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DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards "CRDR Final Summary Rept" in response to SSER 1, Open Item 14,Subpart 1.D.1,per rept Suppl 1 to NUREG-0737 & Reg Guide 1.97,Chronology of util CRDR efforts & util responses to requirements of SSER 1,Section 18 also encl.

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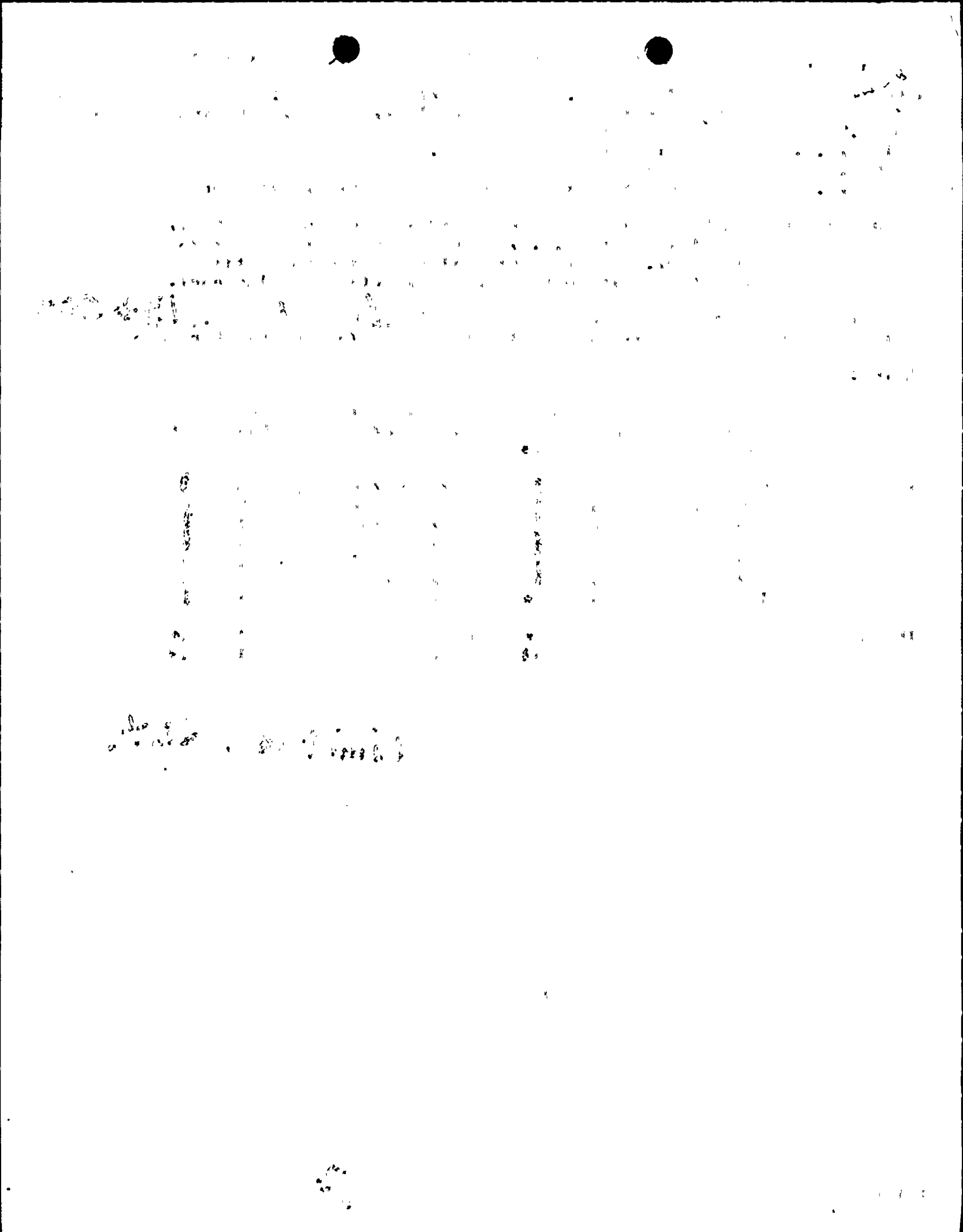

CP&L

Carolina Power & Light Company

SEP 1 3 1985

SERIAL: NLS-85-325

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NO. 1 - DOCKET NO. 50-400
RESPONSE TO SER SUPPLEMENT NO. 1, OPEN ITEM NO. 14, SUBPART I.D1
CONTROL ROOM DESIGN REVIEW

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby submits additional information concerning the Shearon Harris Nuclear Power Plant (SHNPP) Control Room Design Review (CRDR) in response to the SHNPP Safety Evaluation Report (SER), Supplement No. 1, Open Item No. 14, Subpart I.D.1.

