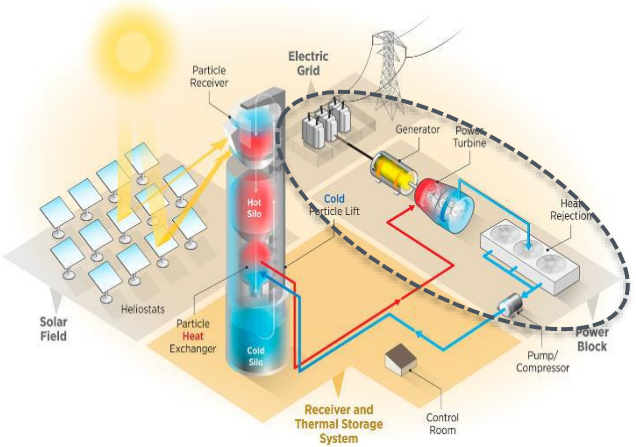
Gen3 CSP Pathway Pilot Plant Power Block



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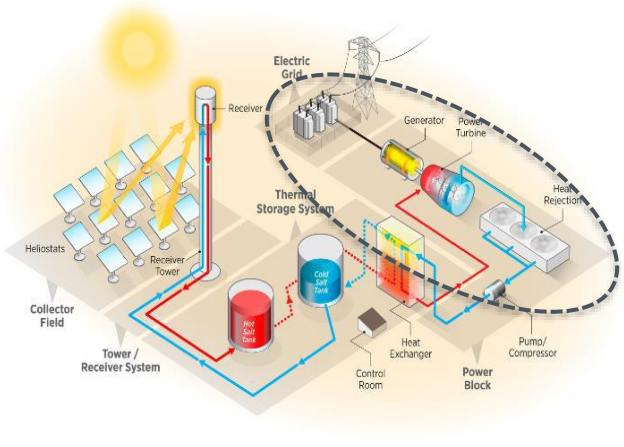

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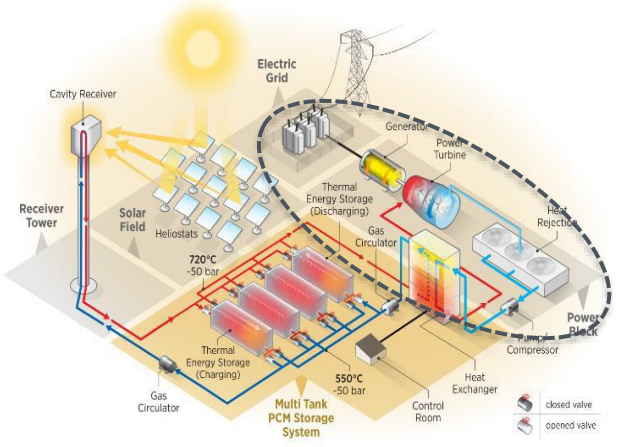

