RESPONSE DOCUMENT

Refer to:
LZ810038

Westinghouse Electric Corporation
Advanced Power Systems Divisions

Advanced Reactors Division
Clinch River Site

Box W
Oak Ridge Tennessee 37830

November 9, 1981

U. S. Department of Energy
Technical Information Center
P. O. Box 62
Oak Ridge, Tennessee 37830

Attention: Special Assistant for Reproduction & Processing

Subject: CRBRP; Release of Technical Paper Under Contract DE-AC15-76CL02395

Dear Sir:

Enclosed are two reproducible copies of a paper entitled "CRBRP Human Factors Contributions to the Nuclear Industry" by H. P. Planchon.

The paper has been patent cleared by the U.S. DOE/Chicago Patent Office and incorporates the comments of the CRBRP Project Office set forth in its approval for release to TIC. It is to be presented to the ANS Topical Conference in March 1982 and published in the proceeding thereafter.

This letter satisfies commitment number LR5778.

Should there be questions or comments concerning the above, please contact Ms. V. K. Hunt (615/576-1644) of the LRM.

Very truly yours,

Jos. A. Heeke, Jr., Manager
LRM Procurement

VKH:mw
LMP-81-813
Enclosures

cc: CRBRP/PO - R. J. Getz, Chief, Information Division
ARD/RM - M. A. Leogas, CRBRP Planning & Scheduling

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CRBRP Human Factors Contributions to the Nuclear Industry

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- ☐ a. Scientific and technical report
- ☒ b. Conference paper: Title of conference ANS Topical Conference

Date of conference 3/18-23/1982

Exact location of conference Charleston, S.C. Sponsoring organization ANS

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H. P. Planchon, Jr., Manager Plant Systems and Safety Related Designs

Organization
Westinghouse Electric Corporation - CRBRP; Oak Ridge, Tn.

Signature H. P. Planchon Jr. Date 9 Sept 81

The Clinch River Project Control Room Task Force was formed in October 1979. The method for conducting the review was defined after consultations with individuals with extensive design and human engineering experience in the power plant, automotive, aerospace, and defense industries. The method chosen was one using a "walk-through" of procedures and the evaluation of operator responses to a spectrum of normal and offnormal events in a control room mockup. The "walk-throughs" were carried out using a full scale mockup of the control room constructed from wooden frames covered with full size prints of the various control room panels. Magic markers and colored "stick on" acetate were used to provide realistic meter and controller indications.

The task force was divided into three groups. Members of the first group were called "simulators." These individuals selected and studied approximately two hundred events to be evaluated by walk-throughs. Events ranging from normal startup to reactor scrams to hypothetical events were selected from the plant design basis duty cycle and from accident analyses in the CRBRP PSAR. For each event, the plant response and its indications in the control room were defined. This involved analysis of the plant nuclear, thermal, and hydraulic response. The normal or off normal operation of the control and protection system was included in these evaluations. The influence of operator actions on plant response was based on plant operating procedures. After determining the plant response, the indications of this response in the control room were determined. Having made these preparations, the "simulators" were able to mark up the indications for each event on the model panels as the walk-through was conducted.

The second group of individuals consisted of "operators." Individuals with power plant operating experience were selected to walk-through the response to each event as it was portrayed on the panel by the simulators. The operators followed operating procedures and simulated the acknowledgement of alarms, receipt of information from indicators and the computer, and control of the plant equipment.

Members of the third group, the "evaluators," were a systems engineer familiar with the operations of CRBRP systems and a human engineer familiar with human factors theory and practical applications. During the walk-throughs, and ensuing discussions, the evaluators recorded problems observed in the areas of systems design and operability, control and indication, computer support in the control room, procedures and man-machine interfaces.

Preparation of the list of events and completion of the walk-throughs consumed approximately six months. The total process was meticulously documented. By following this rigorous disciplined approach, the task force was able to identify a large number of recommendations for improving the man/machine interface. The total number of recommendations was almost five hundred. These ranged from improvements in the procedures and enlarging the size of some labels to providing a separate environmental panel for monitoring and control of environmental conditions in the plant. Other examples of specific recommendations are:

Enhancement of the plant computers capability to display system status

Addition of computer displays to the control room supervisor's console

Grouping of the alarms near the associated control panels indicators and controls

Addition of important controls and indications and deletion of redundant functions on the main control panel for improved operability

Incorporation of additional instruments and indications for accident monitoring

As a result of this comprehensive and disciplined effort, human factors engineering has been incorporated throughout the CRBRP systems design.

Experience with the overall methodology developed and applied by CRBRP for this purpose indicates that it is an economical but powerful tool for accomplishing the objectives without resorting to a computer-based high fidelity simulator.

Furthermore, the methodology provides side benefits of forcing the system designer to think the system thru from the point of view of man/machine interface thus providing thorough overall systems integration with the man/machine interface. Finally, as another by-product, at the conclusion of the effort, there is a high degree of confidence that the system operating outlines are appropriate. All this can be accomplished at the design stage prior to committing the design to hardware. All in all, CRBRP methodology for human engineering is a significant contribution to the technology available to the nuclear industry for improved human factors engineering.

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