

MSR TWG Source Term Discussions



3.28.19



Southern Company

Molten Salt Reactor TWG →

ONE

Terra Power

Fast
Breeder
Liquid Fuel
Salt Cooled
Uranium
(Could use Th)

TWO

Thorcon

Thermal
Burner
Liquid Fuel
Salt Cooled
Thorium

THREE

Terrestrial Energy

Thermal
Burner
Liquid Fuel
Salt Cooled
Uranium
(Could use Th)

FOUR

Flibe Energy

Thermal
Breeder
Liquid Fuel
Salt Cooled
Thorium

FIVE

Muons Inc.

Thermal
Burner
Liquid Fuel
Salt Cooled
Uranium

SIX

Elysium Industries

Fast
Breeder
Liquid Fuel
Salt Cooled
Uranium

SEVEN

Alpha Technology Corporation

Thermal
Breeder
Liquid Fuel
Salt Cooled
Thorium





Regulatory issues

Functional containment

Fuel qualification




Engagement with

DOE and National Labs

MSR National Campaign

NEAMS



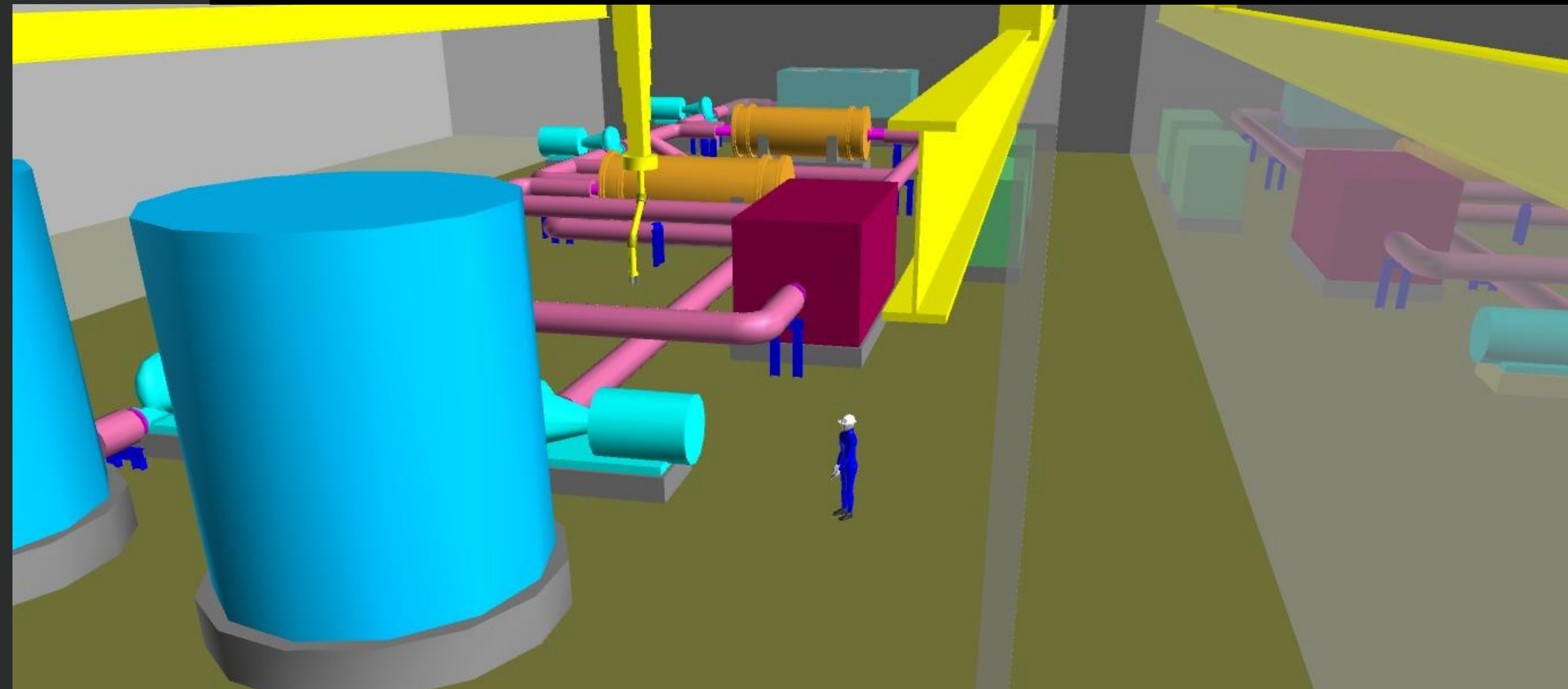
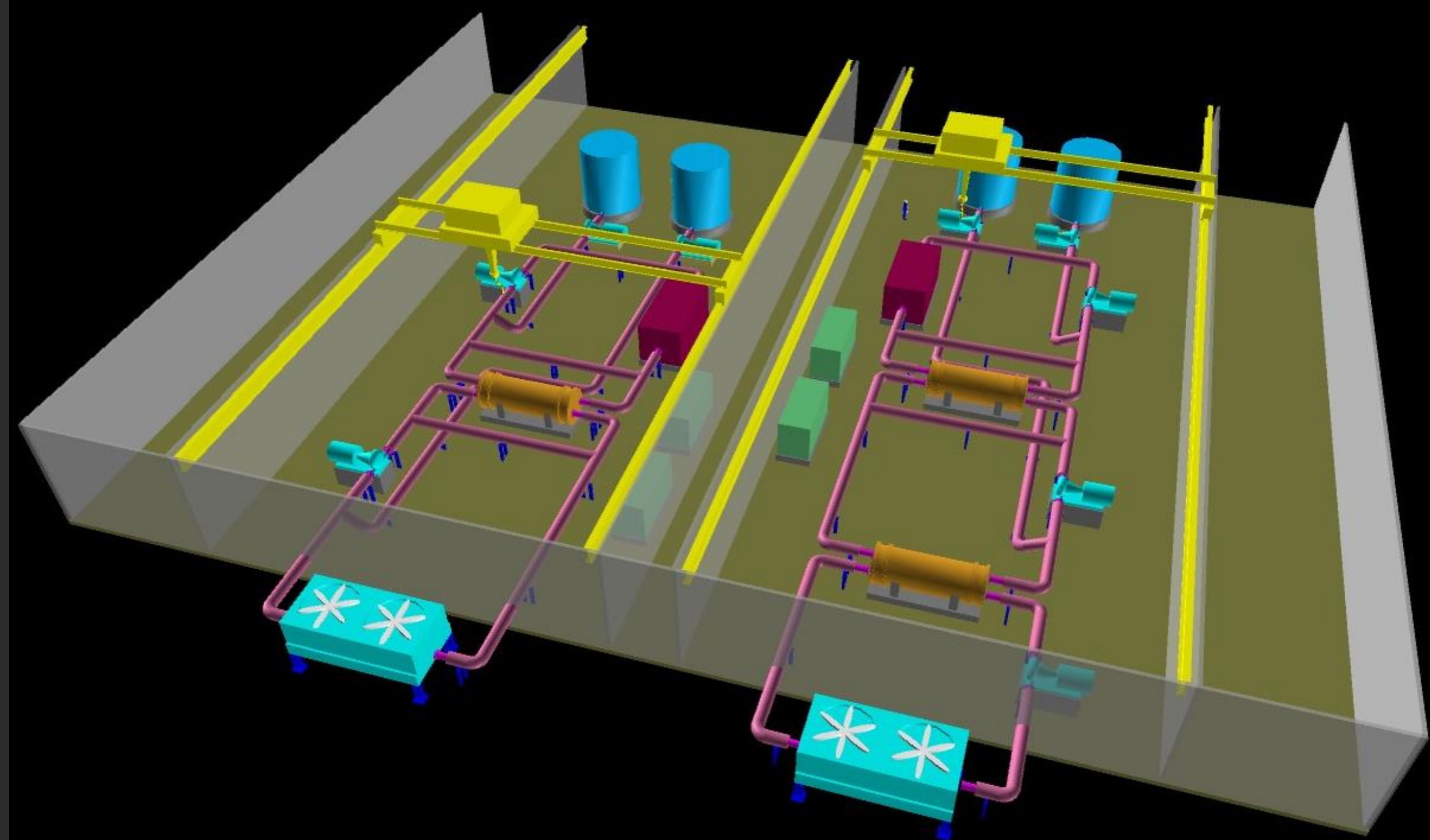
Consensus standards
related to MSRs

