OAK RIDGE National Laboratory

# Status and Direction of Molten Salt Loops at ORNL

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*Acknowledge: Seth Baird, Nolan Goth, Trevor Howard, Ethan Kappes, Jordan Massengale, Ricardo Muse, Thien Nguyen*

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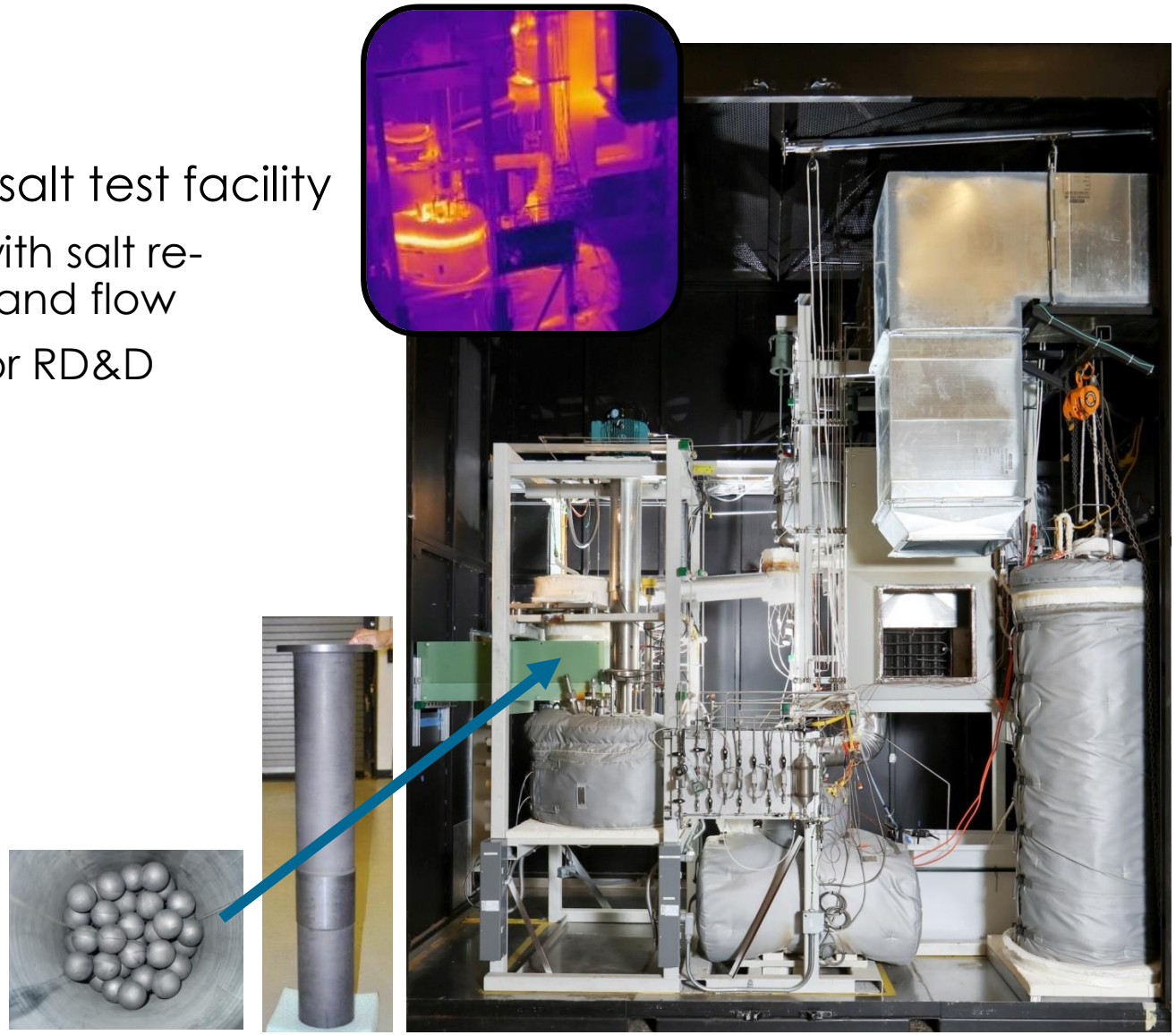
# Liquid Salt Test Loop (LSTL)
## Overview

- Versatile high-temp. forced-flow fluoride salt test facility
  - One of few operable salt loops in the U.S., with salt re-purification capability, with relevant power and flow
  - FLiNaK provides relevant salt environment for RD&D

| | |
|---|---|
| Salt | NaF-KF-LiF |
| Operating Temp. | 700°C |
| Flow rate | ≤4.5 kg/s |
| Primary Material | Inconel 600 |
| Loop salt volume | 80 liters |
| Power (main heater) | 200 kW induction<br>~20 kW trace |
| Primary piping ID | 2.67 cm (1.05 in.) |
| Initial operation | Summer 2016 |



