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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE DETAILED CONTROL ROOM DESIGN REVIEW

TOLEDO EDISON COMPANY

DAVIS-BESSE NUCLEAR POWER STATION

DOCKET NO 50-346

1.0 POSITION

Item I.D.1, "Control Room Design Reviews," of Task 1.D., "Control Room Design," of the "NRC Action Plan Developed as a Result of the TMI-2 Accident (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 accidents or to cope with them, should they occur, by improving the information provided to them. Supplement 1 to NUREG-0737 confirmed and clarified the DCRDR requirement in NUREG-0660. In accordance with NUREG-0737 Supplement 1, each applicant or licensee is required to conduct its DCRDR on a schedule negotiated with the NRC.

2.0 INTRODUCTION

Toledo Edison Company has conducted a Detailed Control Room Design Review for the Davis-Besse Nuclear Power Station. A prior chronology of the Davis-Besse Nuclear Power Station DCRDR is provided below.

June 29, 1984	Davis-Besse DCRDR Summary Report Issued
April 29, 1985	NRC pre-implementation audit of DCRDR Program at Davis-Besse
June 9, 1985	Loss of Feedwater Event
October 9, 1985	Meeting at NRC to Discuss DCRDR Program
April 18, 1986	Proposed Plan for Resolution of the 29 Safety Significant Human Engineering Discrepancies (HEDs) Identified in the DCRDR Summary Report Issued
June 1986	Safety Evaluation Report (NUREG-1177) Related to the Restart of Davis-Besse Nuclear Power Station Issued

December 1986	Davis-Besse Restart
April 9, 1987	Work Plans for Special Studies Issued
June 29, 1988	Human Engineering Discrepancy Resolution Schedule Issued
July 25, 1900	Human Engineering Discrepancy Reports - 1988 Summary Issued
November 28-30, 1989	NRC on-site DCRDR audit.
August 1, 1990	Addendum to 1988 HED Summary Report

This Safety Evaluation (SE) is based on the documentation and events mentioned above. The staff was assisted in their evaluation by Science Applications International Corporation (SAIC).

3.0 EVALUATION

The staff evaluation of Davis-Besse DCRDR follows.

3.1 Establishment of a Qualified Multidisciplinary Review Team

The DCRDR team was managed by a licensee representative. The DCRDR team consisted of individuals with expertise in the areas of instrumentation and control engineering, nuclear systems engineering, nuclear power plant operations and human factors engineering. Human factors engineering support was provided by Essex Corporation. The team composition meets the NUREG-0737 Supplement 1 requirement for establishment of a qualified multidisciplinary review team.

3.2 Function and Task Analysis to Identify Control Room Operator Tasks and Information and Control Requirements During Emergency Operations

In the NUREG-1177 SER, the staff stated that the licensee committed to update its system function and task analysis (SFTA). The SFTA upgrade activities were to include:

(a) an analysis of operator tasks, information and control requirements, and required characteristics of instruments and controls necessary to monitor and assess the various challenges and failure modes of the radioactivity release critical safety function;

(b) a reanalysis of operator actions for steam generator tube rupture to ensure comprehensive identification of information and control requirements;

(c) an analysis of required characteristics of instruments and controls for all operator tasks required during emergency operations.

The licensee conducted an additional task analysis of plant-specific abnormal operating procedures. The procedures analyzed included:

- o High airborne activity
- o High radiation
- o Radioactive spills.

The licensee conducted a reanalysis of operator actions for steam generator tube rupture to ensure comprehensive identification of information and control requirements. The DB-PF-2000 Emergency Procedure for steam generator control rupture was analyzed. Embedded information and/control requirements such as the need to assess makeup pump flow capacity by using pressurizer level were identified in the analysis even though they were not specifically called out in the procedure. It was the November 1989 NRC audit team's judgment that the licensee successfully fulfilled this NUREG-1177 SER commitment.

Based on the staff's review, the NUREG-0737 Supplement 1 requirement for a function and task analysis to identify control room operator tasks and information and control requirements during emergency operations is found to be satisfied.

3.3 Comparison of Display and Control Requirements with Control Room Inventory

The licensee's comparison of information and control requirements to the control room inventory results were previously evaluated by the staff and findings documented in NUREG-1177. The staff concluded in NUREG-1177, that the system function and task analysis was not complete, and therefore, the inventory comparison requirement was also incomplete. NUREG-1177 stated that the licensee committed to verify equipment availability and human engineering suitability for the requirements developed from activities necessary to upgrade the system function and task analysis.