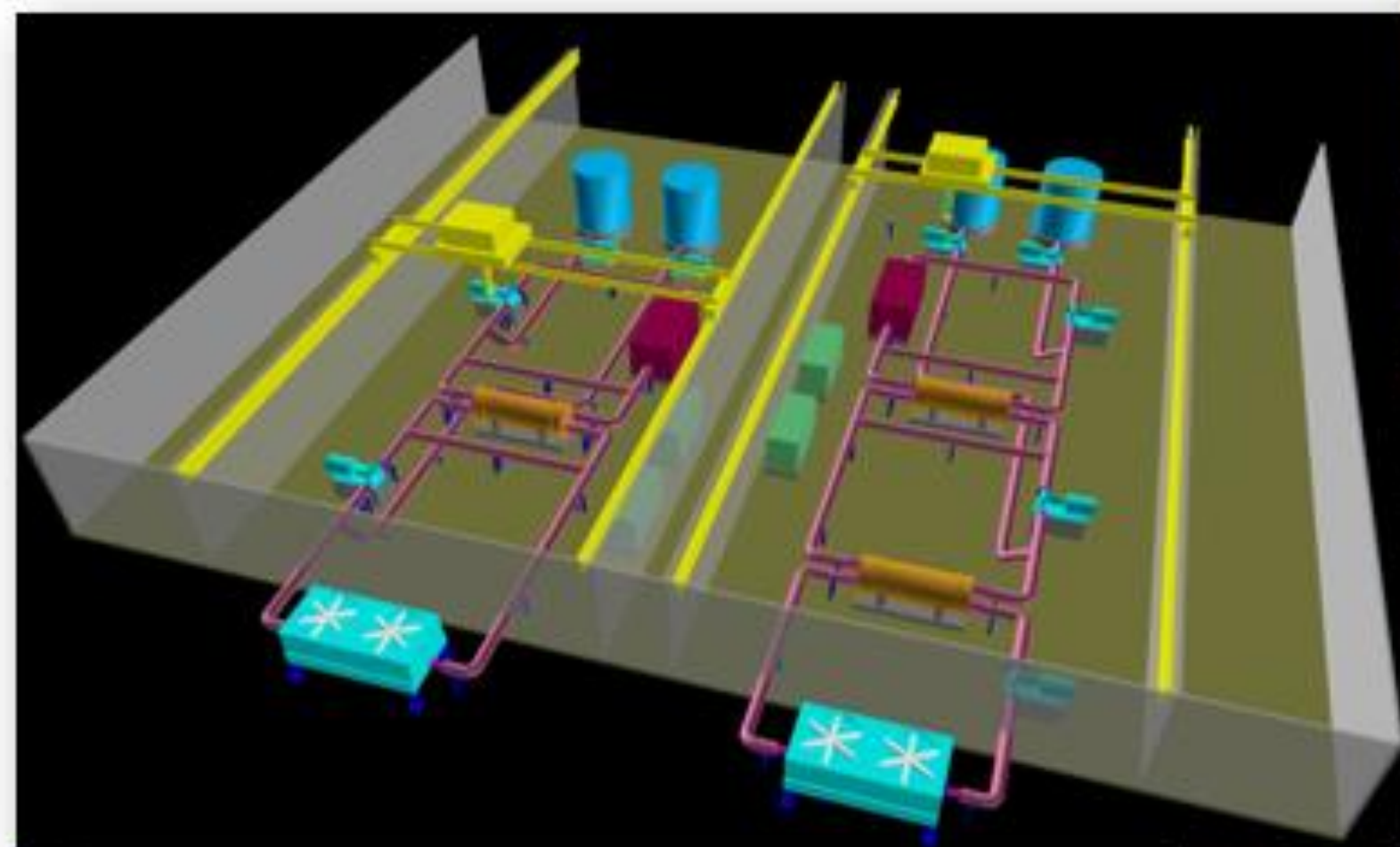
Next MSR TWG Meeting on 6/5/19

- Upcoming training on NEAMS “Yellowjacket” at LANL this summer
- Predictive chemistry and effective “MSR fuel performance code”

Molten Salt Large Component Test Facility (MCTF)

- Pre-Competitive Collaboration
- Multiple MSR Designers, EPRI, Industrial Partners, National Labs, and Utilities Involved
- Leveraging Funding and Infrastructure
- Collaborating with DOE EERE on applications to Molten Salt Thermal Energy Storage
- Test Bed for Advanced MSR Pumps, Valves, Heat Exchangers, and Sensors





Separate
Effects Tests

2017

Integrated
Effects Tests

2020

Large Component
Test Facility
(MCTF)

2022

~1MW Reactor
Experiments

2024

Versatile Test
Reactor (VTR)

