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Docket No. 50-346

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Mr. Richard P. Crouse
Vice President, Nuclear
Toledo Edison Company
Edison Plaza - Stop 712
300 Madison Avenue
Toledo, Ohio 43652

Dear Mr. Crouse:

Subject: DETAILED CONTROL ROOM DESIGN REVIEW; NEED FOR SUPPLEMENT TO SUMMARY REPORT

The staff has completed a review of the Detailed Control Room Design Review (DCRDR) Summary Report submitted June 29, 1984. The NRC staff was assisted by Science Applications, Inc. (SAI) with this review. SAI provided a Technical Evaluation Report which is included as Enclosure A to the Safety Evaluation Report (SER) which accompanies this letter.

Our review indicates that Toledo Edison Company has conducted a DCRDR for the Davis Besse Nuclear Power Station that meets many of the requirements of Supplement 1, NUREG-0737. However, there are a number of items which we could not evaluate either because of insufficient information or lack of information. These items are identified in the SER.

The information required to complete our review is identified in the Conclusion section of the SER. Toledo Edison Company should provide a supplement to the DCRDR Summary Report which should be submitted shortly after the series of special studies which provide for the disposition of and schedule for correcting all HED's identified by the DCRDR program. These special studies were scheduled to be completed during January 1985. The staff plans to conduct a pre-implementation audit of the facility within one month after receipt of the supplemental summary report.

Please advise us no later than March 29, 1984, of the status of the special studies and your schedule for submitting the supplemental summary report.

Sincerely,
"ORIGINAL SIGNED BY:"

John F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing

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Enclosure: As Stated

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 14, 1935

Docket No. 50-346

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Sincerely,

John F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing

Enclosure: As Stated

cc w/enclosure:
See next page

Enclosure 1

HUMAN FACTORS ENGINEERING BRANCH
DETAILED CONTROL ROOM DESIGN REVIEW
SAFETY EVALUATION
FOR
DAVIS-BESSE NUCLEAR POWER STATION, UNIT NO. 1

POSITION

Action Plan Item I.D.1, "Control Room Design Reviews" (NUREG-0660), states that operating reactor licensees and applicants for operating licenses will be required to perform a Detailed Control Room Design Review (DCRDR) to identify and correct design discrepancies. The objective, as stated in NUREG-0660, is to improve the ability of nuclear power plant control room operators to prevent or cope with accidents, if they occur, by improving the information provided to them. Supplement 1 to NUREG-0737, dated December 17, 1982, confirmed and clarified the DCRDR requirement in NUREG-0660. As a result of Supplement 1 to NUREG-0737, each applicant or licensee is required to conduct their DCRDR on a schedule negotiated with NRC.

NUREG-0700 describes four phases of the DCRDR to be performed by the applicant and licensee. These phases are (1) planning, (2) review, (3) assessment and (4) reporting.

The draft of NUREG-0801, "Evaluation Criteria for Detailed Control Room Design Review," provides the necessary criteria for evaluating each phase.

Supplement 1 to NUREG-0737 requires applicants and licensees to submit a Program Plan that describes how they will:

1 Establish a qualified multidisciplinary review team.

2. Perform function and task analyses to identify control room operator tasks and information and control requirements and respective characteristics during emergency operations.

3. Compare display and control requirements with a control room inventory.

4. Survey the control room to identify deviations from accepted human factors principles.

5. Assess Human Engineering Discrepancies (HEDs) to determine which HEDs are significant and should be corrected.

6. Select design improvements.

7. Verify the selected design improvements will provide the necessary correction.

8. Verify that improvements will not introduce new HEDs, and

9. Coordinate control room improvements with changes from other programs such as the Safety Parameter Display System (SPDS), operator training, R.G. 1.97 instrumentation, and upgrade of emergency operating procedures.

The NRC requires each applicant and licensee to submit a Summary Report at the end of the DCRDR process. The report should describe the proposed control room changes and implementation schedules and provide justification for leaving safety significant HEDs uncorrected or partially corrected.

The staff will evaluate the organization, process, and results of each DCRDR with Supplement 1 of NUREG-0737. The evaluation of the applicant's and licensee's DCRDR efforts will consist of the following, as described in draft NUREG-0801:

1. An evaluation of the Program Plan Report submitted by the licensee/applicant

2. A visit to some of the plant sites to audit the progress of the DCRDR process

3. An evaluation of the licensee/applicant DCRDR Summary Report

4. A possible pre-implementation audit, if necessary, and,

5. The preparation of a Safety Evaluation Report presenting the results of the NRC evaluation of the overall DCRDR Program.

