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Docket No. 50-029

FACILITY: Yankee Nuclear Power Station

LICENSEE: Yankee Atomic Electric Company (YAEC)

SUBJECT: MEETING SUMMARY - NOVEMBER 13, 1986 - CONTROL ROOM DESIGN REVIEW

On November 13, 1986, members of the NRC staff met with representatives of YAEC to discuss the control room design review. Enclosure 1 provides the list of participants. This meeting was a followup to a May 15, 1986 meeting on this subject. Following that meeting, the staff developed a report "Evaluation of Supplemental Information", Enclosure 2 to this summary, which was discussed at the November 13, 1986 meeting. In the draft evaluation, the staff raised a concern regarding how control requirements were derived. The licensee discussed their studies of instrumentation and control needs. The evaluation also noted that the staff would need to review YAEC guidelines for resolution of human engineering deficiencies (HED), and justifications for not correcting particular HED's.

Two specification manuals have been prepared by YAEC. One of them, YRS-016, presents the set of abbreviations that will be used in panel labeling. The second manual, YRS-013, provides the design guidelines for human factors engineering. Copies of these documents were discussed with the staff at the meeting The licensee indicated that they were generally following NUREG-0700 and MIL Standard 1472B, with some exceptions dictated by the plant design.

The licensee then presented "before" and "after" views of the diesel generator/safety injection panels. The "before" view was a half-scale photograph of the existing panels. The "after" view is a half-scale mockup showing the labels, mimics, relocated components and other improvements that are planned to resolve HEDs.

On the redesigned panel, color mimics are used to show system flow paths. Mimics were considered very useful by the plant operators and are thus a major part of the planned upgrade. The licensee minimized controls relocation on the board to minimize potential operator confusion, but did relocate some components that were too low, or that had been on a section of the panel away from related controls. The licensee used white lines for demarcation of trains and subsystems. These improvements will be implemented in the May 1987 refueling outage.

Upgrades of the remaining panels will be designed in a similar fashion.

The staff noted that the licensee's approach, using inputs from human factors consultants, engineering and plant operators was good, and that the resulting improvements for these panels were excellent.

Six studies (annunciators, environment, SPDS, fire control panel, control rod position indicator, and failure mode) are to be conducted by the end of the 1987 refueling outage with implementation of the results to be completed by the end of the 1988 outage. The staff is concerned that the annunciator study and implementation of any annunciator improvements may extend beyond the 1988 outage.

In conclusion, the licensee agreed to respond to the issues raised in Enclosure 2 within 60 days. In addition, the licensee will provide their plans and schedules for implementation of all control room improvements.

/S/

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Enclosures:
As Stated

cc w/enclosures:
See Next Page

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YANKEE/NRC MEETING DCRDR

NOVEMBER 13, 1986

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ENCLOSURE 2

YANKEE ROWE NUCLEAR POWER STATION
DETAILED CONTROL ROOM DESIGN REVIEW
EVALUATION OF SUPPLEMENTAL INFORMATION

The attached provides a summary of the NRC's and SAIC's findings from an evaluation of the information provided by Yankee Atomic Electric Company (YAEC) in a supplement to the Yankee-Rowe DCRDR Summary Report (dated March 14, 1986), at a meeting held with the NRC on May 15, 1986, and in additional information provided by YAEC to the NRC subsequent to the meeting. The information provided by YAEC and its plans for completing the remainder of the Yankee-Rowe DCRDR were found to be acceptable. A meeting is currently being planned with YAEC for August of 1986 to confirm YAEC's plans and to review its proposed changes to the diesel generator and safety injection panels. The NRC will also assess the acceptability of YAEC's resolution of human engineering discrepancies (HEDs) by reviewing the differences between YAEC's human factors design specifications and conventions and those provided in NUREG-0700, and by evaluating YAEC's justifications for not taking corrective action on HEDs. Appendix A provides the list of meeting attendees.

1. Qualifications and Structure of the DCRDR Team

A concern of the NRC identified from the review of the Yankee-Rowe DCRDR Summary Report was the adequacy of the multidisciplinary team responsible for selecting and verifying control room design improvements. YAEC has responded to this concern by indicating that a multidisciplinary team will select and verify design improvements, including integral involvement of human factors specialists. The qualifications, structure, and responsibilities of the DCRDR team were found to be acceptable and satisfy the corresponding requirements of Supplement 1 to NUREG-0737.

