ENCLOSURE 1

TECHNICAL EVALUATION REPORT

OF THE

DETAILED CONTROL ROOM DESIGN REVIEW

FOR

CONSOLIDATED EDISON COMPANY'S

INDIAN POINT UNIT 2

September 29, 1986

Prepared for:

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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FOREWORD

This Technical Evaluation Report (TER) documents the findings from a review of Consolidated Edison Company's Detailed Control Room Design Review for its Indian Point Unit 2. Science Applications International Corporation's Evaluation was performed in support of the NRC under contract NRC-03-82-096, Technical Assistance in Support of Reactor Licensing Actions: Program III. SAIC previously participated in the review of the licensee's Program Plan and in two separate meetings with the licensee to discuss Program Plan comments, first on June 26, 1984, and again on November 20, 1984. A third meeting took place on December 4, 1985, to review the progress made on the DCRDR. The licensee submitted its Summary Report for the DCRDR on June 30, 1986, for which this evaluation report has been written.

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TECHNICAL EVALUATION
OF THE
DETAILED CONTROL ROOM DESIGN REVIEW
FOR THE
INDIAN POINT UNIT 2 NUCLEAR STATION

This report documents the findings of an evaluation of Consolidated Edison Company's (Con Edison) Summary Report of the Detailed Control Room Design Review (DCRDR) for the Indian Point Unit 2 Nuclear Station (Reference 1). The purpose of the evaluation was fourfold:

1. To determine whether the DCRDR conducted by Con Edison as documented in the Summary Report satisfies the requirements of Supplement 1 to NUREG-0737

2. To recommend to the NRC whether a Pre-Implementation Audit or a meeting should be conducted

3. To provide an audit or meeting agenda where appropriate

4. To provide a basis for feedback to Con Edison

Con Edison's DCRDR for Indian Point Unit 2 Nuclear Station began with the submittal of a Program Plan to the NRC on February 14, 1984 (Reference 2). The NRC staff comments on the Program Plan were forwarded to Con Edison on April 24, 1984 (Reference 3).

Based on review of the Program Plan, NRC staff members held meetings with Con Edison on June 26, 1984, and on November 20, 1984. Another meeting was held on December 4, 1985, to review the status of the DCRDR. NRC staff comments resulting from these meetings were forwarded to the Division of Licensing for transmittal to Con Edison on July 10, 1984 (Reference 4); December 14, 1984 (Reference 5); and December 12, 1985 (Reference 6), respectively. The DCRDR Summary Report was submitted by Con Edison to the NRC on June 30, 1986. The findings of SAIC's evaluation of the licensee's Summary Report follow a brief overview of the background of the DCRDR requirements.

BACKGROUND

Licensees and applicants for operating licenses are required to conduct a Detailed Control Room Design Review (DCRDR). The objective is to "improve the ability of nuclear power plant control room operators to prevent accidents or cope with accidents if they occur by improving the information provided to them" NUREG-0660, item 1.D.1 (Reference 7). The need to conduct a DCRDR was confirmed in NUREG-0737 (Reference 8). DCRDR requirements in Supplement 1 to NUREG-0737 replaced those in earlier documents. Supplement 1 to NUREG-0737 requires each applicant or licensee to conduct its DCRDR on a schedule negotiated with the NRC. Guidelines for conducting a DCRDR are provided in NUREG-0700 and -0800 (References 9 and 10).

According to NUREG-0700, a DCRDR should include four phases: (1) planning, (2) review, (3) assessment and implementation and (4) reporting. The product of the last phase is a Summary Report which, according to Supplement 1 to NUREG-0737, must include an outline of proposed control room changes, their proposed schedules for implementation, and summary justification for human engineering discrepancies with safety significance to be left uncorrected or partially corrected. Upon receipt of the licensee's Summary Report and prior to implementation of proposed changes, the NRC must prepare a Safety Evaluation Report (SER) indicating the acceptability of the DCRDR (not just the Summary Report). The NRC's evaluation encompasses all documentation as well as briefings, discussions, and audits if any were conducted. The purpose of this Technical Evaluation Report is to assist the NRC by providing a technical evaluation of the Indian Point Unit 2 DCRDR process and results.