Significant HEDs should be corrected. Improvements that can be accomplished with an enhancement program should be done promptly.

DISCUSSION

Toledo Edison Company (TED) submitted its Program Plan for conducting a DCRDR of the Davis-Besse Unit No. 1 control room on June 15, 1983. The staff reviewed the Program Plan in accordance with the requirements of Supplement 1 to NUREG-0737 and the guidance provided in NUREG-0700 and draft NUREG-0801 and transmitted comments to the Division of Licensing on October 7, 1983, to be forwarded to TED for its use in conducting the DCRDR. The staff has also completed review of the TED Summary Report for the Davis-Besse Nuclear Power Station Unit No. 1 dated June 29, 1984. Consultants from Science Applications, Inc., (SAI) assisted the staff in reviewing the Summary Report.

The NRC has adopted most of the technical evaluations, conclusions, and recommendations contained in the SAI Technical Evaluation Report. The Technical Evaluation Report is provided as Enclosure 1 to this SER.

Toledo Edison Company's (TED) DCRDR Summary Report demonstrates a strong commitment towards meeting many of the requirements of NUREG-0737, Supplement 1. The documentation submitted includes a thorough and comprehensive discussion of review activities conducted to perform a DCRDR and indicates that TED has satisfied many of the DCRDR requirements of Supplement 1 to NUREG-0737. However, additional information is required to complete the review and to assure that TED has satisfied all of the requirements of Supplement 1 to NUREG-0737. The following is a summary of the staff's comments on TED's compliance with each of the nine (9) DCRDR review requirements.

Establishment Of A Qualified Multidisciplinary Review Team

Although the program plan described an acceptable organization for the review team, the actual team composition and task assignments made to conduct the DCRDR appear to have deviated from that described in the program plan. For some of the DCRDR tasks, TED provided a description of the personnel involved, but did not however, indicate the extent of their involvement. Although TED has satisfied most of the requirements for establishing a multidisciplinary DCRDR Review team, to complete our review of this element, we will need to review additional documentation with respect to the types of individuals and the extent of their involvement in performing the systems function review, task analysis verification of equipment availability, and the selection of control room design improvements.

Function and Task Analysis

The basis for TED's System Functions Review and Task Analysis was the Davis-Besse Abnormal Transient Operating Guidelines (ATOGs). The Davis-Besse ATOGs were generated to develop symptom-oriented emergency operating procedures. One of the products of the methodology for developing the

Davis-Besse ATOGs was the generation of Safety Sequence Diagrams (SSDs). The SSDs were functional flow diagrams which showed:

1. The systems whose responses are necessary for providing the functions required to mitigate the consequences of postulated events.

2. The series of system functions which comprise the success paths for achieving safety functions.

3. The input signals, logic, setpoints, output actions, parameters monitored, required operator functions, and location of operator functions (e.g., control room, local or both).

These SSDs were used as the data base for performing the system functions review and the subsequent task analysis.

The system functions review consisted of two parts which were performed in parallel. This approach consisted of a (1) procedure based system functions review and a (2) top-down system functions review. However, the procedure based system functions review was used in performing the task analysis. This involved:

1. Reviewing each step of the symptom oriented emergency operating procedures to identify the required operator actions,

2. Identifying the "instrumentation and control requirements" for the operator actions based on the experience of an analyst, and

3. Identifying the existing Davis-Besse instrumentation and controls using control board mockups and a control room inventory.

The data from this review was documented on System Functions Review Tables (SFRTs) and these tables provided the basis for the task analysis and verification of task performance capability.

The SFRTs were used to identify functions, tasks, task sequences, and information and control requirements necessary to maintain plant safety given system failures. The task analysis was performed in two steps: (1) identification of functions, tasks, and task sequences using the SFRTs and (2) analysis of tasks and task sequences, using the SFRTs and task lists, to determine "information requirements, control requirements, communication requirements, constraints (time, etc.) on task performance, and to document task requirements in an accessible, usable format for each task and task sequence." In addition, Spatial-Operational Sequences Diagrams, which graphically present the sequential tasks on line drawings of board layouts, were constructed to identify "instrumentation and communications requirements" for task performance and to assess operator workload.

Although the task analysis methodology described was rigorous and comprehensive, and satisfies the requirements of Supplement 1 to NUREG-0737 to the extent that it was performed, it does not identify operator information and control needs in terms of instrument and control characteristics.

