NRC FOREIGN TRIP REPORT: IFE-Halden Reactor Project – Halden, Norway

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Subject:

1. Support NRC simulator development efforts by capturing Halden best practices in experimental design and methodologies used in simulator studies and simulator facility operation.
2. Evaluate new forms of automation in the advanced control room (e.g. computerized procedures, higher levels of automation, etc.).
3. Interact with the Halden staff regarding designing and conducting human-in-the-loop experiments.
4. Identify aspects of advanced control rooms that are sources of complexity and features of advanced design that may be sources of complexity in the future.

Dates of Travel and Countries/Organizations Visited:

10/9/2010-10/16/2010
IFE-Halden Reactor Project

Desired Outcome:

1. Capture best practices for simulator studies and facitlity operation.
2. Capture Halden knowledge of automation and complexity in advanced control rooms
3. Gain insight into designing and conducting human-in-the-loop experiments in the NPP domain for application in MIT's automation experiments.

Results Achieved:

The desired outcomes were achieved as the team was able to gather information regarding the human factors considerations with automation and complexity in advanced control rooms. In addition we were given many presentations regarding experiments addressing these topics. These presentations allowed us to understand both experimental design in a full-scope simulation atmosphere along with the insights gained regarding automation and complexity. Additionally, information was provided regarding the operation of the facility and the logistics involved in conducting simulation experiments.

Summary of Trip:
Presentations were given by Halden staff on:

1. Work focusing on automation and human performance
2. Work focusing on complexity in advanced control rooms
3. Human performance measurement
4. The progression of design in HAMMLAB

Additionally, the staff held several discussions about experimental design. The following summarizes much of the material covered:

Automation Overview:
One of the major challenges for research automation research is that the term "automation" is not well defined. Halden is working to better define automation and categorize types of automation. Halden has created two broad categories for automation:

1. System automation- individual systems or components- piecemeal view of automation- interlocks (prevent actions from being carried out in safety critical situations), controllers (regulate parameters), etc
2. Plant automation- auto-pilot- holistic view of automation- autonomous automatic agents that can operate plant under normal and well-defined deviating conditions; tasks can be automated.

Additionally, we learned about the evolution of the automation experiments at the Halden Reactor Project:

1) Early phase focused on identifying human factors challenges related to automation.
2) Recent work has focused on designing HSIs to help operators and automation work collaboratively.

Complexity Overview:
The need for a more objective way of defining workload led to Halden's complexity research. The focus of this research was on categorizing the aspects of operator tasks that make them complex. The findings of Halden's complexity research showed that task complexity could be categorized based on three factors: Available time, amount of Information, and ambiguity.

We also had discussion pertaining to the interactions and cumulative properties of crewmembers in the complexity discussion.

Human Performance Measurement
Halden presented how they go about measuring task performance, workload, complexity, trust in automation, human-automation cooperation, situation awareness and several other measurements. We had discussions regarding the advantages and the challenges of using various measurement tools. The conveyed their experiences and what they understand are best practices.

This trip was invaluable to our understanding of how to design, carry-out and analyze information in a NPP control room simulation environment.

Pending Actions/Planned Next Steps for NRC:
Continued collaboration/discussions in order to stay aware of on-going projects and have continued discussion regarding challenging topic areas.

Points for Commission Consideration/Interest:
The content of this report is not likely to be of interest to the Commission.

"On the Margins": NONE

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