THE UNIVERSITY OF TENNESSEE
KNOXVILLE

DOE/NE/37959--30

DE89 010054

College of Engineering

Department of Nuclear Engineering

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SUBJECT: Signal Validation for Nuclear Power Plants
Progress Report No. 8

CONTRACT NO. DE-AC02-86NE37959

DATE: March 28, 1989

1. Introduction

This report is a summary of the progress in the U.S. Department of Energy sponsored project on Signal Validation for Nuclear Power Plants, for the period January-March, 1989. This is the last phase of the project with September 29, 1989 as the official ending date. A preliminary draft of a two-volume final report is scheduled for release in mid-September. One topical report and two conference papers for presentation at the Seventh Power Plant Dynamics, Control and Testing Symposium have been prepared during this reporting period. A comprehensive signal validation system (SVS) is operational in the MicroVax-II workstation.

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A demonstration of the SVS is being developed. The SVS is being tested using operational data from a PWR and from the EBR-II. A new method, called the hypercube memory structure for signal validation, is now available.

2. Staff

B.R. Upadhyaya	Principal investigators
T.W. Kerlin	
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3. Hypercube Memory Structure (HMS) for Signal Validation

As an alternative to storing and using actual observed data values, the storage of relative frequencies of process variable vectors can be achieved by a hypercube memory structure. The storage of frequencies of occurrence will allow retrieval of a representative sample based on an unlimited amount of observed input data, while limiting internal storage and processing requirements. A hypercube structure may be considered as having finite size bins, each representing a state of the system. The

size of a bin is a function of the required precision in defining each state. The system characterization using the HMS module is used for independent signal validation and for system diagnostics. This data compression can be considered as data smoothing in the form of a multidimensional probability density function.

4. Comprehensive Signal Validation System (SVS) Development

The current form of the integrated SVS consists of six signal validation modules. The performance of the modules, the integrated system, and the decision about the validity of process signals have been extensively tested using operational data from a four-loop Westinghouse PWR and the EBR-II. The SVS has been implemented in a MicroVAX-II workstation at the University of Tennessee. A demonstration of the SVS is currently under development.

5. Visit to Combustion Engineering, Inc.

A full-day technical discussion was held at Combustion Engineering (CE) at Windsor, CT. Detailed plans were made for CE to perform an evaluation of two of the signal validation modules. These modules have been transferred to CE. CE will use both simulator data and PWR Plant data.

6. Participation in Conferences

The following two papers have been prepared for presentation at the Seventh Power Plant Dynamics, Control and Testing Symposium, May 15-17, 1989, Knoxville, Tennessee:

(a) "Development of an Integrated Signal Validation System and Application to Operating Power Plants."

(b) Generalized Consistency Checking of Multivariable Redundant Measurements and Common-Mode Failure Detection."

A topical report on the multivariable generalized consistency checking for signal validation was published in January 1989 (DOE/NE/37959-26).

7. Work in Progress

A detailed report on the comprehensive signal validation system, including its implementational aspects, is being prepared. The EBR-II start-up data (reported in DOE/NE/37959-25) will be processed using the SVS. It is anticipated that the SVS demonstration will be available by June 1989.

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June W. Wiinikka, U.S. Department of Energy
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