

TECHNICAL EVALUATION REPORT
OF THE
DETAILED CONTROL ROOM DESIGN REVIEW
FOR
CLEVELAND ELECTRIC ILLUMINATING COMPANY
PERRY NUCLEAR POWER PLANT UNIT 1

June 11, 1985

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Rev. 1, 8-8-85

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1.0 BACKGROUND

Licenses and applicants for operating licenses shall 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 I.D.). The need to conduct a DCRDR was confirmed in NUREG-0737 and Supplement 1 to NUREG-0737. 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 a DCRDR on a schedule negotiated with the Nuclear Regulatory Commission (NRC).

NUREG-0700 describes four phases of the DCRDR and provides applicants and licensees with guidelines for its conduct. The phases are:

1. Planning
2. Review
3. Assessment and implementation
4. Reporting

The requirements of Supplement 1 to NUREG-0737 indicate the need to include a number of elements in the DCRDR. They are:

1. Establishment of a qualified multidisciplinary review team
2. Function and task analyses 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 are significant and should be corrected
6. Selection of design improvements
7. Verification that selected design improvements will provide the necessary correction and do not introduce new HEDs
8. Coordination of control room improvements with changes from other programs such as the safety parameter display system (SPDS), operator training, Reg. Guide 1.97 instrumentation, and upgraded emergency operating procedures (EOPs)

Licensees are expected to complete Element 1 during the DCRDR's planning phase, Elements 2 through 4 during the DCRDR's review phase, and Elements 5 through 7 during the DCRDR's assessment and implementation phase. Completion of Element 8 is expected to cut across the planning, review, and assessment and implementation phases.

A Summary Report is to be submitted at the end of the DCRDR. As a minimum it shall:

1. Outline proposed control room changes
2. Outline proposed schedules for implementation
3. Provide summary justification for HEDs with safety significance to be left uncorrected or partially corrected

The NRC staff evaluated the organization, process and results of the DCRDR. Results of the evaluation are documented in a Safety Evaluation Report (SER) published within two months after receipt of the Summary Report.

2.0 DISCUSSION

Cleveland Electric Illuminating Company (CEI) submitted a DCRDR Program Plan for Perry Nuclear Power Plant Unit 1 (PNPP) on June 7, 1982 (Ref. 7). NRC staff comments on that Program Plan were forwarded to CEI on December 23, 1983 (Ref. 8).

CEI submitted a Summary Report for PNPP January 10, 1985. Based on the results of previous activities and on review of the Summary Report, the NRC staff conducted a pre-implementation audit of the PNPP DCRDR April 9-12, 1985.

2.1 Establishment of a Qualified Multidisciplinary Review Team

Supplement 1 to NUREG-0737 requires the establishment of a qualified multidisciplinary review team. Guidelines in team selection are found in NUREG-0700 and NUREG-0800, Standard Review Plan, Section 18.1, Appendix A Rev. 0.

The Perry Nuclear Power Plant (PNPP) Summary Report describes a multidisciplinary team that appears to possess the necessary skills to perform a DCRDR. Team members are identified with their area of expertise and involvement in each phase of the DCRDR on Table 2-1 of the Summary Report. Attachment L of the Summary Report also includes resumes and a description of tasks performed and level of effort of team members.

The review team includes the following groups:

- o PNPP Human Factors Unit
- o PNPP Support Personnel
- o Human Factors Specialists
- o Consultants
- o Personnel from other Utilities

The disciplines involved include various full-time engineering and operations personnel, part-time engineering, operations, technical, and training personnel, all from PNPP; three human factors specialists that work closely

with the team throughout each phase of the DCRDR; systems and operations engineers from GE who participate in all phases of the DCRDR except selection of design improvements; and a systems engineer and operations engineer from two other BWR utilities who provided support through the BWROG Control Room Survey Program.

The PNPP Human Factors Unit is responsible for the implementation of the DCRDR and the Human Factors Unit lead engineer provides the administration and technical direction for the DCRDR. CEI has given technical task assignments that are appropriate to the review team disciplines. The DCRDR team, as a whole, does not appear to have been provided with a specific DCRDR orientation. However, key individual members of the team did, participate in activities which provided information on DCRDR background and methods.

Based on the Summary Report and discussions during the pre-implementation audit, the NRC audit team found that the review team members have the suitable expertise to perform an adequate DCRDR. We conclude that the PNPP review team meets the requirement of Supplement 1 to NUREG-0737 to establish a multidisciplinary review team for conducting a DCRDR. CEI should assure continued participation of personnel from appropriate disciplines, including human factors and operations, during the completion of the DCRDR to fully satisfy the requirement.

2.2 Systems Function and Task Analyses

Supplement 1 to NUREG-0737 requires the applicant to perform systems function and task analyses to identify control room operator tasks and information and control requirements during emergency operations. Furthermore, Supplement 1 to NUREG-0737 recommends the use of function and task analyses that had been used as the basis for developing emergency operating procedures, technical guidelines, and plant-specific emergency operations procedures to define these requirements.

The following steps for a top-down systems function and task analysis are identified in NUREG-0700 guidelines.

1. Identification of Systems and Subsystems
2. Identification of Operating Events for Analysis
3. Function Identification
4. Operator Task Identification and Analysis

Operator information and control needs must be determined independently from the existing CR design, and not be influenced by existing equipment.

CEI has used the BWROG Emergency Procedure Guidelines (EPG) as the basis for the DCRDR task analysis and to develop Perry Plant Emergency Instructions (PEI). These EPG's were the topic of a May 4, 1984 meeting between the NRC and the BWROG (see ref. #5). Based on that meeting, the staff concluded that:

1. It appears that revision 3 of the EPG provides a functional analysis that identifies, on a high level, generic information and control needs. However, these EPG's do not explicitly identify the plant-specific information and control needs, which are necessary for preparing emergency operating procedures and determining the adequacy of existing instrumentation and controls.
2. Because detailed plant-specific information and control needs cannot be extracted directly from the EPG's, plant-specific analysis is required.
3. Each licensee and applicant must describe the process used to identify plant-specific parameters and other plant-specific information and control capability needs and must describe how the characteristics of needed instruments and controls will be determined. These processes may be described in either the Procedure Generation Packages (PGP) or the DCRDR Program Plan with appropriate cross-referencing.
4. For each instrument and control used to implement the EOP's, there should be an auditable record that defines the necessary characteristics of the instrument or control and the bases for that determination. The

necessary characteristics should be derived from analysis of the information and control needs identified in NRC approved EPG's and from analysis of plant-specific information.