The DCRDR requirements as stated in Supplement 1 to NUREG-0737 can be summarized in terms of the nine specific elements listed below:

1. Establishment of a qualified multi-disciplinary review team

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

3. A comparison of display and control 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 that will correct those discrepancies

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

8. Verification that improvements can be introduced in the control room without creating any unacceptable human engineering discrepancies

9. Coordination of control room improvements with changes resulting from other improvement programs such as Safety Parameter Display System (SPDS), operator training, new instrumentation, Reg. Guide 1.97, Rev. 2, and upgraded emergency operating procedures

1. <u>Establishment of a Qualified Multidisciplinary Review Team</u>

The organization for conduct of a successful DCRDR can vary widely, but is expected to conform to some general criteria. Overall administrative leadership should be provided by a utility employee. The DCRDR team should be given sufficient authority to carry out its mission. A core group of specialists in the fields of human factors engineering and nuclear engineering are expected to participate with assistance as required from other disciplines. Staffing for each technical task should bring appropriate expertise to bear. Human factors expertise should be included in the staffing for most, if not all, technical tasks. Finally, the DCRDR team should receive an orientation which contributes to the success of the DCRDR. Section 18-1, Appendix A of NUREG-0800 describes criteria for the multidisciplinary review team in more detail.

Both the Program Plan and the Summary Report for the Indian Point Unit 2 included a description of the staffing and management that were established to conduct the DCRDR team. Con Edison has established three independent teams: executive, management and review teams. They are cognizant of the teams' need for human factors input and have m*xed human factors consultants from Torrey Pines Technology for both the management and review teams.

One concern addressed in SAIC's evaluation of the licensee's Program Plan was a lack of in-depth information regarding staff assignments and individual levels of effort. This concern was resolved during the meeting of June 26, 1984. Con Edison provided a description of task assignments and levels of effort which addressed SAIC's concerns related to the involvement of a human factors specialist and nuclear system engineer in the review and the freedom of the team to call on additional technical assistance. The licensee stated that the review team will have management support and access to needed information and support facilities. It described the management approach to the effort, indicating that individual personnel are assigned to the tasks called for in the Supplement 1 to NUREG-0737 initiatives. Further discussion during the meeting showed a significant commitment by Con Edison to the DCRDR. For example, the licensee stated that as the DCRDR is ongoing, Con Edison will set up a permanent, in-house program with appropriate human engineering expertise for future control room design efforts once the DCRDR is completed.

The basic organization and functions of the DCRDR review team (executive review team, management review team, and the design review and technical task team) are shown in Figure 2-2 of the Program Plan. The staffing of this team is shown in Figure 2-1 of the Summary Report. Table 2-1 of the Summary Report also outlines the procedures, purpose, applicability, responsibilities, and requirements of each activity used for performing the DCRDR.

As noted, the Summary Report provides a description of Indian Point Unit 2's DCRDR management and staffing. Resumes were provided for the principal DCRDR team members who participated and the qualifications of Torrey Pines Technology personnel have also been reviewed by the NRC in past DCRDR programs. Evaluation of these resumes and of the DCRDR team organization lead the reviewers to conclude that a qualified team has been assembled which satisfies this requirement of Supplement 1 to NUREG-0737.

2. System Function and Task Analysis

The purpose of the function and task analysis is to identify the control room operators' tasks during emergency operations and to determine the information and control capabilities the operators need in the control room to perform those tasks. An acceptable process for conducting the function and task analysis is:

1. Analyze the functions performed by systems in responding to transients and accidents in order to identify and describe those tasks operators are expected to perform

2. For each task identified in Item 1 above, determine the information (e.g., parameter, value, status) which signals the need to perform the task, the control capabilities needed to perform the task, and the feedback information needed to monitor task performance

3. Analyze the information and control capability needs identified in Item 2 above to determine appropriate characteristics for displays and controls to satisfy those needs

A system function and task analysis was performed to establish the input/output requirements of operator tasks, particularly during off normal plant events; and to identify the instruments, displays, and controls, and their specific characteristics required for the control room operators to perform their identified emergency tasks successfully.

