U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Molten Salt Reactor PROGRAM

Radionuclide Release

Overview of the Technology and Development Demonstration

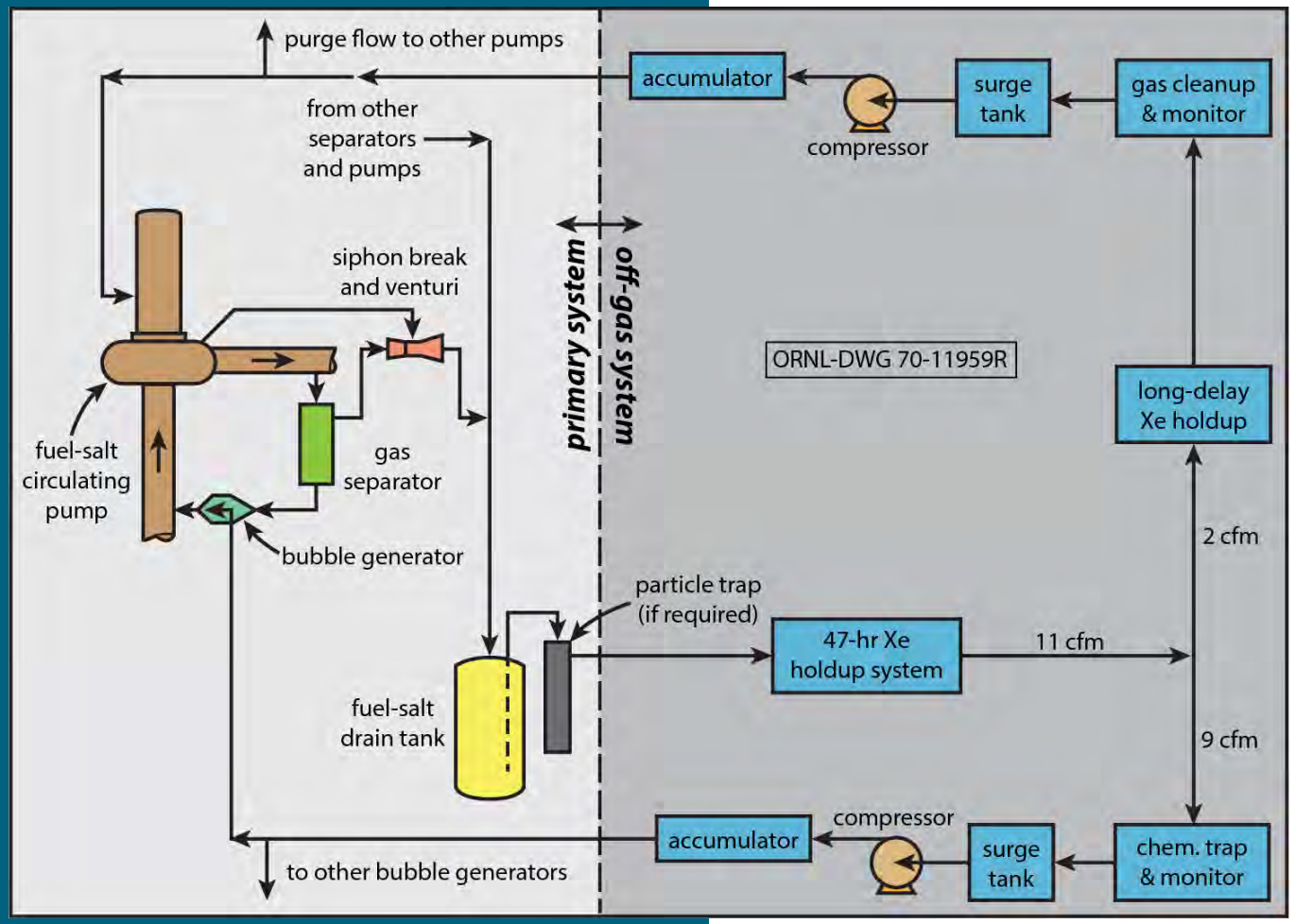
Joanna McFarlane

OAK RIDGE National Laboratory

Annual MSR Campaign Review Meeting 16-18 April 2024

What is different about an MSR?