In order for the SPTA to be acceptably accomplished for all emergency conditions, the systems function and task analyses should:

- o Be independent of existing equipment.
- o Identify and analyze the appropriate operating events, plant safety-related systems, and functions which must be exercised and analyzed.
- o Identify the EOP's and tasks which must be executed and analyzed.
- o Name the independent reference sources used, and describe who will use them and how they will be used to specify and document the transition from BWROG generic guidelines to the plant-specific characteristics of information and controls needed by the operator to mitigate the effects of the emergency conditions.
- o Completely cover all emergency operations included in the EPG's.

To enhance the acceptability of the description of the methodology, the applicant's documentation should include the following:

- o Discussions of the approaches and information sources used (e.g., documents, guidelines, operations personnel, multiple approaches, plant-specific calculations, etc.).
- o The rationale and methodology used in the selection of event sequences, along with a description of how it was verified that the selected sequences adequately cover the complete range of systems needed to mitigate abnormal plant conditions.
- o The process used to identify the functions, systems, subsystems, and events selected for analysis. It should be made clear that the applicant is using an independent objective top-down approach rather than a bottom-up procedure-based approach.
- o A discussion of who will perform the work and how the independent reference sources, the documented independently determined information and control needs and characteristics, and the inventory process were coordinated to ensure independence, completeness, and accuracy.

An essential part of the above is the method by which the independent reference sources were documented and used to ensure the independence of the identified characteristics of the information and control needs from those of existing equipment.

During discussions at the pre-implementation audit PNPP provided clarification of their methodology, as explained in the Summary Report, for conducting a SFTA.

PNPP will use their PEI's that were developed from the BWROG's EPG's to satisfy the need for a function analysis. The transition from the BWROG EPG's to the plant PEI's was accomplished using the Procedure Generation Package (PGP). This methodology is a departure from what is recommended in the guidelines. The process used by PNPP can be made to satisfy the need for a function analysis, but it relies on development of complete and technically adequate PEIs. Because the PEIs are still under development, the function and task analysis element of the PNPP DCRDR cannot be considered complete. We understand that CEI intends to update the task analysis as PEIs are "finalized" prior to fuel load.

Several concerns were identified during the pre-implementation audit. The first being that CEI needs to document which version of the EPG's will be used for the final revision of the PEIs. As PEIs, SOIs, ONIs, and IOI-11 are updated prior to fuel load, the task analysis should also be updated to fully satisfy the requirement. CEI stated during discussions that a mini-review will be performed after the PEI update has taken place. One area to be addressed during the mini-review is to consider the impact of PEI changes on work already completed based on HEDs identified during the task analysis. The task analysis update should identify new and modified tasks, the information and control capabilities required to perform these tasks, and appropriate

characteristics of displays and controls to satisfy the information and control capability requirements.

We conclude that with the exceptions mentioned above that PNPP should meet this requirement to Supplement 1 of NUREG-0737.

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

Supplement 1 to NUREG-0737 requires the applicant to make a control room inventory and to compare the operator display and control requirements determined from the task analyses with the control room inventory to determine missing controls or displays.

PNPP conducted their control room comparison through the use of the PNPP CRDR Task Analysis Data Sheet. The operator response section of this form was completed during this process. To accomplish this element of the review operators were given a task which had been identified in the task analysis. Operators were asked to identify on the actual control room panels which instruments and controls would be used to successfully accomplish this task. The location and informational characteristics of the instruments and controls were recorded on the appropriate form at this time. The identified instruments and controls were then reviewed by the PNPP review team for availability and suitability. Human engineering observations were recorded in cases where displays and controls were unavailable or unsuitable to satisfy requirements for information and control capabilities.

The Summary Report describes the comparison of display and control requirements with the control room inventory. The control room itself was used as the inventory against which display and control requirements were compared. That approach is generally acceptable. Supplemental information may, however, be required to identify the characteristics of some instruments and controls.

The organization, process, and results of this element of the DCRDR was found to be acceptable by the pre-implementation audit team. Complete satisfaction of the requirement in Supplement 1 to NUREG-0737 will require comparison of display and control requirements identified in the task analysis update (discussed in the previous section) with the control room inventory.

2.4 Control Room Survey

Supplement 1 to NUREG-0737 requires that a control room survey be conducted to identify deviations from accepted human factors principles. NUREG-0700 provides guidelines and criteria for conducting a control room survey. The objective of the control room survey is to identify for assessment and possible correction, the characteristics of displays, controls, equipment, panel layout, annunciators and alarms, control room layout, and control room ambient conditions that do not conform to good human engineering practices. CEI has executed their DCRDR survey in several parts all of which served to identify potential Human Engineering Deficiencies (HEDs).

- o BWROG CR Survey (September 21-25, 1981)
- o NRC in-progress Audit (with discussions) (August 9-13, 1982)
- o BWROG CR Survey Supplement (June 11-15, 1984)

The above sources identified over 1000 observations and discrepancies which CEI reduced by a screening process to 334 valid HEDS. These HEDS are reported in Attachment I of the Summary Report.

The NRC reviewed these 334 HEDS in the Perry control room during the pre-implementation audit. The results of that review are as follows:

- o 38 HEDs that are considered closed with no further action required. See Appendix A for details.
- o 250 HEDs that are considered open pending implementation and audit. NRC agrees with the proposed resolutions and implementation schedules. All items must be implemented and verified per the HED report sheet schedule. See Appendix B for details.
- o 46 HEDs that are considered open pending revised response, additional review, and implementation. These include the environmental survey items and HEDs that need a revised response or review by CEI. See Appendix C for details.

