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September 19, 1983

Docket Nos: 50-329
and 50-330

Mr. J. W. Cook
Vice President
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Dear Mr. Cook:

Subject: Comments on Midland's Detailed Control Room Design Review Summary Report

The staff has reviewed the Consumers Power Company Control Room Design Review Final Report dated March 31, 1983. This report was submitted as requested to fulfill the stipulations of NUREG-0737, Supplement 1. The staff's comments are enclosed.

The staff plans to conduct a pre-implementation audit at the Midland site during the week of October 17, 1983. If prior to that time, you wish to discuss the staff's comments, inform Melanie Miller at (301) 492-4259, so that a meeting can be arranged.

Sincerely,

/S/

Elinor G. Adensam, Chief
Licensing Branch No. 4
Division of Licensing

Enclosure:
As stated

cc: See next page

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MIDLAND

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Comments
on the
Control Room Design Review Program Plan
and
Control Room Design Review Final Report
Midland Plant - Units 1 & 2
Consumers Power Company

Control Room Design Review

Consumers Power Company (CPCo) has submitted their "Midland Plant Control Room Design Review Plan" dated January 15, 1982, and their "Control Room Design Review Final Report - Midland Plant Units 1 & 2" dated March 31, 1983, to the NRC. These documents were submitted as CPCo's Detailed Control Room Design Review (DCRDR) Program Plan and DCRDR Summary Report for the Midland Plant, Units 1 & 2, in response to the requirements of NUREG-0737 and NUREG-0737, Supplement 1.

Supplement 1 to NUREG-0737 requires that the licensee's program plan describe how the following elements of the DCRDR will be accomplished:

1. Establishment of a qualified multi-disciplinary review team.

2. Function and task analysis to identify control room operator tasks and operator information and control requirements during emergency operations.

3. A comparison of control and display requirements with a control room inventory.

4. A control room survey to identify deviations from accepted human factors principles.

5. Assessment of human engineering discrepancies (HEDs) to determine which HEDs are significant and should be corrected.

6. Selection of design improvements.

7. Verification that selected design improvements will provide the necessary correction of HEDs.

8. Verification that improvements will not introduce new HEDs.

9. Coordination of control room improvements with changes from other programs such as SPDS, operator training, Regulatory Guide 1.97 instrumentation, and upgraded emergency operating procedures.

A summary report of the completed review outlining proposed control room changes, including the proposed schedules for implementation and providing justification for HEDs with safety significance to be left uncorrected or partially corrected is also required.

The following comments describe the results of our review of the submitted documents for conformance with these requirements.(1) Topics where additional staff review will be needed to determine acceptability of the CPCo DCRDR are identified. We plan to make these reviews during an on-site audit at the Midland Plant.

1. DCRDR Review Team

The applicant used the recommended multi-disciplinary team approach to conduct their DCRDR. The program plan stated that the DCRDR team included engineers, a reactor operator, and human factors consultants.

The applicant's DCRDR team size, structure, and organization is not clearly defined. The program plan states that the team was headed by a CRDR program director and consisted of human factors consultants and representatives from plant design and plant operations. We will review the size, composition, responsibilities, authority, objectivity, and organizational charter of the team in conducting the DCRDR to evaluate the review team organization, administration, and management and to determine how the team operated.

The CPCo descriptions of the education and experience of the DCRDR team members are general and vague. Specific qualifications of individual team members are not provided. Our review will seek identification of team members and more specific information about their individual experience and qualifications.

Human factors support to CPCo was provided by consultants who were not identified. The program plan states only that the human factors director is an engineer with an advanced engineering degree, has 10 years operational and training systems development experience, and is a candidate for an advanced degree in psychology/human factors. The role of the human factors director as a DCRDR team member is not defined. The participation of additional human factors consultants in the DCRDR process is not described. We will review details of the human factors consultants' activities to determine whether the human factors support and participation in the DCRDR was adequate.

The DCRDR final report notes that the assigned operations personnel were not always able to participate on the DCRDR team due to scheduled training, simulator, or shift work. The qualifications and indoctrination of substitute operating personnel who were assigned to DCRDR team meetings "as necessary" will be reviewed to determine the consistency of operations representation on the review team.

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(1) The staff recognizes that the Midland Program Plan was submitted before NUREG-0737, Supplement 1, was published.

The applicant stated that personnel from the NSS supplier (B&W) and the architect/engineer (A/E) would also be used to supply design information and information on procedures. We could not determine whether these additional people participated as members of the DCRDR team or as independent sources of information for the team. Their participation in the DCRDR will be reviewed.