# Liquid Salt Test Loop (LSTL)
## Highlighted Efforts

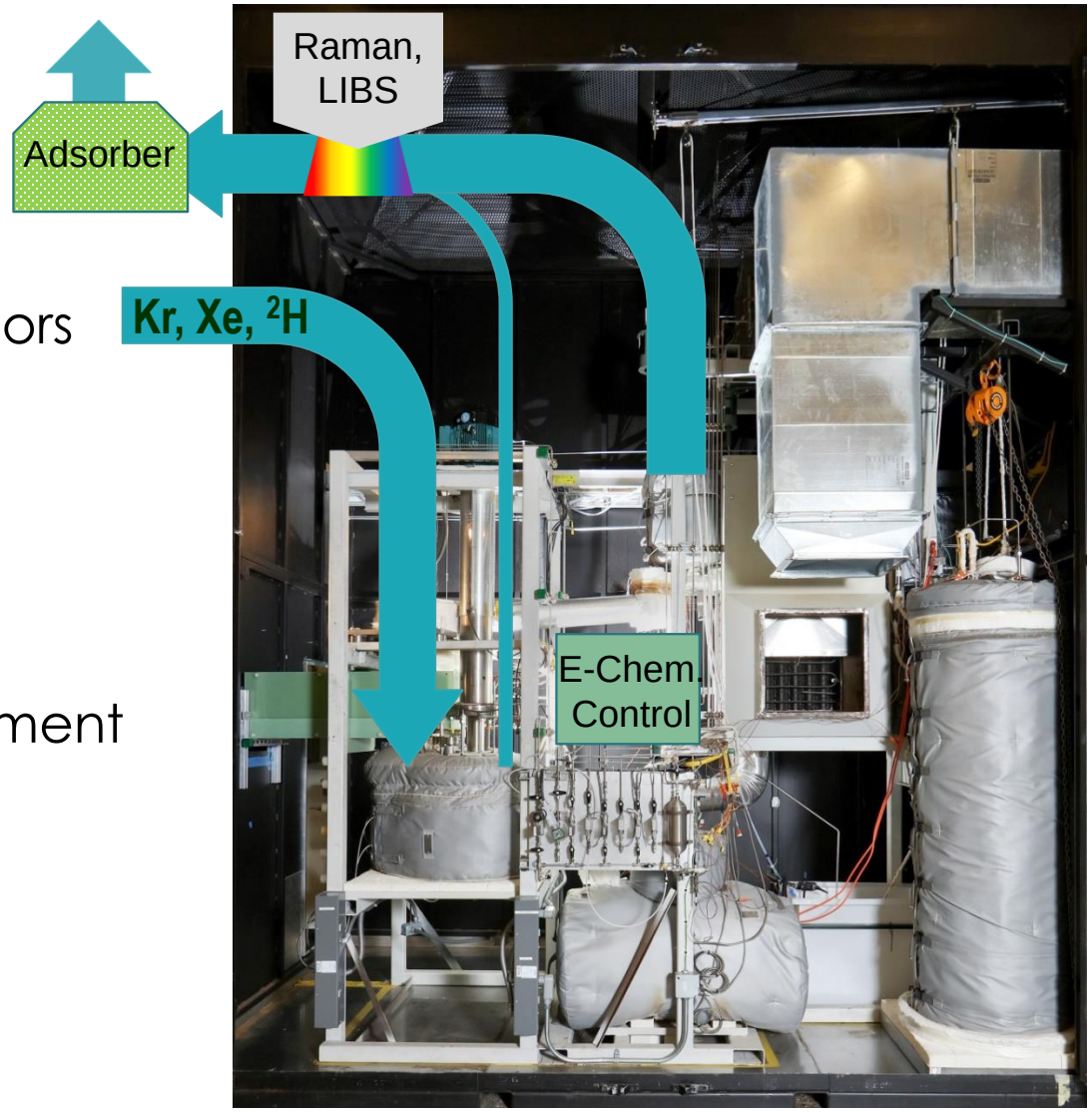
- Series of efforts over the last couple years
  - Repurified salt through hydrofluorination
  - Restarted loop
  - SiC section cracked on cool down
  - Disassembly and cleanout of SiC pieces
  - Designed new heated section and filter
  - Fabricate and install new section
- Surveyed valve options, created test plan
- Examined heat ex. freezing susceptibility


-T. K. Howard, David Holcomb, Kevin Robb, "Assessment on the Practicality of Off-the-Shelf Valves for Use in Molten Salt," Proc. NURETH-18, Portland, OR, August 18-23, 2019.
-Goth, N., Delgado, M., Howard, T., & Robb, K., (2020). Molten Salt Air-Cooled Heat Exchanger Fluid Dynamics. Trans. of the ANS - Volume 123. doi:10.13182/t123-33521