In order for the NRC to complete its review of this element, the licensee will be required to provide documentation which demonstrates that the task analysis performed yielded the following types of display and control information:

- The appropriate means of displaying the parameters (e.g., trends, status indications, digital, analog)
- The parameter units (e.g., PSIG, inches of H_2O, GPM)
- The accuracy or precision with which the readings must be made (not the same as the "range" column in the tables)
- Acceptable tolerances
- The type of control capability needed (e.g., discrete versus continuous)
- The control operation if the control capability needed is discrete (e.g., detented versus spring-loaded, momentary contact positioning)

- The rate, gain, and response characteristics, etc.

A Comparison of Display and Control Requirements with a Control Room Inventory

The licensee did not develop a specific control room inventory, but instead, performed a task described as "verification of equipment availability." The objectives of this task were to "identify availability of required instrumentation and controls in the control room to support performance of systems functions." The criteria used to perform this task were: (1) the control and display designs should match the task needs and operator's capabilities; (2) frequently required or important instruments or controls should be located in the control room; and (3) infrequently used or unimportant instrumentation should be excluded from the primary panel locations in the control room. The method used to verify equipment availability included walk- and talk-throughs of the control panel, responding to the following questions:

- "Is all the information you require present in the control room to perform the task(s)

- All needed controls are provided to perform the task(s)

- Do the controls and/or displays provide the appropriate range of information/control

- ° Are the controls/displays adequate in terms of precision and accuracy?"

These criteria for verifying the availability of equipment appear to be sufficient to allow an adequate evaluation of the presence or absence of needed instruments and controls as well as a partial evaluation of the suitability of instruments and controls. Of these four criteria only the first three could be answered by comparing the data collected during the task analysis with the tasks that were walked- and talked-through. The data did not provide information on the types of displays and controls, precision and accuracy, range, momentary or continuous switch action, etc., which are needed to display and control required parameters from the control room during emergency operations. The suitability of existing instrumentation appeared to be determined on an ad hoc basis during walk- talk-throughs of panels by an analyst "based upon his experience to identify these indicators and/or controls that the operator would need to execute the operator action requirements." The licensee did not provide documentation that the "analyst" possessed the required technical and human factors expertise to conduct an objective analysis to determine the adequacy of existing information and control capability.

Control Room Survey

TED conducted a control room survey at Davis-Besse to determine the extent to which human factors guidelines were applied during the design of the control boards and panels. TED divided the control room survey activity into the following surveys or tasks:

1. Workspace Survey
2. Anthropometric Survey
3. Illumination Survey
4. Ambient Noise Survey
5. Heating, Ventilation, and Air Conditioning Survey
6. Emergency Equipment Survey
7. Maintainability Survey
8. Communications Survey
9. Annunciator Survey
10. Controls Survey
11. Displays Survey
12. Labels and Location Aids Survey
13. Conventions Survey
14. Computer System Survey

The methodology used to conduct the surveys varied depending on which of the above surveys or tasks were being performed. TED and the Essex Corporation (the human factors consultant) established task plans for each of the above surveys or tasks in order to develop a standardized and organized approach to conducting and documenting the control room survey. Although the summary report did not include the task plans, it did present an outline of the contents of a task plan. In addition, the summary report provided an overview of each of the surveys which included the following information:

1. Objectives
2. Scope
3. Applicable Criteria from NUREG-0700
4. Methodology
5. Findings

In summary, we found that the methodologies and findings described in the summary report were comprehensive and indicative of a valid approach. The use of standardized and practical task plans contributed to the effectiveness of the survey approach. We believe that TED has demonstrated the performance of a control room survey which meets this requirement in Supplement 1 to NUREG-0737.

Assessment of Human Engineering Discrepancies (HEDs) to Determine Which HEDs Are Significant and Should Be Corrected

The methodology and criteria for assessing HEDs appear to be sound. TED states that the committee which reviews the HEDs consists of, as a minimum, two human factors specialists, two systems engineers, two I&C engineers, and two Davis-Besse operations specialists. TED divided the assessment methodology into four steps:

1. Assess extent of deviation from NUREG-0700 guidelines
2. Assess Human Engineering Discrepancy impact on error occurrence
3. Assess potential consequences of error occurrence on plant operation/safety
4. Assign Human Engineering Discrepancy scheduling priority

The review committee assigned a subjective rating of 1-5 (low to high) to each HED for the extent of the deviation from the guidelines in NUREG-0700. Following this, HEDs were assessed for the probability of inducing operator errors with a "1" indicating a low probability and "5" indicating a high probability. TED used three categories for classification of HEDs. HEDs classified in Category 1 are those which have been noted from documented operational errors or problems reported by the operators (such as those HEDs identified in the operating experience review). HEDs classified in Category II are those which have no documented cases of operator error but have an error potential greater than "1". Those HEDs placed in Category III were those which have no documented cases of operator error and have "little or not impact on operator performance." TED is now in the process of determining the consequences of Category 1 HED errors to assign an "ultimate scheduling priority" for correcting the Category 1 HEDs. TED did not provide a schedule for correcting HEDs, nor did TED discuss whether it intended to correct all significant HEDs.

