CONF-801107--6

MEETING THE REACTOR OPERATOR'S INFORMATION NEEDS USING FUNCTIONAL ANALYSIS

MASTER

By

William R. Nelson
Michael T. Clark
EG&G Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83415

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Submitted for Presentation at:
American Nuclear Society
1980 International Conference
November 17-21, 1980
Washington, D.C.

NOTICE

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, or any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for any third party's use, or the results of such use, of any information, apparatus, product or process disclosed in this report, or represents that its use by such third party would not infringe privately owned rights. The views expressed in this paper are not necessarily those of the U.S. Nuclear Regulatory Commission.

Work supported by the U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research under DOE Contract No. DE-AC07-76ID01570.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MEETING THE REACTOR OPERATOR'S INFORMATION NEEDS USING FUNCTIONAL ANALYSIS

William R. Nelson
Michael T. Clark
EG&G Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83415

INTRODUCTION

Since the accident at Three Mile Island, many ideas have been proposed for assisting the reactor operator during emergency situations. However, some of the suggested remedies do not alleviate an important shortcoming of the TMI control room: the operators were not presented with the information they needed ~~when they needed it.~~ in a manner which would allow prompt diagnosis of the problem. To address this problem, functional analysis is being applied at the LOFT facility to ensure that the operator's information needs are being met in his procedures and graphic displays. This paper summarizes the current applications of functional analysis at LOFT.

FUNCTIONAL ANALYSIS

Functional analysis (References 1 and 2) is a class of techniques used in the design of systems, especially in the defense and aerospace industries. It is used to extract information concerning the operation of a system by decomposing the operation into separate functions. The functional analysis procedure being used at LOFT has three steps.

A functional decomposition is performed to segment the operation into functions. For example, the process of responding to an accident and bringing the facility to a stable condition can be divided into six functions: (1) detect the event, (2) diagnose the event, (3) determine an

appropriate response, (4) perform the action, (5) control the disturbance, and (6) establish a stable condition. Each of these functions can be further divided to gain more information concerning the operator's role and his needs for performing the operation.

A flow diagram is drawn for each function. The flow diagram shows the decisions the operator must make during the operation and the different paths he may take based on his decisions. It also illustrates the individual tasks the operator must perform to complete the operation. If desired, a task analysis can be performed to establish relative measures of the operator's physical and mental workload.

Information is extracted from the flow diagram using a tabular format. Emphasis is given to the decisions required of the operator, the information required to make the decision, potential sources of the information, and the consequences of an incorrect decision. In this manner the specific information needs of the operator can be systematically defined.

The information gathered during the functional analysis can be used in the development of procedures and graphic displays.

PROCEDURE DEVELOPMENT

The flow diagram and information from the functional analysis table can be used to develop procedures for the operation. The decisions required by the operator, the actions taken based on his decisions, and the paths through the procedure are taken from the flow diagram. The procedure is then written to include: (1) instructions for performing each action, (2) the expected system response, (3) what to do if the system does not respond as expected, and (4) where to find the information required for each decision. Special care is taken to ensure that the operator is given adequate information needed to make the decisions to avoid unnecessary confusion and ambiguity.

DISPLAY DEVELOPMENT

Whenever a decision must be made based on the status of plant systems, a display must convey this information to the operator. Color graphic displays have the flexibility to present the operator needed information in a usable form when he needs it. However, useful information should not be suppressed because its need was not anticipated. Various displays are being developed at LOFT using the information gathered in the functional analysis process. These displays include system status displays, trend displays, diagnostic displays, and displays used for procedure following.

CONCLUSION

During the development of operating procedures and graphic displays particular care must be taken to ensure that the operator's information needs are met by the final product. Functional analysis is a tool being used at LOFT to meet these needs. Functional analysis is proving to be beneficial for systematically establishing the form and content of operating procedures and graphic displays.

REFERENCES

1. Rabideau, Gerald F. and David Meister, Human Factors Evaluation in System Development, New York, John Wiley & Sons, 1965.

2. Gagne, Robert M., ed., Psychological Principles in System Development, New York, Holt, Rinehart and Winston, 1963.