2. Function and Task Analysis

CPCo conducted an operating experience review, a system function review, and a task analysis for the Midland Plant.

The operating experience review consisted of structured interviews with Midland reactor operators (ROs) and senior reactor operators (SROs) and a review of recent operating experience at similar NSSS supplied plants.

The RO interviews were conducted using a 34 item questionaire focused on control panel configuration and utilization, and on training as related to specific RO responsibilities and jobs. The SRO survey was conducted using a 12 item questionaire directed toward overall design configuration and operational relationships. Sample questions from the questionaires were provided in the CPCo reports. The staff wishes to review the complete questionaires and DCRDR team's analyses of the responses.

Significant transients that occurred in seven similar NSSS plants between January 1980 and April 1982 were reviewed. The applicant states that the information from those plants that was applicable to the Midland plant design was evaluated as part of the task anaysis. The staff wishes to review CPCo's analysis and evaluation of information obtained from review of operating experiences at similar plants.

The functional analysis was done for normal operations, off-normal operations for conditions not involving an immediate reactor trip, and emergency operations that ensue after a reactor trip. Normal operations were divided into four baseline operations: Heatup, Startup and Power Operation, Shutdown, and Cooldown. Normal operations were analyzed as sequential timelines. Emergency operations were analyzed using multiple failure event tree analyses performed by B&W during ATOG development and using symptom-oriented functional flow diagrams that included special equipment operating rules for emergency conditions.

The task analysis was performed at a full-scale control room mockup by the DCRDR review team. It included walk-throughs and talk-throughs of difficult task sequences.

The sample function analysis and task analysis documentation provided in the CPCo reports indicate that acceptable methodology and documentation was used for the function and task analyses. The reports do not indicate which team members performed the function and task analyses.

The CPCo function and task analyses generally appear to satisfy the function and task analysis requirement of NUREG-0737, Supplement 1. The staff plans to review the process and criteria CPCo used to choose the operational sequences for task analysis. The staff will also evaluate the CPCo task analysis documentation to verify that it was performed to a level of detail and completeness appropriate for a DCRDR.

3. Control Room Inventory

The CPCo reports state that a systematic panel-by-panel inventory of components in the control room was conducted and documented. The inventory was used as an aid in the construction of a full scale Unit 2 control room mockup. Only sample inventory documentation was provided. The staff will review the inventory process to determine adequacy and completeness of the control room inventory.

4. Control Room Survey

The CPCo final report states that they conducted a control room survey of the Midland Unit 2 control room using the latest standards as design criteria. The standards cited are NUREG/CR-1580, NUREG-0700, MIL-STD-1472B, and Van Cott and Kinkade (Human Engineering Guide of Equipment Design, 1972). The report does not describe how the criteria used in the control room survey were determined from these standards.

The control room survey methodology used by CPCo categorized equipment being evaluated by levels of complexity. Three categories were used: component, type sets of components, and panels.

Thirty nine types of components were identified. Design characteristics of each type of component that remain constant regardless of application of the component were evaluated. Fifty three types of similar type sets were identified. A set was defined as a unique arrangement of components which (1) serve a common function, (2) are repeated frequently throughout the control room, and (3) are identified by a single common placard. A Set Design Checklist was used to evaluate the arrangement of components within the set.

The panel reviews were top-down functional operational evaluations of control display relationships and system functional grouping to support normal and emergency conditions of plant operations. Talk-throughs and walk-throughs of event operations were conducted using the control room mockup configuration prior to addition of enhancements and using plant operators. Problems in performing operations and HEDs noted during the walk-throughs and talk-throughs were recorded on event sequence sheets. Audio and video recordings were made of walk-throughs. It is not clear from the CPCo reports when walk-throughs and talk-throughs were used for task analysis, for control room survey, and for verification and validation activities. Our review will seek clarification of the uses of walk-throughs and talk-throughs and of the times that they were performed during the DCRDR process.

Based upon the summary description, the survey techniques CPCo used appear to satisfy the control room survey requirement of NUREG-0737, Supplement 1. We plan a further review and analysis of the control room survey documentation and the evaluation criteria used to determine HEDs to confirm this observation.

5. Assessment of HEDs.

Section 2, General Findings, of the CPCo final report provides a review of the Midland DCRDR findings. The findings are divided into nine categories that generally follow the human engineering guidelines of NUREG-0700. Significant HEDs are described and analyzed. This summary appears to be a concise and complete topic by topic description of important HEDs that were observed.

