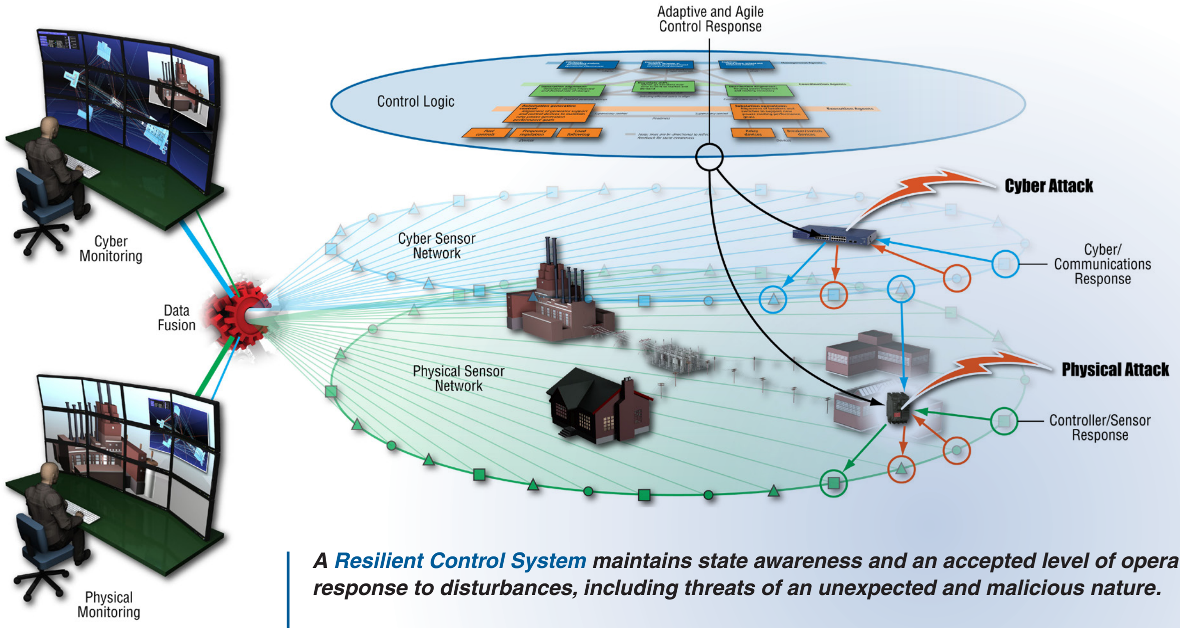
RESILIENT CONTROL & INSTRUMENTATION SYSTEMS



A Resilient Control System maintains state awareness and an accepted level of operational normalcy in response to disturbances, including threats of an unexpected and malicious nature.

Resilient Systems

Transformational Solutions from Concept to Deployment

Idaho National Laboratory has envisioned "resilient" systems that ensure control systems are more resistant to interruption from natural or man-made disasters. Through the lab's Resilient Control and Instrumentation Systems (ReCIS) Program these are being demonstrated for adoption by industry. Complex infrastructure systems with enhanced resilience have the capacity to maintain safe levels of operation in response to natural or man-made threats. INL has led the innovation to improve system resilience and minimize outages from unplanned natural disturbances, malicious attacks or new vulnerabilities inherent to critical infrastructure systems. This ReCIS focus anticipates emerging national challenges associated with the efficiency, effectiveness, and security of the Nation's defense and critical infrastructure systems, including its wired and wireless communications networks. Whether a swarm of unmanned air vehicles or a smart power grid, mission assurance will require the deployment of distributed control systems intended to efficiently, economically and intelligently interact with end user devices. Given the multiple competing demands with which such an interdependent control system must cope, its complexity may well prove to be its Achilles heel. Addressing this vulnerability will require control system technologies that are resilient by nature and remain resilient when interoperating. The development of such technologies will underpin next generation designs for defense and critical infrastructure systems where adversarial threats and benign, but undesirable human responses can create an even greater liability than the loss of use.

Resilience Research

- Resilience Research Leads – Interdisciplinary team of individuals representing technical excellence in cyber-physical security, intelligent design and control, and human system applied research, development, demonstration and deployment
- Select Resilience Papers – Papers representing several of the resilience research projects associated with ReCIS efforts, vetted by an advisory committee composed of National Academy, National Laboratory, Society Fellows and Industry members.