2. Function and Task Analysis

The concerns of the NRC identified from the review of the Yankee-Rowe DCRDR Summary Report were (1) the comprehensiveness of the EOPs and task analysis in covering the tasks performed and man-machine interfaces involved in emergency operations, and (2) the adequacy of the detail with which information and control requirements of emergency-related tasks were identified.

YAEC performed a probabilistic risk assessment (PRA) in 1980-1982. Based on its PRA and on a parallel effort by NRC and various owners group emergency procedure committees to analyze and proceduralize multiple failure scenarios, YAEC developed function-based, symptom-oriented procedures for ascertaining plant system configurations and recovery from abnormal or emergency conditions. The task analysis was based on the function-based emergency operating procedures which ensure maintenance of the tasks associated with fuel cladding integrity. Based on the information provided in the Supplement to the Summary Report which describes YAEC's efforts in detail, the EOPs and task analysis were found to be comprehensive in covering the tasks performed and the man-machine interfaces involved in emergency operations.

During the in-progress audit conducted at Yankee-Rowe in October of 1984, the NRC audit team found instances in the task analysis where the information and control requirements were not adequately identified and documented (e.g., the requirements were found to be too general or vague to provide for a detailed verification of suitability in the control room). A review of the Summary Report found that YAEC's response did not resolve this

concern. Based on information provided by YAEC in the Supplement to the Summary Report and in the meeting, the NRC concluded that the information requirements, including needed characteristics of instrumentation, are adequate for verification of instrument suitability to be performed. However, the NRC found that control requirements were not determined in adequate detail.

Subsequent to the meeting, YAEC submitted to the NRC its "Standard Requirements for Control Needs." YAEC has developed design requirements for the following control types or applications in the Yankee-Rowe control room:

- Control Switch for Electrical Distribution System Breakers
- MOV Control Switch
- Pump Controls and Indication
- Trip Valves (SOV or Air-Operated Valves)
- Function Actuation Switches
- Process Controllers

Apparently YAEC will apply these requirments as criteria to evaluate the controls in the control room. It is unclear whether these requirements or evaluation criteria were derived from an analysis of tasks, or were based on Yankee-Rowe and industry conventions for controls. For example, the following requirement appears for most of the Yankee-Rowe control types:

> "When positive feedback via process variable indication (flow, level, pressure, etc.) exists, it shall be identified by instrument tag number on the review forms."

Before this requirement is applied, an analysis of tasks for needed control characteristics should determine the need for positive feedback of control actuation and in what form (e.g., via process variable indication such as flow, level, pressure, or temperature) the feedback is needed. YAEC's above requirement does not reflect such a task analysis.

The following three requirements are further indications of the possibility that the "Standard Requirements for Control Needs" were not derived from an analysis of tasks:

"For MOV throttling service, switches shall be spring return to center from open or close position, generally. If MOV is used as a pump discharge valve, a stop pushbutton switch may be utilized to stop valve travel for system pressure surge considerations;

" 'Auto' (automatic) position, if required by system design, shall be the center switch position;

"If the control switch has an automatic start position, ('AUTO'), the AUTO position shall be the center position."

In the first of the three examples, the word "generally" and the reference to the use of a stop pushbutton switch in the case of a pump discharge valve raise some concern as to whether these requirements were derived from a task analysis, and whether these requirements were derived independently from what actually exists in the Yankee Rowe control room. The use of the word "generally" permits the evaluator to accept differences or discrepancies with the requirement in the control room. It appears that the switch for the pump discharge valve is one such discrepancy with the requirement. Although a discrepancy with a requirement may ultimately be acceptable and not detrimental to operator performance, the provision for exceptions to a requirement prior to control room verification may be inappropriate.

In the second and third of the three examples are the phrases "... if required by system design...," and "If the control switch has an automatic start position, ('AUTO'), ..." Prior to applying the criteria of which these phrases are a part, a task analysis should be performed which determines whether system design and operator functions require an AUTO position or an automatic start position. It is not clear whether such an analysis has been or will be performed.