A top-down approach was used. First, a review of system-related documents, based primarily on the documentation developed by the Westinghouse Owners Group (WOG), was performed to identify the major plant operating systems and subsystems and also to identify those cases wherein the Indian Point 2 (IP2) systems differed from the generic WOG systems. This review process also provided delineation of the specific functions of the systems and subsystems identified.

After having established the major plant systems, subsystems, and their respective functions, the next step was to select plant event sequences to be utilized in the conduct of the task analysis. Criteria for choosing selected operational events (SOEs) were based on guidance provided the NRC, WOG, discussions with experienced operations personnel and consideration of Reg. Guide 1.70 (Rev. 3) and NUREG-0700. The SOE selection criteria consisted of the following:

- The event should utilize a broad range of control room functions
- The event should require time-dependent action by operators
- The event should represent a high stress or complex situation for the operators
- The event should require an unusual sequence or combination of multifunction operations by the operators

Based on the above criteria, the following SOEs were selected:

- Reactor trip
- Large break LOCA
- Loss of secondary coolant (steam line break)
- Steam generator tube failure
- Loss of AC power
- Anticipated transient without scram (ATWS)

A review was performed of the generic system function review and task analysis (SFTA) developed by WOG. This review established that the SOEs listed above represented a complete and comprehensive set of events for task analysis. The plant systems involved were presented in the WOG ERG documentation and included the ten operator functions as defined by the ERGs:

- Verify automatic actions
- Diagnose plant condition
- Monitor/regulate RCS boron content
- Monitor/regulate RCS pressure
- Monitor/regulate RCS temperature

- Monitor/regulate RCS inventory
- Monitor/regulate RCS secondary coolant pressure
- Monitor/regulate RCS secondary coolant inventory
- Monitor/regulate RCS containment environment
- Evaluate equipment status

Based on these operator functions, the task analysis established the operator tasks and information and control requirements that are necessary to perform all the required operator functions in connection with the SOEs. This analysis included the following activities:

- Definition of operator tasks; for example, the tasks that are part of verifying automatic actions are to Verify Reactor Trip and Verify Turbine Trip, etc.

- Development of the required control room information and controls (characteristics) and activities

- Development of the data that describes the operators' needs and actions for each specific SOE

The content of the Emergency Operating Procedures (EOPs) follows the generic WOG ERGs, Rev. 1, with plant-specific information, operations, or values as appropriate indicated in the ERGs. For any step which differed from the corresponding ERG step, a Step Documentation Form was completed. This form provided a detailed description and a basis for the difference between the IP2 EOP and the ERG Rev. 1 step.

For analysis of the operator tasks/steps for the SOEs, the information and control requirements were defined for the tasks, including branching or alternate tasks. These were established independent of the existing control room and simulator. They included a description of the required task, the required information or action, the information and control requirements (defined as the types of devices required) and the required characteristics (e.g., for instruments and displays: value, range, status, setting, trend, accuracy, and for controls: incremental, discrete, continuous, available set positions, expected response and precision). For instance, to ensure that the accuracy/precision required exists on the equipment in the control room, the necessary range and parametric values had been compared to the minimum scale increments and parametric units on the inventory forms. Moreover, during the validation process, the operators were asked, whether they were satisfied with the accuracy, minimum increment marking and range of each instrument. These data were recorded on pre-printed forms for entry into the data base management system (DBMS).

The information and control requirements were derived prior to discussion with operators. The majority of the information and control requirements were obtained from information presented in the ERGs, ERG background documents, and documentation from the SFTA performed by the WOG. In situations where plant-specific steps or plant-specific parameter values were required, the IP2 "Plant Design Differences and Generic Analysis Applicability" document and the IP2 "Plant Specific Setpoints for Emergency Operating Procedures" document were used for reference.

The Required Operator Task Data form presents detailed information regarding instruments and controls needed by the operator to perform the required tasks, which was taken from the information and control requirements documentation. Additionally, this form was used to record the results of talk-throughs with operators to gather additional information regarding actions/decisions, alternate tasks, results or system response, and consequences of errors. This form provides additional input to the DBMS. After the talk-through, the SOEs were walked through and the information/control number for the device used for each operator action was also added to the subject form for entry into the DBMS and subsequent use in the Control Room Inventory. These talk-throughs and walk-throughs were conducted using a mockup/simulator or control room.