- **Fuel in liquid form**
  - Fuel dissolved in coolant/carrier
  - High temperature (up to 650°C)
  - Fission products distributed: i) soluble, ii) insoluble (particulates or plated out), iii) volatile
- **Open core**
  - Radionuclide transport to cover gas
  - Decay heat management in cover gas
  - Cover gas/off-gas forms pressure boundary, confines radionuclides
- **Halide chemistry**
  - Sensitive to air
  - Materials challenges
- **Radiolysis may affect phase behavior**
  - In salt – enhanced particulate formation
  - In storage (temperatures below 200°C)

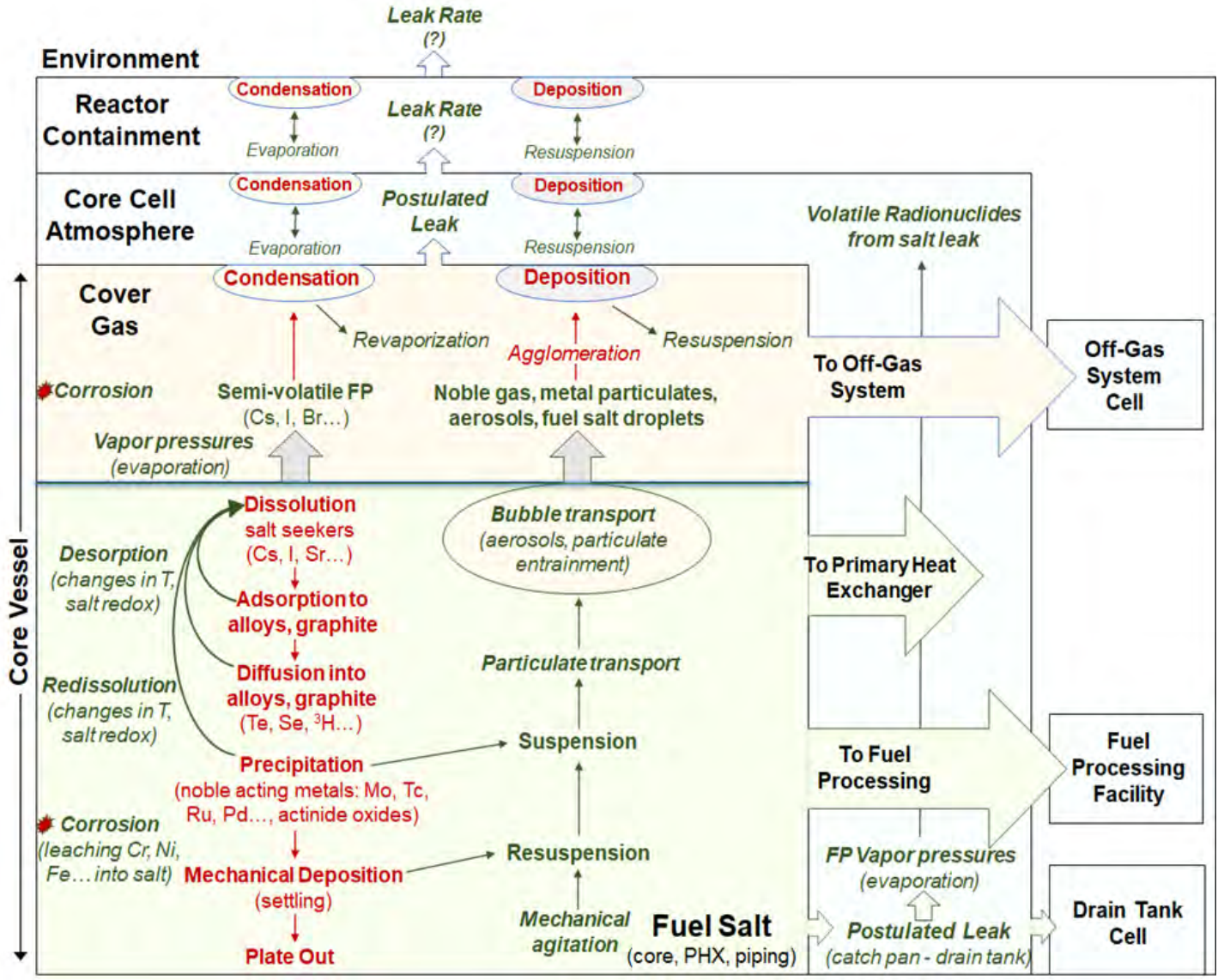


Why the focus on radionuclide relocation & decay in the off-gas?