Gas

All three pathways require a largely similar power block

Design and implement a common cooling system

Breakdown of Work Activities

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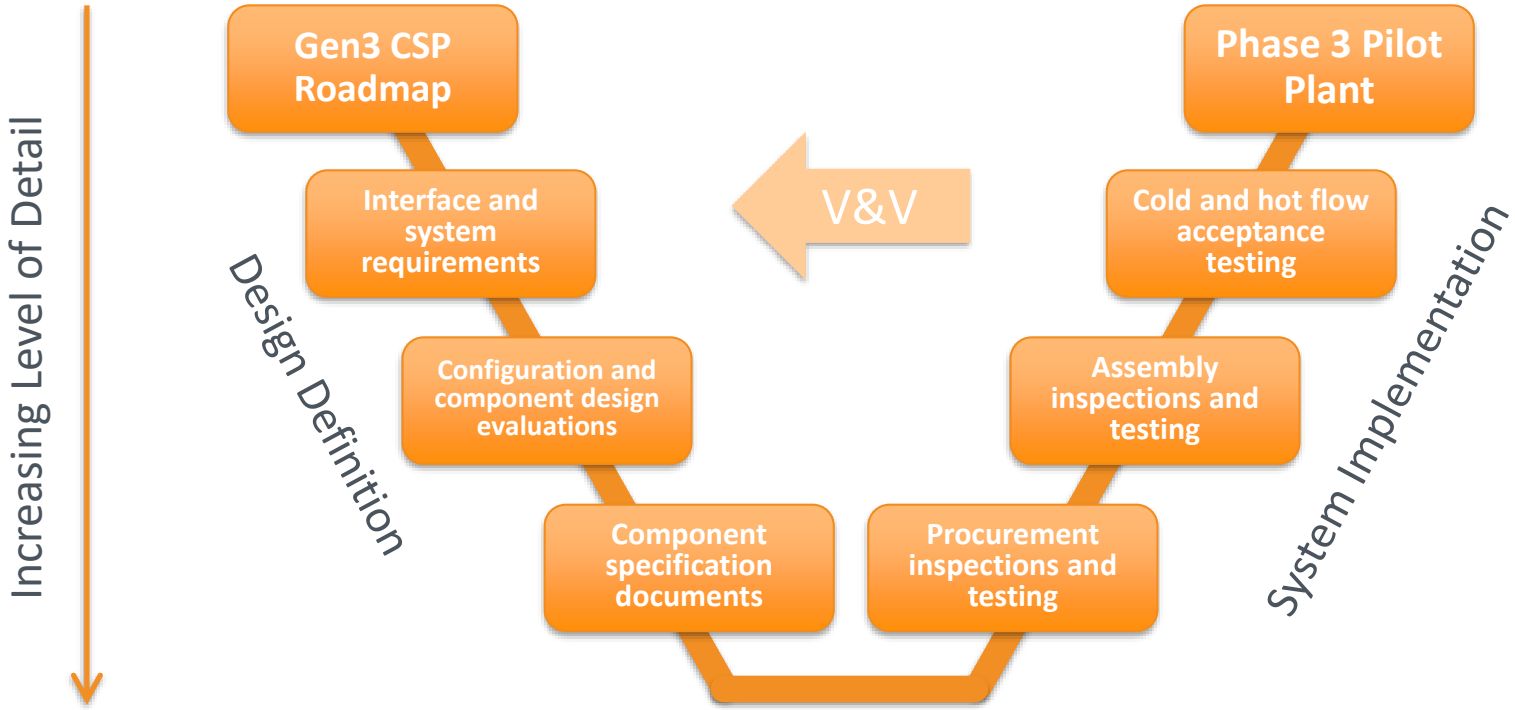
1. **System Requirements**
   - Coordinate requirements definition and provide weightings to guide design decisions.
2. **System Design**
   - Preliminary and detailed design including evaluations of configuration and component tradeoffs.
3. **Procurement**
   - Pre-plan and execute procurement of equipment 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