The balance of the Human Engineering Observations (HEOs) that didn't become valid HEDs were assessed by CEI and categorized as follows:

- o Disagree-----160
- o Duplicate-----379
- o Procedure Related-----216

These HEOs were reviewed by the NRC audit team with a check of the documentation, which appeared adequate. There was an auditable paper trail that could track all HEO and HED numbers.

The NRC audit team agrees with the disposition of these HEOs but had some concern with the 216 that were procedure related and were sent to the operations procedures group for assessment. The concern was that these observations were not assigned HEO numbers and there was some question about the auditability of them after they were transferred to the operations group. During the pre-implementation audit the NRC recommended that there be a follow-up of these observations by the PNPP review team and CEI agreed to this.

The summary report generally describes what CEI did during the conduct of the CR Surveys and what the results were. The descriptions of who performed the work are also generally acceptable. During the pre-implementation audit the NRC review team found that human factors and other recommended skills and expertise were continually present during the generation of the observations and discrepancies. CEI also stated that the remote shutdown panels have been included in CR Survey. An audit of the RSP HEDs was performed by the NRC team at the panels.

During the pre-implementation audit, the NRC reviewed the CR Survey and operating experience review documentation. An acceptable comparison of selected CR Survey checklists with accepted human factors principles was made. A review of all HEDs for disposition was conducted at the actual control panels and there was a review of HEOs that didn't become HEDs. In all cases the documentation was available and adequate.

Complete satisfaction of the control room survey effort requires environmental surveys in the completed control room and a survey of communication equipment when it is available in the control room. CEI will provide documentation of survey results to NRC of the Environmental, Emergency Equipment, Communications, and Computer Systems Surveys by fuel load.

We conclude that CEI has performed an acceptable systematic comparison of the control room against accepted human engineering guidelines.

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We conclude that CEI has performed an acceptable systematic comparison of the control room against accepted human engineering guidelines.

2.5 Assessment of HEDs

Supplement 1 to NUREG-0737 requires that HEDs be assessed to determine which HEDs are significant and should be corrected. NUREG-0700 and NUREG-0800, SRP Section 18.1, Appendix A, Rev. 0, contain guidelines for the assessment process.

Our review of the Human Engineering Discrepancy Report (HEDR) and Human Engineering Deficiency Reports (HEDs) included in the Perry Summary Report confirmed that Cleveland Electric Illuminating Company (CEI) has analyzed, prioritized, and recommended means for correcting or modifying those HEDs which will impact safety or plant/operation performance. Human factors personnel and General Electric consultants assisted CEI in these efforts. Procedural items were stated to be referred to the CEI Operations Section for resolution. A formal assessment process is described and diagrammed in the summary report. (Table 2-1 and Figure 2, and Attachment L).

Figure 2 of the Summary Report illustrates the assessment process showing that all discrepancies and observations were reviewed to determine which ones qualify as HEDs for which corrections or modifications would be selected for implementation. Some observations were identified as not being significant enough to modify or fix, and were placed in the "None" classification.

The HED's selected for correction were placed in the "Fix" classification to bring into full compliance with HF guidelines or benchmarks. The HEDs

selected for improvement were placed in the "Modify" classification to be brought into partial compliance with guidelines or benchmarks. Observations placed in the "None" classification will not be corrected or modified.

HEDs originally placed in the "Modify" and "None" classifications were further assessed for safety compliance and operability significance. If deemed to have unsatisfactory safety or operability consequences, these HEDs were reconsidered for reclassification to "Fix" or "Modify" and implemented accordingly.

CEI's "Integrated Assessment Methodology" describes a process that permits a significant number of HEOs to be assessed into categories before HEO numbers are assigned. These categories are as follows:

- o Duplicate human engineering discrepancies/observations
- o Human engineering discrepancies/observations that were determined to be invalid or inappropriate for the PNPP control room
- o Procedure related human engineering discrepancies/observations

There was some concern as to the auditability of the procedure related HEOs that were sent to the CEI Operations section for resolution. CEI has agreed to maintain an auditable documentation trail showing the disposition of these items after they have been assessed by the procedures group.

The NRC audit team reviewed the procedure related HEOs and the valid HEDs during the pre-implementation audit and generally agreed with the proposed resolutions. The audit team found that CEI has used an assessment method that assures an acceptable resolution to these HEOs and HEDs and has provided an auditable documentation trail. The remaining activity is to assess any HEOs/HEDs identified as a result of the comparison of displays and controls with the control room inventory and as a result of completing the control room survey.

CEIs "Integrated Assessment Methodology" is a process that combines assessment of human engineering discrepancies/observations and the selection of design improvements. Perry's assessment process was not consistent with guidelines since the determination of whether an item should be corrected on the basis of error probability and potential consequences of that error, was not made. PNPP did, however, assess all items which were to remain uncorrected or to be only partially corrected. If there was a significant safety or operability consequence the item was iteratively subjected to selection of design improvements and assessment until resolved. The pre-implementation audit team reviewed the assessment process carefully. Although the assessment process was not consistent with the NRC guidelines, the results of the assessment process were adequate to satisfy the assessment requirement of Supplement 1 to NUREG-0737.

2.6 Selection of Design Improvements

Supplement 1 to NUREG-0737 requires selection of control room design improvements that will correct significant HEDs. It also states that improvements that can be accomplished with an enhancement program should be done promptly.

The Summary Report states:

The determination of "Fix" and "Modify" HED design was an integrated effort taking into account the following considerations:

- o Does the modification fully correct or improve the HED as intended?
- o Is the modification coordinated with changes from other improvement programs such as SPDS, R.G. 1.97, Operator Training and PNPP Emergency Procedures?
- o Have alternate methods for modification been explored, such as SPDS or Operator Training?