The licensee compared operator information and control requirements to the actual control room. This was done by comparing the operator's requirements identified on Action Information Requirements Detail (AIRD) forms to the control room instruments to verify availability and suitability.

The results were documented on Action Information Requirements Summary (AIRS) forms. These included: control room instrument numbers, panel numbers, a pass/fail assessment/actual range/actual precision, and HED numbers.

In summary, the staff reviewed the licensee's AIRD and AIRS forms to determine if they addressed the concerns identified in NUREG-1177. It is the staff's judgment that the licensee satisfactorily compared additional operator information and control requirements to the control room inventory resulting from the upgraded system function and task analysis to the control room. Therefore, the licensee adequately addressed the NUREG-1177 concern and met this NUREG-0737 Supplement 1 requirement.

3.4 Control Room Survey

The staff concluded in NUREG-1177, that the control room survey conducted up to that time was satisfactory. However, the following aspects of the control room were not surveyed by the licensee:

(a) the new components added to the control room since the survey was performed

(b) the annunciator system flash patterns.

The licensee did conduct a supplemental survey of the new instruments added to the control room between the original survey and the NUREG-1177 SER.

The licensee completed a control room survey of annunciator flash pattern as part of a special study team effort. The annunciator flash patterns review was conducted by MPR Associates Inc. HEDs identified as a result of this effort were reviewed by the November 1989 NRC audit team. For example, HED no. 31042 for complex flash patterns was documented and corrected in the last refueling outage.

Based on a review of the supplemental survey activity results, the requirement for a control room survey to identify deviations from accepted human factors principles has been properly implemented.

3.5 Assessment of Human Engineering Discrepancies to Determine Which are Significant and Should be Corrected

In NUREG-1177, the staff concluded that there had been no systematic review of individual HEDs to determine the presence of cumulative and interactive effects upon the assessment of HEDs.

During a meeting between the staff and the licensee on October 9, 1985, the licensee proposed a method for determining cumulative and interactive effects. The approach would use various HED data base fields to enable the identification of component or problem interaction. The staff found the licensee's proposed approach acceptable.

The licensee identified 29 safety-significant HEDs prior to the 1986 restart. The staff determined that these HEDs had to be corrected before restart, or a justification provided which demonstrated that the plant could be operated

safely with uncorrected HEDs. All but two of the HEDs were corrected by the time of the 1989 audit. Based on Toledo Edison's letter dated August 1, 1990 (serial number 1820), these two HEDs were corrected during the sixth refueling outage.

Based on the 1989 audit and previous reviews, the requirement for assessment of HEDs to determine which are significant and should be corrected has been satisfied.

3.6 Selection of Design Improvements

In NUREG-1177, the staff concluded that the following activities were necessary for the licensee to meet this DCRDR requirement:

- Perform and document a systematic process of selecting design improvements
- Ensure consideration of cumulative and interactive effects of individual HEDs on the entire integrated control room improvement program
- Improve HED documentation for completeness, clarity, accuracy, and auditability
- Develop solutions to HEDs and implementation schedules that are acceptable to the NRC staff.

For the staff to close out this requirement of NUREG-0737 Supplement 1, the licensee was instructed to provide the following documentation:

- proposed work plans for the special studies (except for the SFRCS panel)
- several sample HEDs that demonstrate the upgrading of HED documentation
- all the proposed corrections to HEDs, including those to be performed during and after the current outage
- justification for HEDs not corrected or partially corrected
- an implementation schedule for each HED correction, including the rationale for schedule delays beyond the sixth refueling outage

The licensee did prepare work plans for special studies (April 9, 1987 submittal) to meet the need for a systematic process for selecting design improvements. This included 11 special studies to select design improvements for 378 HEDs.

The licensee improved HED documentation by providing additional detail in component listings in HED reports. The revised HED descriptions were presented in the Davis-Besse DCRDR Human Engineering Discrepancy (HED) Reports 1988 Summary (submitted July 25, 1988). The 1989 audit team reviewed a sample selection of the HEDs. Several fields were added including:

- o NUREG-0700 Guideline
- o Data source field added (i.e., task analysis or operator interviews)
- o Special study fields
- o Assessment category
- o Related modifications
- o Related HEDs.