In addition to the SFTA description provided in the Summary Report, the licensee has submitted supplementary information at meetings (June 26, 1984; November 20, 1984; and December 4, 1985) between the licensee, NRC staff, the NRC contractor from Science Applications International Corporation (SAIC) and Comex Corporation (a subcontractor to SAIC). This information provided the NRC staff confidence that the licensee has satisfied this requirement of Supplement 1 to NUREG-0737. However, since IE Information Notice No. 86-64, dated August 14, 1986, indicates that many utilities may have not appropriately developed or implemented upgraded emergency operating procedures (EOPs), the licensee should verify that the problems with EOPs identified in this Information Notice are not applicable to Indian Point Unit 2. If there are problems, the licensee should consider reevaluating the adequacy of their DCRDR task analysis.

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

The purpose of comparing display and control requirements with a control room inventory is to determine the availability and suitability of displays and controls required for performance of the EOPs. Success of this element depends on the quality of the function and task analyses and the control room inventory. The control room inventory should be a complete representation of displays and controls currently in the control room. The inventory should include appropriate characteristics of current displays and controls in order to allow meaningful comparison with the results of the function and task analyses. Unavailable or unsuitable displays and controls should be documented as HEDs.

An inventory of controls, instrumentation, displays, and other control room man/machine interface equipment was completed as part of the Con Edison plant documentation from earlier studies. Outage-related changes that have been added to the control room since 1981 have been added to the original inventory list.

Data for the inventory were obtained from photos of the IP2 simulator, current control panel drawings, the control room and the control room simulator. During the SFTA, all related instrumentation and controls were again photographed by Torrey Pines Technology and compared to information and control requirements and their associated characteristics in order to identify any missing controls or displays.

The control room inventory represents a file of data that describes every instrument, control, display, and other equipment that is in the control room; i.e., a total of 1345 devices, listed in 986 line items, each of which is entered into the DBMS and described as follows:

- Device number
- Type of device
- Functional title
- Panel location
- Calibrated range for instruments, status light information for indicators, or switch positions
- Minimum scale increment for instruments

This inventory established the device specifications for comparison with the device requirements established from the operator task analysis data. Data was defined such that a one-to-one match could be performed with the DBMS. A suitability finding would result from a mismatch and would be identified by the device number.

As discussed on pages 4-50 through 4-55 of the Summary Report, the methodology for verification of task performance capability is thorough and technically adequate. This process included verifying the presence (or absence) of information and controls required to perform each task and verifying the suitability of the information and controls for performing each task. The verification of availability resulted in two Human Engineering Observations (HEOs) and the suitability evaluation resulted in a total of 25 HEOs.

In addition to the verification of task performance capabilities, the licensee conducted procedures to "determine if the functions required of the control room operating crew can be accomplished effectively within the control room design under dynamic, real-time abnormal and emergency conditions," Reference 1, page 4-56. The licensee further summarizes the methodology as follows:

"• Selection of event sequences for validation from the SFTA results
- Briefing of the operators prior to simulation exercises
- Walk and talk through of the selected event sequences
- Video taping of real-time simulation of selected event sequences
- A review and discussion of the video tape results with the plant operators
- Preparation of HEOs resulting from the walk/talk through and real-time simulation exercises"

The events selected for walk-/talk-through were the loss of cooling accident (LOCA) event and the steam generator tube rupture event. The events were evaluated both in the control room and on the simulator (real-time). The simulator permitted evaluation of training, workload, and workflow issues while the control room portion allowed a slower paced evaluation by questioning operators while they performed specific tasks. Real-time simulator exercises were also videotaped to permit a closer review of problem areas. The validation of operator functions led to the identification of 43 HEOs.

A review of the HEOs documented in Appendix A of the licensee's Summary Report for the verification of task performance capabilities and the validation of operator functions (V/V) indicate that a total of 68 HEOs were found. The reviewers determined that the HEOs documented are the type one expects from this review phase, and conclude that the effort was adequate. Thus, it is concluded that this requirement of Supplement 1 to NUREG-0737 has been satisfied by the licensee.

