Using Immersive Virtual Reality to Develop and Evaluate NPP Construction Schedules

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Ongoing Nuclear Energy Research Initiative funded research aims to determine if virtual reality technology can be used to reduce the construction costs of advanced nuclear power plants. A virtual reality mockup of a room in the Westinghouse AP600 nuclear power plant has been developed to study construction, installation, and maintenance tasks. This mockup of Room 12306 in the auxiliary building is displayed in Penn State Applied Research Lab's CAVE-like immersive projection display (IPD), shown in Figure 1. Room 12306 is created from a number of construction modules, which contain piping and equipment from ten different fluid systems. The order in which the modules are loaded and connected affects the construction time, and thus the cost of construction.

An experiment was developed, which used the virtual mockup to test various module installation sequences. Two teams of experienced construction superintendents were asked to develop construction schedules for Room 12306 based on conventional isometric drawings provided by the designer. The virtual mockup was animated to simulate the assembly of the room based on the schedules provided. The participants then reviewed the schedules and evaluated the sequence to optimize construction time and constructability. Their changes were fed back into the virtual simulation for another round of reviews. In addition to reviewing the installation sequence in the IPD, the participants were asked to test an interactive sequence development tool. The results of the interactive schedule development effort were compared with the results using conventional schedule development methods.

The results of the experiment suggest that there is a benefit associated with developing installation sequences interactively, in full-scale. The duration of the assembly of Room 12306 using the conventional and interactive schedule development tools was compared. The construction sequence developed using the interactive method lasted 35 days. The sequences developed by the two teams using the CAD drawings had durations of 48 days and 53 days. The interactive method resulted in schedule savings of 27-percent and 33-percent, respectively. Participants attributed the decrease in installation time to their better sense of spatial perception, which allowed them to plan multiple parallel activities. Additional experiments are planned to confirm these findings.

Acknowledgement:
This work has been supported by the US DOE Nuclear Energy Research Initiative under award number 2001-069.

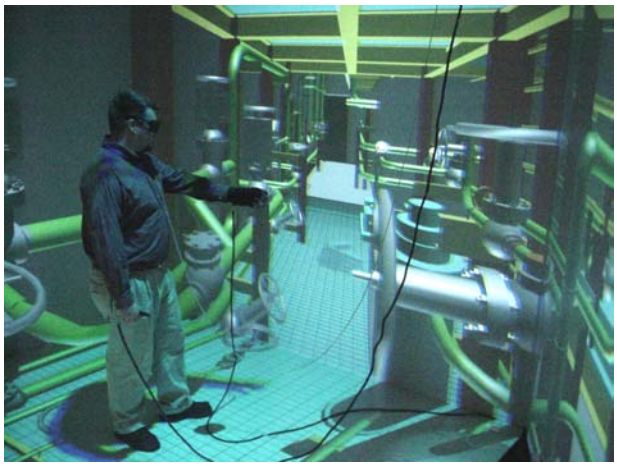

Figure 1: Virtual Mockup of Room 12306