# Liquid Salt Test Loop (LSTL)

## Future: Multi-year testbed studying specie transport and sensors

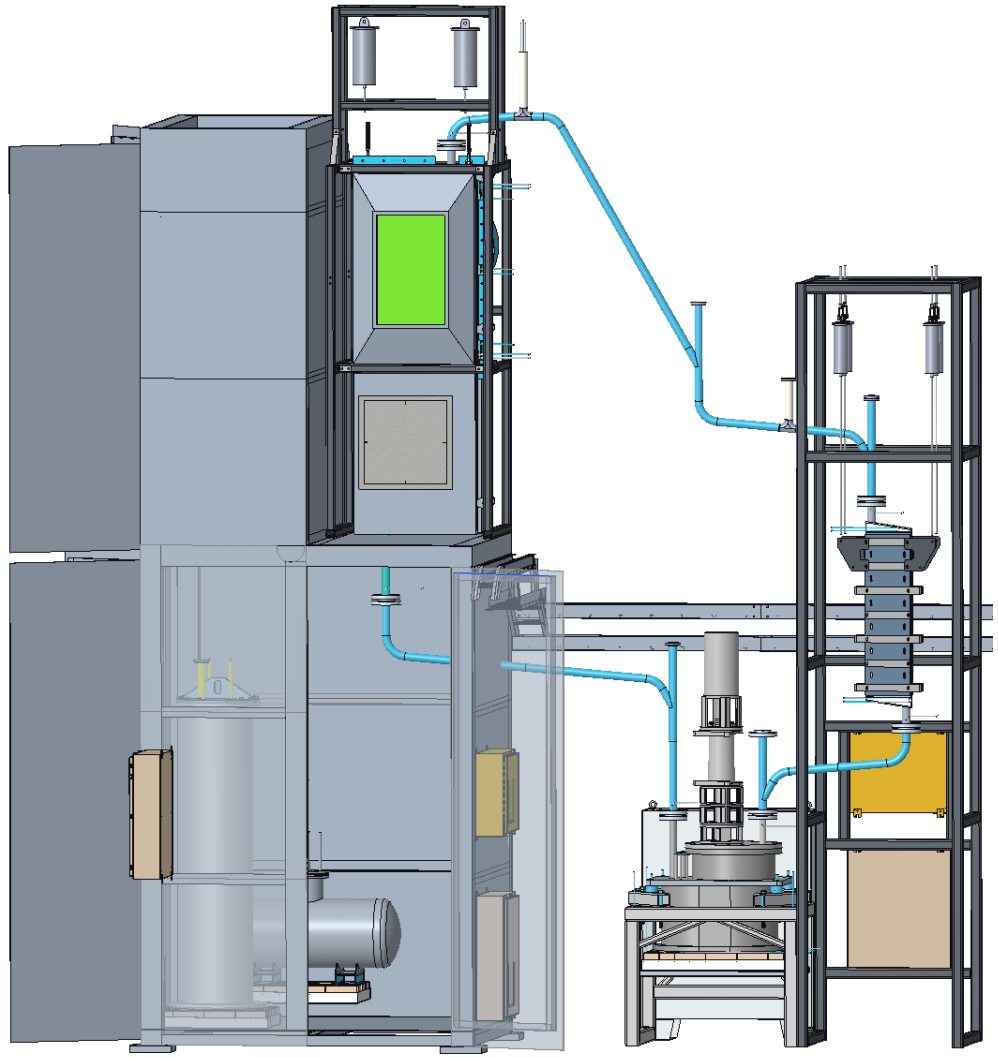
- Progressive injection and tracking of species
  - Gases: Kr, Xe, $^{2}H$
  - Iodine, Cerium, etc.
- Parallel development and demonstration of sensors from collaborators
  - Raman (PNNL), LIBS (ORNL)
  - E-Chem monitoring and control (ANL)
  - Novel sensors from industry and universities
  - In situ corrosion sensors (ORNL)
- Collaborative design and testing of off-gas treatment
  - Noble gas (i.e. Xe) adsorbers
  - Aerosol capture
- Provide validation data for specie transport phenomena models and integral predictions



# Facility to Alleviate Salt Technology Risks (FASTR)
## Overview

- Relevant-scale facility to de-risk molten salt technology for Gen 3 Concentrating Solar Power (CSP)
  - ~2x larger than LSTL
  - Under development

| | |
|---|---|
| Salt | $NaCl\text{-}KCl\text{-}MgCl_2$ |
| Operating Temp. | 725°C |
| Flow rate | 3-7 kg/s |
| Primary Material | C-276 |
| Loop salt volume | 120 liters |
| Power (main heater) | 350 kW main<br>~50 kW trace |
| Primary piping ID | 5.25 cm (2.07 in.) |
| Planned operation | Fall 2021 |







Robb, Kevin R., et al. *Facility to Alleviate Salt Technology Risks (FASTR): Preliminary Design Report with Failure Modes and Effects Analysis*. No. ORNL/TM-2019/1370, 2019.

# Facility to Alleviate Salt Technology Risks (FASTR)

## Highlighted Efforts

*210 kg Batch Purification*

*Flow Loop Construction*

First Operation
Fall 2021

Open facility for Cl salt technology RD&D



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Ren, Weiju, and Kevin Robb. "Alloy Selection and C-276 Code Design Value Extension for Advanced Molten Salt Technology Test Facilities Experimentation." *Pressure Vessels and Piping Conference*. Vol. 83860. ASME, 2020.

# Thank you

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