Recognized Resilience Events and Collaborations

- Resilience Week – Symposia dedicated to promising research that transforms the resilience of cognitive, cyber-physical systems
- University Challenge – Develop a control system design that maintains quantifiable, stable control in spite of threats, including process disturbances, sensor degradation, cyber

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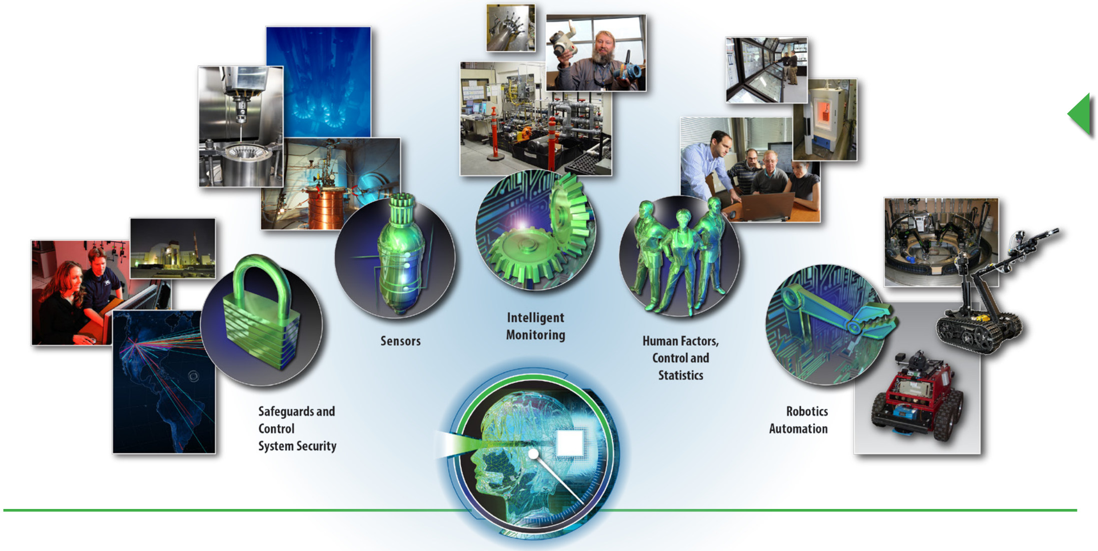
The Energy of Innovation

Idaho National Laboratory

Resilient Control & Instrumentation Systems



ReCIS research covers the following areas: Safeguards and control systems security, sensors, intelligent monitoring, human factors, controls and statistics, and robotics automation.

For more information

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intrusion, human error, and related interdependencies

- Resilience and Security for Industrial Applications (ReSia) Technical Committee – Engendering threat-resilience into industrial applications through metrics and standards codified by demonstrated technologies with firm scientific underpinnings.

ReCIS programmatic research is centered on developing components, programs, systems and individuals for any application that requires monitoring, control, security and human interaction. These capabilities have provided core competencies to address national challenges, and culminated in the development and deployment of cutting edge resilient systems:

- Advanced safeguards research that applies to the simultaneous action of technology, policies, and accountability procedures to intrinsically protect nuclear facilities.
- Control system security methods to protect digital systems from the intelligent adversary
- Digital control for nuclear facilities at INL's premier Advanced Test Reactor have allowed for consolidation of control rooms, greater flexibility in adjusting experiment configuration, and unlimited expansion capabilities.
- Specialized sensors and sensing systems at the High Temperature Testing Laboratory are designed to monitor critical infrastructure and withstand demanding environments associated with nuclear facilities and emergency response during natural and manmade events
- The Monitoring and Decision Systems Laboratory develops specialized technologies for the modeling, analysis, and deployment of sensor, control, monitoring, and decision systems specifically for advanced energy systems and national security
- The Human Factors, Controls and Statistics Department employs specialized methods and state-of-the-art data analysis and modeling tools to support diverse customers in mission-critical industries to improve their decision-making, operational performance, evaluation of technology options, reliability of humans and systems, and reduction of error
- Robotics and automation has a long history of specialized applied robotics that include operation in remote would-be hazardous domains. The legacy has transformed into a continuation of unmanned aerial vehicle and advanced manufacturing programs.

Expertise

ReCIS hosts a team of more than 50 scientists and engineers who specialize in each technological area. Applied research is performed in support of the three research mission areas, and practical design performed in support of the operating facilities. Each activity is important to the overall ReCIS capability, and provides not only an individual programmatic capability but also a diverse INL capability to meet the challenges of this evolving technological area.

Facilities

The laboratory can be utilized for complex evaluation of control system designs for cyber security, advanced control, human performance and operational verification and validation. Some of these include:

- SCADA Test Bed (STB) – Vulnerability assessment and risk analysis of energy sector industrial control systems
- High Temperature Testing Laboratory (HTTL) – Dedicated to sensor development, fabrication, and evaluation
- Human System Simulator Laboratory (HSSL) – Supporting human factors design for prioritized and efficient interfaces to nuclear and other critical infrastructure facilities
- Isolated Unmanned Aircraft Systems (UAS) test bed – Airfield for UAS design testing with full radio spectrum authority and authorization from the Federal Aviation Administration, allowing UAS operation.
- Machine Condition Monitoring (MCM) test bed - an engineering-scale environment to verify and validate advanced monitoring and control strategies, including diagnostics, prognostics, data analytics, smart components, resilient controls, and wired/wireless online condition monitoring technologies.