- Reactor operation
- Safety
- Licensing
- Waste
- Safeguards

Andrews et al. Nucl Eng & Design 2021

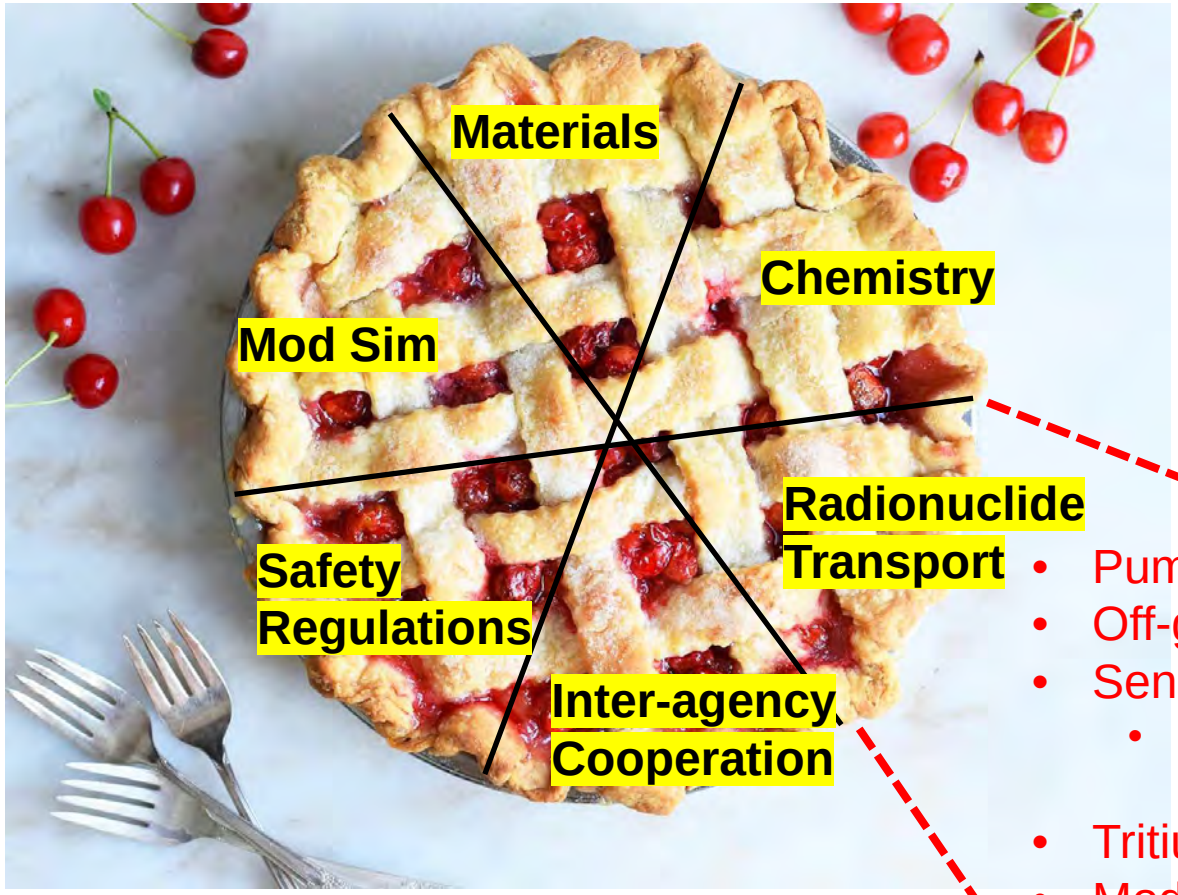
Transport behavior is complex, multiphase, dynamic