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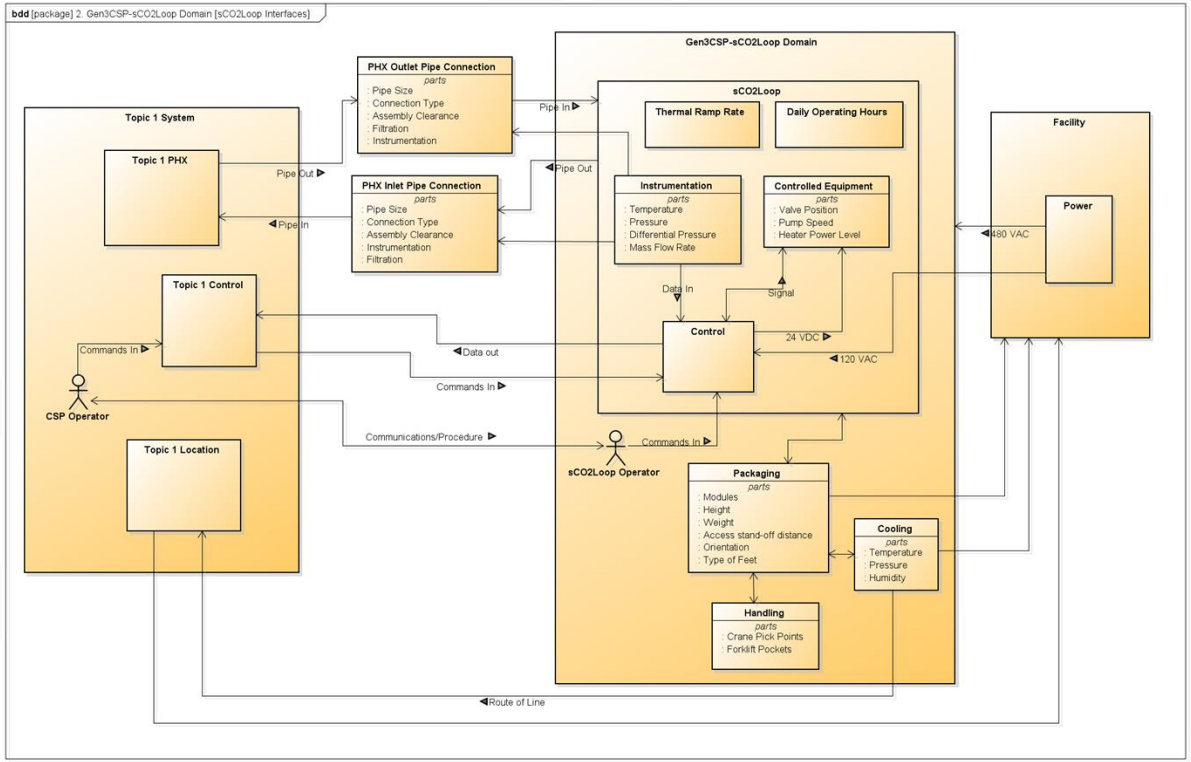
Requirement	Value	Source
Operating Fluid	Carbon Dioxide	DE-FOA-0001697
PHX Outlet Pressure	250 bar	DE-FOA-0001697
PHX Outlet Temperature	715 °C	DE-FOA-0001697
Thermal Duty	≥1 MWth	DE-FOA-0001697
Operational Time	≤16 hr/day*	DE-FOA-0001697
PHX Inlet Pressure	246 bar	1.5% pressure drop
PHX Inlet Temperature	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

