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A University-Utility Collaborative Program of Simulator-Interfaced Instruction & Research

by
Brian K. Hajek John M. Christenson, Eugene Rutz, and Don W. Miller

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Introduction

The Collaborative Utility - University Project has now completed two years of performance. Through this project, a comprehensive program of simulator-interfaced instruction and research is being pursued as a collaborative effort by the American Electric Power Corporation and Centerior Energy Corporation working with the Nuclear Engineering programs at the University of Cincinnati and the Ohio State University. Funding and resources for the program are being provided by the Department of Energy (DOE) and the utilities. The program, initiated in September 1993 as the result of a proposal submitted by the Universities to the DOE, has been well received at the utilities and the universities and has produced tangible results for all participants.

Course Implementation

The primary emphasis during the first two years was on development and presentation of a two-quarter course sequence on commercial nuclear power plant system design and operation. With two cycles completed, more than 40 students have participated, and the sequence is now an integral part of the curricula at both schools.

Visits are made to each of three nuclear power plants involved in the collaboration during both quarters. On-campus class lectures are presented in video-classrooms allowing instructors at one site to simultaneously present audio and visual information to students on both campuses. Class lecture material was developed primarily from similar materials utilized and developed by the utilities to train their own engineers and operators. The initial development effort was described in an earlier paper [1].

Thesis Research

A second emphasis of the program is on the performance of research projects centered around plant-specific problems. Each research project should (1) lead to a thesis meeting university academic standards for graduation, and (2) provide the utility with results that lead to improvements in some aspect of plant operations. Since the program emphasis is simulator based, projects have been centered around efforts to improve the use of the simulator in training activities. Two projects are currently being completed. One involves a collaboration between the University of Cincinnati and personnel from the D.C. Cook plant; the other involves a collaboration between The Ohio State University and the Perry Nuclear Power Plant.

DISCLAIMER

Both research projects involve extensive interaction with plant personnel, including personnel in engineering and personnel responsible for the maintenance and use of the plant simulators. Plant staff provides engineering and design information, explanations of system interactions, insight on the effects of system and component malfunctions, understanding of simulator operation, and guidance on the importance of various levels of fidelity of models used in plant personnel training. Throughout the research plant personnel serve as consultants to the students to both respond to questions and to assure that models being developed will provide the necessary utility when used to train plant operators.

The Perry research involves development of an improved radiation transport model for the plant ventilation systems. The new model is based on flow considerations through plant ductwork, fan capacities, louvre position effects, and newly developed source terms. Accidents being considered include primary system steam leaks and pipe breaks, as well as the possibility of radiation transport from the Suppression Pool following either a Safety Relief Valve opening or a large break LOCA releasing significant amounts of radioactive water to the pool.

The objective of the D.C Cook research is to develop a first principles model for the operation of the reactor coolant pump seals, and to use this model to improve the conformance of the simulator computer to situations in which seal failures occurs. The current model is based on empirical data from the manufacturer and observations of operations and training staff. Using updated design drawings, plant data, and additional information gathered from interviews with engineering staff, models to calculate the flow rates through the seals under abnormal conditions (loss of all AC power, etc.) are currently being developed. The impact of various malfunctions on seal flows and leaks will be investigated, and the impact of model improvements on the overall fidelity of the simulation will be evaluated.

Summary

The collaborative effort required to present the course sequence has produced a variety of benefits, including:

- Enhanced preparation of students to enter the professional workforce,
- Opportunities for graduate student research in practical engineering applications,
- First-rate research projects at minimal costs to the utilities
- Significant student enrichment through plant visits and use of the plant simulators, and
- Professional enrichment for the collaborators through interaction with peers at multiple sites.

When the graduate student research projects are completed the students will make presentations of their findings to the collaborators at the plant sites. The results will be documented, provided to the utilities, and are expected to be implemented on the plant simulators. Identification of additional topics pertinent for graduate research is underway and two new research projects will be initiated before the end of 1995.

The program of simulator-interfaced instruction will be extended beyond the current course offering. The goal is to include "modules" of simulator-based instruction in existing courses, not

the creation of entirely new courses. These modules will be developed through the collaborative effort of utility and university personnel and will provide university students with significant enhancements over existing teaching techniques.

References

1. "Initiation of a Program of Simulator-Interfaced Instruction & Research," by John M. Christenson, Don W. Miller, Brian K. Hajek, Eugene Rutz. Presented at the ANS 1994 Annual Meeting, Trans. Am. Nucl. Soc. 70, 26-27, (June 1994).