ThorCon: Status 2022

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2022 Hybrid Molten Salt Reactor Workshop

Energy Through Safe, Secure and Sustainable Technology

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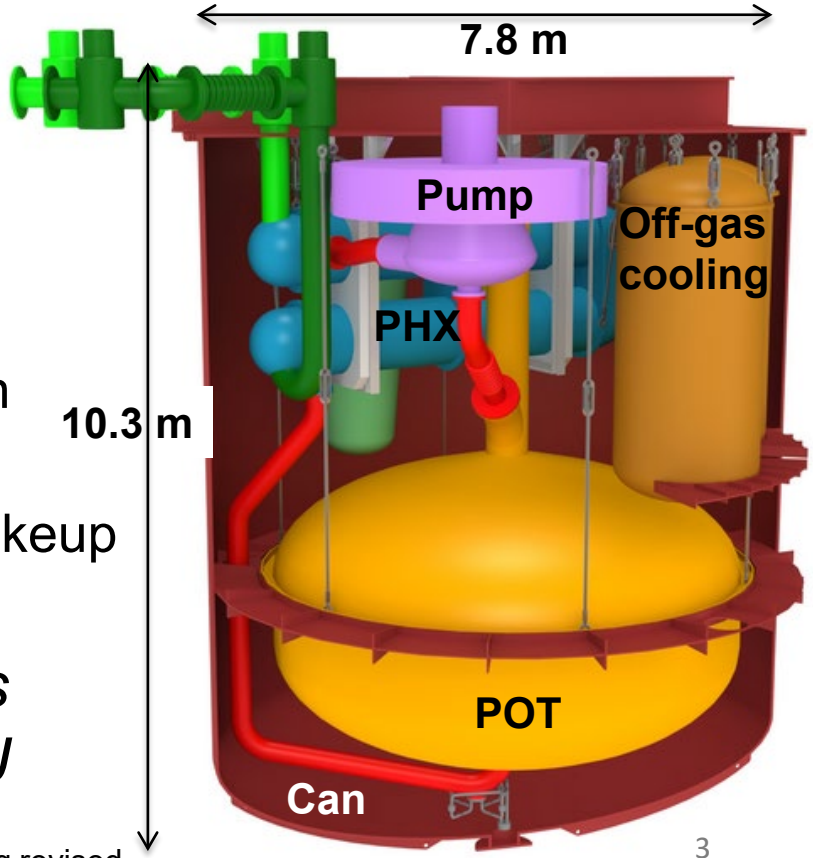
Two 500 MWe ThorCon liquid fission power plants

Several Organizations Facilitates The Development Of ThorCon Fission Reactor, Including

- Milano Multiphysics (MMP)
- Empresarios Agrupados (EA)
- PLN Engineering
- Virginia Tech
- University of California, Berkeley
- University of Wisconsin, Madison
  - Purification of barren salt