Thomas and Jerden, 2020, ANL/CFCT-20/16

Holcomb, ORNL/TM-2020/1719

MSR Program approaches problem in bite-sized pieces

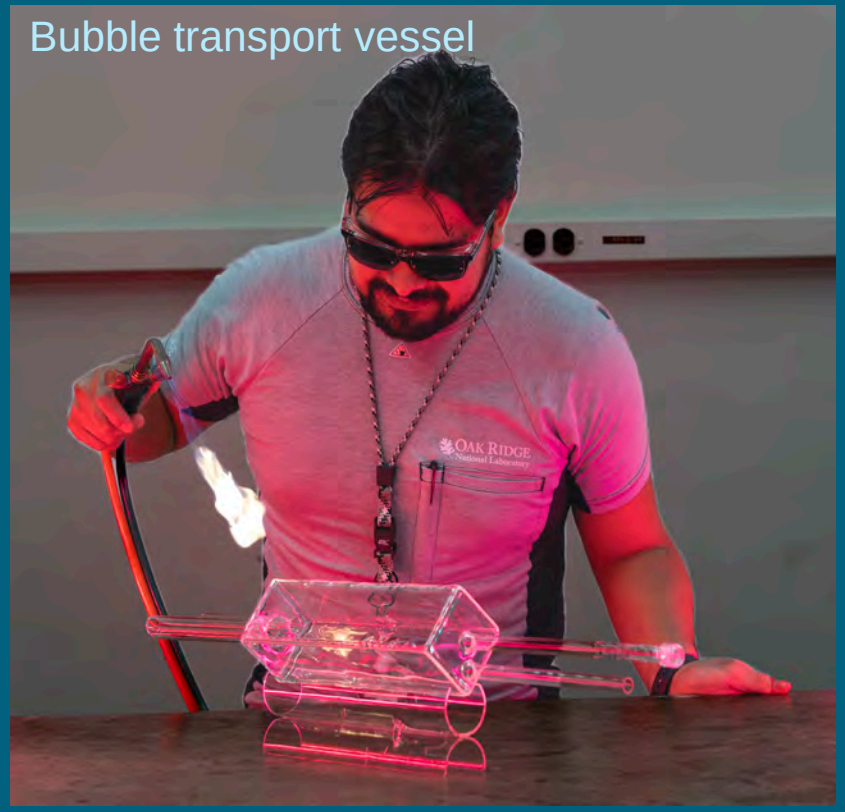


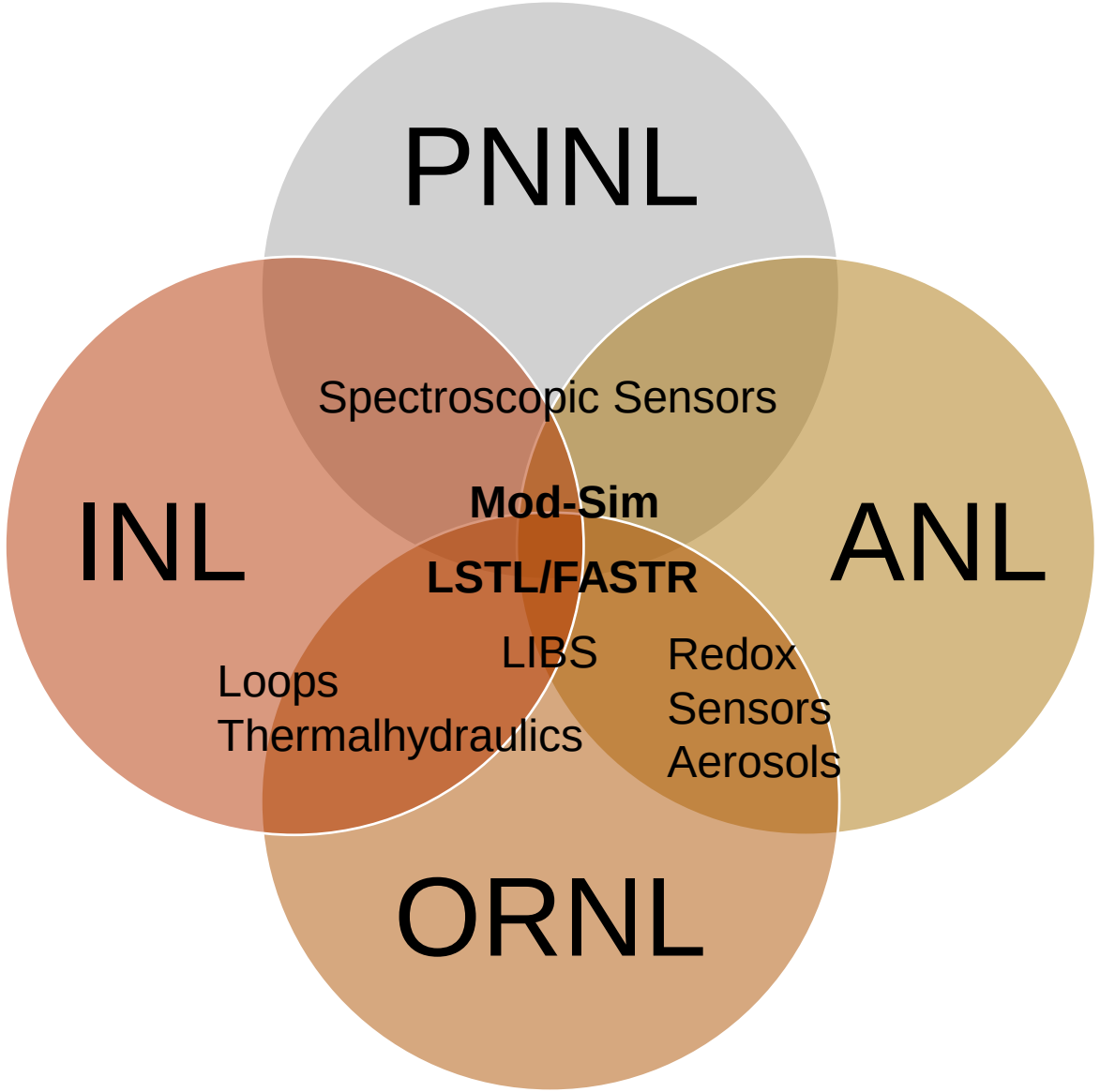
- Pumped Loops
- Off-gas components
- Sensors
  - Redox, Optical Spectroscopy, LIBS
- Tritium Transport
- Mod Sim
- Salt Spill - Accident

Radionuclide Release Lineup

RADIONUCLIDE RELEASE			
8:05 AM	8:20AM	Overview of the technology development and demonstration	Joanna McFarlane/ORNL
8:20 AM	8:45 AM	Salt Loop and Capability for Testing Sensors and Off Gas Components	Kevin Robb/ORNL
8:45 AM	9:15 AM	Distributed Salt Chemistry Monitoring and Control	Nathaniel Hoyt/ANL
9:15 AM	9:40 AM	On-line Monitoring for MSR Off-Gas Treatment: Molecular approach	Heather Felmy/ Amanda Lines and Sam Bryan/PNNL
9:40AM	10:05AM	Laser Induced Brekadown Spectroscopy (LIBS) for elemer monitoring of MSR off-gas streams	Hunter Andrews/ORNL
10:05 AM	10:25 AM	Update on Radiation Exposure Measurements of Metal Organic Framework at PNNL	Praveen Thallapally/Mark Murphy/PNNL
10:25 AM	10:50 AM	Experiment and Modeling Liquid Salt Test Loop LSTL	Kyoung Lee and Bob Salko /ORNL
10:50 AM	11:00 AM	BREAK	
11:00AM	11:30PM	Tritium Transport	Thomas Fuerst/INL
11:30 AM	12:00 PM	Salt Spill Testing	Sara Thomas/ANL

Inter-lab collaboration





Thank you

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