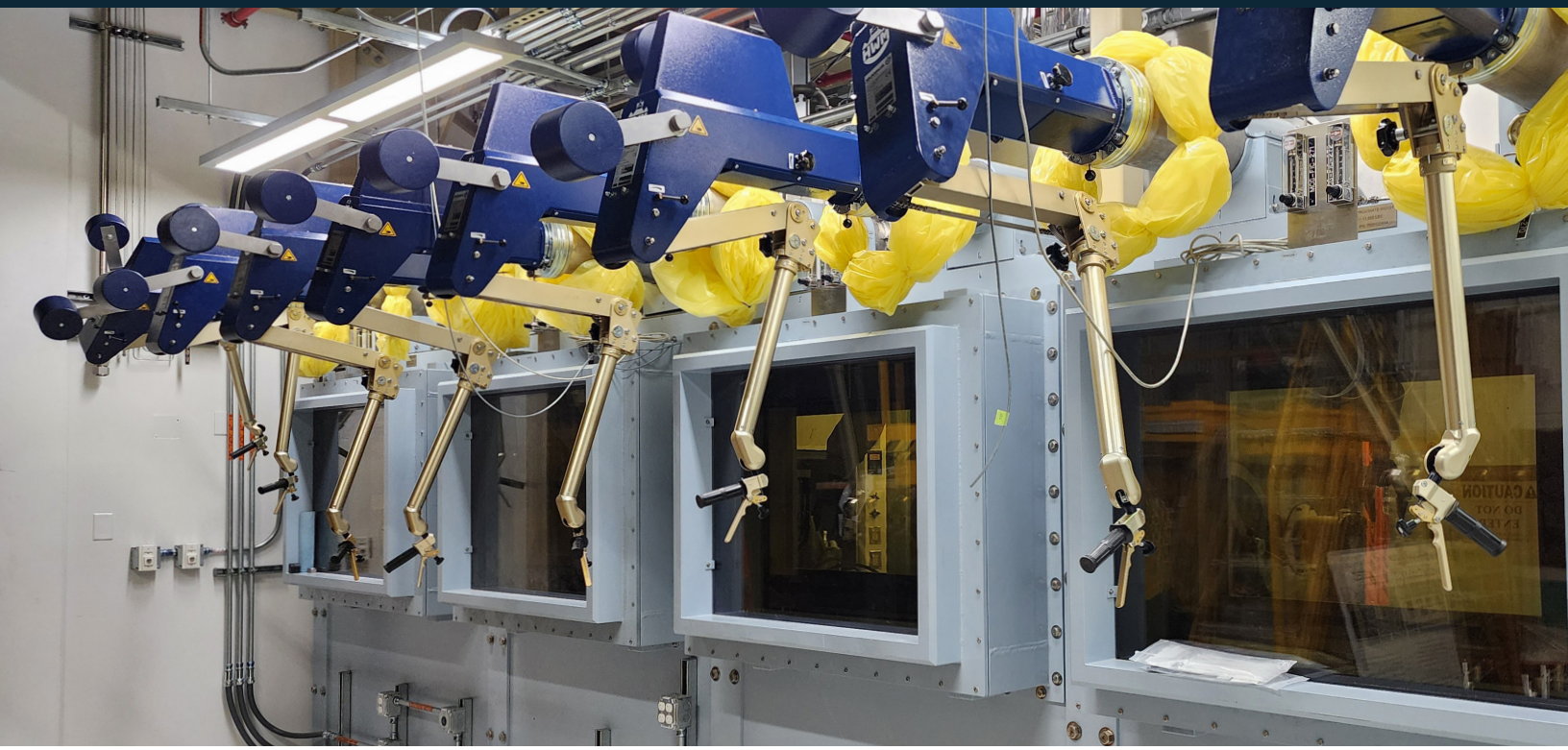


Molten Salt Thermophysical Examination Capability

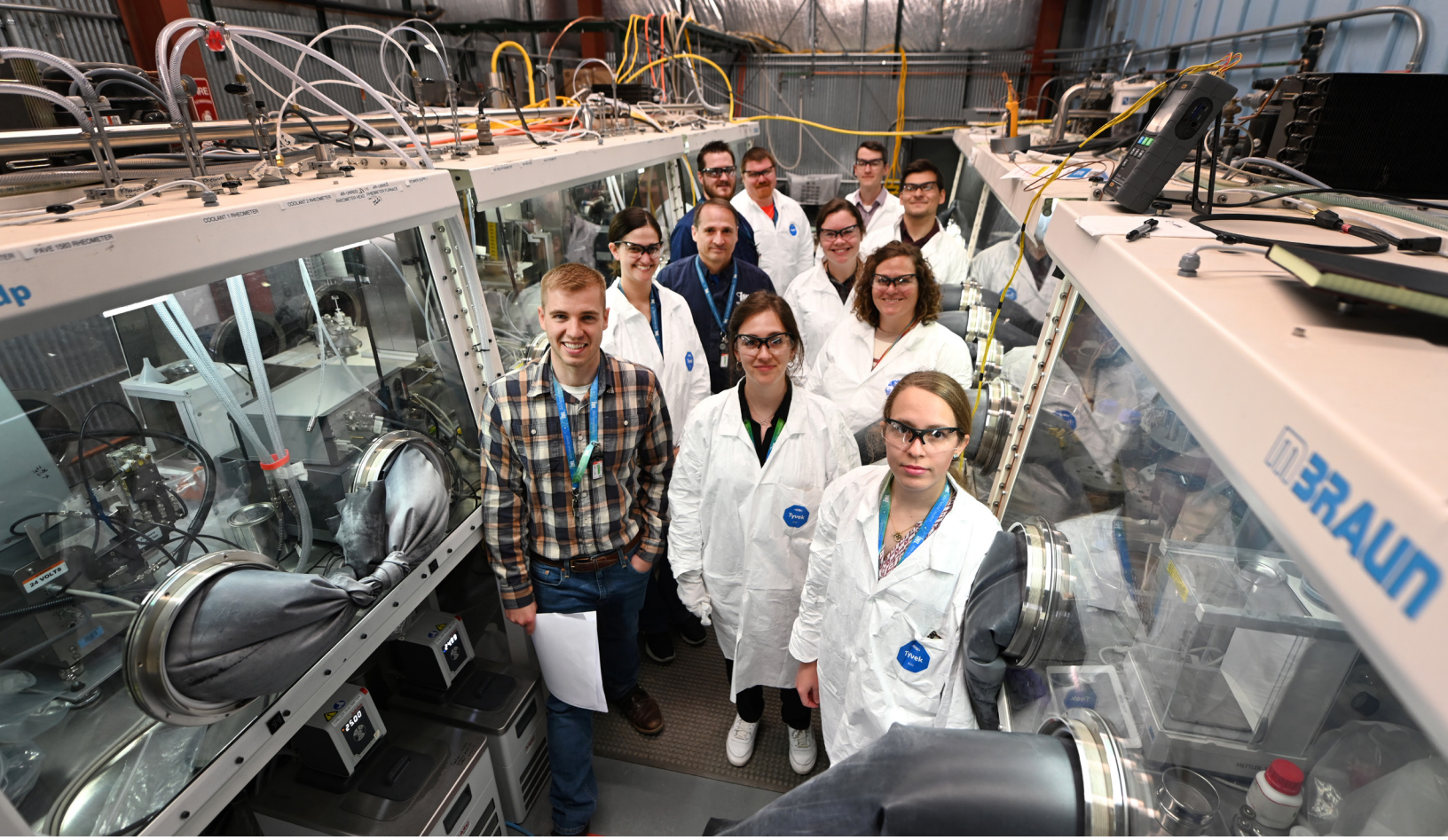
A state-of-the-art, shielded argon glovebox for irradiated and nonirradiated actinide materials.

Advanced molten salt reactors use high-temperature chloride or fluoride salts as the fuel, coolant or both. Research and infrastructure are needed to provide data on the properties of molten salts and their interaction with construction materials. This data will be used in the design, licensing, material tracking and predicting of safe reactor operations.

The Molten Salt Thermophysical Examination Capability (MSTEC) is a state-of-the-art, shielded argon glove box for irradiated and nonirradiated actinide materials. MSTEC is part of the National Reactor Innovation Center (NRIC) portfolio of experimental facilities designed to accelerate advanced nuclear reactor development by providing infrastructure and expertise for demonstration projects to meet national energy needs. NRIC funded MSTEC to bridge key knowledge gaps in molten salt behavior under reactor conditions, directly supporting the design, licensing and eventual commercialization of molten salt reactors by delivering essential data to innovators and industry partners.

