Energizing the Nuclear Industry through Innovation and Collaboration

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Plant Modernization Pathway

First mover utilities within the U.S. nuclear industry have started to invest in a new approach to control room modernization; to look for opportunities to improve and innovate operations rather than simply manage obsolescence. Among the first movers is Palo Verde Generating Station, which is in the midst of a large-scale upgrade for their main control room. Instead of relying on past upgrade approaches, which are essentially piecemeal like-for-like replacements of outdated equipment, Palo Verde is looking to the future by applying a cohesive approach to the control room upgrades, as well as incorporating more labor saving technologies to reduce operations and maintenance costs. LWRS Program human factors researchers are assisting this effort by providing innovative solutions to support control room modernization for the existing fleet of light water reactors. Through this collaboration, the researchers are providing a framework for plant modernization that leverages the use of digital technology to improve the way nuclear power plants are operated to reduce operations and maintenance costs by automating manual, labor intensive tasks.

This framework was developed through a series of workshops that focused on operator in-the-loop studies. The most recent workshop, hosted at Idaho National Laboratory in July 2018, served multiple purposes; to

Figure 13. Palo Verde operators seeing what their future control room could look like in the CAVE.

continue research on control room modernization and to demonstrate the benefits of this research to the senior leadership of Palo Verde. This senior leadership team traveled to INL to participate in the workshop to gain a first-hand understanding of how a modernized control room can improve operations and can leverage substantial cost savings in plant support activities.

A variety of facilities and human factors methods were utilized to support these operator demonstrations such as the Human Systems Simulation Laboratory (HSSL), virtual reality (VR) in the computer assisted virtual environment (CAVE), and micro-task simulations. The HSSL is a reconfigurable simulation laboratory wherein operators had the opportunity to interact with new designs on their Palo Verde simulator and actually experience how their control room might function. Since the proposed designs are still under development, VR in the CAVE enabled the Palo Verde operators to be immersed in the end-state vision of their modernized control room. Operators also participated in micro-task simulations wherein their performance was measured to evaluate specific design concepts. Both the operators and the senior leadership team valued the human factors research methods which focused the control room upgrades on operator requirements and demonstrated performance improvements. This early identification and optimization of the control room operator interface assures that the final design will reflect sound human factors principles and will support control room operations activities in best possible way.

John Hernandez, Department Leader of Operations Computer Systems at Palo Verde, said "In this project, we have the opportunity to change the way we operate the plant." This change is made possible by eliminating the idea of like-for-like replacements and taking advantage of the need for an upgrade by leveraging the use of technology and automating manual, labor intensive processes. Donald Cotter, Director of Maintenance, added "These are exciting times, the chance for a plant to move into the 21st century with these types of controls..." These new technologies are being developed with human factors expertise which can enhance efficiency by presenting the operators with intuitive interfaces created with their input and feedback. Lorenzo Slay, who is a digital modification engineer working closely with the INL team stated, "The work we are doing is not just about upgrades for today, but it's for upgrades for the future, and making sure we remain viable moving into the future." The overall goal of this collaboration is to lay the foundation for the existing fleet of light water reactors to transition into the future and to not only address obsolescence, but to secure economic viability.

For further reading, see:

K. Le Blanc, J. Hugo, Z. Spielman, C.R. Kovesdi, R. Hill, and J. Oxstrand, *Control Room Modernization End-State Design Philosophy*, INL/EXT-18-44798, 2018

C. Kovesdi, Z. Spielman, R. Hill, K. Le Blanc, and J. Oxstrand, *Development and Evaluation of the Conceptual Design for a Liquid Radiological Waste System in an Advanced Hybrid Control Room* INL/EXT-18-51107, 2018.

Figure 14. An operator has the chance to interact with an evaporator design while completing a micro task study.