



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

**Office Of Nuclear Energy
Sensors and Instrumentation
Annual Review Meeting**

**LWRS Control Room Modernization
Ken Thomas (for Ron Boring)
Idaho National Laboratory**

September 16-18, 2014



Project Overview

■ Goal, and Objectives

- Current control rooms have not been updated significantly
- Analog only instrumentation and control technology is obsolete and difficult to maintain
- Need for digital replacement technology in the control room as plants undertake 20-year license extensions
- A survey INL conducted of 11 utilities found that they were unlikely to replace the control room
 - Instead, build hybrid analog-digital control boards
 - Upgrade one system at a time while retaining the underlying boards
- There is no template for how to upgrade control rooms
 - Make use of human factors to meet operational needs
 - Follow NUREG-0711, *Human Factors Engineering Review Plan*
 - Use Human Systems Simulation Laboratory (HSSL) to conduct operator-in-the-loop studies



Project Overview

■ Participants

- **Project led by INL**
 - Dr. Ron Boring, PI
 - Jeffrey Joe, Heather Medema, Kirk Fitzgerald, and Brandon Rice as technical staff
 - Bruce Hallbert and Ken Thomas as project technical oversight
 - Two PhD interns—Tom Ulrich and Roger Lew (University of Idaho)
 - One NEUP fellow—Rachel Shirley (Ohio State University)
- **Utility participation**
 - Heavy involvement from Duke Energy, who is conducting fleetwide turbine control system replacement on legacy Progress plants including Robinson, Harris, and Brunswick
 - Funds-in CRADA currently valued at \$1.2m
 - Additional partners including Southern Company, Xcel Energy, Arizona Public Services, and Exelon
 - Collaborative studies planned for FY15 and FY16



Accomplishments

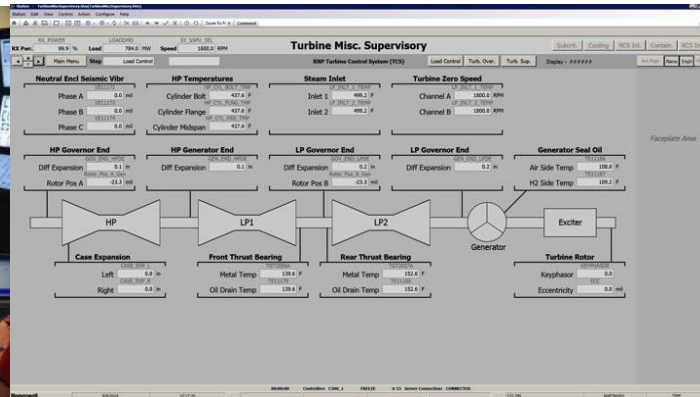
- Moved HSSL from Engineering Research Office Building (EROB) to new Engineering Innovation Laboratory (EIL)
- Secured funds-in CRADA with Duke Energy to support turbine control system modernization at three plants
- Developed a rapid application development framework to create custom distributed control system prototypes on simulator
- Completed three operator-in-the-loop studies with licensed reactor operators in HSSL in support of modernization
- Installed advanced large overview displays from Halden Reactor Project in HSSL
- Completed M4, M3, and M2 milestone reports for LWRS and four M3 reports in support of Duke Energy CRADA **[on schedule]**
- Published 8 peer-reviewed conference papers
- Received notable media coverage and distinguished visitors



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Accomplishments





Technology Impact

■ Project builds critical modernization know-how

- Control room modernizations of digital interfaces were not being undertaken domestically
- Had to rely on out-of-country experience, much of which was not applicable to U.S. industry
 - e.g., full control room swap-out vs. hybrid control room
- Minimal experience applying NUREG-0711 guidance
 - Several gaps identified in the guidance as it would be applied by industry
 - Teaming with Electric Power Research Institute (EPRI) to capture lessons learned in joint technical reports disseminated to whole industry
 - Development of human factors competence in support of nuclear applications in the DOE and at utilities

■ Control room modernization impacts all plants, and this project is establishing the process by which utilities can safely and effectively upgrade control rooms to support long term operations



Conclusion

- **One key to long term operations of plants is reactor operators**
 - **Project redresses lack of substantial updates and upgrades in the main control rooms of nuclear power plants**
 - **Control room modernization ensures operators have reliable and up-to-date equipment to operate the plant**
 - **Integration of human factors ensures that operator performance is benchmarked for the new systems and that the new systems will meet regulatory requirements when implemented**
- **Project strengthens the role of nuclear energy**
 - **Ensures that nuclear control rooms are up-to-date and competitive with other energy sources**
 - **Ensures that utilities have a clear process for making necessary replacements and upgrades in control rooms**
 - **Ensures that operators are given digital tools in the control room to enhance safety and decrease workload**