CEI's methodology for selecting design improvements as stated in the PNPP Summary Report appears acceptable. Through discussions during the audit, the processes by which the team members reviewed the HEDs and selected corrective action designs and modifications within the guidance of the above

considerations were appropriate. The pre-implementation audit team reviewed all proposed corrective actions resulting from the DCRDR. In general that review indicated that results were acceptable (see Appendixes A and B). However, some concerns were identified. Those concerns were discussed with CEI and should be addressed as indicated in Appendix C. The pre-implementation audit also identified a number of recommendations (see Appendix D). Those recommendations should be reviewed by CEI as part of the ongoing DCRDR activity. A report of the results of that review should be provided to the NRC.

CEI states that an ongoing HF Program is committed to review and resolve HEDs over the life of the plant. They also state that there is a Design Procedure to ensure that a HF design review is performed on design changes that affect the control room.

We conclude that CEI has developed a methodology that meets the requirement of Supplement 1 to NUREG-0737 to select design improvements that will correct safety significant HEDs.

2.7 Verification that Design Improvements Provide Necessary Correction and Do Not Introduce New HEDs

Supplement 1 to NUREG-0737 requires verification that selected design improvements will provide the necessary corrections of HEDs and will not introduce new HEDs into the control room.

The CEI summary report states that the improved control room design was evaluated to assure that the selected design improvements, both individually and collectively, adequately correct the deficiencies and do not introduce other HEDs. This was accomplished by performing the following:

- o A review of HED report sheets to verify that the corrective actions comply with specific HF guidelines, and can be implemented without creating new HEDs.

- o A comprehensive survey of the improved control room design on the primary control panels (P-680, P-601, P-870, P-877, P-883) using BWROG checklists. The survey considers possible interactive effects to ensure that no new HEDs are introduced and that no safety questions or potential risks remain unrecognized.

Attachment M of the Summary Report exhibits the Design Improvement Review sheet and provides instructions for its use. This sheet is used to determine:

- o Whether the HEDs will be fully or partially corrected, or will not be corrected.

- o What the safety consequences are.

- o Whether a design selection creates new HEDs.

- o Whether unsafe operation or violation of a technical specification might result.

The verification function was performed by an independent verification team which includes a HF specialist, a licensed shift supervisor, and a senior design engineer from CEI Reliability and Design Assurance.

Because most corrections have not been implemented, CEI has performed their verification through iteration of the processes of selection of design improvements, verification that the selected design improvements will provide the necessary correction, and verification that improvements will not introduce new HEDs. They have described a process that reviews revised panel drawings against BWROG panel survey checklists. The Summary Report states that this was the comprehensive review of the primary panels. It is not clear whether verification extended to all panels or just the primary control panels.

It appears that CEI has not completed their verification requirement. It would be very difficult to sit down, without a simulator or mocked-up panels, and perform an engineering analysis that would verify that no new HEDs were introduced without being able to see how all the proposed corrections work together.

CEI has described a method, that is part of the PNPP assessment process, to ensure that the design improvements provide the necessary corrections and will not introduce new HEDs into the control room. CEI should continue with follow-up surveys as design improvements are put in place. We also recommend a hands-on walk/talk through verification/validation after all control room design changes are installed, to demonstrate that operators can use the implemented HED control room corrections to effectively execute the EOP tasks.

When CEI completes their verification/validation on the completed control room, including an auditable documentation trail of design changes and review by the DCRDR team, the design improvement verification requirement of Supplement 1 to NUREG-0737 will be satisfied.

2.8 Coordination of the DCRDR with Other Programs

Supplement 1 to NUREG-0737 requires that control room improvements be coordinated with changes from other programs such as SPDS, operator training, RG 1.97 instrumentation, and upgraded EOP's.

The present coordination status as presented by CEI is as follows:

- o The PNPP Human Factors unit has been involved in the review of the SPDS ERIS, and participated in displayed parameters selection, format, and integration of terminals into the CR and RSP.

- o The PNPP HF unit reviewed RG 1.97 improvements prior to their implementation in the CR. RG 1.97 variables were identified where applicable in the information and control portion of the task analysis.
- o The DCRDR task analysis and walk-through utilized Plant Emergency Instructions (PEI) and System Operation Instructions (SOI).
- o The task analysis ensured that PEI information and control requirements will be available and suitable in the control room.
- o Human engineering observations concerning procedures were forwarded to the procedure writing section for resolution. The procedure writing section received DCRDR improvement selections before the changes appeared on plant drawings.
- o The PEI Validation Plan of the Procedure Generation Package (PGP) requires that all PEI Revisions be reviewed by the HF unit.
- o ATWS modifications were reviewed and improved by the HF unit to ensure proper integration into the control room.
- o The training section was utilized throughout the DCRDR regarding the operator training program and systems technology.

- o A licensed operator is designated as HF interface between the HF unit and the various operator programs.
- o Training will provide feedback on any HF observations associated with DCRDR improvements.
- o The simulator will be updated to reflect the completed control room..

During discussions at the pre-implementation audit CEI stated they have assigned one of their engineers to handle the overall coordination effort. CEI stated that they will provide a schedule of completion dates for the various coordination activities to the NRC for review.

We conclude that PNPP has met the requirement for this task in Supplement 1 to NUREG-0737.

2.9 Other

The NUREG-0700 guidelines recommend that a review of operating experience be performed that includes the examination of available operating experience documents and a survey of control room operating personnel. An operating experience review is not a requirement but CEI conducted theirs in two parts:

- o Preliminary operator interviews, which were done at the time of the BWROG CR survey in 1981.

- o Supplemental operator experience review in June 1984 which was based on accumulated experience during intervening years.

The PNPP operator experience review was responsible for the generation of many procedure related HEOs and several HEDs.

CEI has developed an on-going human factors program that is supported by a PNPP design procedure to ensure that a Human Factors Design Review is performed on design changes that affect the control room or remote reactor shutdown system interfaces. This document will be maintained and updated over the life of the plant.

