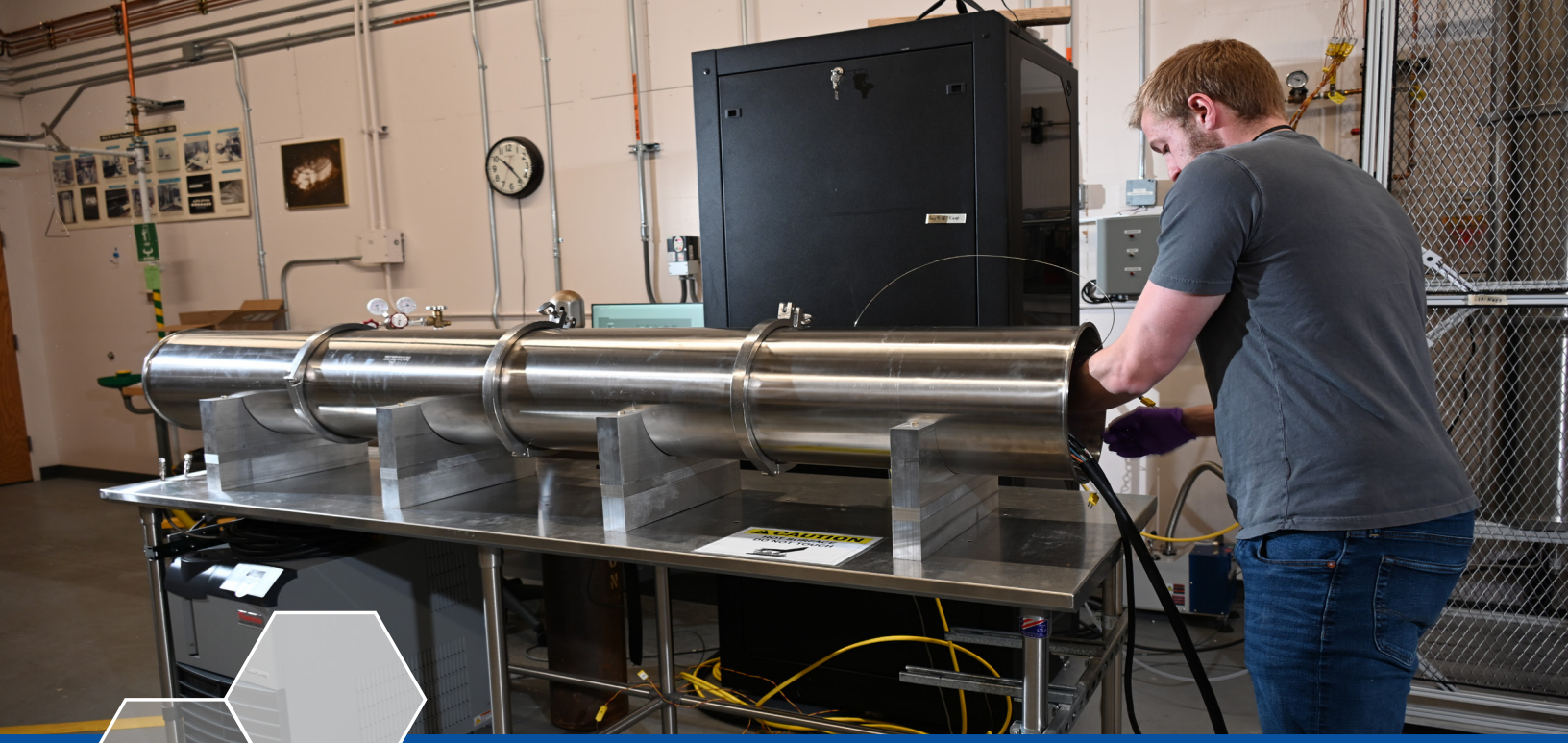


SPHERE test bed and seven-hole test article

Single Primary Heat Extraction and Removal Emulator (SPHERE)

Thermal Testing Capability to Enable Microreactors

The U.S. Department of Energy (DOE) Microreactor Program supports research and development of technologies related to the development, demonstration, and deployment of very small, factory-fabricated, transportable reactors to provide power and heat for decentralized generation in civilian, industrial and defense energy sectors.