ThorCon Is a Thermal Spectrum, Molten Fluoride Salt Reactor Contained in a Can

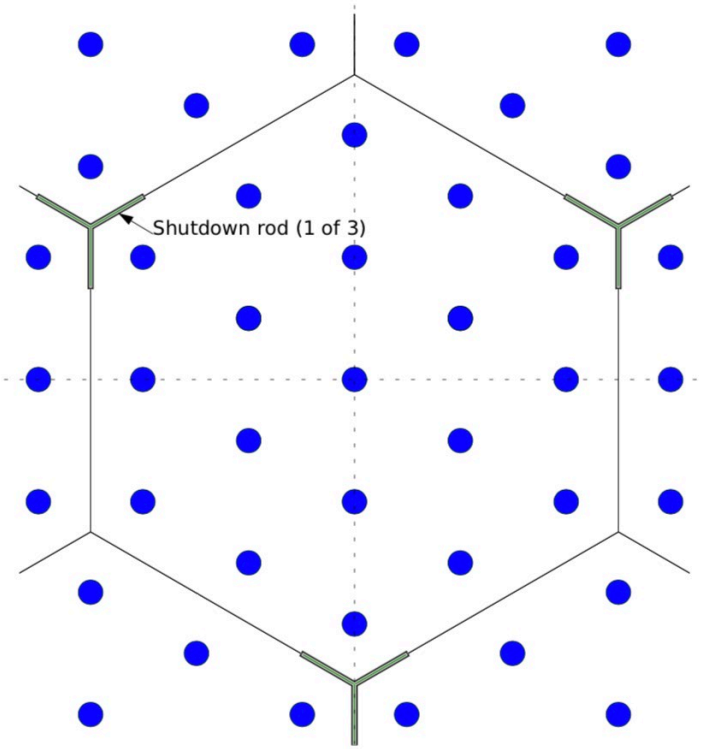
- Pot (Vessel) (316 SS)
  - Pressure: 3.5 bar (0.33 Mpa)
  - $NaF\text{-}BeF_2\text{-}UF_4$ (72-16-12 mol %)*
  - Temperature: inlet/outlet 564/704°C
  - Graphite moderator (4 y lifetime) with channels for molten salt flow
  - Converts some U-238 to Pu-239 (makeup fuel is added continuously)
- *Due to recent events, the systems have been redesigned to use LEU*



*Being revised

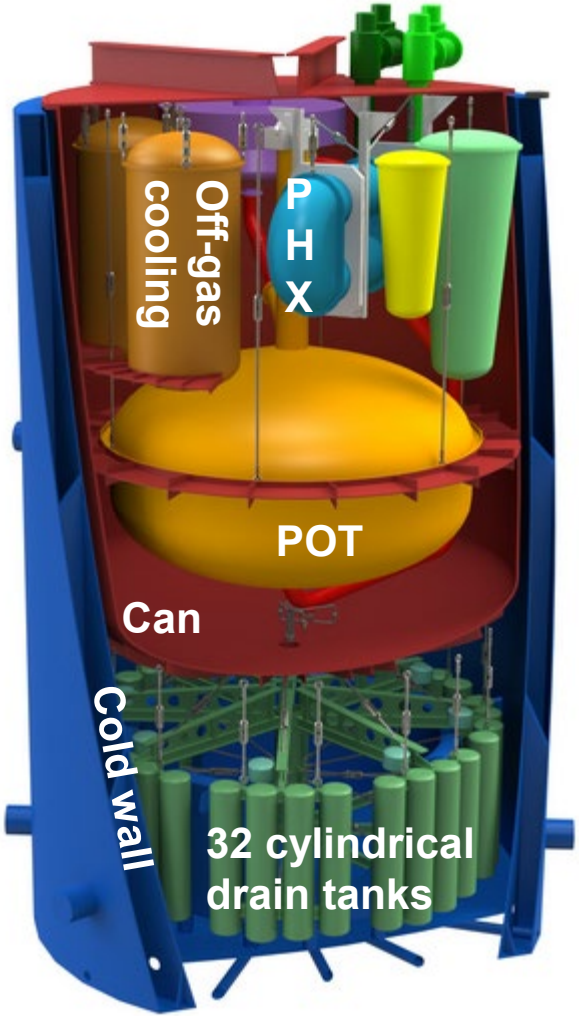
Control of ThorCon Is Achieved via:

- Negative temperature coefficient (−6 to −2 pcm/K)
  - Increased temperature reduces reactivity
- Drop of any one of 3-control rods
- Drain of fuel-salt to drain tank
  - Loss of heat sink or loss of flow that results in a temperature rise of ~120K
- Redox control
  - Minimized corrosion (general & localized)
  - Avoid carbide precipitation ….
- Removal of Xe (transient response) via Off-gas system