Enclosure 1 provides a background on CP&L's CRDR efforts including a chronology of the licensing correspondence concerning the issue. Enclosure 2 presents each requirement of SER Supplement No. 1, Section 18, with the corresponding CP&L response. Enclosure 3 is the CRDR Final Summary Report, which includes the relevant information on the SHNPP CRDR needed to complete the Staff's review.

With this submittal, CP&L considers this issue closed. If there are any further questions, please contact Mr. David McCarthy at (919) 362-2410 or (919) 836-7715.

Yours very truly,

A. B. Cutter - Vice President
Nuclear Engineering & Licensing

ABC/DCM/rtj (1908CGL)

Enclosures

cc: Mr. B. C. Buckley (NRC)
Mr. G. F. Maxwell (NRC-SHNPP)
Dr. J. Nelson Grace (NRC-RII)
Mr. Travis Payne (KUDZU)
Mr. Daniel F. Read (CHANGE/ELP)
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ENCLOSURE 1 to NLS-85-325

Background

Carolina Power & Light Company (CP&L) conducted a control room human factors design evaluation between April 1980 and January 1981. By letter dated December 7, 1982, CP&L submitted to the NRC a detailed CRDR Report based on NUREG/CR-1580 criteria. This submittal included evaluations and recommendations concerning the following:

- human engineering requirements specifications
- main control board design
- annunciator review
- anthropometrics and workspace
- systems operation analysis
- emergency procedures review.

In the January 1983 Draft SER, the NRC stated that CP&L should submit a report addressing the points of a program plan (in accordance with NUREG-0700 and NUREG-0737, Supplement No. 1) along with a schedule for completing the CRDR and implementing modifications. Furthermore, in a March 25, 1983 meeting, NRC requested CP&L to provide the following:

- description of CRDR methods and procedures
- review staff composition and qualifications
- resolution of 'Summary Report' recommendations.

The Company responded to this request by letter dated June 1, 1983.

The NRC staff conducted a CRDR audit of the redesigned control room layout and the redesigned main control board on August 15-19, 1983 which resulted in a request for additional documentation (September 9, 1983) to include descriptions of the following:

- an analysis performed for developing the control board arrangement (Function/Task Analysis);

- an analysis for implementing corrections to Human Engineering Discrepancies (HEDs); and

- an implementation plan for verifying the Main Control Board design.

CP&L responded to this request by letter dated September 27, 1983. The response also included a description of the development, verification, and validation process for Emergency Operating Procedures.

In the January 1984 ACRS subcommittee meetings, CP&L discussed the history of the CRDR project, including:

- redesign of the control room layout
- redesign of the main control board
- emergency operating procedures
- integration of other NUREG-0737, Supplement No. 1, requirements

- ERFIS
- SPDS
- qualifications of human factors reviewers.

NRC identified areas where the Staff needed additional information to complete its review in its November 1983 SER and July 1984 Supplement No. 1 to the SER. Furthermore, shortly after issuing SER Supplement No. 1, NRC transmitted requests for additional information (July 1983 comments on CP&L's December 1982 CRDR report, and March 1984 comments on the August 1983 audit). Since these comments were based on much earlier work, CP&L considers the SER Supplement No. 1 requirements as encompassing this transmittal.

CP&L provided preliminary information in response to the SER by letters dated January 11 and April 9, 1985. The April submittal included a Summary Report. Enclosures 2 and 3 to this submittal complete the response to the SER.

The major documentation concerning the SHNPP CRDR is summarized in the following chronology.