In summary, the description of the methodology, criteria, and personnel used to assess the significance of HEDs identified in the review phase was satisfactory. With the exception of the absence of a logic diagram which is planned for use in assigning scheduling priorities for correcting Category I HEDs, the information provided in the summary report demonstrates that TED possesses the knowledge and capability for assessing HEDs and meeting this requirement of Supplement 1 to NUREG-0737. However, TED needs to provide the logic diagram to be used for assigning scheduling priorities to correct Category I HEDs.

Selection of Design Improvements

The licensee has provided little documentation or discussion to assure this element of a DCRDR has been satisfied. The licensee has in fact provided: (1) a table which lists "HEDs For Which Short Term Corrective Actions Have Been Identified" without describing the process used for selecting the proposed design change and without defining what is meant by "short term;" and (2) an appendix of "HED Summary Tables," which lists HEDs by number and provides a disposition of the HED, without describing the process used to select the proposed design change, or determine that an HED is N/A or should be deleted. In addition, the licensee does not discuss corrective actions for Category I HEDs which "are those which have been noted from documented operational errors or problems reported by operators" which the licensee indicated would be corrected.

In summary, the licensee did not describe the process or analysis it used or will use to select design improvements to correct significant HEDs. In addition, the licensee has opted to conduct a number of "Special Studies" to determine the disposition of all HEDs and "in January, 1985, TED will provide detailed schedules for the completion of the short term actions and the special studies." Based on these facts, we conclude that the scheduling information and disposition of HEDs contained in the TED summary report are not conclusive and, therefore, no judgment as to their adequacy can be made at this time.

We have determined that the licensee has not complied with the requirements for this element of a DCRDR and for a summary report.

Verification that Selected Design Improvements Will Provide the Necessary Corrections Without Introducing New HEDs

TED states that "the goal of the disposition process was an integrated control room design improvement effort that will solve problems cost effectively without introducing new problems" and that "the objective of each special study will be as a minimum to review and resolve each associated HED listed while assuring that the resolution does not generate any additional HEDs." Although TED appears to recognize the need to ensure that the resolutions do not introduce new HEDs, no such attention is paid to the necessity of ensuring that the selected improvements provided the necessary corrections. In addition, no methodology was provided in the summary report which described how TED was going to ensure that resolutions do not introduce new HEDs. We conclude from the information provided in the summary report that TED has not demonstrated either the understanding of this requirement or the commitment necessary in order to successfully meet this requirement of Supplement 1 to NUREG-0737.

Coordination of the DCRDR With Other Improvement Programs Such as SPDS, Operator Training, Reg. Guide 1.97 Instrumentation and Upgraded Emergency Operating Procedures

TED demonstrated that it recognized the need to integrate and coordinate the DCRDR with other improvement programs, that "the organization and scheduling reflected in the Program Plan were selected to coincide with other Toledo Edison ERC initiatives (e.g., Reg. Guide 1.97, EOP upgrade, SPDS implementation, etc.)" Except for the description of the role the EOPs serve in the system function review and task analysis, no other reference was made concerning the coordination and integration of the DCRDR program with other ERC initiatives. In addition, the summary report does not clarify whether or not the upgraded EOPs are validated with the instruments and controls list generated from the top-down system function review (which was compared with the lists generated in the procedures-based, system function review). The integration of the upgraded EOPs in the DCRDR is described, however, the integration of the DCRDR results (from the system function review and task analysis) into the upgraded EOPs is not described.

In summary, the upgraded EOPs were the only source of information from other ERC initiatives that were integrated into the DCRDR. TED should provide documentation which describes the process used to coordinate and integrate the DCRDR program with other ERC initiatives. We conclude that from the information provided by TED in the summary report, the coordination of the DCRDR with other improvement programs was minimal and did not demonstrate either the understanding of this requirement or the commitment necessary to successfully meet this requirement of Supplement 1 to NUREG-0737.