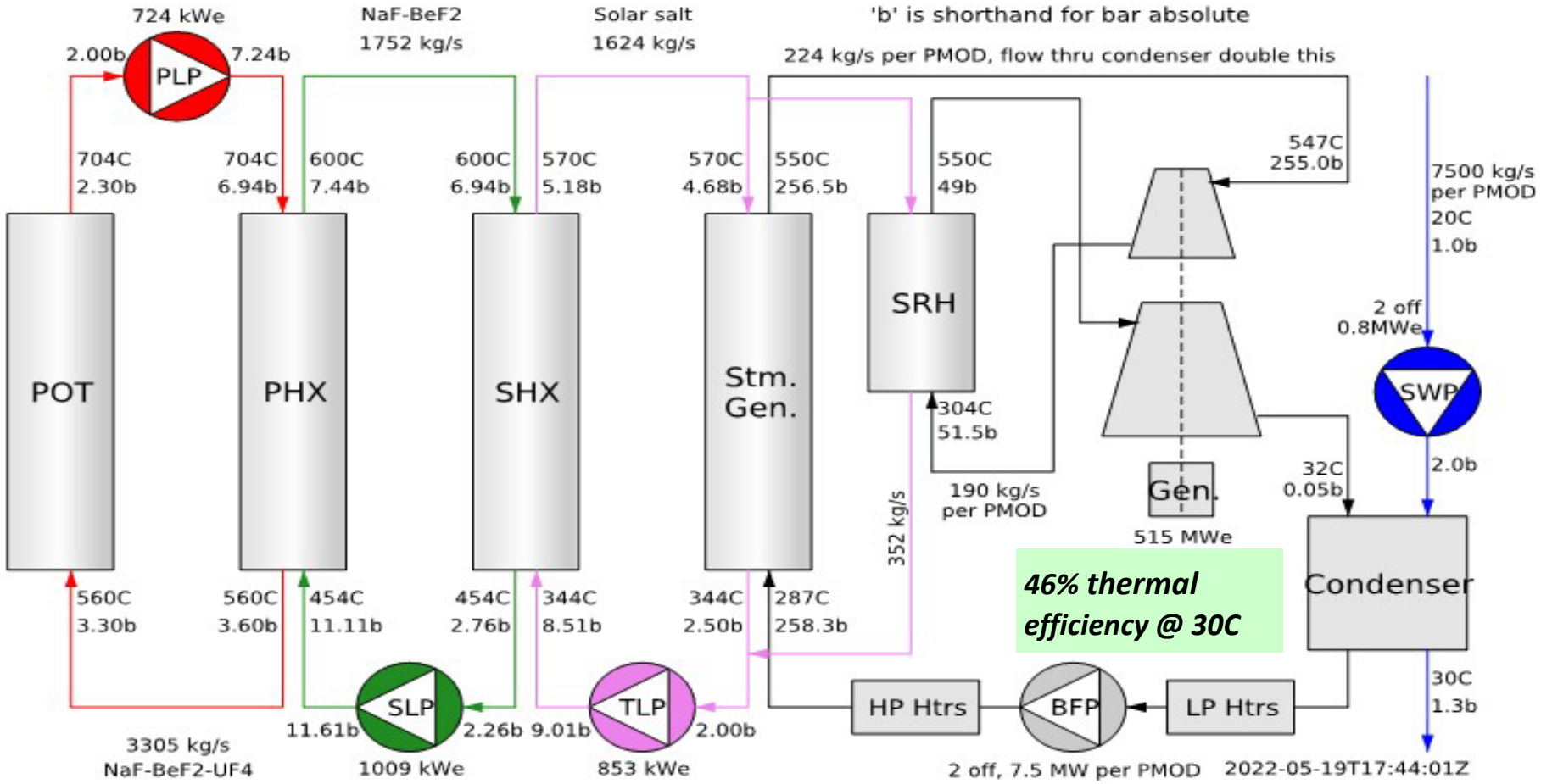


Cooling Is Achieved By Housing Can Unit Within A Cold Wall

- Cold wall (25 mm 316 SS/500 mm water/25 mm 316 SS) continuously absorbs heat
  - Radiated from the Pot
  - Radiated from the drain tanks
- Cold wall is cooled by natural water circulation



