Office Of Nuclear Energy
Sensors and Instrumentation
Annual Review Meeting

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

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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- Analog only instrumentation and control technology is obsolete and difficult to maintain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
9. Case expansion, ... instead of mil. 
Action Item: Double check this is correct and change if it 
needed. 
Turbine Misc. Supervisory
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