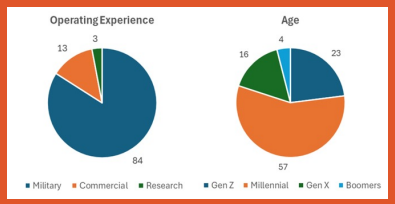
NUCLEAR REACTOR CONTROL ROOM USER INTERFACE AND USER EXPERIENCE DESIGN

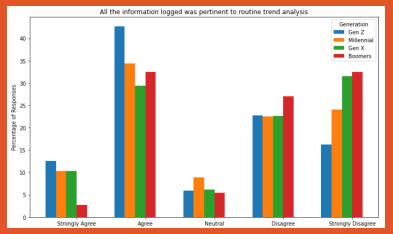
Team: C. Cressman, J. Riddle, J. Lim and S. Lalley
Mentor: Dr. Izabela Gutowska

REACTOR OPERATOR SURVEY

972 active and retired reactor operator personnel were surveyed via an online Microsoft Form advertised by The Reactor Is Critical on Facebook. The survey asked questions about their age, operating experience, and quality questions about their interactions with their system. The survey identified trends for each generation which reinforced the UI/UX best practices developed from a review of literature and experience.



In addition to reinforcing the UI/UX best practices developed, trend analysis of the survey data provides insight on areas of improvement.



PROBLEM STATEMENT

The nuclear power industry has fallen behind other industries with its hesitancy to utilize digital control equipment. When digital equipment is used for reactor control, it is typically to augment existing analog equipment. If nuclear power is to be a modern source of reliable energy, then the control rooms need to be designed for the modern user.

To optimize the design and implementation of digital reactor control room, a better understanding of best practices is needed. Best practices should focus on three key principles: the control room will apply to post-millennial generations; the user interface will be clear, concise, and direct attention towards important operating parameters; the users will find the system convenient to use.

CONCLUSIONS

UI/UX: A control room display should meet the following general criteria: clear and consistent formatting; card UI to create visual separation; high contrast; neomorphism. When evaluating UX design, engineers should allow for several iterations of user testing and alterations to ensure that the design is as user-centered as possible.

Human Factors: Careful consideration needs to be made about when indications should rely on bottom-up or top-down processing to ensure key indications can be easily located without overloading or fatiguing the operator.

The audience: Post-millennial generations thrive in a work environment that allows them to multitask, be cooperative, be heard, and be trusted.

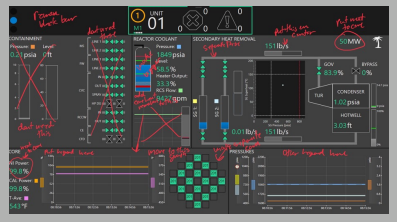
NUSCALE INTERACTIVE DISPLAY ENVIRONMENT

The NuScale Integrated Development Environment, NSIDE, facilitates user interaction, simulation, and immersion in the operation of NuScale's 12-module reactor. This platform serves to enhance comprehension of the user interface and overall user experience in operating a digital control room.

Through performing a series of routine operations, a list of recommendations was compiled according to the best practices researched through a detailed literature review. Building familiarization with how the system operated allowed for operators to identify ways to improve the simulator. This feedback will serve as a foundation for a standardized digital control room design.

Drawing upon the general recommendations a proposed restructuring of the display layout was generated and visualized with Photoshop. Considerations gathered by the survey were also incorporated into the visualization to assist with a more coherent layout in addition to the details outlined by the group's research.

The ability to work on and collaborate with NuScale on NSIDE was critical to identifying key trends to be used in a digital control room. Data and trend analysis performed on the results of the survey data further supported that the features available on NSIDE were highly desired and structured to be beneficial for the next wave of reactor operators.



Oregon State University