CRDR LICENSING CHRONOLOGY

4/80	CP&L begins evaluating CR design.
7/80	NRC issues NUREG/CR-1580.
11/80	NRC issues NUREG-0737
1/28/81	CP&L completes Human Factors Design Evaluation (CRDR) (not formally submitted to NRC until 12/7/82).
9/81	NRC issues NUREG-0700.
12/7/82	CP&L submits "Human Factors Design Evaluation Report for Shearon Harris Unit 1 Control Room" to NRC based on NUREG/CR-1580 criteria.
12/17/82	NRC issues NUREG-0737, Supplement No. 1.
1/83	NRC issues DSER - requires CP&L to follow NUREG-0700 criteria for CRDR.
3/25/83	CP&L meets with NRC. NRC requests additional information on CRDR.
4/15/83	CP&L submits letter on Emergency Response Capability, includes discussion on CRDR.
6/1/83	CP&L submits CRDR 'program plan,' responding to 3/25/83 request from NRC.
8/15-19/83	NRC audits CRDR, comparing CP&L's efforts against NUREG-0700.
9/6/83	CP&L submits information on compliance with Regulatory Guide 1.97.
9/19/83	NRC submits summary of audit.
9/27/83	CP&L submits additional information as requested at audit.
11/83	NRC issues SHNPP SER; Open Item 14, Subpart I.D.1, addresses CRDR.
1/3-4/84	ACRS meetings discussed CRDR and integration of CRDR activities with SPDS.
7/84	NRC issues Supplement No. 1 to SER; updating Open Item No. 14, Subpart I.D.1, CRDR.

8/84	NRC requests additional information, forwarding 7/23/83 comments on 12/7/82 submittal and 3/28/84 comments on 8/83 audit.
1/11/85	CP&L submits additional information on CRDR.
4/9/85	CP&L submits preliminary CRDR Summary Report.

ENCLOSURE 2 to NLS-85-325

Response to SHNPP SER Supplement No. 1, Open Item No. 14. Subpart I.D.1: Control Room Design Review

1. Action Required by SER Supplement No. 1, Section 18.6(1):

"Provide a detailed description of the Shearon Harris system function and task analysis." (SFTA)

Furthermore, Section 18.4.1 states:

> "The staff finds that the applicant must provide a more complete rationale and justification of the method for conducting task analysis for the staff to determine whether the requirements of Supplement No. 1 to NUREG-0737 have been satisfied."

CP&L Response:

CP&L described the SHNPP SFTA in its December 7, 1982, April 15, 1983, June 1, 1983, September 27, 1983, and April 9, 1985 submittals.

The Company's April 15 and June 1, 1983 submittals indicated that CP&L used H. B. Robinson Unit 2 (also a Westinghouse PWR Emergency Operating Procedures (EOPs) adapted to the SHNPP design to perform the task analysis. The June submittal indicated that these EOPs were used at the simulator to videotape operator activities in abnormal operating and emergency situations. In turn, the videotapes were reviewed by senior human factors specialists to analyze task flows for human factors concerns. This letter also stated that operational information was obtained from H. B. Robinson operators cross-trained to SHNPP and through document reviews (such as FSAR and system descriptions).

In the September 1983 letter, CP&L described involvement in the development and use of the Westinghouse Owners' Group (WOG) Emergency Response Guidelines (ERGs), Revision 1. CP&L committed to the following:

- identifying SHNPP EOPs deviations from the generic EOPs
- task analyzing those deviations
- generating plant-specific lists of instruments and controls needed to perform the EOPs in the SHNPP control room
- comparing the lists to control room design to identify missing or additionally needed components
- reviewing the Generic Task Analysis along with the ERGs deviations analysis to ensure review of each EOP step and resolving any discrepancies

The letter further stated that the functional analysis that CP&L would perform in redesigning the Main Control Board (MCB) would preclude major human engineering discrepancies.

Sections 6.1.3.3 and 6.4 of the Final Summary Report (Enclosure 3) describe the SFTA in detail including how CP&L used Revision 1 of the WOG ERGs, and the WOG High Pressure (HP) Basic System Review and Task Analysis (SRTA) to develop the plant-specific SFTA.

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The methodology of the SFTA is outlined below:

1. Plant-specific ERGs were prepared based on the WOG ERGs.

2. A EOP/ERG Transition Document was prepared which (a) lists differences between the ERG High Pressure (HP) reference plant and SHNPP, (b) explains differences between a WOG and SHNPP step (using step deviation forms), and (c) describes deviations for SHNPP EOP parameters.

3. Using the SHNPP ERGs, the Transition Document, and other pertinent data, the WOG HP Basic SRTA was converted into a plant-specific SFTA. For each plant-specific ERG, CP&L prepared a plant-specific Task/System Sequence Matrix and Element Table (similar to the WOG tables). The Matrices provided inventories of tasks and sub-tasks; the Element Tables described tasks and include related knowledge, task decision, action, instrumentation, and control requirements.