4. Control Room Survey

The key to a successful control room survey is a systematic comparison of the control room against accepted human engineering guidelines. One accepted set of human engineering guidelines is provided in Section 6 of NUREG-0700. However, other accepted human factors standards may be chosen. Discrepancies between the control room and human engineering guidelines should be documented as HEDs.

The licensee states on pages 4-41 and 4-42 of the Summary Report that "the objective of the control room survey was to evaluate the control room against established human factors guidelines. Further, the control room survey examined the consistency of control room conventions, as well as the adequacy of the control room to fulfill requirements determined from both the System Function and Task Analysis and the verification of task performance capabilities." The licensee indicates that checklists were developed directly from NRC-recommended guidelines contained in NUREG-0700. Checklist items were marked "No" for noncompliance and then documented on an HEO form which included a statement of the problem devices or observation of the potential error that could occur and suggestion for a solution. The licensee further notes in the Summary Report that the control room survey was performed by a suitable mix of two human factors specialists and operations personnel familiar with the control room, and that it produced a total of 153 HEOs.

The reviewers conclude that the control room survey was conducted in a thorough, professional manner, employed the appropriate human factors guidelines, gave due consideration to the results of the SFTA and control room inventory, adequately documented activities and findings, and therefore satisfies this requirement of Supplement 1 to NUREG-0737.

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

Based on the guidance of NUREG-0700 and the requirements of Supplement 1 to NUREG-0737, all HEDs should be assessed for significance. The potential for operator error and the consequence of that error in terms of plant safety should be systematically considered in that assessment. Both the individual and aggregate effects of HEDs should be considered. The result of the assessment process is a determination of which HEDs should be corrected because of their potential impact on plant safety. Decisions on whether HEDs are safety-significant should not be compromised by consideration of such issues as the means and potential costs of correcting those HEDs.

Con Edison's methodology for HED assessment and implementation were developed on the basis of NUREG-0700 and draft NUREG-0801 guidance, and the procedures are described in Section 5 of the Summary Report. The description of HEO assessment is consistent with the one submitted in the licensee's Program Plan, which reviewers found to be an adequate process. The Summary Report states that the assessment of all HEOs was performed by the assessment and improvement team (AIT). They categorized each HEO using the definitions given on page 5-1 of the Summary Report, and Figure 5-1 explains the HEO categorization process. These assessments were based on an evaluation of the impact of each observation on operating crew performance, overall plant safety and plant reliability. The observations judged to have a high potential for affecting plant safety and reliability were categorized as HEDs. Nonsignificant observations in Category D remained as HEOs. After the initial categorization process, remaining HEOs (Category D) were reanalyzed by the AIT to identify any cumulative or interactive affects of HEOs. Observations categorized A through C were assigned an HED number and recorded on the master log sheet as shown in Figure 5-2 of the licensee's Summary Report.

NRC staff evaluation of the HEO forms with the assistance of the definitions given of main sections of the HEO in Figure 3-1a shows the involvement of both the management and executive review team in the assessment process. The HED processing presented incorporates relevant significant factors such as the impact of error on safety as well as the potential for error.

In conclusion, the assessment process as applied was adequate and satisfies this requirement of Supplement 1 to NUREG-0737.

6. Selection of Design Improvements

The purpose of selecting design improvements is to determine corrections to HEDs identified from the review phase of the DCRDR. Selection of design improvements should include a systematic process for development and comparison of alternative means of resolving HEDs. Furthermore, according to NUREG-0737, Supplement 1, the licensee should document all of the proposed control room changes.

Con Edison provided the method to select corrections for HEDs explaining that recommendations may be provided by the review team but final corrective action is selected by the management and executive review teams. Human factors input to the selection process is provided on the management team.

