

Integrated Thermal Energy Storage Heat Exchanger

Unit-Cell Plate Fin HX/Graphite Foam-
PCM Composite

Project Goal and Objectives

Demonstrate an Integrated PCM Heat Exchanger capable of full-life operation at 760°C and 24 MPa in a commercial supercritical CO₂ CSP powerplant.

Objectives:

1. Full-scale integrated PCM heat exchanger design concept.
2. Adaptable to other TES media; e.g. thermo-chemical.
3. Structural validation of heat exchanger at pressure and pressure with accelerated testing.
4. Experimental characterization of HX-PCM interface performance.
5. Fabrication of a full-scale sub-core.
6. Performance validation in sCO₂ test facility.

Key Design Specifications & PCM Characteristics

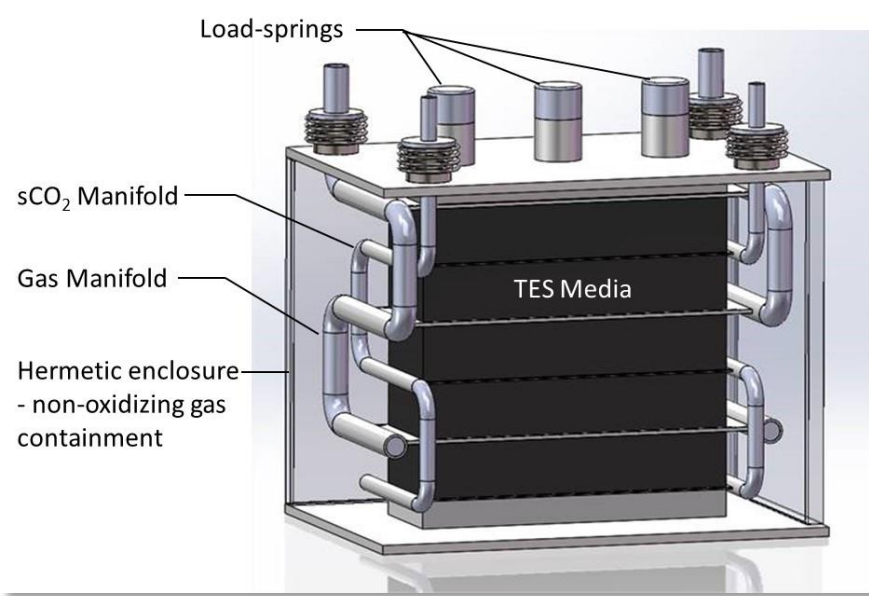
Key Design Specifications

T, CO ₂ Charge	760°C
P, CO ₂	24MPa
Lifetime	30years
Charge Duration	6h
T, Discharge, IN	556°C
T, Discharge, OUT, min	670°C

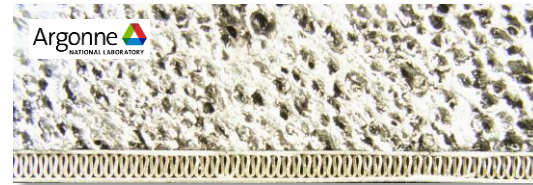
Key PCM Characteristics

T, Solidus	706°C
T, Liquidus	718°C
Latent Heat of Fusion	377kJ/kg
Thermal Conductivity, x-y	23.6W/m·K
Thermal Conductivity, z	14W/m·K

