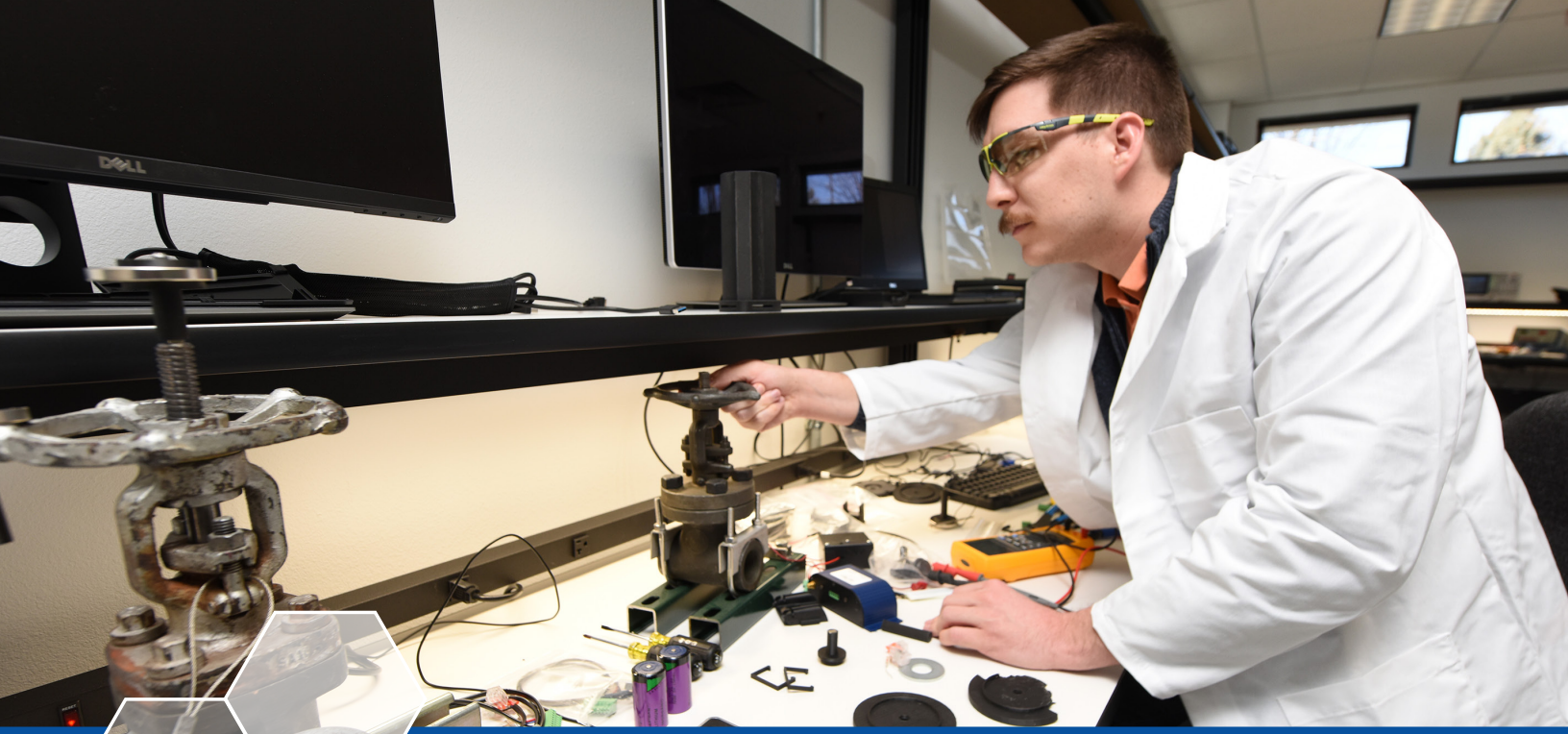

Monitoring, Diagnostics and Automation Laboratory

Automation, Instrumentation and Control Research

MDAL has the capabilities to both develop new sensors and find unique ways to process and visualize the data.

Running a nuclear power plant involves a complex set of controls, from sensors the size of a sewing needle to large control systems that display live reactor and sensor data. As plants move from analog to digital controls, new ways of monitoring existing reactors (e.g., using drones to help conduct maintenance or smart sensors and control algorithms to adjust equipment) must be developed, tested and proven safe for nuclear applications.

The Monitoring, Diagnostics and Automation Laboratory is helping the nuclear industry develop new sensors, control algorithms and innovative ways to reduce plant operational costs. In addition, the lab looks for ways to use the sensor data more efficiently with its unique approach to both data processing and visualization.

MONITORING AND DIAGNOSTICS

The monitoring and diagnostics portion of the laboratory enables researchers to bring together experimental sensors and live reactor data — generated both by the generic Pressurized Water Reactor model operated in the Human Systems Simulation Laboratory and commercial nuclear power plants — for advanced experimental applications, such as diagnosing defective equipment based on sensor data.

Three secure servers allow the lab to connect to live

Idaho National Laboratory

MDAL includes soldering stations for circuit modification and repair.

reactor data from commercial nuclear power plants, a unique and valuable capability. The lab allows for interaction and visualization of the data via state-of-the-art human interfaces including interactive touch screens, monitors and tablets. The computational infrastructure enables continuous and online data manipulation and analysis.

The lab is equipped with the following capabilities:

- Data analysis, visualization, manipulation and interconnections.
- Modeling and simulation for advanced concepts of operation and plant outage management.
- Control interface and algorithm development and testing.

The monitoring and diagnostic capability is essentially a replica of a nuclear power plant's monitoring and diagnostics center, and its resources include:

- Data processing and storage servers.
- A computational workstation for system configuration and data interaction.
- Interactive and touch interface consoles for data visualization.
- A digital whiteboard for illustration and brainstorming.

AUTOMATION

The automation portion of the laboratory is an experimental facility for developing, evaluating and piloting advanced sensors, communication instruments, embedded and integrated systems, control methods, and novel automation technologies.

As nuclear plants move to embedded systems (i.e., systems with "smart" features) to monitor the plant, the lab is available to test the systems and components to ensure they meet the needs of the plant as well as the rigorous regulatory requirements of the Nuclear Regulatory Commission (NRC).

Additionally, the lab and its researchers are working to use system data to increase plant automation using control algorithms (an automated process to adjust the system based on sensor data). For example, if a sensor detects a pressure change in a pipe, the system can automatically adjust by throttling a valve until the pressure is within the pre-determined limits.

The laboratory focuses on projects that cover:

- Control research, including software and hardware modification and development.
- Automation research, ranging from using advanced computer visualization and machine learning to automate processes to developing and testing drones and wireless technologies.
- Instrumentation research and developing nuclear industry instruments.

The automation resources include multifunction research test benches; state-of-the-art tooling and electronics measurement, and signal analysis capabilities; and advanced automation demonstration, controls testing setups, and measurement instrumentation development.

TECHNICAL SPECIFICATIONS

Two drones for autonomous flight guidance testing and instrument reading capability evaluations.

Soldering stations for circuit modification and repair.

Four oscilloscopes.
- One for digital signals analysis from multiple data channels.
- Three for individual circuit signal analysis from up to four channels.

Function generator.

Signal generators.

DC power supplies.

Multimeters.

Heat guns.

3D printer.

INL is a U.S. Department of Energy (DOE) national laboratory that performs work in each of DOE's strategic goal areas: energy, national security, science and environment. INL is the nation's center for nuclear energy research and development. Day-to-day management and operation of the laboratory is the responsibility of Battelle Energy Alliance.

FOR MORE INFORMATION

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