

INL's Human Systems Simulation Laboratory allows the safe testing and simulation of current plant systems, as well as new instrumentation and control technologies prior to implementation in the real world.



Human System Simulation Laboratory

A complete virtual nuclear control room

The Human System Simulation Laboratory (HSSL) at Idaho National Laboratory is a complete virtual nuclear control room created to safely test new technologies before they are implemented in real commercial reactor control rooms. The HSSL can interactively simulate digital, analog and combination systems with touch-screen versions of physical controls like switches, gauges, keyboards and other interfaces. This one-of-a-kind

control room simulator is configurable and can support a variety of real control room formats, to test emerging control room technologies such as digital upgrades.

How does modernization help the nuclear industry?

The HSSL is part of the U.S. Department of Energy's Light Water Reactor Sustainability Program supporting extended operation of nuclear power plants. This effort includes control room modernization, which focuses on addressing aging and

long-term reliability issues of legacy instrumentation, information, and control (II&C) systems used in the current light water reactor fleet. The primary benefits of modernization are to:

1. Reduce the technical, financial and regulatory risk of upgrading the aging II&C systems to support long-term operation up to and beyond 60 years.
2. Provide the technological foundation for a

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The Energy of Innovation



Optical tracking equipment helps human factors researchers evaluate operator response and performance under a wide range of scenarios.



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transformed nuclear power plant-operating model that improves plant safety and performance.

3. Address the challenges of the future business environment.

How does the HSSL support modernization?

The HSSL offers nuclear energy utilities a low-risk, cost-effective framework for design and modernization. This facility enables INL scientists to safely and cost-effectively develop and evaluate new control room technologies with actual operators in a representative setting.

This capability offers utilities definite advantages such as being a resource to rapidly prototype new control room design concepts, and

then to safely evaluate their performance and usability with operating crews under both normal and emergency operating conditions. INL human factors researchers can then work toward mitigating human error traps posed by

the system before ever being released into the plant.

INL human factors researchers use the HSSL to test emerging technologies that serve to enhance plant safety and performance, such

The HSSL provides a valuable tool for simulating control room configurations, operator training & evaluation, control room design, and human factors research.





HSSL training evaluators and human factors researchers can observe, record and study operator performance and introduce changing scenarios in real time.

as advanced alarm systems and computerized procedure systems. Additionally, the HSSL supports utilities' transition from legacy analog II&C systems to digital II&C systems, and has recently focused on migrating legacy

digital II&C systems to new and advanced digital II&C systems.

HSSL research areas
INL researchers use HSSL's capabilities to conduct research in several areas

of human factors research, including:

- Human Performance Evaluation and Modeling: Focuses on the physical and mental aspects required of the operator under different operational conditions.
- Usability: Focuses on the effectiveness, efficiency, satisfaction, safety and reliability of new display technologies and different human-system interface configurations with which an operator can perform specific tasks in an operational context (normal or emergency).
- Situation Awareness: Focuses on the assessment of how new control room technologies offer

Digital displays can condense information from several gauges into visual, at-a-glance overviews of what is happening in a process or system.



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information to operators that support detecting, diagnosing and forecasting future states of the plant.

- Crew Communication:

Focuses on the impact of given technologies on operator communication and coordination under different operational conditions.

- Staffing Configurations: Focuses on the impact of different staffing configurations with a given control room configuration.

For more information

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HSSL at a Glance

General simulator characteristics

- Full-scope simulator encompassing all functions found in a control room
- 15 touch-screen bays comprising a full-scale control room model
- Capability of modeling normal and off-normal plant operations
- Reconfiguration to multiple plants using L-3, GSE, or WSC simulator architectures
- Suite of human

performance measurement tools (e.g., eye tracking devices) for operator-in-the-loop studies

Types of control rooms

- Current control rooms for pressurized and boiling water reactors
- Hybrid analog-digital upgraded control rooms
- Advanced control rooms for next generation plants such as small modular reactors

Applications

- Human-system interface design and prototyping

for control room modernization

- Operator evaluation
- NUREG-0711 compliant human factors engineering process
- Integrated system validation
- Digital control system integration
- Advanced alarm management
- Computer-based procedures
- Computerized operator support systems



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