3.0 Conclusions

Based upon our review of the PNPP Summary Report and the pre-implementation audit conducted April 9-12, 1985 it appears PNPP has satisfied the requirements of Supplement 1 of NUREG-0737 with the following exceptions:

- o To fully satisfy the requirement for Systems Function and Task Analysis, CEI must update the task analysis as the PEIs, SOIs, ONIs, and IOI-11 are finalized prior to fuel load.
- o To fully satisfy the requirement for Comparison of Display and Control Requirements With a Control Room Inventory, CEI must compare the display

and control requirements identified in the task analysis update with the control room inventory.

- o To fully satisfy the requirement for Control Room Survey, CEI must perform environmental surveys in the completed control room and perform a survey of communication equipment when it is available in the control room.
- o To fully satisfy the requirement for Selection of Design Improvements, CEI must address the 46 HEDs in Appendix C that are considered open pending revised response, additional review, and implementation. These items must be evaluated, resolved, implemented, and verified with a schedule that is acceptable to the NRC.
- o To fully satisfy the requirement for Verification that Design Improvements Provide Necessary Correction and Do Not Introduce New HEDs, CEI should perform a hands-on walk/talk through verification/validation in the completed control room.
- o CEI should assure continued participation of personnel from appropriate disciplines, including human factors and operations, during the completion of the DCRDR.
- o CEI should provide a schedule of completion dates for the various elements involved in the DCRDR coordination effort.

- o CEI should enhance the completeness of their Summary report by supplying comprehensive outlines of the proposed control room changes and summary justification for HEDs with safety significance to be left uncorrected or partially corrected.

In our judgement, completion of the above items is essential for satisfaction of the DCRDR requirements of Supplement 1 to NUREG-0737. Evaluation of the PNPP DCRDR should continue through completion of the above elements.

Several recommendations also resulted from the NRC staff's evaluation of the PNPP during the pre-implementation audit. These recommendations are not intended as additional requirements. They are intended to encourage the fullest possible benefit from the DCRDR. Those recommendations are:

- o CEI is encouraged to see that the simulator be made and kept as an exact duplicate of the completed control room.
- o CEI needs to clarify whether verification extends to all panels or only to the primary control panels.
- o CEI is encouraged to follow the 29 recommendations listed in Appendix D.

PERRY NUCLEAR POWER PLANT

UNIT 1

REFERENCES

1. NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," May 1980; Revision 1, August 1980.
2. NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980; Supplement 1, December 1982 (Generic Letter No. 82-33).
3. NUREG-0700, "Guidelines for Control Room Design Review," September 1981.
4. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 18.1, Appendix A, Rev. 0, "Evaluation Criteria for Detailed Control Room Design Reviews," September 1984.
5. Memorandum for Voss A. Moore, from S.H. Weiss, "Meeting Summary - Task Analysis Requirements of Supplement 1 to NUREG-0737 - May 4, 1984 Meeting with BWR Owner's Group Emergency Procedure Guidelines and Control Room Design Review Committees," May 1984.

6. Perry Nuclear Power Plant Detailed Control Room Design Review Summary Report. Submitted January 10, 1985.

7. Letter from D. R. Davidson to A. Schwencer, Subject "Control Room Design Review" June 7, 1982.

8. Letter from B. J. Youngblood to M. R. Edelman, Subject "NRC Staff Comments on the Detailed Control Room Design Review Program Plan for Perry Nuclear Power Plant (Units 1 and 2)" December 23, 1983.

PERRY NUCLEAR POWER PLANT
UNIT 1

HED/APPENDIX CROSS REFERENCE

<u>HED</u>	<u>APPENDIX</u>	<u>HED</u>	<u>APPENDIX</u>
1	B	47	A
2	C	48	A
3	B	49	B
4	B	50	B
5	B	51	B
6	A	52	B
7	B	53	B
8	B	54	C
9	B	55	B
10	B	56	B
11	A	57	B
12	B	58	A
13	B	59	B
14	C	60	B
15	B	61	B
16	B	62	B
17	A	63	B
18	A	64	B
19	A	65	B
20	A	66	B
21	A	67	B
22	B	68	B
23	C	69	B
24	A	70	B
25	B	71	B
26	C	72	B
27	A	73	B
28	A	74	B
29	C	75	B
30	A	76	C
31	B	77	C
32	C	78	B
33	B	79	B
34	B	80	C
35	A	81	C
36	C	82	B
37	B	83	B
38	B	84	B
39	A	85	C
40	B	86	C
41	B	87	B
42	B	88	C
43	B	89	B
44	A	90	B
45	A	91	B
46	A	92	B

HED/APPENDIX CROSS REFERENCE

<u>HED</u>	<u>APPENDIX</u>	<u>HED</u>	<u>APPENDIX</u>
93	B	143	B
94	B	144	B
95	C	145	B
96	C	146	B
97	A	147	B
98	B	148	B
99	A	149	A
100	C	150	B
101	B	151	B
102	B	152	B
103	B	153	B
104	C	154	B
105	B	155	B
106	B	156	B
107	B	157	B
108	A	158	B
109	B	159	B
110	B	160	B
111	B	161	B
112	B	162	B
113	B	163	B
114	B	164	B
115	B	165	B
116	B	166	B
117	B	167	B
118	A	168	B
119	B	169	C
120	B	170	B
121	A	171	B
122	B	172	B
123	B	173	B
124	B	174	B
125	B	175	B
126	B	176	B
127	B	177	B
128	C	178	B
129	B	179	C
130	B	180	C
131	B	181	B
132	B	182	B
133	B	183	C
134	B	184	B
135	C	185	C
136	B	186	A
137	B	187	A
138	C	188	C
139	B	189	B
140	B	190	A
141	B	191	A
142	B	192	A

