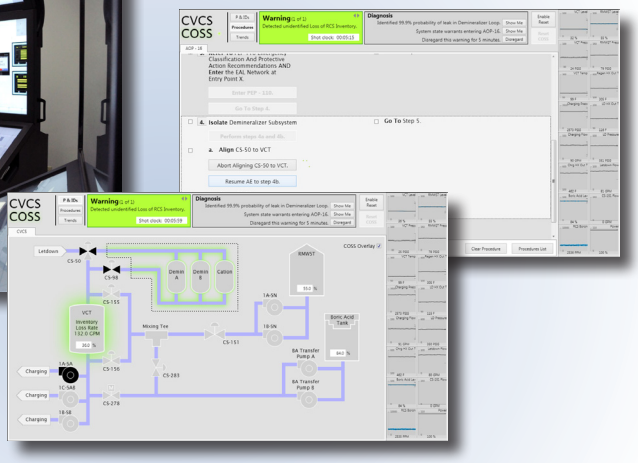


HSSL allows the safe testing of new technologies prior to implementation in the real world

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 mimics both digital and analog systems, which typically support physical controls like switches, gauges, keyboards and touch screens. This one-of-a-kind control room simulator is configurable and can support a variety of real control room formats, and from there test 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 to safely extend the operating lifetimes of nuclear power plants. This effort includes control room modernization, which can replace aging analog technology to enhance safety and functionality within plants. The simulation laboratory enables scientists to improve control room designs by studying human interactions with digital and analog instruments and controls. The HSSL can offer nuclear energy utilities a low-risk, cost-effective framework for design and modernization.

What is human factors research?

Human factors is a branch of psychology applied to things people use every day – iPhones, Facebook, the turn signal lights on the dashboards of cars. Researchers study how people

Continued next page

The Energy of Innovation

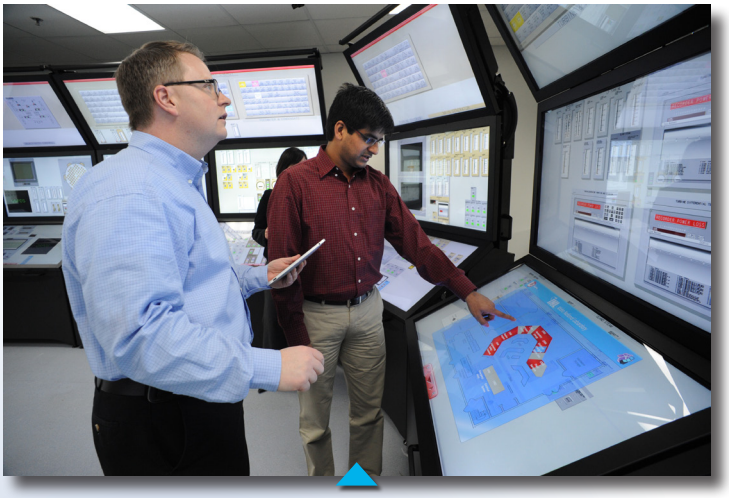
INL Idaho National Laboratory

Continued from previous page

interact with technology. Their findings and observations inform designs that are intuitive to the human mind. Human factors can be used to improve aspects of nuclear control rooms by examining how operators gather information from indicators and interact with controls.

What can be improved?

A modernized control room will be one that minimizes distraction and lessens the need for operators to ping-pong their focus from panel to panel. Digital displays can be added to organize information from several gauges into visual, at-a-glance overviews of what is happening in a process or system. Updated alarm displays can be made to fade into the background when all is well but turn eye-catching red if conditions turn critical.

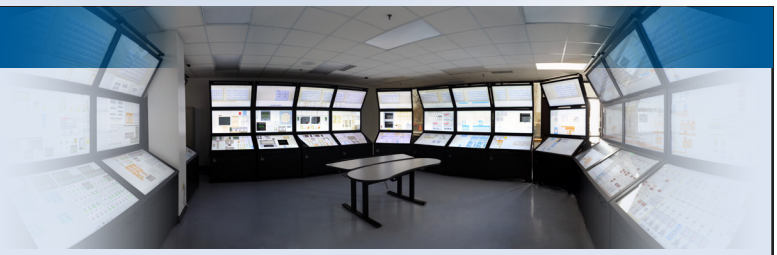


Digital displays can condense information from several gauges into visual, at-a-glance overviews of what is happening in a process or system.

How are new concepts tested?

Once designs for new display features are complete, researchers can test prototypes in the control room simulator. Real control room crews run through scenarios, while cameras look on to capture data on operator behaviors. Then, like any good science, it's back to the drawing board to tweak and improve for maximum usability.

HSSL at a Glance



General simulator characteristics

- Full-scope simulator encompassing all functions found in a control room
- 15 touch screen panels comprising a full-scale control room model
- Capable of modeling normal and abnormal plant operations
- Reconfigurable to multiple plants using L-3, GSE, or WSC simulator architectures
- Suite of human performance measurement tools 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 like small modular reactors

Applications

- Human system interface design 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

For more information

Joseph Campbell
(208) 526-7785
joseph.campbell@inl.gov

A U.S. Department of Energy National Laboratory