High Temperature Pumps and Valves for Molten Salt

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Overall Goals of the Project

- **Objective (1):** Demonstrate a centrifugal pump with an impeller, shaft, bearing, and housing made of a refractory material that is corrosion resistant, mechanically stiff, and creep resistant at 800°C when exposed to a ternary chloride salt.

- **Objective (2):** Demonstrate a refractory material that can be used to make a corrosion resistant, mechanically stiff plug valve for operation in a ternary chloride salt at 750°C.

- **Objective (3):** Design a full scale vertical turbine pump (VTP) that uses the tested materials and could be deployed in a full scale CSP plant employing a ternary chloride salt at 750°C.

- **Objective (4):** Design a pump made from conventional materials (i.e., Ni-based alloys) that can be used at 750°C to pump molten salt in a 2 MW pilot scale plant.
Circulation Loop
Goal is to subject the pump to the same types of stresses it would experience in the full scale application → 6000 RPM
Advantages with refractories:

- **Creep**: We propose to use a ceramic/metal composite material, ZrC/W, which has much higher creep resistance than Ni alloys like H230 and 740H.

- **Fabrication**: ZrC/W can be fabricated into the requisite complex shapes needed for pumps and valves by using a novel net-shape, reactive melt infiltration process.

- **Corrosion**: DCP-derived ZrC/W composites exhibit high temperature corrosion resistance in low-oxygen-bearing molten MgCl2-KCl salt.
Overall circulation setup

- The system is held inside the chamber
- The system provides the inert Ar environment.
- The chamber’s walls are water-cooled