HED/APPENDIX CROSS REFERENCE

<u>HED</u>	<u>APPENDIX</u>	<u>HED</u>	<u>APPENDIX</u>
193	B	326	B
194	B	327	B
195	B	328	B
196	B	329	B
197	B	330	B
198	B	331	B
199	C	332	B
200	B	333	B
201	B	334	B
202	B	335	B
203	B	336	B
204	B	337	B
205	B	338	B
206	A	339	B
207	A	340	B
208	B	341	B
209	B	342	B
210	B	343	C
211	B	344	B
212	B	345	B
213	B	346	B
214	B	347	B
215	B	348	B
216	B	349	B
300	A	350	C
301	B	351	C
302	C	352	C
303	B	353	B
304	B	354	C
305	B	355	B
306	B	356	B
307	B	357	C
308	B	358	B
309	B	359	B
310	B	360	B
311	B	361	B
312	B	362	B
313	C	363	B
314	B	364	B
315	A	365	C
316	A	366	C
317	C	367	A
318	C	368	C
319	B	369	B
320	B	370	B
321	B	371	B
322	B	400	B
323	B	401	C
324	B	402	B
325	B	403	B

HED/APPENDIX CROSS REFERENCE

<u>HED</u>	<u>APPENDIX</u>	<u>HED</u>	<u>APPENDIX</u>
404	B	1017	B
405	B	1018	B
406	B	1019	C
407	B	1020	B
408	B	1021	C
1001	B	1022	B
1002	B	1023	C
1003	B	1024	B
1004	B	1025	B
1005	B	1026	B
1006	C	1027	B
1007	B	1028	B
1008	A	1029	B
1009	C	1030	B
1010	B	1031	B
1011	B	1032	B
1012	C	1033	B
1013	B	1034	C
1014	B	1035	B
1015	B	1036	B
1016	A	1037	B

PERRY NUCLEAR POWER PLANT
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APPENDIX A

Appendix A contains a list of 38 HEDs that are considered closed. These items were reviewed and evaluated by the NRC review team during the pre-implementation audit and no further action is required.

HED

6, 11, 17, 18, 19, 20, 21, 24, 27, 28, 30, 35, 39, 44, 45, 46, 47, 48, 58, 97,
99, 108, 118, 121, 149, 186, 187, 190, 191, 192, 206, 207, 300, 315, 316, 367,
1008, 1016

PERRY NUCLEAR POWER PLANT

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APPENDIX B

Appendix B contains a list of 250 HEDs that are considered open pending implementation. These items were reviewed and evaluated by the NRC review team during the pre-implementation audit and it was determined that the proposed resolutions and implementations were satisfactory. All items must be implemented and verified per the schedule as stated on the HED Report Sheets. In the event an HED cannot be corrected as scheduled, the applicant will be required to provide a rationale for deferral and a schedule for completion that is acceptable to the NRC.

HED

1, 3, 4, 5, 7, 8, 9, 10, 12, 13, 15, 16, 22, 25, 31, 33, 34, 37, 38, 40, 41,
42, 43, 49, 50, 51, 52, 53, 55, 56, 57, 59, 60, 61, 62, 63, 64, 65, 66, 67,
68, 69, 70, 71, 72, 73, 74, 75, 78, 79, 82, 83, 84, 87, 89, 90, 91, 92, 93,
94, 95, 98, 101, 102, 103, 105, 106, 107, 109, 110, 111, 112, 113, 114, 115,
116, 117, 119, 120, 122, 123, 124, 125, 126, 127, 129, 130, 131, 132, 133,
134, 136, 137, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 150, 151,
152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166,
167, 168, 170, 171, 172, 173, 174, 175, 176, 177, 178, 181, 182, 184, 189,

193, 194, 195, 196, 197, 198, 200, 201, 202, 203, 204, 205, 208, 209, 210,
211, 212, 213, 214, 215, 216, 301, 303, 304, 305, 306, 307, 308, 309, 310,
311, 312, 314, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330,
331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 344, 345, 346,
347, 348, 349, 350, 353, 355, 356, 358, 359, 360, 361, 362, 363, 364, 365,
369, 370, 371, 400, 402, 403, 404, 405, 406, 407, 408, 1001, 1002, 1003, 1004,
1005, 1007, 1010, 1011, 1013, 1014, 1015, 1017, 1018, 1020, 1022, 1023, 1024,
1025, 1026, 1027, 1028, 1029, 1030, 1031, 1033, 1034, 1035, 1036, 1037.

APPENDIX C

Appendix C contains a list of 46 HEDs that are considered open pending revised response, additional review, and implementation. For some, the condition of construction in the control room or the installation of these items at the time of the pre-implementation audit was not sufficiently finalized to permit a review. For others, a revised response or review is needed by CEI. All items must be evaluated, resolved, implemented, and verified with a schedule that is acceptable to the NRC.

HED

- 2 Close on implementation and lighting survey to verify HED corrected and no new HEDs introduced. Survey results to be provided to the NRC with any new HEDs identified along with proposed corrections and implementation schedules.

- 14 Revised response to indicate I&C responsibility for storage and replacement of light bulbs, expendables, etc.

- 23 OK with possible exception of panel 623. Glare on vertical panels should be checked once temporary HVAC, etc. is removed. Diffusers on lights above vertical panels are less effective than those in control room horseshoe. Include in environmental surveys.

- 26 Revised response for annunciator 680-1-16 to indicate additional information available and used by the operator to determine cause of the alarm. Revised response for annunciators 845-C7 and E8 to indicate how operator determines cause of the alarm (TRAIN A/E).
- 29 Revised response to indicate finalized list of first and second priority alarms.
- 32 Revised response on f and g.
- 36 Revised response to indicate whether inactive points will light anytime other than when tested.
- 54 Check PNPP HUMAN FACTORS CONTROL ROOM STANDARDS for completeness. CR2940's and SBM's can have several types of handles. Standard doesn't indicate keyswitch applications, J-handles, oval handles, push buttons with rotary collars, etc.
- 76 Describe how "where applicable" is determined for this and other HEDs for which such a decision is to be made.
- 77 Needs category assignment if full correction is to be delayed until prior to startup after first refueling outage.
- 80,81 OK if based on PNPP HUMAN FACTORS CONTROL ROOM STANDARD. Need revised response.