4. A list consisting of plant-specific action and information requirements for each task, was generated using ACTION-INFORMATION REQUIREMENTS DETAIL Forms. This form breaks down each task into behavioral elements.

5. After computerizing the system, data were selected and sorted by task to summarize information and action requirements.

The final SFTA product identifies the action and information requirements and performance criteria for tasks that a SHNPP operator would have to complete under emergency conditions.

In conclusion, the information provided in the April and June 1983 and April 1985 submittals and Final Summary Report adequately describes the SHNPP SFTA. Furthermore, recent discussions with the NRC staff indicated that completion of the process described in the April 9, 1985 submittal would adequately satisfy the NUREG-0737, Supplement No. 1, requirements. Therefore, CP&L considers the SER Supplement No. 1, Sections 18.4.1 and 18.6(1) open items resolved.

2. Action Required by SER Supplement No. 1, Section 18.6(2):

"Describe the process used to compare display and control requirements as determined by the function and task analysis, with the control room inventory."

In addition, Section 18.4.2 states:

> "During the in-progress audit, the applicant stated that the Ebasco panel component list had been substituted for a control room inventory [to check existence of controls and displays on the MCB drawings and confirm content vs. need]....Because of the list used and the fact that the WOG generic function and task analysis does not provide a detailed list of control and display requirements, an accurate comparison of control and display requirements with the inventory is not possible."

CP&L Response:

CP&L described the process used to compare display and control requirements with the control room inventory in its April 9, 1985 submittal. In addition, Sections 6.1.3.4 and 6.5 of the Final Summary Report describe the control room inventory, and Section 6.6 describes how this inventory was used to verify the availability and suitability of control room (CR) components, as identified in the task analysis. Appendix A-26 of the Final Summary Report contains the HEDs generated by this task (as well as their dispositions).

The methodology of the comparison process is outlined below:

1. The CR and relevant information were reviewed to prepare the inventory, which is a database containing information on each CR component including:

   - type of component
   - location
   - description or nomenclature
   - application/function
   - identification number
   - labels
   - characteristics (scale ranges, etc.).

2. The inventory was compared to the operator action and information requirements identified in the SFTA for each component to verify the presence of required instruments and controls for each task sequence analyzed.

3. The inventory was also compared to the range, accuracy trend, nomenclature, and control function requirements in the SFTA database to verify the suitability of CR components.

4. Deviations found in Steps 2 and 3 were documented as HEDs (See Appendix A of the Final Summary Report for HED disposition).

In conclusion, the information provided in the April 1985 submittal and in the Final Summary Report adequately describes the process used to compare display and control requirements with the CR inventory. Furthermore, recent discussions with the NRC staff indicated that completion of the process described in the April 1985 submittal would adequately satisfy NUREG-0737, Supplement No. 1, requirements. Therefore, CP&L considers the SER Supplement No. 1, Sections 18.4.2 and 18.6(2) open items resolved.

3. Action Required by SER Supplement No. 1, Section 18.6(3):

"Describe the process used to verify that the corrective actions achieved the desired improvement without introducing new HEDs into the control room."

CP&L Response:

As a result of the CRDR (conducted from April 1980 through January 1981), CP&L redesigned the main control board and modified associated CR components using human factors engineering principles. This complete redesign effort produced an optimum human factors design (This effort is described in CP&L's December 7, 1982, June 1, 1983, and April 9, 1985 submittals to the NRC).

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Furthermore, to provide consistent application of human factors principles throughout CR construction, Human Engineering Requirements Specifications (HERS) were developed and applied in designing features that could not be evaluated at the time of the review (such as CR noise levels, unpurchased equipment, etc.). These HERS included the following areas:

- annunciator systems
- color codes for strip chart recorders, pens, and pointers
- computer systems
- demarcation and mimic lines
- labeling
- rotary selector switches
- status/monitor light boxes
- vertical indicators
- ambient illumination
- control room furnishings
- control room temperature, humidity, and ventilation
- emergency operating procedures
- noise
- procedures
- protective equipment
- temporary labels
- voice communications, unaided and telephone.

The HEDs identified through this application of human factors guidelines are listed in Appendices A and B of the Final Summary Report. The methods CP&L used to resolve HEDs are described in the responses to Nos. 4 and 6 of this enclosure. These methods followed human factors guidelines.