MSTEC will offer thermophysical property characterization equipment, multifunctional furnaces and versatile workspaces for lab-scale experiments. Equipment within the MSTEC shielded glove box has been designed for use with high-temperature fluids, such as molten salts, and modified to be operated remotely when necessary for handling samples.

The goal is to provide users with characterization equipment, infrastructure and technical staff necessary to provide reliable and reproducible data for designing,



demonstrating, licensing and operating molten salt reactors.

MSTEC equipment can also be used for fuel cycle research and development, as well as material accountancy and mass tracking for nuclear safeguard-related research.

MSTEC is strategically located at the Idaho National Laboratory, which contains unique facilities such as the Neutron Radiography Reactor and the Advanced Test Reactor for irradiating salts, and the Analytical Research Laboratories for isotopic and elemental analysis.

Materials that can be handled in MSTEC include, but are not limited to, irradiated and nonirradiated chlorides, fluorides, beryllium, actinides including plutonium and other minor actinides, and gases such as hydrogen, chlorine and fluorine.

Scientific expertise

Scientists, engineers and technicians are MSTEC's most valuable asset. Staff members are experts in their fields, ranging from mechanical and electrical engineers to distinguished instrument scientists who study molten salts and other nuclear applications. The MSTEC team will aid in experimental studies to troubleshoot complex problems and offer simplified solutions.

Technical capabilities

A **rheometer** is a precision instrument used to measure viscosity and provide an understanding of fluid flow. The rheometer can accurately measure viscosity over a wide range of flow conditions, such as different shear stresses and temperatures, with relatively small sample volumes.

- Operating temperature up to 1,000 C
- Sample size of less than 10 milliliters
- Accuracy within ±5%
- Measuring geometries include parallel plate, cone and cup, and double gap with custom designs available upon request

The **gas displacement pycnometer** is a device for nondestructively measuring the density of a solid. It does this by first determining the mass using a highly accurate balance and second by volume determination using argon or helium.

- Operating temperature up to 200 C
- Sample size of 1 centimeter^3
- Accuracy within ±2%

The **densitometer** is a custom instrument using the Archimedes principle to measure density in the liquid phase. The instrument interfaces with the MSTEC universal furnace to allow for density measurements of high-temperature liquids, such as molten salts or liquid metals.

- Operating temperature up to 1,000 C
- Sample volume of 10 milliliters or less
- Accuracy within ±5%

The **universal furnace** can be used for a large range of applications including salt synthesis of novel fuel compositions, electrochemical measurements, probe development for real-time estimation of oxide and actinide species, and comparison of anode materials for electrochemical reduction and corrosion studies.

- Operating temperature up to 1,000 C
- Hot zone dimensions: 6.375″ in diameter by 9.875″ tall
- Featureless internal to accommodate different process operations
- Electrochemical and gas line feed throughs

The **simultaneous thermal analyzer** is a multifunctional instrument used to measure weight loss and energy change as a function of temperature. Applications include phase diagram development, enthalpy, vapor pressure, salt stability and temperature-dependent changes, i.e., invariant temperatures, polymorphic and melting temperatures determination.

- Operating temperature up to 1,650 C
- Sample size greater than 10 milligrams
- Accuracy within ±5%

(Top to bottom) Rheometer and gas displacement pycnometer.

Thermomechanical analyzer.

The **differential scanning calorimeter** is an instrument for high-precision measurement of specific heat capacity and determining sample purity. In addition, it can measure temperature-dependent transitions and the energy associated melting, crystallizations or other crystallographic transitions.

- Operating temperature up to 1,650°C
- Sample size greater than 10 milligrams
- Accuracy within ±5%

Versatile work areas – MSTEC includes dedicated space for incorporating of new experimental equipment or testing setups. This space includes various feedthroughs such as thermocouples, electrical, USB and fiber optics.

Salt synthesis and purification – MSTEC can be used to synthesize novel and difficult to acquire salts. It has been designed to handle lab-scale quantities of corrosive gasses such as NF3, HCl and others. In simple cases, current furnaces can be modified to accompany salt synthesis activities; in others new equipment may need to be designed. In more complex cases, new equipment may be required.

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