- 85 OK except for amber and blue single lamp indicators. Need revised response to address.
- 86 OK except for amber and blue single lamp indicators. Need revised response to address.
- 88 Who does this and what tools are available? Need revised response.
- 96 Need revised response to indicate labeling.
- 100 Not evaluated. Pre-implementation audit team indicated concern about use of color banding techniques with color indication used on recorder meters. Need details of finally selected and verified correction.
- 104 Provide list of recorders not covered by ERIS and recorders which give trends of greater than 15 minutes.
- 128 Revised response needed to indicate how controllers will be labeled on all panels including the vertical panels.
- 135 Not OK. Use of "ALRM" for alarm is not consistent with the PNPP HUMAN FACTORS CONTROL ROOM STANDARDS.
- 138 Not OK. Proposed correction uses "COND" as abbreviation for condenser. PNPP HUMAN FACTORS CONTROL ROOM STANDARDS indicate abbreviation for condenser is CNDR.

- 169 Color convention upgrade. Revise PNPF HUMAN FACTORS CONTROL ROOM STANDARDS to include red demarcation lines and color padding.
- 179 A revised response indicating that, e.g. "Each alarm must be individually acknowledged" would clarify the resolution of the HED.
- 180 Perform a human factors review of additions to Perry standard abbreviations to prevent conflicts and possible misunderstandings.
- 183 Revised response to indicate use of QAP-1702 when completed, approved, and implemented.
- 185 Revised response indicating administrative procedures for periodic maintenance (calibration and convergence).
- 188 Review of color standards ERIS/process computer vs. control room identifying potential problems, assess and correct if warranted.
- 199 Revised response to indicate in detail, how the operator determines water level under accident conditions using control room instrumentation and/or ERIS.
- 302 Review to assure HED is corrected and no new HEDs introduced.
- 313 Review to determine whether turbine eccentricity, speed, and valve position all need to be displayed on the subject recorder.

- 317 Revised response. Consider reduced lighting in control room.
- 318 OK if potentiometer with on-off switch, but verify proper indication of switch on-off so that operators are aware alarm has been turned off or reduced in volume.
- 343 Review adequacy of input to ERIS for determining CST level.
- 351 Revise response to include emergency equipment storage.
- 352 Verify existence of an administrative procedure on housekeeping or provide revised response.
- 354 Revised response to indicate slippage of final correction to prior to end of first refueling outage. Indicate interim fix. Provide list of all "OPEN-CLOSE" controllers and indicate which will be corrected. Justify those not corrected.
- 357 OK but revise convention to indicate "special case" use of oval instead of J-handles.
- 366 Conduct sound survey in completed control room and provide results to NRC. Identify any HEDs along with proposed corrections and implementation schedules.
- 368 Verify ability to communicate while performing control room tasks in breathing equipment.

- 401 Revised response to indicate actual resolution of HED.

- 1006 Revised response to indicate whether dedicated channel is incoming or outgoing.

- 1009 Revised response to indicate final resolution.

- 1012 Consider use of 3-position switch for B33-F019 and B33-F020 to be consistent with rest of control room.

- 1019 Revised response to indicate how operators will keep track of the situation, inform the new shift, etc.

- 1021 Revised response to clarify position of hydrogen analyzers and annunciators and to clarify modification.

- 1032 Revised response on item 1. Item 2 OK.

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APPENDIX D

Several recommendations resulted from the NRC staff's evaluation of the PNPP DCRDR. The recommendations are not intended as additional requirements, but they are intended to encourage the fullest possible benefit from the DCRDR. Although some changes to the current process of the DCRDR may be necessary to follow the recommendations, the benefit should easily justify the effort. The recommendations are:

1. Recommend that labels on pushbuttons on HOTWELL LEVEL CONTROLLER (Panel 870-2) be changed from "CLOSE - OPEN" to something which more clearly reflects the actual change in plant condition (e.g., "LOWER LVL - RAISE LVL")
2. Recommend shortening the ends of the rails on panels 680, 870, and 601 so that they do not project out as far as the ends of the panels to reduce the likelihood of snagging.
3. Recommend specific training of operators with respect to the resolution of HED 27 as well as detailed coverage in the Annunciator Response Instructions

4. Recommend that the PNPP HUMAN FACTORS CONTROL ROOM STANDARDS be upgraded to include various handle types and that the control room then be upgraded to the standards
5. Recommended enhancement of position markings on rotary collars so that operators can quickly discern collar position (e.g., MANUAL SCRAM BUTTONS on Panel 680)
6. Recommend investigating use of hierarchical labeling with the proposed demarcation around MANUAL SCRAM and MANUAL ISOLATION pushbuttons on Panel 680
7. Recommend RFP and MFP flow indicators on Panel 680-3B be made consistent (i.e., both to have same scale multiplier) prior to fuel load to minimize negative transfer of training
8. Recommend careful monitoring of implemented corrections to assure they are as specified and work with other corrections
9. Recommend removal of "CONTROL VALVE POSITION" from face of N27-12546 A&B as unnecessary information
10. Recommend use of hierarchical labeling on vertical panels (with demarcation where demarcation is used)
11. Recommend Bailey Control Station lights (green "A", yellow "M") be changed to conform to the PNPP HUMAN FACTORS CONTROL ROOM STANDARDS

