Measurement Science Laboratories

Nuclear instrumentation for irradiation experiments and advanced reactors

Using a microscope to characterize a strain gauge fabricated by advanced manufacturing methods.

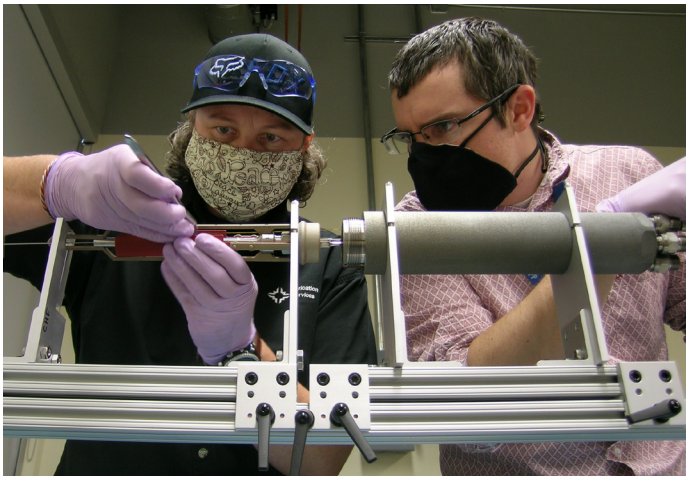
A critical part of nuclear energy research is the ability to precisely measure the extreme conditions inside a nuclear reactor. This is a significant technical challenge, but Idaho National Laboratory's Measurement Science Department addresses it with the Measurement Science Laboratories (MSL). MSL are a collection of laboratory spaces, equipment and capabilities supporting the activities of INL's Measurement Science Department. MSL provide broad support to many programs within the U.S. Department of Energy's Office of Nuclear Energy (DOE-NE) and allow access to researchers and engineers from organizations inside and outside INL.

Most MSL facilities are located at INL's Energy Innovation Laboratory (EIL), including the High Temperature Test Laboratory (HTTL). Other labs are in the Idaho National Laboratory Research Center (IRC) and Idaho Engineering Demonstration Facility (IEDF).

MEASUREMENT SCIENCE LABORATORY CAPABILITIES

MSL contain an array of specialized equipment for nuclear instruments development, fabrication and testing.

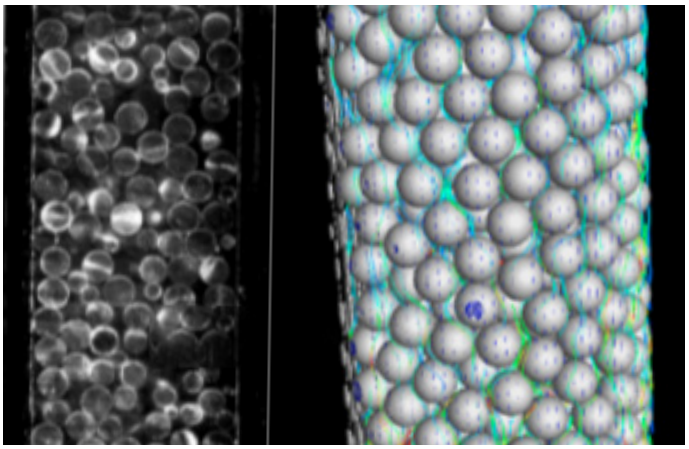
- The autoclave testing area includes various flowing and static containment vessels that simulate pressurized water reactor temperature, pressure, flow and chemistry. This allows instrument testing of advanced instrument concepts, test assemblies, reactor components, materials, and coatings in prototypic, but non-nuclear conditions.



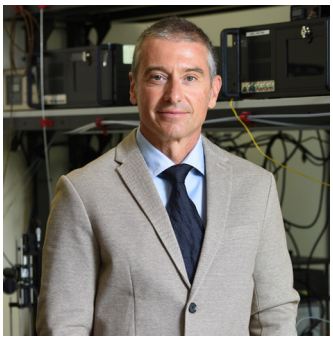
Assembling an experimental capsule for the TREAT reactor.

Idaho National Laboratory

The HTTL houses specialized instrument fabrication equipment and can perform high-temperature evaluations as well as non-destructive analysis of instruments through a micro focus X-ray computed tomography scanner. The HTTL can also handle radioactive materials relevant for instrument research.



MSL researchers use computed tomography analysis to better understand the conditions inside a pebble bed reactor.



Pattrick Calderoni is the manager of the Measurement Science Department and the National Technical Director for the DOE Advanced Sensors and Instrumentation Program.

- The fiber optics and acoustic sensors fabrication and testing area includes specialized spectrometers, spectrum analyzers, laser interrogators, pulse power system, power meters, and fiber fabrication equipment.

MSL provide research and development, testing and characterization, and engineering services including:

- **Developing and fabricating nuclear instrumentation** for irradiation experiments to provide real-time characterization of local test parameters, such as neutron flux, temperature, pressure and materials mechanical responses. MSL instruments are deployed in INL irradiation facilities, primarily the Advanced Test Reactor (ATR) and the Transient Reactor Test Facility (TREAT), as well as facilities in collaborating institutions, such as the Massachusetts Institute of Technology Research Reactor.
- **Engineering services for instrumented irradiation rigs.** Those include design integration, instrument calibration and out-of-pile testing, assembly processes as well as post-irradiation examination for passive monitors. The assembly of instrumented TREAT experiments, design and calibration of linear variable differential transformers and services related to passive monitors for ATR experiments without sensor leads (melt wires, SiC monitors) are an important component of MSL activities.
- **Development of innovative sensing technologies** for advanced reactors instrumentation and control systems. Through use in irradiation experiments, sensing technologies are matured for commercialization or integration in advanced reactor designs. Innovative technologies such as optical fibers and acoustic measurements are key to enable advanced maintenance (such as early fault detection) and operation modes (toward autonomous operation).

A self-powered neutron detector being inserted into INL's Neutron Radiography Reactor.

FOR MORE INFORMATION

Technical contact
Pattrick Calderoni
208-526-3492
pattrick.calderoni@inl.gov

General contact
Joel Hiller
208-526-7456
joel.hiller@inl.gov

www.inl.gov

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