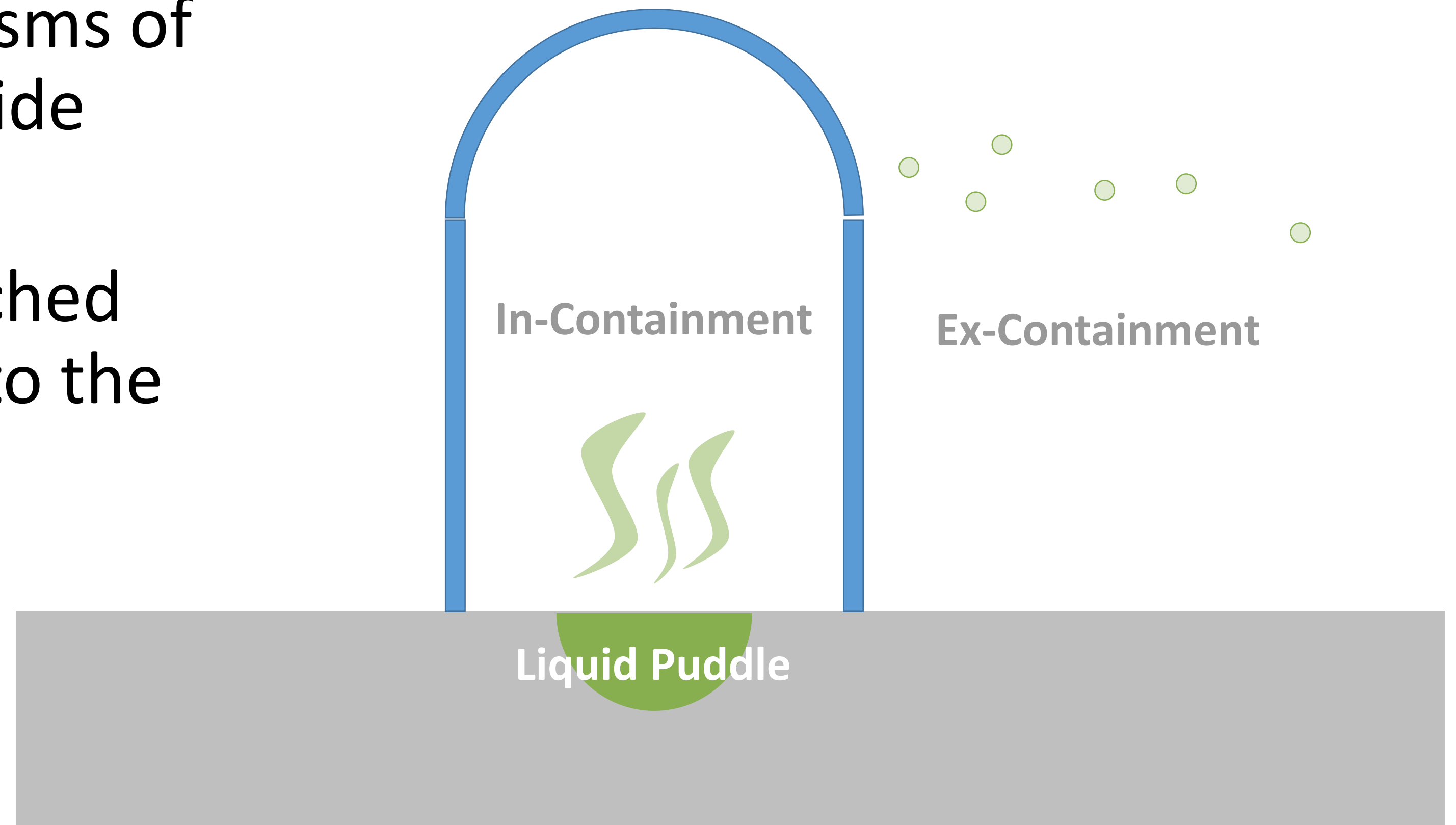
2026

Demonstration
Reactor

2028

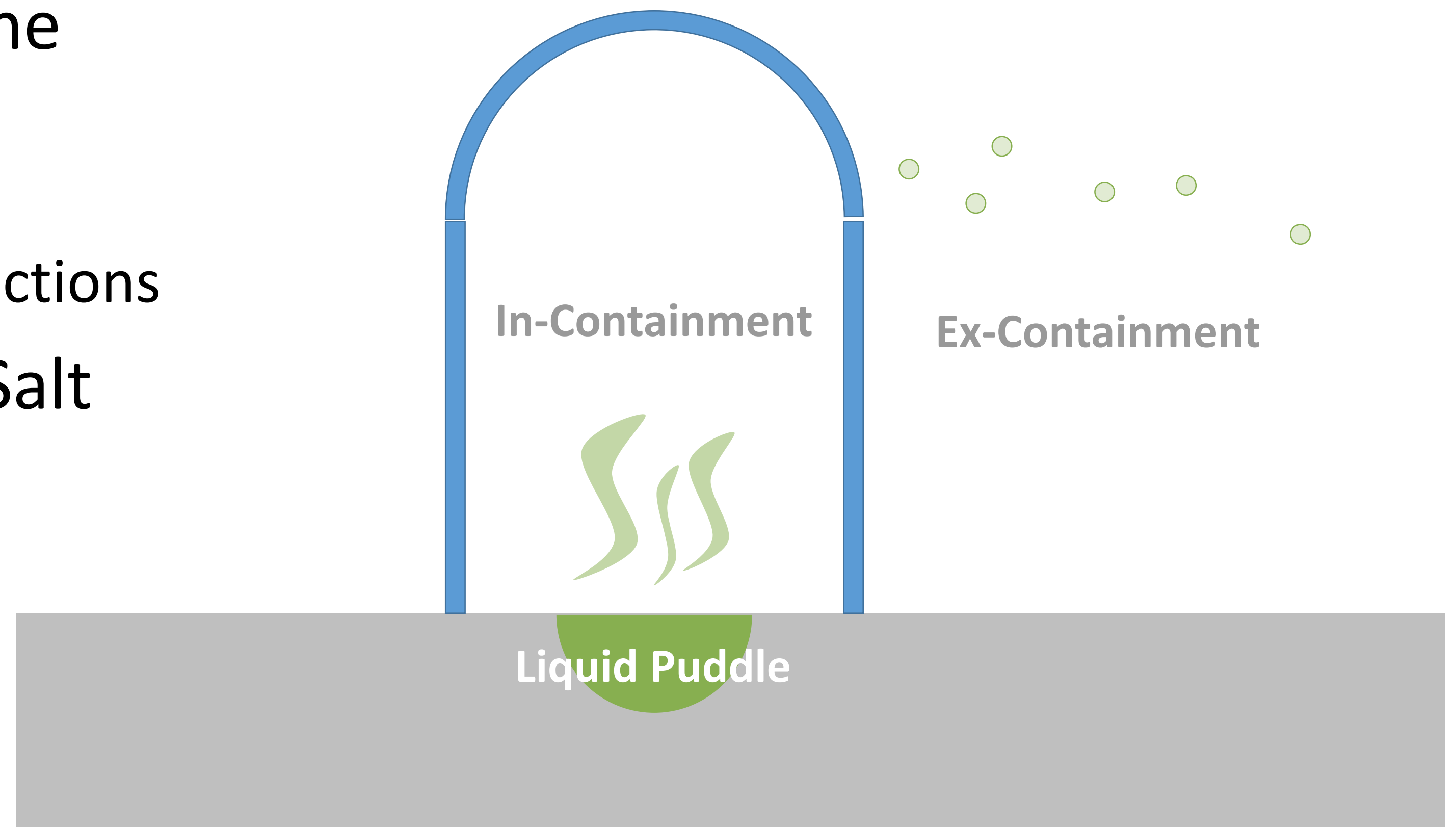
Simplified Source Term Model

- Simple Model to start to think about the physical mechanisms of how radiation gets from inside containment to the public.
- The fuel salt barrier is breached and fuel salt is dumped on to the containment floor.



Simplified Source Term Model

- Molten Salt Reactors do not have a mechanisms to disperse the fission products.
 - Low Operation Pressure
 - No Exothermic Chemical Reactions
- Fission Products in Molten Salt may be released by forming chloride molecule vapors



Accident Sequence

- After a breach of the first fission product barrier the volatile noble gases and high volatility halide gases are rapidly released – on the order of seconds.
- The low volatility halides will be released slowly and likely freeze inside.
 - Heat is removed from the fuel salt by Convection to in-containment atmosphere and radiation.
 - Heat is conducted to containment floor rapidly cools the fuel salt.

Fuel Polishing mitigates potential releases

- Allowing noble gases and volatile fission product chlorides to evaporate from the fuel salt in a fuel polishing system mitigates the consequences of fuel salt releases.
- Since these mobile fission products are removed in situ, there are fewer fission products available in the fuel salt to be released.
- This decouples a lot of the dose potential from the decay heat source.
- However, this dose is moved from the reactor core system to the fuel polishing system.
 - There is a significant inventory of mobile fuel salt in the fuel polishing system
 - The fuel polishing system contains decay heat

Open Items

- Aerosol formation in from fission product bearing chloride salts is not well understood and may contribute to the mobility of fission products.
- Dose conversion factors for halide or chloride molecular forms are not available for all elements – Niobium and Plutonium are of interest because of the confluence of concentration and mobility – in *EPA-520/1-88-020 Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors For Inhalation, Submersion, and Ingestion*
- Iodine is a halogen and it may form molecules similar to fluorides and chlorides - this results in iodine mobility when it forms volatile halide molecules.