Systems Engineering to Expand Requirements

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



Other Requirements Finalized in Q2

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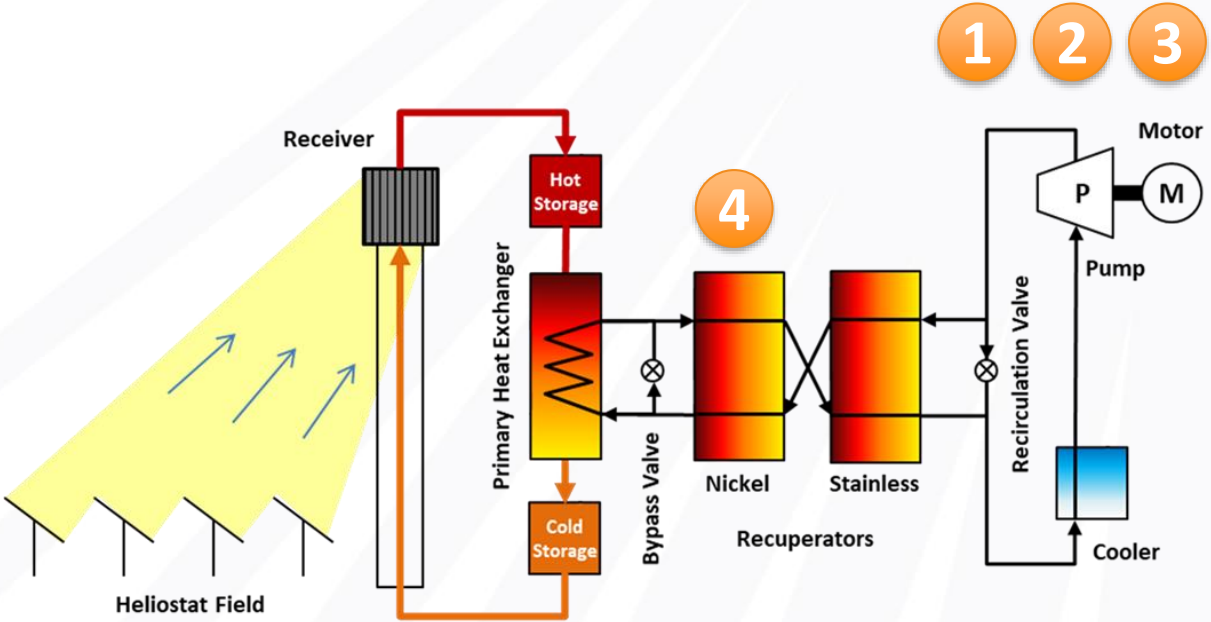
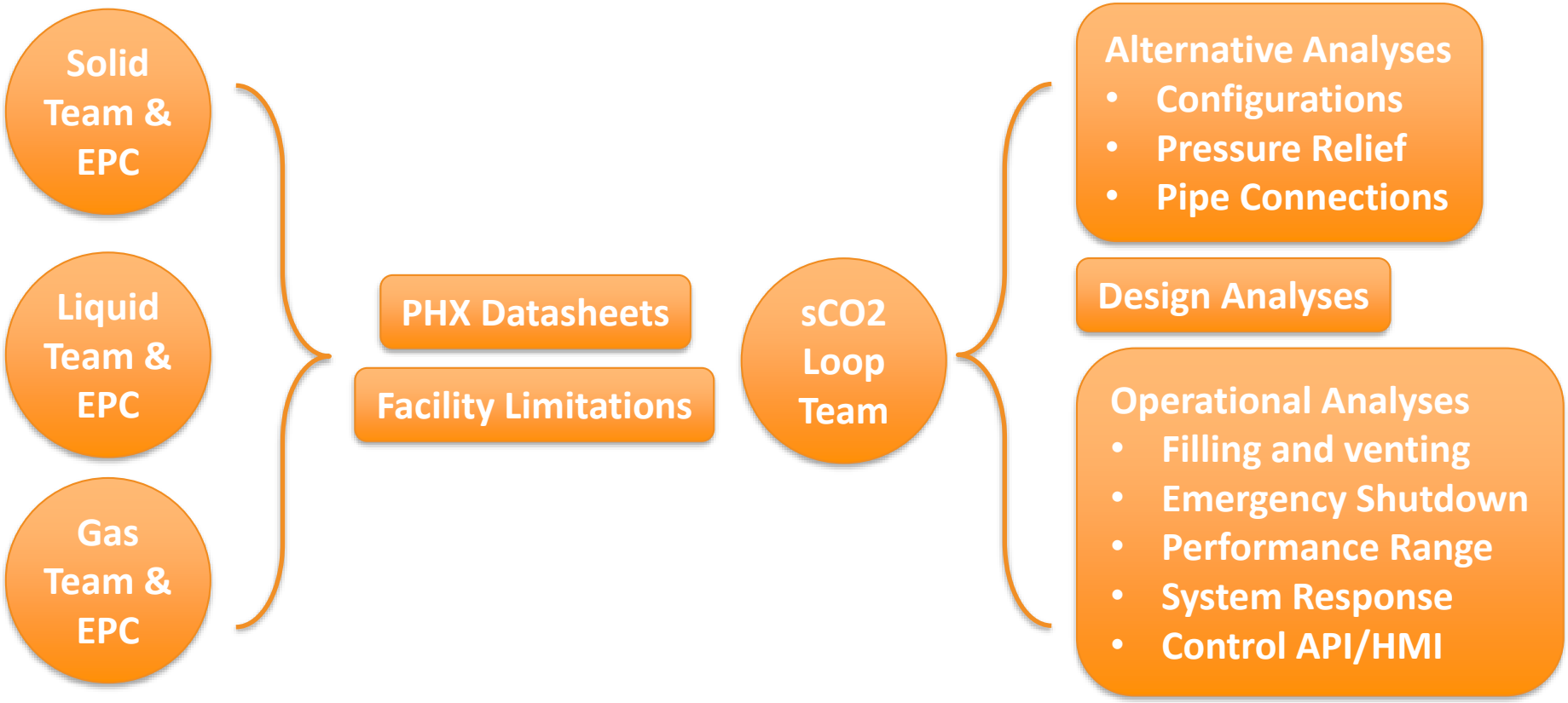
Category	Type	Key Source
PHX Outlet Conditions	Performance	DE-FOA-0001697
Operational Time	Performance	DE-FOA-0001697
Thermal Duty	Performance	DE-FOA-0001697
PHX Inlet Conditions	Operational	Topic 1 Teams
Transient Performance	Operational	Topic 1 Teams
System MAWP/MDMT	Design	Sandia SMEs
Plumbing Connections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