12. Recommend design of labels on back row of "C" inserts on Panel 680 (e.g., MANUAL SCRAM SWITCHES) be modified (e.g., enlarged) to reduce obscuration of position information (i.e., position indicators for rotary collars)
13. Recommend review of mimics to determine whether additional start and end point information would aid the operator's memory of system operation, particularly on vertical panels
14. Recommend review of mimics to determine whether additional engraved flow arrows would aid the operator's memory of system operation (e.g., flow can be either direction in part of the RHR system depending on valve alignment - double ended arrows may be useful in that portion of mimic)
15. Recommend mimic symbols (arrows, pumps, etc.) be included in the PNPP HUMAN FACTORS CONTROL ROOM STANDARDS
16. Recommend that computer keys be designed so that dirt does not impair the readability of the information on them
17. Recommend enhancement aid on Division 3 WIDE RANGE AND FUEL ZONE REACTOR WATER LEVEL INDICATING RECORDER on Panel 601-2B to increase the operator's ability to acquire necessary information while operating in the HPCS area

18. Recommend review of annunciator readability from annunciator control stations, especially on vertical panels
19. Recommend addition of "scribble plates" so the operator can denote what parameters have been selected for display on the three digital displays for computer output on Panel 680
20. Recommend review of all the different uses for amber and reduction of that number
21. Recommend color banding of meters associated with "HI/LO" annunciators to aid quick recognition of whether parameter is HI or LO
22. Recommend that consistency of labeling between annunciators and displays be confirmed (e.g., the HPCS DAY TANK LEVEL HIGH/LOW annunciator and the FUEL DAY TANK LEVEL display on Panel 601-16 refer to the same tank using different terms)
23. Recommend that consistency between control room, DCRDR Summary Report, and drawings be confirmed:
 - a. e.g., Summary Report indicates annunciator 601-20-D5 should read "RCIC & RHR ST & SHTDN ISOL RHR RM A/B HOT" while the drawing indicates that it should read "RCIC & RHR ISOL RHR RM A/B TEMP HIGH"

b. e.g., Drawing indicates that annunciator 680-1-A1 should read "RWCU F/D INLET COND HI/FAILED" while the actual tile reads "RWCU F/D IN CONDUCTIVITY HIGH/FAILED"

(information provided during the pre-implementation audit indicated the drawing was correct in example 1 and the panel was correct in example 2)

24. Recommend that PNPP HUMAN FACTORS CONTROL ROOM STANDARDS be revised to include PSID if that abbreviation is used in the control room
25. Recommend scheduled check (e.g., daily) of printer paper and ribbons, recorder paper and ink, etc. to assure that I&C technicians can be notified of service needs in a timely manner
26. Recommend that an administrative procedure addressing coordination between the control room and computer room be developed (specifically addressing timely provision to the control room of any output directed to the backup printer in the computer room when the control room printer is out-of-service)
27. Recommend that resets and indicators in the control room be reviewed for consistency of operator interface (e.g., B33A-S110 is not consistent with other RCIRC system reset indication). Further recommend that consistent approach be developed, documented in the PNPP HUMAN FACTORS CONTROL ROOM STANDARDS, and implemented in the control room

28. Recommend FDW A/B PRESS and RX PRESS on Panel 680-3 be scaled the same. FDW A/B PRESS are scaled 0-150 x 10 while RX PRESS is scaled 0-1200. The values are to be compared

29. Recommend consideration be given to removing from the control room any displays or controls identified during the DCRDR as not required

STATUS OF HUMAN ENGINEERING DISCREPANCY CORRECTIONS
 BASED ON APRIL 8-12, 1985 PRE-IMPLEMENTATION AUDIT

- A. Human engineering discrepancies (HEDs) which have been corrected and are closed:

6,17,18,19,21,28,30,35,39,44,45,46,47,48,99,118,121,149,186,187,
 190,191,367,1008,1016

- B. HEDs to be corrected by fuel load:

1. Open pending implementation of correction:

1,3,4,5,7,8,9,10,12,13,15,16,22,25,31,33,34,37,38,40,41,42,43,
 49,50,51,52,53,55,56,57,59,60,61*,62,63,64,65,66,67,68,69,70,71,
 73,75,78,79,82,83,87,89,90,91,92,93,94,95,98,101,103,105,106,109,
 110,111,112,113,114,115,116,117,119,120,122,123,124,125,126,127,
 129,130,131,132,133,134,136,137,139,140,141,142,143,144,145,146,
 147,148,150,151,152,153,154,155,156,157,158,159,160,161,162,163,
 164,165,166,167,168,170,171,172,173,174,175,176,177,178,181,182,
 184,189,193,194,195,196,197,198,200,201,202,203,204,205,208,209,
 210**,211,212,213,214,215,216,301,303,304,305,306,307,308,309,
 310,311,312,319,320,321,322,323,324,325,326,327,329,330,331,332,
 333,334,335,336,337,338,339,340,341,342,344,345,346,347,343,349,
 350,353,355,356,358,359,361,362,365,371,400,402,403,404,405,406,
 407,1001,1002,1003,1004,1005,1007,1010,1011,1013,1014,1015,1017,
 1018,1020,1022,1023,1024,1025,1026,1027,1028,1029,1030,1031,1033,
 1034,1035,1036,1037

2. Open pending additional review, revised response, and implementation of correction:

2,14,23,29,32,36,54,76,85,86,96,104,128,135,138,169,179,180,183,
 185,188,199,302,318,343,351,357,366,368,401,1006,1009,1012,1021,
 1032

- C. HEDs for which partial or interim corrections will be implemented by licensing and which will be completely corrected by end of first refueling outage:

1. Open pending implementation of partial or interim correction:

84,102,314,328,360,363,364,369,370

* need revised response/justification if CEI chooses not to ~~expand~~ water level range indication at the remote shutdown panel to include the top of the vessel

** no implementation schedule provided, pre-licensing completion is consistent with schedules for correction of other HEDs

2. Open pending additional review, revised response, and implementation of partial or interim correction:

77,80,81,100,313

D. HEDs to be corrected by the end of the first refueling outage:

1. Open pending implementation of correction:

72,74,107,408

2. Open pending additional review, revised response, and implementation of correction:

354

E. HEDs for which acceptable justification for not correcting has been, or is expected to be, provided:

1. Closed:

11,20,24,27,58,97,108,192,206,207,300,315,316

2. To be closed upon revised response:

26,88,317,352,1019