According to the licensee's Summary Report, three corrective methods were considered by the assessment and improvement team (AIT); design enhancement, design changes, and procedure changes. These methods were defined as follows:

- Design Enhancement - any control room improvement accomplished by a surface treatment technique such as painting or changing labels

- Design Change - corrections which were developed through planned engineering efforts

- Procedure Correction - changes to existing procedure to correct or mitigate the effects of an HED

The corrective actions and the scheduled implementation dates for the HEDs are summarized in Table 6-3 of the Summary Report; the implementation schedule is also shown in Figure 6-1 of the Summary Report. The licensee further states on page 6-1, that, to assure an efficient and integrated approach for correcting the identified HEDs, a cross-reference was prepared. This cross-reference identifies HEDs applicable to a particular instrument number and is also helpful in evaluating proposed changes to the baseline system. To support the implementation effort, three further studies of the control panels were performed; a panel demarcation study, an annunciator study, and a lamp test capability study. This process indicates Con Edison's awareness of the need for implementation in an integrated fashion.

In summary, the proposed control room changes and the implementation effort presented in the licensee's Summary Report are described in an appropriate level of detail and reflect the integration of human factors in the design process. The NRC staff concludes that Con Edison has satisfied this requirement of Supplement 1 to NUREG-0737.

7. Verification That Selected Design Improvements Will Provide The Necessary Correction Without Introducing New HEDs

A key criterion of DCRDR success is a consistent, coherent, and effective interface between the operator and the control room. One good way to satisfy that criterion is through iteration of the processes of selection of design improvements, verification that selected design improvements will provide the necessary correction, and verification that improvements will not introduce new HEDs. According to NUREG-0800, techniques for the verification process might include partial resurveys on mocked-up panels, applied experiments, engineering analyses, environmental surveys, and operator interviews. The NRC staff believes that each iteration of the selection and verification processes should reduce inconsistencies in the operator-control room interface while increasing the coherence and effectiveness of that interface. The consistency, coherence, and effectiveness of the entire operator-control room interface is important to operator performance. Thus, evaluation of both the changed and unchanged portions of the control room is necessary during the verification processes.

In the Summary Report, the licensee did not address the above verification in much detail except to state that after the initial HEO categorization, the remaining (Category D) HEOs were reanalyzed to identify any possible cumulative or interactive effects of multiple HEOs. At the meeting on June 26, 1984, between representatives from NRC, SAIC, Con Edison, and Torrey Pines Technology, however, this verification requirement/process was discussed. Con Edison described its techniques to verify that the correction will resolve the HED without creating new ones. The techniques described/discussed included the following steps:

- Use of a partial mock-up and drawings to portray the correction
- Application of the relevant checklist criteria
- Application of task analysis procedures as applicable
- Application of appropriate EOP steps with mini walk-throughs by operations personnel as necessary
- Completion of the verification signoff form

The reviewers concluded that the techniques described constitute adequate verification processes and that they satisfy these requirements of Supplement 1 to NUREG-0737.

8. Coordination of the DCRDR With Other Improvement Programs

Improvement of emergency response capability requires coordination of the DCRDR with other activities. Satisfaction of Reg. Guide 1.97 requirements and the addition of the SPDS requires modifications and additions to the control room. These modifications and additions should be specifically addressed by the DCRDR. Exactly how they are addressed depends on a number of factors including the relative timing of various emergency response capability upgrades. Regardless of the means for coordination, the result should be integration of Reg. Guide 1.97 instrumentation and SPDS equipment into a consistent, coherent, and effective control room interface with the operators.

One of the objectives listed in the licensee's Summary Report is the integration of the DCRDR with other areas requiring the application of human factors principles identified in Con Edison's April 15 response to NUREG-0737, Supplement 1. Con Edison's Program Plan outlines the coordination of the DCRDR with SPDS, Reg. Guide 1-97, human engineering review of the reactor vessel level instrumentation, review of control room corrective actions to determine possible incorporation into the emergency operating procedures, the emergency response facility, and training. During the meeting of June 26, 1984, Con Edison presented a milestone chart for review which indicated an effort to conduct activities in an integrated manner. Based on the evaluation of the Program Plan, Summary Report, and information provided the reviewers during meetings, the reviewers conclude that the licensee has satisfied this requirement of Supplement 1 to NUREG-0737.

