

Project ID: 36335 / DE-EE0002064-2260

SAND2021-10149 O

High-Temperature Freeze & Leak Resistant Molten Salt Valve

1. Impact

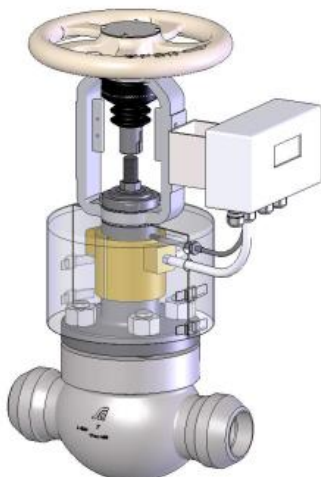
- Cost reduction of liquid-based solar by an additional 40% - 70% beyond 2018 costs, with more reliable, highly manufacturable flow-control valve, capable of achieving operational temperatures of $>700^{\circ}\text{C}$ is required.
- Design, development and characterization of a 2-in. freeze-resistant, leak-reduction flow-control valve used for strategic, robust configurations for supporting LCOE reduction to $\phi 5/\text{kWh}$.

2. Project Goals

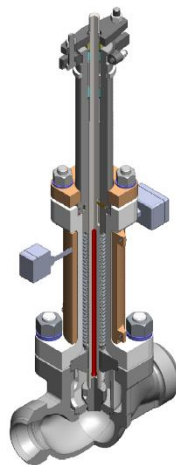
- Development of 750°C molten salt globe valve, capable of $<.3\text{mm}/\text{yr}$. corrosion resistance of valve components.
- Subcomponent materials compatibility with Gen 3 ternary chloride salt chemistry - 20%NaCl/40%MgCl/40%KCl by mol wt. %
- Uniform and controllable temperature ($\Delta T < 50^{\circ}\text{C}$) across the valve bonnet.
- $<20^{\circ}\text{C}$ thermal gradient between the valve stem heat pipe and connected valving structure.
- Techno-economic scalability of 2 in. valve to 6-8 in. industrial size, with translatability to other valve types (e.g. check, isolation valves, etc.)

3. Method(s)

Innovative STM system, and heat pipe valve stem development to enhance salt drainage



Valve with STM



Valve w/ Heat Pipe
Valve Stem



Materials Batch
Screening Test



Isothermal Batch Flow Test System

and reduce traditional thermal-cycling material challenges related to creep and fatigue which will improve component lifetime.

4. Outcomes(s)

- Completion of the primary batch-process chloride salt compatibility characterization for 750°C component materials down-selection.
- Completion of preliminary designs for two prototypes:
 - Bellows-Based Design
 - Quick-Change Packing Canister Design
- Completion of Isothermal-Batch test System for 750°C Halide Salt Valve Characterization.

5. Conclusion/Risks

- Materials characterization has found only a select number of alloy and ceramic materials are compatible with the salt at high temperatures for ≥ 500 hr. durations.
- Sodium is the best HTF for optimized heat valve stem performance.

6. Team (Project Leads)

- Sandia National Laboratories
 - Dr. Ken Armijo (PI)
- Flowserve Corporation
 - Mr. Bryan Winkel
- Kairos Power LLC
 - Dr. Alan Kruiuzenga