Individual HEDs for each category with descriptions of each deficiency and a proposed resolution are provided in Appendix A of the CPCo final report. The HED resolution entries include justifications for instances where no corrective action will be taken. No summary is provided of items originally noted as HEDs that will be left unchanged or that will be partially corrected. The program plan document states that there were 194 HEDs. The final report provides information on 170 HEDs. We will need to determine disposition of the 24 HEDs that do not appear in the CPCo final report.

The CPCo reports do not include a description of the details of the assessment process used to evaluate the significance of individual HEDs or of the standards used to justify decisions not to correct specific HEDs. We will need to review details of the assessment process and the standards/criteria used to justify not correcting HEDs.

6. Selection of Design Improvements

Section 3, Implementation, of the CPCo final report discusses modifications to be made to improve the control room man-machine interface. The modifications to be implemented are divided into four categories: overall panel improvements, controls, displays, and dedicated panels. Some of the corrective actions provided are too vague for staff review, (e.g. "swap components as required and enhance" and "enhance to show functional relationships"). The staff will review specific details of selected design improvements.

Overall panel improvements consist mainly of swapping positions of like components to improve component functional groupings, demarcation, color coding, color enhancements, changing the color of control panel from green to beige to provide a neutral background for color enhancements, labeling improvements, and addition of mimics.

We will review the design improvement selection process used to determine the individual HED corrective actions, including the criteria used to chose improvements. It appears that redesign of panel layouts beyond swapping of like components was not considered. The staff will evaluate whether CPCo gave proper consideration to panel design changes in selecting design improvements.

The example photographs provided in the final report indicate substantial improvements were made using the enhancement techniques chosen by CPCo, but the photos lack sufficient detail for a complete evaluation. Our on-site review will include a more detailed evaluation of HED corrective actions.

CPCo states that a best effort will be made to implement identified improvements prior to fuel load of each unit. CPCo will report modifications that cannot be completed by fuel load, describe the reason for delay, and provide a new schedule of implementation. The staff will review progress in the implementation of control room improvements and will review any delays that may have developed.

CPCo identifies two items, (digital indicators and steam generator level and feedwater flow indication/recorder), that are unresolved and are still being investigated and evaluated. Resolution of these items will be needed prior to licensing.

CPCo has identified control room workspace and environment topics that could not be evaluated due to the construction status of the control room. CPCo expects to review these topics and provide a supplementary report of the results approximately 6 month prior to scheduled fuel load. Reports on uncompleted evaluations of communications and process computers will also be needed prior to licensing.

7. Verification of Design Improvements

After panel enhancements were selected and designed, they were implemented on the full-scale mockup of the Unit 2 control room. The CPCo reports state that operational personnel were formally and informally involved in reviewing and commenting on panel enhancements. When the mockup was completed a formalized validation was conducted.

The process of verifying and validating enhancements and correcting HEDs has not been fully described. It is not clear what verification and validation activities were conducted using the original mockup, what activites were performed after the mockup was enhanced, and what documentation was made supporting verification and validation of design improvements. The staff will need to review these activities or plans for verification and validation of design improvements at the mockup and in the control room.

8. Verification That Improvements Will Not Introduce New HEDs

While it may be inferred that validation activities conducted after control room enhancements were made on the control panels included evaluation of the introduction of new HEDs, there are no statements supporting verification that chosen HED corrections did not generate other HEDs. The staff will need to confirm that DCRDR enhancements did not introduce new HEDs.

9. Coordination of DCRDR with Other Programs

The CPCo reports state that the SPDS will be coordinated with the CRT displays. Development of the Midland task analysis was coordinated with the ATOG and the development of plant specific emergency operating procedures and included evaluation of instruments installed to meet Regulatory Guide 1.97 requirements.

Coordination of DCRDR control room improvements with operator training is implied but is not specifically addressed. During the on-site audit, the staff will review DCRDR integration with operator training and with other control room improvements.

CONCLUSIONS

Based upon our review of the Midland Plant DCRDR documents submitted by CPCo, we conclude that CPCo has conducted a DCRDR that generally meets the intent of NUREG-0737, Supplement 1, and that CPCo is implementing control room improvements to correct HEDs noted during the review. An on-site control room review pre-implementation audit to review detailed DCRDR documentation and to evaluate supplementary information cited in this review of the CPCo DCRDR program plan and summary reports is planned.

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