9. Operating Experience Review

Although not a requirement of Supplement 1 to NUREG-0737, a review of operating experience is beneficial to the DCRDR. Con Edison's review of operating experience consisted of two parts:

- Examination of available documentation
- Survey of operations personnel

Both industry-wide reports, particularly Licensee Evernt Reports (LERs) and plant-specific documents, were reviewed. Criteria developed to identify historical incidents resulted in selection of six LERs for future review. As summarized on page 4-5 of the Summary Report, the six selected LERs resulted in three being attributed to procedure or check-off list limitation, and one to training limitations. The remaining two were equipment problems with no human engineering design efficiency. Since the errors were adequately corrected by procedure COL or training revisions, HEOs were not initiated as a result of the IP2 operating history document review effort.

A survey of operations personnel was conducted using questionnaire and interview techniques. Con Edison's Summary Report states that questionnaires were administered to Indian Point Unit 2 operations personnel. The respondents were asked to explain the specific problem or deficiency, and if applicable to identify the associated panel, system, equipment, and/or components. The respondents were asked to make recommendations concerning actions that could be taken to correct or improve deficiencies. A total of 24 operations personnel including some training people were interviewed. The results of the interviews were reviewed and observation of potential deficiencies which could contribute to human error or degraded operator performance were documented as Operating Experience Review (OER) observations. A total of 51 observations are described in Appendix B of the Summary Report, and 41 were used to document HEOs. In short, the Summary Report demonstrates that useful data was obtained from the above sources.

In summary, the operator interviews and the operating experience documentation review were found to be acceptable and to have produced valuable data for integration into the survey, task analysis and verification efforts, and the identification and assessment of HEOs/HEDs.

10. Analysis of Proposed Design Changes, Justification for Leaving HEDs Uncorrected or Partially Corrected, and Schedule for Implementing Design Changes

According to Supplement 1 to NUREG-0737, a Summary Report should outline proposed control room design changes and proposed schedules for implementation, and provide summary justification for HEDs with safety significance to be left uncorrected or partially corrected.

Appendix A of Con Edison's Summary Report provides a complete record of the DCRDR results as documented on the HEO forms. These forms contain individual findings, categorization (according to potential operator error and safety impact), and the corrective actions or reasons for leaving the HED uncorrected. The forms also indicate AIT review of the recommended corrective action; the recommended implementation schedule, management review/approval; and, finally, executive review and approval. Appendix A of this TER provides reviewers comments and questions regarding Con Edison's justification for not taking corrective action or the proposed corrective action. The questions and concerns are brief and most likely could be resolved during a teleconference or meeting with the licensee.

The schedule for implementation of corrective action is described in the cover letter to the Summary Report. That letter indicates that at least two refueling cycles will be required to implement corrections, however, by the projected 1989 refueling outage, the NRC can expect all corrections to be completed. This projected final completion date is in accordance with the NRC staff position that all action be taken within two refueling outages or three years after submittal of the Summary Report.

Furthermore, the licensee states in the cover letter that "the two Category A corrective actions will be accomplished before the startup from the projected 1987 outage" (Reference 1). All other corrections will be implemented both with the unit on line and during outages through the projected 1989 outage.

With the exception of the questions concerning corrective actions and justifications for no action, outlined in Appendix A to this TER, it is concluded that the schedule projected to implement design corrections adequately addresses the NRC staff's position.

CONCLUSIONS

Review of the Consolidated Edison Final Summary Report on the Detailed Control Room Design Review conducted for the Indian Point Unit 2 plant revealed that the DCRDR was well conducted and satisfied all the requirements of Supplement 1 to NUREG-0737. There are, however, some questions remaining regarding some HEOs and HEDs generated during the DCRDR. It is therefore recommended, in order to close out this project fully, that a meeting or phone conference between Con Edison and the NRC be arranged to resolve the questions listed in Appendix A.

REFERENCES

1. Final Summary Report for the Detailed Control Room Design Review of Indian Point Unit 2, Consolidated Edison Company of New York, Inc., June 30, 1986. Attachment to letter from John P. O'Toole, Consolidated Edison Company of New York to Hugh L. Thompson, Director, Division of PWR Licensing-A, Office of Nuclear Reactor Regulation, USNRC.