ThorCon Employs Three Salt Loops To Generate Power



MMP Performs Extensive Neutronic And Heat Flow Analyses That Supports 2022 Design Modifications

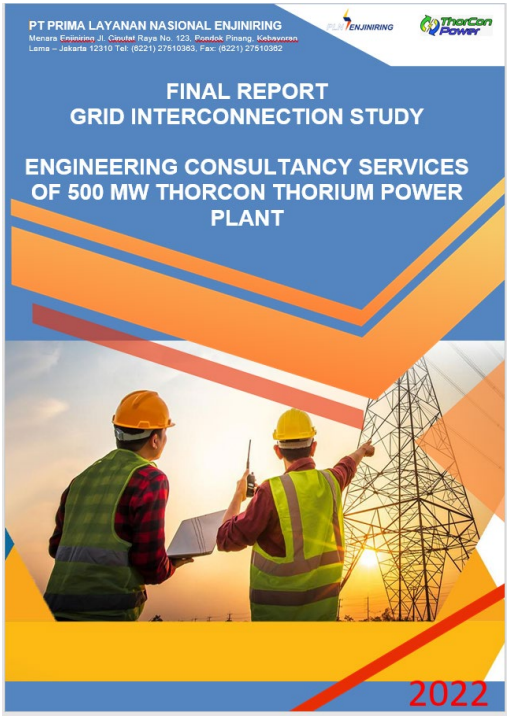
- Provide passive cooling for an unlimited grace period for all but two rare events where the grace period is at least two months
- Compensate for xenon-135 transient during power level changes

Empresarios Agrupados (EA) Entered A Partnership With Thorcon

- Brings 50 years of nuclear engineering, construction and operation experience
- Supports the engineering design of the full-scale Non-Fission Test Platform (NTP) and the 500 MWe demo plant
- Develops a procurement plan engaging suppliers such as ENSA, Doosan, ENUSA, DSME, etc.
- Manages the project schedule and budget

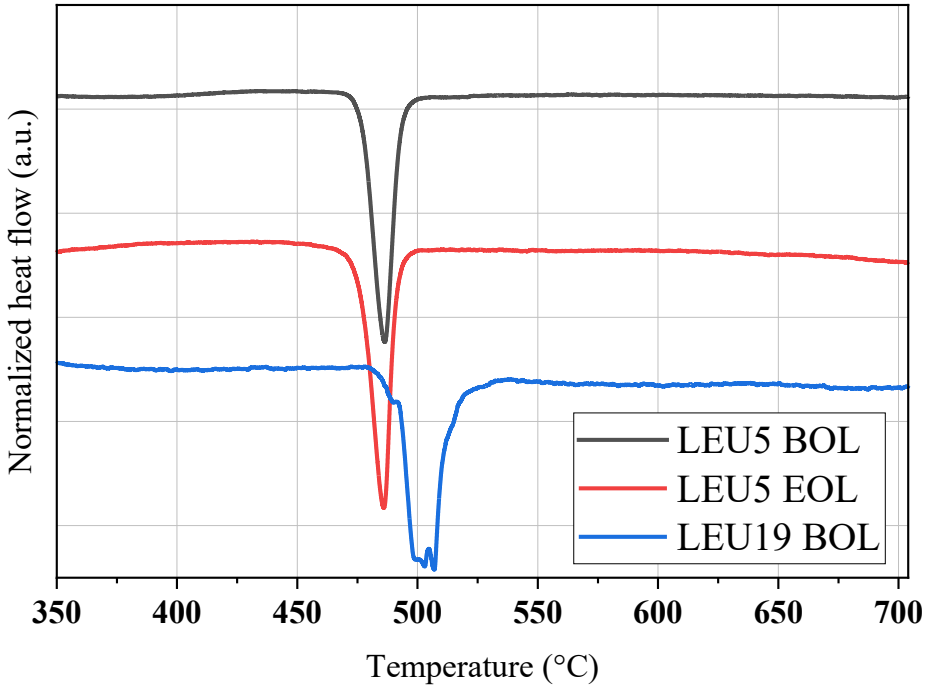
Demonstration Site And Grid Interconnection Studies Are Ongoing (PLN Engineering)