Concept



MgCl₂ Infused Graphite Foam



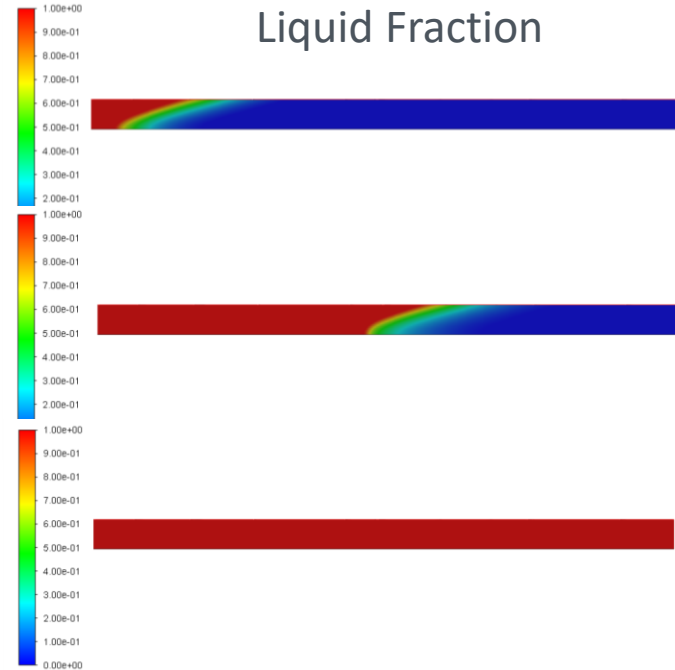
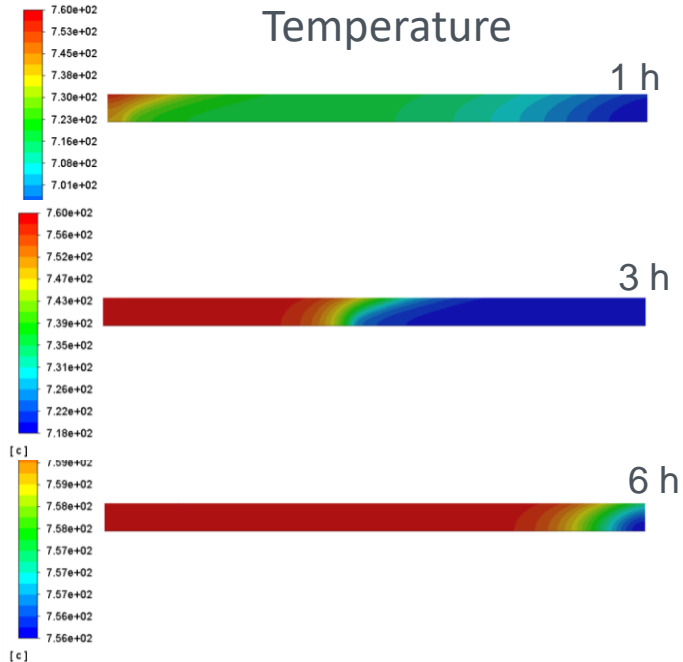
Unit-Cell Plate Fin Heat Exchanger Cell



Design Simulations - Charging

Analysis Objective: Optimize thermal-fluid design for minimum \$/kWh

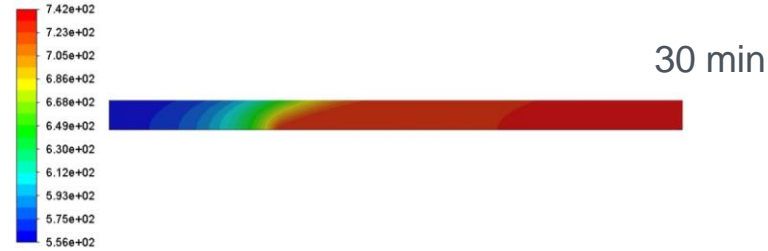
CHARGING



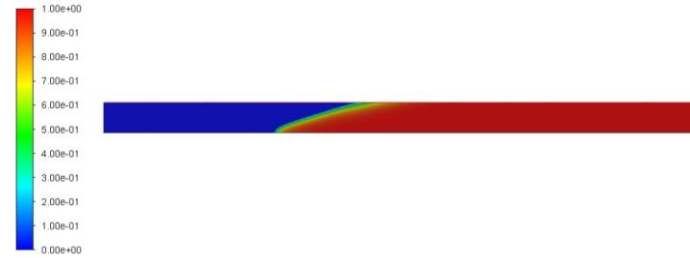
- PCM dimensions: 50 mm x 1 m
- Scales vary by plot

Design Simulations - Discharging

Temperature



Liquid Fraction



DISCHARGING

Status

- Thermal-fluid design optimization in process.
 - Collaboration with ANL.
 - Coordination with Gas-Phase System effort.
- Test article design for ANL in process.
- Next:
 - Integrated Heat Exchanger mechanical design
 - Specifications and envelope to Echogen
 - Structural validation test article design and preparation.

Questions?