In summary, the NRC concerns regarding the task analysis effort have been satisfied with the exception of the analysis of control requirements. It is not clear whether the requirements YAEC has identified have been derived from an analysis of tasks as required by NRC or from the conventions for control design present in the Yankee-Rowe control room. This concern must be resolved to the acceptance of the NRC before this requirement can be closed out.

3. Comparison of Display and Control Requirements With a Control Room Inventory

The NRC concerns for the acceptability of the comparison/verification of display and control requirements with the control room were those expressed for the task analysis; namely, the level of detail with which the information and control requirements were defined was not specific enough to allow for any acceptable verification of suitability of controls and displays to be made. Based on the information YAEC provided in its Supplement to the Summary Report and in the meeting, the identification and verification of information requirements were found to be acceptable. In order to complete the comparison/verification activity and to meet the requirements of Supplement 1 to NUREG-0737, YAEC should verify that the existing controls in the control room possess the required characteristics as defined in the analysis of tasks. YAEC should also ensure that any HEDs identified are included in the assessment, selection, and verification processes of the DCRDR.

4. Control Room Survey

The NRC in-progress audit team's review of the survey documentation revealed numerous instances where criteria or results were ambiguous, incomplete, or inconsistent, and where sections of the checksheets were omitted. In the Supplement to the Summary Report, YAEC stated that the survey team has completed all of the generic questions and two of the nongeneric questions. YAEC noted that no additional findings resulted from this effort. Subsequently, the entire package of survey checksheets was independently audited to verify that each question was answered. This documentation satisfies the NRC's concern regarding the completion of the survey checksheets.

Another concern remaining from the Summary Report is the safety-significant human engineering discrepancy (HED) which was discovered by the NRC during the in-progress audit but which had not been reported as an HED. In response to this, YAEC stated that "while not adhering to the strictest human factors standard... no operator has ever been confused by this layout and the reviewers thought it unworthy of comment." The NRC indicated that this response was not an adequate justification for omitting an HED from the assessment, resolution, and implementation processes, and that YAEC should

provide evidence that it has included this HED in these processes. In the Supplement to the Summary Report, YAEC states that this discrepancy was documented as Finding No. 563. The resolution of Finding No. 563 will be reviewed by the NRC along with the remainder of the HEDs/Findings identified by YAEC. The concerns of the NRC regarding the control room survey have been satisfied, and YAEC has satisfactorily met this requirement of Supplement of NUREG-0737.

5. Assessment of HEDs

The concern of the NRC regarding YAEC's assessment of HEDs is the emphasis with which HED categorization will be considered in determining the priority assigned to implementing corrections to HEDs. In response to the NRC's concern, YAEC stated in the meeting that no HEDs were of such absolute safety significance that the schedule for implementing HED corrections would be affected. Although some HEDs are more safety-significant than others, none were of such safety significance that they received priority for immediate changes to the control boards. In addition, YAEC's integrated approach to determining, verifying, and implementing design improvements will result in safety-significant HEDs of various categorizations being corrected together. Since an integrated approach is preferable to a piecemeal approach to developing control board changes, implementation scheduling needs to be considered in light of this. However, if any flexibility exists in scheduling the implementation of control board changes in the next two refueling outages, YAEC should consider the categorization of the HEDs which comprise design change packages and allow those HEDs of highest safety significance to weigh as heavily as the criteria which determines the implementation schedule. YAEC's responses regarding the impact its categorization of HEDs should have upon the design change implementation schedule have been found to be acceptable, and the NRC's previous concern has been resolved. Provided that any HEDs identified from a comparison of control task analysis requirements will undergo the assessment process, YAEC will have met the requirements of Supplement 1 to NUREG-0737 for the assessment of HEDs.