- Northern part of Kelasa Island, Central Bangka Regency, Bangka Belitung Islands Province

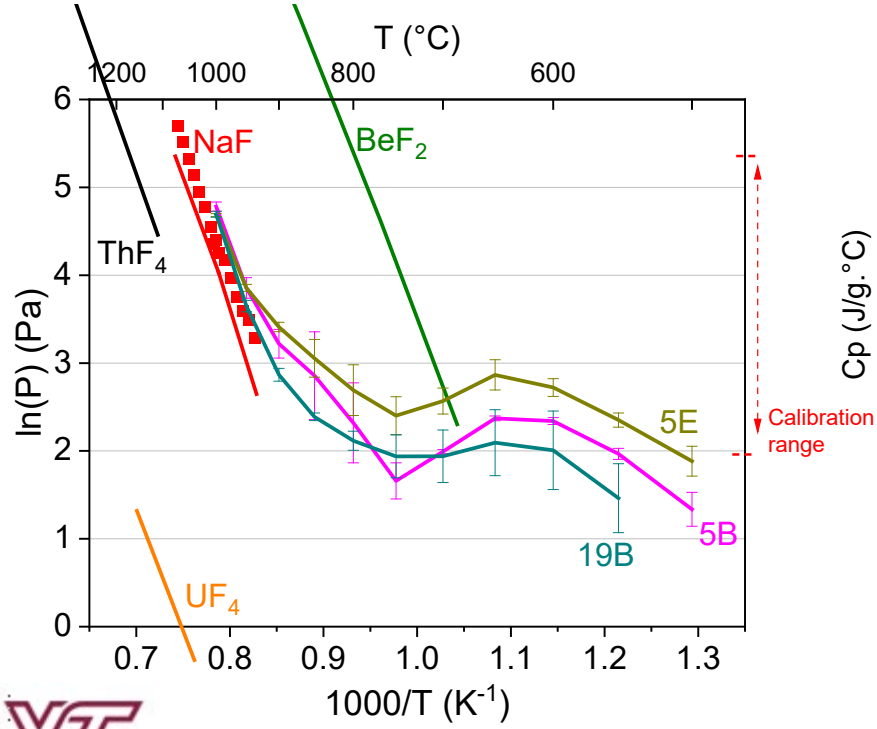


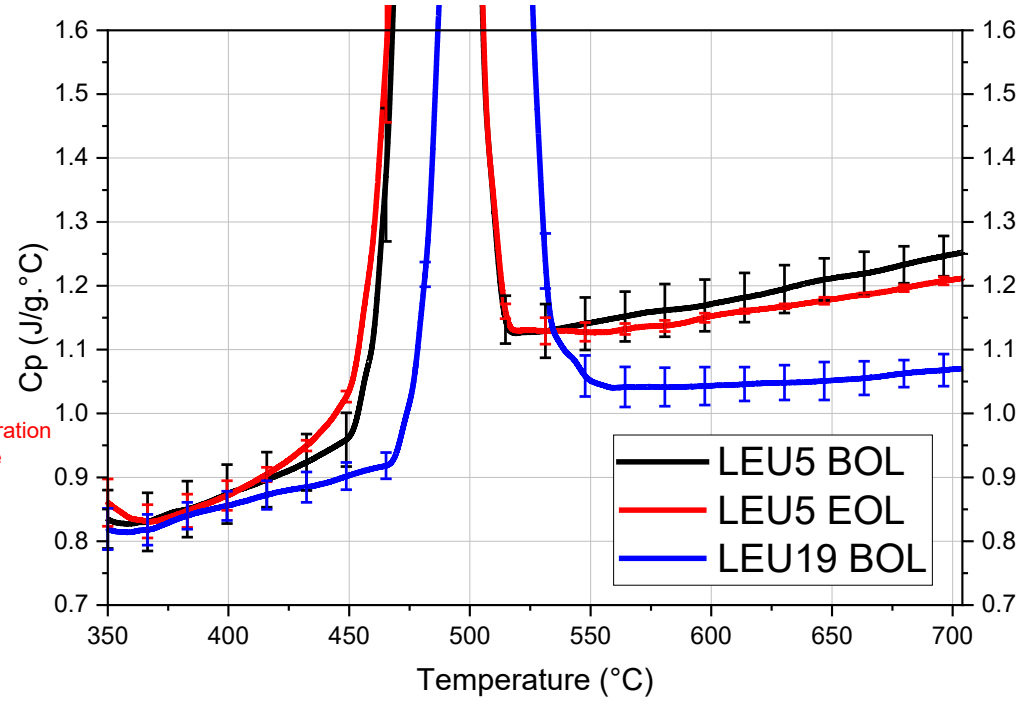
Virginia Tech Has Measured (DSC) the Melting Point And Heat of Fusion Of Salts