2. "Program Plan for the Detailed Control Room Design Review of Indian Point Unit 2," Consolidated Edison Company, February 1984.

3. Review of the Control Room Design Review Program Plan for Consolidated Edison Company's Indian Point Unit 2, U.S. NRC, April 24, 1984.

4. NRC/Con Edison Meeting on Detailed Control Room Design Review, U.S. NRC, July 10, 1984.

5. NRC/Con Edison Meeting on Detailed Control Room Design Review, U.S. NRC, December 14, 1984.

6. NRC/Con Edison Meeting on Detailed Control Room Design Review, U.S. NRC, December 12, 1985.

7. NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," May 1980, Revision 1, August 1980.

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

9. NUREG-0700, "Guidelines for Control Room Design Reviews," U.S. Nuclear Regulatory Commission, Washington, D.C., September 1981.

10. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 18.1, Revision 0, September 1984.

APPENDIX A

Table 6-1 of the Summary Report shows that five Category A HEDs were identified during the DCRDR. Table 6-3 shows that two of these HEDs (6.2.001 and 6.5.001) are to be corrected. Review of Appendix A of the Summary Report: "DCRDR HEO Forms" indicates that Category A HEDs 6.2.006 and 6.8.009 will be resolved in conjunction with the resolution of HEDs 6.2.001 and 6.5.001, respectively. Table 6-3 does not show any correction commitment for Category A HED 6.2.004; however, in Appendix A, on the Human Engineering Observation Assessment sheet, the recommended implementation for this HED is "promptly." Please explain why there is no apparent corrective action commitment shown for this HED.

HED 6.1.005 deals with reading displays located above 70 inches and possible accidental activation of controls located below 34 inches. The NRC does not consider the rolling ladder as a satisfactory solution to reading high location instruments or controls located too low. Is there any other solution (e.g., instrument/control relocation) feasible? If not, why? Con Edison should provide the following information: (1) What is the required accuracy or precision with which displays located above 70" must be read (i.e., are there detrimental parallax effects) and what are the consequences of misreading these displays? (2) What controls are located below 34", what is the distance between the panel these controls are on and any equipment, furnishings, and panels across from these controls, and what are the consequences of accidental activation?

HEO 6.1.016 - More detail/proof is needed that labels are, in fact, readily visible.

HEO 6.1.021 - Explain the use of/necessity for the beeper as an operational aid.

HEO 6.1.025 - What are the alternate means for verifying the steam dump valve position? Where is alternate information located relative to associated displays/controls?

HEO 6.3.002 - How do the new administrative controls alleviate this concern? How do they specifically address this concern?

HEO 6.3.005 - Explain what features the window has that permits the operator to determine if alarm is incoming or cleared.

HEO 6.4.004 - What kinds of protective clothing is the HEO addressing? The Comment/Note/Reason doesn't seem to address the problem.

HEO 6.4.015 - The AIT may not consider this as applicable to the control room environment, but it is a violation of the NUREG-0700 guideline 6.4.4.3.b.

HEO 6.5.039, HEO 6.5.041, HEO 6.5.047, HEO 6.5.049 - The reviewers need a color code of color and all applications in the control room.

HEO 6.5.045 - Further explanation is needed of what has been done to operator's instructions regarding margins to saturation. What does this mean?

HEO 6.5.016 - Why is this not an HED?

HEO 6.5.024 - This reason seems illogical - "Its primary use is during an accident and as such is adequate for normal operation." Why is this not an HED?

HEO 6.5.028 - What constitutes acceptable tolerances?

HEO 6.5.036 and 6.5.040 - What is a "two-is-true" panel?

HEO 6.5.038 - This is a violation of NUREG-0700 guideline 6.5.1.2.b. Why is this not an HED?

HEO 6.5.046 - How does the suggested resolution address the stated problem?

HEO 6.6.021 - This should be implemented immediately.

HEO 6.6.027 - If the procedure is in place, why does the problem continue?

HEO 6.6.029 - Why is color coding suggested not necessary?

HEO 6.8.014 - Why is this not a problem?

HEO 6.8.009 - Why is this not a problem?