Section 7.3.4 of the Final Summary Report indicates that corrections were verified to be in compliance with NUREG-0700 human engineering guidelines by using mockups, computer-aided design systems and simulator and H. B. Robinson EOPs (where possible).

In conclusion, the information provided in the December 1982, June 1983 and April 1985 submittals, and the Final Summary Report adequately describes the process used to verify that the corrective actions achieved the desired improvement without introducing new HEDs into the control room. Therefore, CP&L considers the SER Supplement No. 1, Section 18.6(3) open item resolved.

4. Action Required by SER Supplement No. 1, Section 18.6(4) [first part]:

"*For each of the HEDs listed in Part A of the in-progress audit report, the applicant should give the Staff the status and proposed resolutions, as well as a schedule for implementing corrective action.*"

Furthermore, Section 18.5.1 states:

> "For those instances in which an HED with safety significance cannot be designed out of the system, and a decision is made by the applicant not to correct the HED or to only partially correct it, the applicant must provide justification for the action taken."

CP&L Response:

CP&L provides the dispositions of the HEDs listed in Part A of the in-progress audit report (Enclosure 2 of NRC's August 1984 transmittal) in Appendix B of the Final Summary Report. In addition, CP&L-identified HEDs and their dispositions are listed in Appendix A.

Corrective actions for currently identified HEDs have either been completed (as indicated in Appendices A and B of the Final Summary Report) or are currently in the process of being completed. CP&L expects to complete these prior to fuel load, with the exception of installation of carpeting (HED No. 3100-0107; A17-5), which is expected to be completed prior to commercial operation.

CP&L described the methods used to prioritize and resolve HEDs in Sections 7.2 and 7.3 of the Final Summary Report. This methodology is outlined below:

1. HEDs were assessed for potential for error based on component design factors, task factors, and human factors.

2. Consequences of the error were estimated. The systems and/or functions that would be affected were used to determine impact.

3. Four categories of 'severity' were assigned to the HEDs. The highest category was given to HEDs having errors related to safety-related systems and/or functions and those related to Technical Specifications.

4. HEDs that could be corrected by enhancements, training, and/or procedural revisions were identified.

5. HEDs initially identified for correction by enhancement were reassessed for their effect on operator performance.

6. For the remaining HEDs, design improvement alternatives were chosen after considering:

   - relevant task analysis data
   - potential constraints
   - costs and benefits (where applicable)
   - impact of operator training, plant maintenance, and documentation
   - reduction in probability of operator error.
   - verification that the improvements provide the necessary correction without creating new HEDs

Section 7.3.5 describes the method used for scheduling HED solutions. The schedule was chosen after considering:

- safety consequences of operator errors that could be caused by the HED
- integration with other NUREG-0737, Supplement No. 1, programs
- plant construction, turnover, and operational constraints
- operator training/retraining requirements.

In conclusion, the information provided in the Final Summary Report adequately describes the resolutions for implementing corrections for the HEDs identified in NRC's in-progress audit report. Furthermore, the methodology described above

assured that proper resolutions and implementation schedules were chosen for HEDs with safety significance. Recent discussions with the NRC staff indicated that these methods represented a satisfactory process for evaluating the significance of HEDs and developing corrections. Therefore, CP&L considers the SER Supplement No. 1, Sections 18.5.1 and 18.6(4) [first part] open items resolved.

5. Action Required by SER Supplement No. 1, Section 18.6(4) [second part]:

"..provide the results of the evaluation of the following items so the staff can determine whether the requirements of Supplement No. 1 to NUREG-0737 have been satisfied."

1. workspace
2. communications
3. remote shutdown panel
4. recorder panel
5. CRTs
6. process computer and periphirals
7. annunciator systems.

CP&L described these evaluations in its December 7, 1983, June 1, 1983, and April 9, 1985 submittals. In addition, the Final Summary Report addresses the evaluation processes and results for each of the items in the sections listed below:

NRC Item		Section of Final Summary Report Addressing
1.	workspace	3.2, 6.1.3.2, 6.2.2.4, 6.3.1
2.	communications	3.2, 6.1.3.2, 6.2.2.4, 6.3.1
3.	remote shutdown panel	5.0
4.	recorder panels	4.4.4
5.	CRTs	6.1.3.2, 6.3.3.10
6.	process computer and periphirals	6.1.3.2, 6.3.3.10
7.	annunciator systems	6.1.3.2, 6.2.2.4, 6.3.1, 6.3.3.6

Appendix A of the Final Summary Report contains the HEDs generated as a result of these evaluations and their dispositions. The communications survey has not yet been completed; however, it will be completed prior to fuel load and any related corrections will be dispositioned.