Salt	Melting point (°C)	Heat of fusion (J/g)
5B	477.4	146.9
5E	476.5	144.3
19B	493.0	177.7

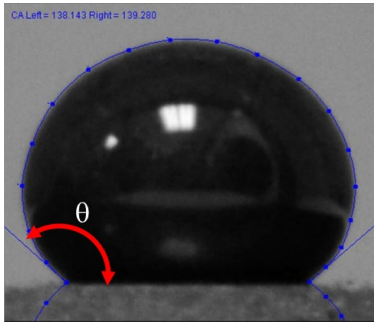


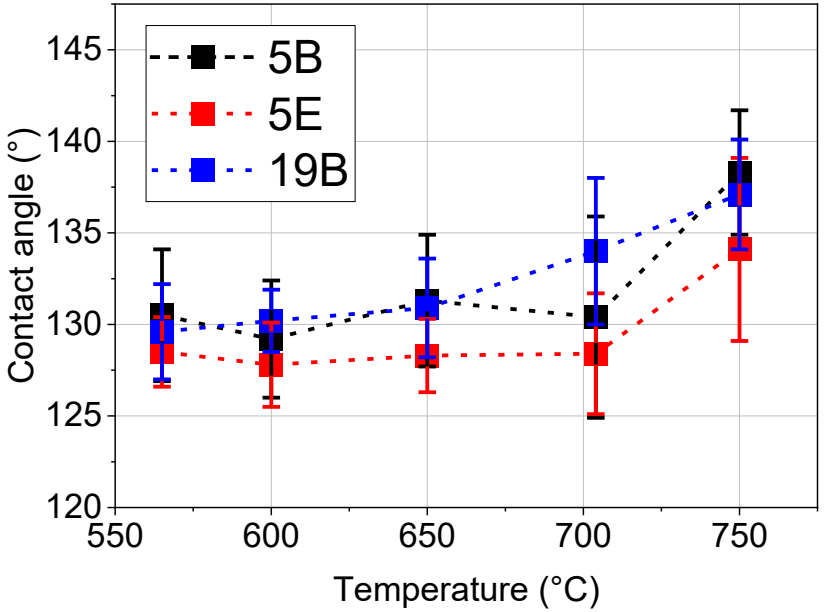
Virginia Tech Has Measured Vapor Pressure (Effusion via TGA) of Salts and Specific Heat Capacity (MDSC)