6. Selection of Design Improvements and
7. Verification That the Improvements Will Provide the Necessary Corrections Without Introducing New HEDs

The concerns of the NRC identified from the review of the Yankee-Rowe Summary Report and supplemental information were that (1) the selection and verification methodologies were not well defined, and (2) the criteria used to select and verify design improvements were not sufficiently described. YAEC responded to these concerns in the meeting by describing the methodology and criteria to be used in selecting and verifying design improvements. The multidisciplinary review team will conduct an iterative process of developing approaches to correct HEDs using a photomockup of the control boards. YAEC will determine design improvements on a panel-by-panel basis. This should allow appropriate consideration of interactions among separate design changes within panels. YAEC should consider not only interactions of HED corrections within a panel but also across panels and the entire control room. Such corrections may involve interrelationships among systems on different panels as well as procedures, control room environment, color coding, labeling, SPDS, and training. YAEC's grouping of HEDs into categories such as this should aid in considering "larger scale" interactions.

The guidelines or criteria YAEC intends to use to design and verify corrections includes human factors conventions/specifications as well as those criteria which originally identified the HEDs. YAEC will be developing a set of human factors conventions for the Yankee-Rowe control room, including conventions for abbreviations, color usage, labeling, demarcation, mimicking, and anthropometrically-related areas. YAEC intends for these to be used not only within the scope of the DCRDR but also for future control room changes. In order to assess the adequacy of the conventions as a criterion base for selecting and verifying HEDs, the NRC will review the differences between the criteria in YAEC's conventions and specifications and those provided in NUREG-0700.

The methodology described by YAEC for selecting and verifying design improvements is acceptable to the NRC. The acceptability to the NRC of the conventions and specifications for designing and verifying HED corrections and improvements will be determined once the differences between these and NUREG-0700 have been identified.

8. Coordination of the DCRDR With Other Improvement Programs

A review of the Yankee-Rowe Summary Report and supplemental information found that although YAEC has described various means of coordinating the DCRDR with other improvement programs, clarification of the particulars (e.g., how, what, and when) of coordinating the improvement programs was still needed. YAEC clarified in the meeting how the DCRDR was and will be coordinated with training, SPDS, EOP upgrade, and Reg. Guide 1.97 review.

Changes to the control room that occur from the DCRDR will be done on a photomockup that will also be used in operator training. YAEC stated in the meeting that the training on the photomockup will be conducted using procedures which will be walked through. The SPDS was evaluated during the DCRDR using the control room survey which identified HEDs. The task analysis used the function-based, upgraded EOPs which were based on the Yankee-Rowe PRA. Of the items from Reg. Guide 1.97 that were incorporated as changes to Yankee-Rowe, none were of the type which would be useful to have evaluated by the control room survey. In addition, the use of the task analysis to support the Reg. Guide 1.97 review was seen as unnecessary.

Based on a review of the means available to YAEC to coordinate improvement programs as described in the Supplement to the Summary Report and the integration of DCRDR efforts and products with other improvement programs, the coordination efforts performed so far, and those planned, are acceptable to the NRC. If YAEC carries out its plans for coordinating the DCRDR with training, as discussed in the meetings, and with any other areas as necessary, then it will have met this requirement of Supplement 1 to NUREG-0737.

9. Proposed Corrective Actions

The NRC has not currently performed a complete evaluation of YAEC's proposed corrective actions to HEDs. Up to this time, the evaluation of resolutions to HEDs was performed on the proposed resolutions for each HED and their potential interactions. The NRC will restart its evaluation of proposed HED resolutions in a meeting to be held with YAEC in the August 1986 timeframe. In this meeting, YAEC should present to the NRC the differences between the human factors design conventions on which the proposed corrective actions will be based and the guidelines given in NUREG-0700. If

the differences are found to be acceptable to the NRC, then the NRC will base its evaluation of HED corrections on the acceptability of YAEC's human factors conventions.

10. Justifications for HEDs Left Uncorrected

In the upcoming meeting YAEC will be presenting its justifications for not correcting any of the HEDs associated with the panels that will have undergone the processes for selecting and verifying design improvements. YAEC stated in the meeting that these panels will probably be those associated with the diesel generator and safety injection systems. The NRC will at that time evaluate any justifications for not correcting HEDs and the extent to which it will continue its evaluation.

APPENDIX A

Attendees of the NRC meeting held with Yankee Atomic Electric Company (YAEC) on May 15, 1986, to discuss the Yankee-Rowe Nuclear Power Station Detailed Control Room Design Review.

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