SAND2020-2786C

PROJECT NAME: Particle Heat Transfer Mechanisms

Last 5 digits of project number: 34152
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BACKGROUND / INDUSTRY IMPACT

- High-performance, cost effective particle-to-sCO_2 heat exchangers are imperative to the success of particle thermal energy storage
- Prototype measurements to obtain model validation data is essential

PROJECT OVERVIEW / OBJECTIVES

- This project seeks to design and test a subscale moving packed-bed heat exchanger with features to improve performance (pressure drop and heat transfer) that are relevant to scaled up versions
- Particle and sCO_2 flow loops are being developed to obtain more robust model validation data

METHODS

- Particle heat exchanger and flow loops developed based on learnings from SuNLaMP project and model based analysis

KEY OUTCOMES / MILESTONES

- Initial sizing and design of the prototype 20 kW_t particle/sCO_2 heat exchanger has been completed based on FEA analysis
- The important features to include in the prototype heat exchanger that are relevant to a multi-megawatt design have been identified based on the G3P3 project
- Design of the particle and sCO_2 flow loops is complete and assembly is currently under way

CONCLUSION / REMAINING RISK

- Future work will focus on commissioning the particle and sCO_2 flow loops
- Manufacturing of prototype heat exchanger is being finalized with targeted delivery date in beginning of July
- Prototype heat exchanger testing campaign will be completed prior to October of 2020

CONCENTRATING SOLAR-THERMAL POWER TRACK (Gen3 Lab Call)

Development of a Small-Scale Testbed for Novel Particle-to-sCO_2 Heat Exchangers to Enable Gen3 Particle Thermal Energy Storage

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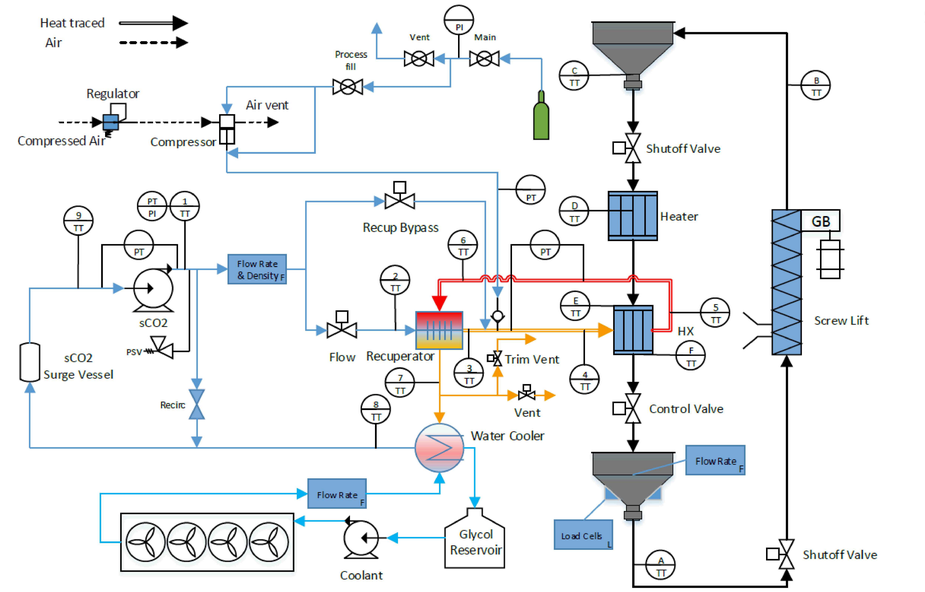
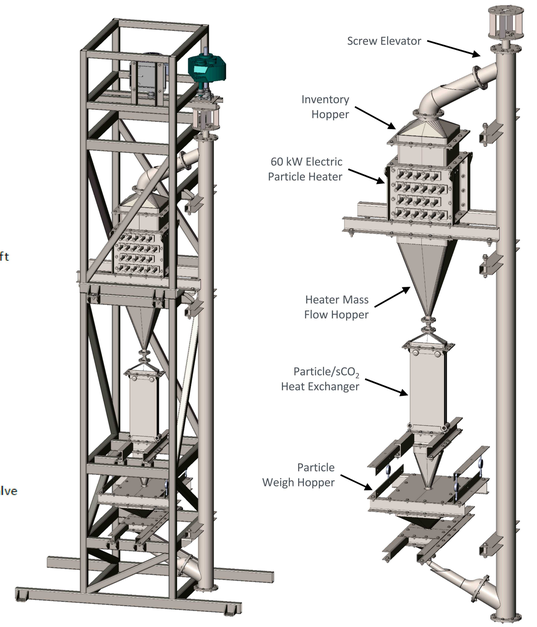
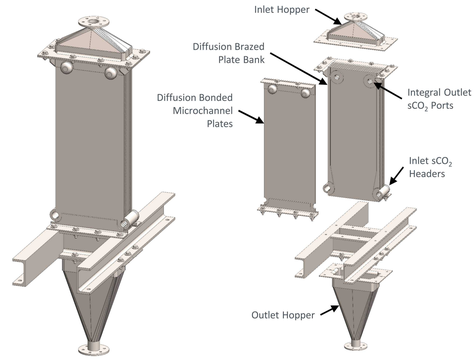


Process flow diagram of the integrated particle and sCO_2 flow loops to provide constant boundary conditions for heat exchanger testing

SolidWorks model of electrically-heated particle flow loop



20 kW_t Diffusion Bonded/Brazed Heat Exchanger Concept



Nominal Particle and sCO_2 Flow Loop Operating Conditions

Metric	Value
Thermal Duty	40 kW
HX Design Temperature	550 °C (1022 °F)
HX Design Pressure	20.0 MPa (2900 psi)
HX Operating Pressure	17.0 MPa (2466 psi)
Particle Inlet Temperature	500 °C (932 °F)
Particle Outlet Temperature	340 °C (644 °F)
Particle Flow Rate	0.224 kg/s
CO_2 Inlet Temperature	290 °C (554 °F)
CO_2 Outlet Temperature	450 °C (842 °F)
CO_2 Flow Rate	0.206 kg/s
CO_2 Pressure Drop	< 40 kPa (5.8 psi)

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