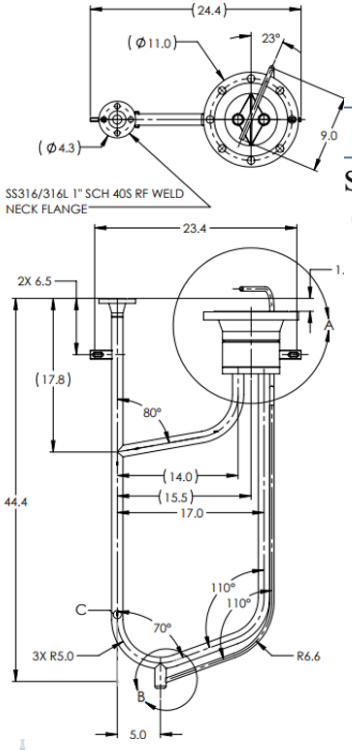
Contact Angle (Salt/Graphite) Varied With Temperature And Salt Composition





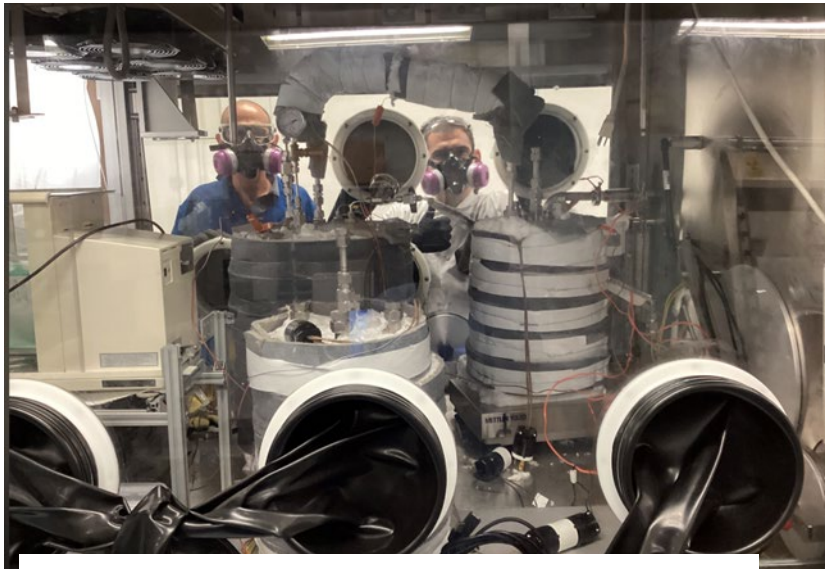
- *For FLiBe on graphite at between 500 to 800°C, ORNL 3591 reports 147 ± 12°*

UCB Designed And Constructed 316H Thermal Convection Loop *(Matches Prototypical Surface/Volume Ratio)*



Design Parameter	Prototypical	Experimental Loop
Salt bulk temperature drop across the loop	$\Delta T_{b,loop} = \mathbf{170°C}$	$\Delta T_{b,loop} = \mathbf{167°C}$
Hot leg maximum bulk and wall temperatures	$T_{b,hot} = \mathbf{620°C}$ $T_{wall,hot} = 670^oC$	$T_{b,hot} = \mathbf{621°C}$ $T_{wall,hot} < 720^oC$ $(@\ Q_h = 1kW, T_{wall,hot} = 670^oC)$
Cold leg minimum bulk and wall temperatures	$T_{b,cold} = \mathbf{450°C}$ $T_{wall,cold} = 400^oC$	$T_{b,cold} = \mathbf{454°C}$ $T_{wall,cold} > 350^oC$ $(@\ Q_h = 1kW, T_{wall,hot} = 400^oC)$
Surface Area/Vol. of hot leg and cold leg	$\Phi_{hl} = \mathbf{450 m^{-1}}$ $\Phi_{cl} = \mathbf{560 m^{-1}}$	$\Phi_{hl} > \mathbf{130\ m^{-1}}$ $\Phi_{cl} > \mathbf{140\ m^{-1}}$ (loop only; high-surface area SS316H probes will be inserted to match prototypical SA/Vol)

Supported Loop Has Been Installed In Glovebox. Down-Batching Of NaF-BeF_2 Has Been Achieved



In-glovebox salt transfer operation from 50 kg tank to 20 kg tank.

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