The licensee developed solutions to all 29 safety-significant HEDs and documented these in the 1988 DCRDR summary of HEDs. Schedules for implementation of safety-significant HED modifications were submitted to the NRC by letter dated June 29, 1988. According to Toldeo Edison's letter dated August 1, 1990 (serial number 1820), no safety-significant HEDs remain open after the sixth refueling outage.

The licensee documented the justifications for leaving HEDs uncorrected or partially corrected in the documents listed above. The licensee provided a schedule for each correction, including rationale for schedule delays beyond the sixth refueling outage.

Based on an on-site review of implemented and proposed HED resolutions, the requirement for selection of design improvements has been satisfied.

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

In NUREG-1177, the staff concluded that the licensee did not include a human factors engineering specialist as an active member of the verification team. As a result, the licensee committed to use human factors specialists as active, integral members of the DCRDR team to develop and verify human engineering design changes.

The licensee included human factors engineering specialists from Essex Corporation in the verification that modifications correct the HEDs. In addition, the licensee developed a formal human factors review process EN-DP-1200, Engineering Procedures for Plant Modifications Human Factors Checklist.

Based on the review of the licensee's staffing and procedures, the NUREG-0737 Supplement 1 requirement for verification that the selected design improvements do provide the necessary corrections without introducing new HEDs has been satisfied.

3.8 Coordination of Control Room Improvements with Changes from Other Programs Such as Safety Parameter Display System (SPDS), Operator Training, Regulatory Guide 1.97 Instrumentation, and Upgraded Emergency Operating Procedures.

In NUREG-1177, the staff concluded that the licensee did not provide documentation of a systematic plan to coordinate all emergency response initiatives. The licensee only described points of integration of the various improvements, which the staff concluded was a loosely coordinated program. For the staff to close out this requirement, the licensee was required to provide documentation that explicitly described the status and integration of the results of each review with each of the initiatives in NUREG-0737 Supplement 1.

The integration of the DCRDR with other NUREG-0737 Supplement 1 activities was formally documented in EN-DP-01166, Revision 0, "DCRDR Close-out Implementation Procedure." The coordination of DCRDR with other initiatives is outlined below.

Safety Parameter Display System

- The DCRDR team leader served as a member of the SPDS user group that was formed to upgrade the system and displays.

- Based on NRC Generic Letter 89-06, the licensee determined that the SPDS needed additional human factors review. To accomplish this, the licensee made a formal commitment to the NRC by letter dated November 28, 1989 to conduct additional human factors reviews considering control room indications and emergency operating procedures.

Operator Training

- The Lynchburg Simulator was modified with surface enhancements and software logic changes to reflect DCRDR modifications. The operators were trained on the modifications using the simulator.

- The full scale photo mockup of the DCRDR modified control room has been left intact for use in operator training. Training classes were conducted in the mockup during the November 1989 on-site audit.

- DCRDR modification packages went to the training department to develop training changes parallel to design change implementation.

Regulatory Guide 1.97 Instrumentation

- The Regulatory Guide 1.97 instrumentation was labeled according to DCRDR labeling conventions.

Upgraded Emergency Operating Procedures

- o Upgraded emergency operating procedures DB-PF-2000 were used as the basis for the DCRDR system function and task analysis.

Based on the material presented in the Summary Reports, the NUREG-0737 Supplement 1 requirement for coordination of the DCRDR with other improvement programs such as SPDS, operator training, Regulatory Guide 1.97 instrumentation and upgraded Emergency Operating Procedures is satisfied.

4.0 CONCLUSIONS

The DCRDR program implemented at Davis-Besse Nuclear Power Station satisfies all the DCRDR requirements of NUREG-0737 Supplement 1. The staff may confirm, by means of inspection at some future date, that corrective actions have been properly and completely implemented.

References

1. U.S. Nuclear Regulatory Commission, "NRC Action Plan Developed as a Result of the TMI-2 Accident," NUREG-0660, Vols. 1 and 2, May 1980.

2. U.S. Nuclear Regulatory Commission, "Clarification of TMI Action Plan Requirements, Requirements for Emergency Response Capability," NUREG-0737 Supplement 1, December 1982.

3. U.S. Nuclear Regulatory Commission, "Safety Evaluation Report Related to the Restart of Davis-Besse Nuclear Power Station, Unit 1, Following the Event of June 9, 1985," NUREG-1177, June 1986.

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