

# An Experimental Program to Investigate Advanced Reactor and Small Modular Reactor Technologies

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## Objectives

Develop capabilities and perform experiments relating to nonwater-cooled SMR technologies that will support regulatory guidance and provide information for policy decision making:

- Perform experiments on fission product releases from lead coolants and molten salts
- Develop experimental capabilities to measure thermophysical/dynamic properties of molten salt systems
- Develop atomistic modelling capabilities for the prediction of molten salt properties

## Federal Stakeholders:

- Natural Resources Canada (NRCan)
- Canadian Nuclear Safety Commission (CNSC)

## Fission Product Releases Experiments

### Previously:

- Performed release tests using irradiated molten salt fuel and UO<sub>2</sub> fuel under lead coolant

### Progress in FY:

- Inter-test comparison of molten salt and lead release data

### Remaining work:

- Post-test examination of molten salt and lead samples

### Key outcomes:

- First-of-a-kind measurements of releases from molten salt fuels and UO<sub>2</sub> fuel under lead in accident conditions

## Atomistic Modelling of Molten Salts

### Previously:

- Literature review to determine interatomic potentials that could be used for Molecular Dynamics (MD) simulations
- Modified CP2K code to calculate thermal conductivity, electrical conductivity, viscosity of simple fluorides/chlorides

#### Progress in FY:

- MD simulation of more complex salts including FLiBe, KNO<sub>3</sub>
- Transferred model to licensed software VASP to facilitate modelling of heavier atoms (e.g. actinides)

#### Remaining work:

- MD simulation of molten salt fuel systems (incl. actinides)
- Open-literature publication of modelling results

#### Key outcomes:

- Predictive capability for fundamental properties of molten salt fuels and coolants

### Measurement of Thermophysical and Thermodynamic Properties of Molten Salts

#### Previously:

- Literature review and knowledge gap assessment
- Strategic plan for laboratory capability development
- Procurement and commissioning of “dry” glovebox (“drybox”) for salt sample preparation
- Developed encapsulation protocol for Differential Scanning Calorimetry (DSC) samples in the drybox
- First benchmark measurement of KNO<sub>3</sub> thermal diffusivity using Laser Flash Analysis (LFA)

#### Progress in FY:

- Assessment of push-rod dilatometry technique for molten salt density measurement
- DSC measurements of nitrate and chloride salts using commercially available crucibles
- Finite Element Method (FEM) simulations of graphite sample holders for LFA leading to improved design

#### Remaining work:

- Further modification of Thermogravimetric Analyser (TGA) to enable corrosive gas (chloride) applications
- Testing commercially available DSC crucibles for compatibility with fluoride salts

#### Key outcomes:

- Assessment of existing laboratory capabilities and development of new capabilities for fundamental property measurements of molten salts