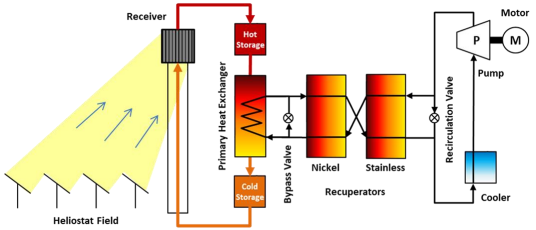
1. Blowdown vs. recirculation
2. Liquid pumping vs. gas compression
3. Low-temp vs. high-temp compression
4. High-temp recuperation vs. preheating and after-cooling

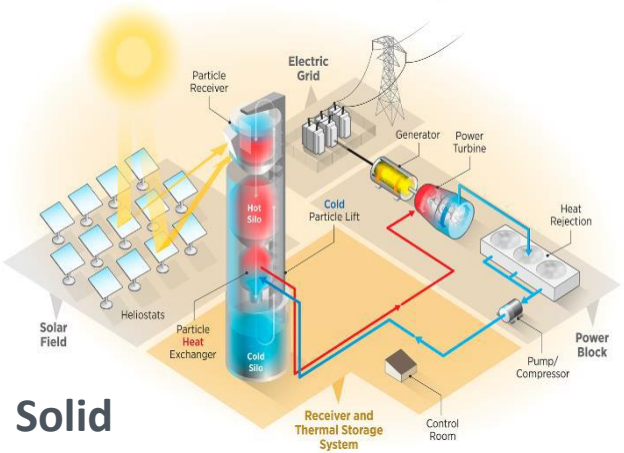


Interactions for Requirements Definition



sCO2 PHX Coolant System for Any Pathway





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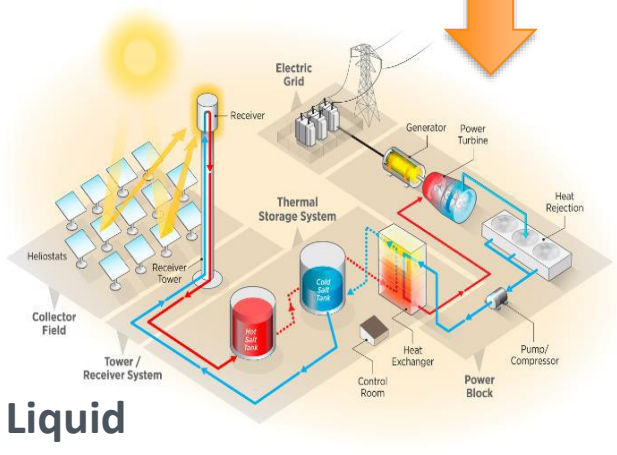

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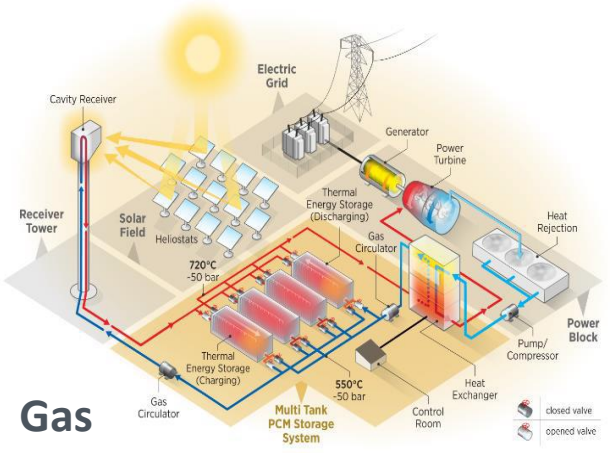

Gas