In conclusion, the information provided in previous submittals and in the Final Summary Report adequately addresses the seven items listed above. Therefore, CP&L considers SER Supplement No. 1, Section 18.6(4) [second part] open item resolved.

6. Action Required by SER Supplement No. 1, Section 18.5.2:

"Applicant must submit for staff evaluation information concerning any HEDs identified during the verification process, their resolution, and an acceptable time schedule for implementing corrective actions."

CP&L Response:

CP&L describes the verification process in Section 6.6 of the Final Summary Report. (The response to No. 4 of this enclosure summarizes the methods used to resolve and schedule HEDs.) This report indicates that HEDs were prepared for any action or information requirement where an appropriate display, control, or other device was missing or where components deviated from selected NUREG-0700 criteria.

Appendix A-26 of the Final Summary Report provides a summary description and disposition for HEDs identified in the verification process. Corrective actions for currently identified HEDs have either been completed (as indicated in Appendices A and B of the Final Summary Report) or are currently in the process of being completed. CP&L expects to complete these prior to fuel load, with the exception of installation of carpeting (HED No. 3100-0107; A17-5), which is expected to be completed prior to commercial operation.

In conclusion, the Final Summary Report provides adequate information on the HEDs identified during the verification process, including their resolution and implementation schedule. Therefore, CP&L considers the SER Supplement No. 1, Section 18.5.2 open item resolved.

7. Action Required by SER Supplement No. 1, Section 18.5.3

"The applicant did not provide information on coordinating the CRDR activity with the SPDS, Regulatory Guide 1.97, and the emergency response facilities."

CP&L Response:

Safety Parameter Display System (SPDS)

CP&L described the coordination of CRDR activities with the SPDS in its April 15, 1983 and April 9, 1985 submittals, as well as in the January 3, 1984 Advisory Committee on Reactor Safeguards (ACRS) Subcommittee meeting.

In the April 1983 submittal, CP&L stated that it would perform the control room design improvement verification and validation activities after the SPDS was installed and functional; in the ACRS meeting, CP&L explained that as a result of the CRDR, the SPDS would be added as two board-mounted CRTs nearest the dedicated ESF controls.

Sections 1.3, 6.1.3.2, 6.1.3.7, 6.4.3.10, and 6.3.3.10 of the Final Summary Report (Enclosure 3) also discuss the coordination of CRDR activities with SPDS. Section 1.3 states that the placement of the primary and redundant SPDS CRTs ensure maximum readability of the displays.

Regulatory Guide 1.97

CP&L described the coordination of CRDR activities with Regulatory Guide 1.97 requirements in its September 6, 1983 and April 15, 1983 submittals and in the January 1984 ACRS Subcommittee meeting.

In its April 1983 submittal, CP&L indicated that it was developing final Regulatory Guide 1.97 compliance plans following the ERC NUTAC Draft Guidelines for

Integrated Implementation Plan, and that it would perform the design improvement verification and validation activities after the Regulatory Guide 1.97 instrumentation is installed and functional.

In the January 1984 ACRS meeting, CP&L described the integration of the ERFIS computer system with Regulatory Guide 1.97 requirements.

Section 1.3 of the Final Summary Report (Enclosure 3) states that CP&L incorporated the Regulatory Guide 1.97 instrumentation into the MCB layout using the same human factors guidelines used in the MCB re-design effort.

The Final Summary Report also states that the verification and validation activities have assured that these modifications did not introduce HEDs.

Emergency Response Facilities (ERFs)

In the January 1984 ACRS meeting, the April 9, 1985 submittal, and Section 1.3 of the Final Summary Report, CP&L states that the same integrated plant computer system (ERFIS) drives the CRTs in the MCB and ERFs. The Final Summary Report further states that the communications systems between the control room and ERFs conform to 10CFR50, Appendix E, requirements. These documents adequately describe coordinating the CRDR activities with the ERFs.

Conclusion:

The information provided in previous submittals and in the Final Summary Report adequately describes the coordinating of the CRDR activities with the SPDS, Regulatory Guide 1.97, and the emergency response facilities. Therefore, CP&L considers the SER Supplement No. 1, Section 18.5.3 open item resolved.