Led by Idaho National Laboratory (INL), the program conducts fundamental and applied research and development to reduce the risks associated with new technology performance and manufacturing readiness of microreactors. The intent is to ensure that microreactor concepts can be developed, licensed, and deployed by commercial entities to meet specific uses.

The program coordinates work across participating laboratories, universities, and industry as well as other DOE programs. Participants include Argonne National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory and Sandia National Laboratory.

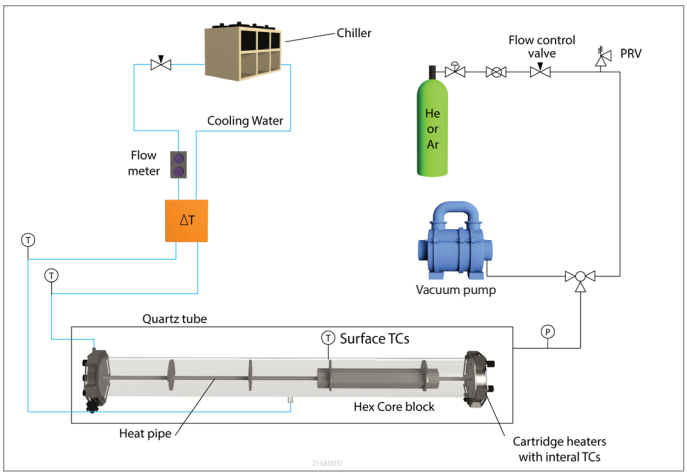
WHAT IS THE SINGLE PRIMARY HEAT EXTRACTION AND REMOVAL EMULATOR (SPHERE)?

The DOE Microreactor Program has developed a non-nuclear thermal and integrated systems test bed. Through collaboration between participating national laboratories, SPHERE allows for better understanding of thermal performance of heat pipes under a range of heating values and operating temperatures, further enhancing understanding of heat pipe startup and transient operation.

SPHERE can be broadly used to test microreactor structures and subsystems. SPHERE supports a variety of testing, tool development and experimental needs. Tests on heat transfer limitations between assembly layers, validation for Nuclear Energy and Advanced Modeling and Simulation (NEAMS) tools and characterization of the impacts of orientation on testing are all being addressed by the SPHERE system, thus enabling microreactors in their use.

SPHERE's testing and experimentation capabilities enable the advancement of microreactor technologies. Greater ability to perform

Idaho National Laboratory



and confirm various tests through SPHERE contribute to a better understanding of microreactors and therefore enhance microreactor implementation and use.

WHAT ARE SPHERE'S UPCOMING EXPERIMENTS?

- Determine thermal conductivity in a gap through gap conductance testing.
- Long-term operation and validation of system durability.
- Couple advanced heat removal technologies with condenser heat exchanger (HX) coupling.
- Testing of components made with additive manufacturing methods.

HOW WILL SPHERE BE USED TO SUPPORT MICROREACTOR DEVELOPMENT?

SPHERE will

- **Provide capabilities to perform steady state and transient testing** of heat pipes and heat transfer.
- **Develop effective thermal coupling methods** between the heat pipe outer surface and core structures.
- **Measure heat pipe axial temperature profiles** during startup, steady-state, and transient operation using thermal imaging and surface measurements.
- **Provide a facility and capability for researchers and technology** to test non-nuclear thermal and integrated systems. This allows for a better understanding of thermal performance of heat pipes.

WHAT ARE THE DESIGN SPECIFICATIONS FOR SPHERE?

Test chamber characteristics include:

- Vacuum (10^{-4} torr) or inert gas.
- 10 ft long x 12 in. diameter 304 stainless steel tube.
- Flanges for gas flow connections and instrumentation feedthrough ports.

Test bed attributes:

- A test bed designed for up to 20 kW electrical power to heaters.
- Maximum test article temperature of 900 C.
- Heat rejection through passive radiation or coupled with a water cooled gas gap calorimeter.

Parameter	Value
Length	10 ft
Diameter	12″
Tube material	Stainless Steel
Connections	Flanged for gas flow and instrumentation feed through
Maximum power	20 kW
Max temperature	900 C
Heat removal	Passive radiation or water cooled gas gap calorimeter

FOR MORE INFORMATION

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