CONCLUSIONS

The licensee addressed all elements for conducting a DCRDR except for: (1) describing the process used for selecting design improvements to correct HEDs, and (2) Verifying that the selected design improvements in the control room will provide the necessary correction. However, except for the discussions on the integration procedures for performing the systems function review, the task analysis, and verification of task performance capabilities, the summary report lacked sufficient depth in describing the analysis, methodologies, and systems used to accomplish the remaining DCRDR activities. Furthermore, a complete evaluation of the HED resolutions and their implementation schedules could not be made since all of the HEDs will be reviewed for disposition during special studies to be conducted. The selection and implementation schedules of all HED corrections will be finalized by January of 1985.

The following is a list of items for which additional information is needed before we can complete our evaluation of the Davis-Besse DCRDR program:

- Function and Task Analysis
  - A description of the types of personnel used to perform the systems functions review, task analysis, verification of equipment availability, and the extent of each individual's responsibility and participation in conducting these activities.
  - A description of the criteria used to analyze operator traffic patterns and the specific HEDs identified from this analysis.
  - A description of the process used and the analysis conducted to develop information and control requirements independent of existing control room instrumentation which are extensive enough to encompass a comprehensive set of operator EOP tasks.
- Assessment of HEDs
  - A description of the logic or analysis used for assigning priorities to Category I HEDs.
- Selection of Design Improvements
  - A description of the methodology used to conduct each of the special studies.
  - A description of the process and the analysis used to provide disposition of HEDs and to determine schedules for correcting HEDs.

- Information on the disposition of significant HEDs to be left uncorrected and HEDs being deferred to the special studies.

- A description of the criteria and methodology used for selecting actions to correct HEDs.

- A discussion of the personnel used to (1) perform each of the special studies, (2) coordinate and integrate the control room design improvement effort (including any system or organization established to support this function), and (3) approve recommendations of the special studies group.

° Verification that Improvements Will Provide the Necessary Corrections Without Introducing New HEDs
  - A description of the methodology used for verifying that design improvements in the control room do not introduce new problems or HEDs.

  - A description of the system used for verifying that selected design improvements provide the necessary human factors corrections to HEDs.

° Coordination of the DCRDR With Other Improvement Programs
  - A description of the process used to integrate the DCRDR with the results from the system functions review, task analysis, and

verification of task performance capabilities in the upgraded EOPs.

- A description of the process used to integrate the changes resulting from the DCRDR with other improvement programs, such as the SPDS, Regulatory Guide 1.97 review, and operator training and changes from these programs into the DCRDR.

- A description of the personnel and the system used to perform the integration or coordination function.

° Remote Shutdown Panel

  - A discussion on the results of the human factors evaluation of the remote shutdown panel.

° Other Post TMI Action Items

  - A discussion of control room modifications and additions made or planned as a result of other post TMI Actions (such as controls and displays for inadequate core cooling, reactor vents and lessons learned from the Salem ATWS events) and how these modifications or changes were incorporated into the DCRDR process.

The licensee should provide the above information and the results of its special studies in a supplemental summary report. We plan to conduct a pre-implementation audit at Davis-Besse within one month after receipt of the supplemental summary report.

<u>REFERENCES</u>

1. "Detailed Control Room Design Review for the Davis-Besse Nuclear Power Plant" summary report, attachment to letter from R. P. Crouse, TED, to J. F. Stolz, NRC, dated June 29, 1984.

2. "Detailed Control Room Design Review Program Plan for the Davis-Besse Nuclear Power Plant," attachment to letter from R. P. Crouse, TED, to J. F. Stolz, NRC, dated June 15, 1984.

3. "DCRDR Program Plan Evaluation for Davis-Besse Nuclear Power Plant," Science Applications, Inc., September 13, 1983.

4. "NRC Review Comments on Davis-Besse DCRDR Plan," attachment to memorandum from W. T. Russell, NRC to G. C. Lainas, NRC, dated October 7, 1983.

5. NUREG-0660, Vol. 1, "NRC Action Plan Developed as a Result of the TMI-2 Accident," USNRC, Washington, D.C., May 1980; Rev. 1, August 1980.

6. NUREG-0737, "Requirements for Emergency Response Capability," USNRC, Washington, D.C., November 1980.

7. NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability," USNRC, Washington, D.C., December 1982, transmitted to reactor licensees via Generic Letter 82-33, December 17, 1982.

8. NUREG-0700, "Guidelines for Control Room Design Reviews," USNRC, Washington, D.C., September 1981.

9. NUREG-0801, "Evaluation Criteria for Detailed Control Room Design Reviews," USNRC, Washington, D.C., October 1981, draft report.