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Docket No.: 50-397

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Dear Mr. Sorensen:

SUBJECT: DETAILED CONTROL ROOM DESIGN REVIEW (TAC NO. 56181)

On November 1, 1985 WPPSS submitted (G02-85-758) the Summary Report on the Detailed Control Room Design Review as required in the WNP-2 Operating License. This was supplemented by letters dated December 12, 1985 (G02-85-815) and June 3, 1986 (G02-86-517). On July 15 through July 18, 1986 NRC conducted a pre-implementation audit of the DCRDR. Based on our review of the Summary Report and on the site audit, we find the DCRDR to be incomplete in several aspects.

Enclosed is a Safety Evaluation (SE) summarizing the findings of our review. The SE identifies eight items which need further attention to comply with Supplement 1 to NUREG-0737. Please propose a schedule for completion of the activities identified in the conclusion section of the SE and prepare a Supplemental Summary Report providing the results of those activities.

We would like to conduct a post-implementation audit of the DCRDR in January, 1988. Your proposed schedule for completion of the eight open items should allow resolution of as many as possible prior to the audit.

Sincerely,

George W. Knighton, Director  
Project Directorate V  
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IV, V and Special Projects  
Office of Nuclear Reactor Regulation

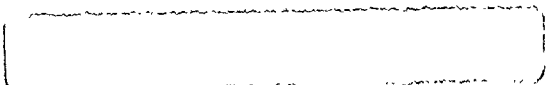
Enclosure:  
SE for DCRDR

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Washington Public Power Supply System

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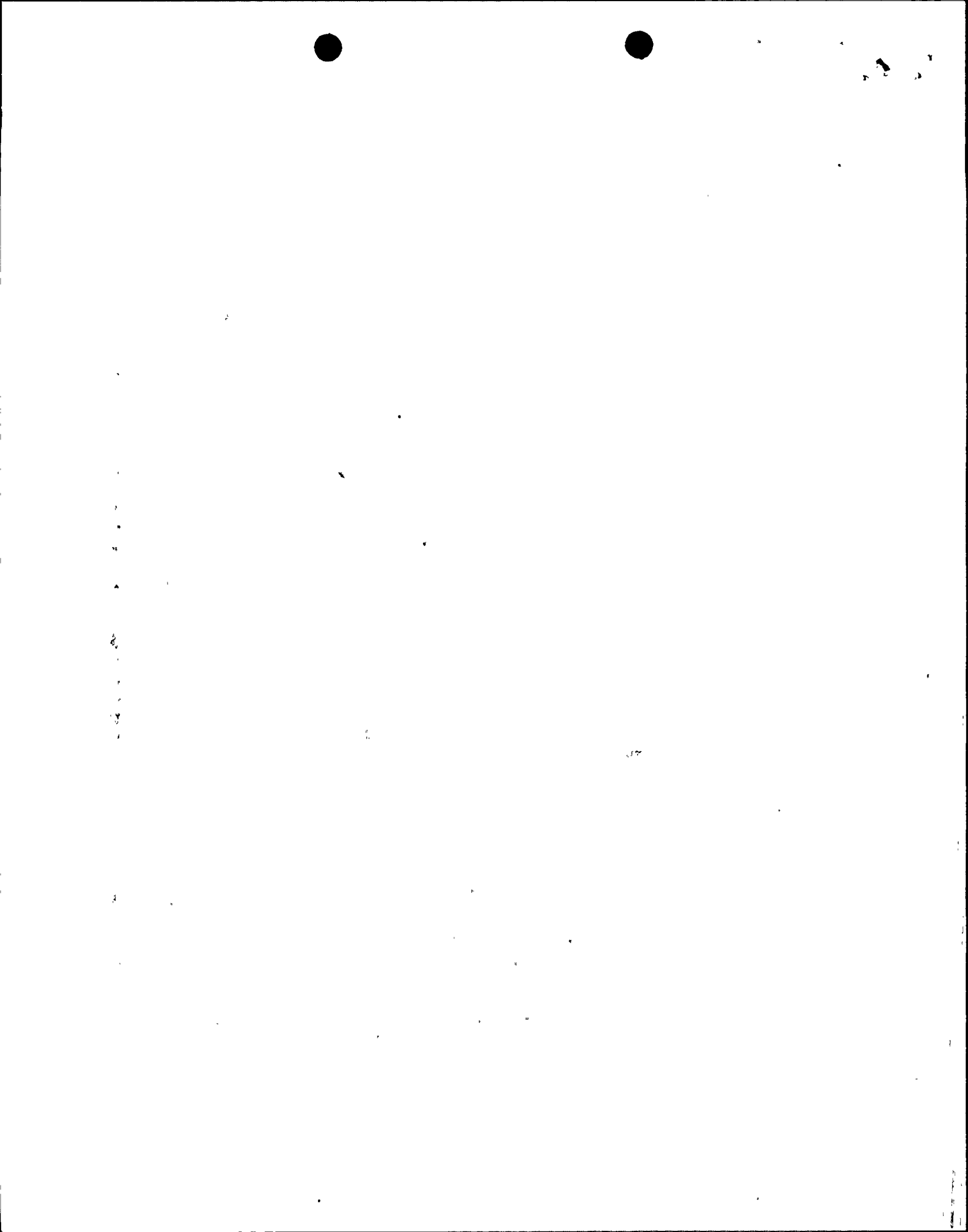
SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATING TO THE DETAILED CONTROL ROOM DESIGN REVIEW OF  
WASHINGTON PUBLIC POWER SUPPLY SYSTEM'S  
NUCLEAR PLANT 2  
DOCKET NO. 50-397

**1.0 INTRODUCTION**

NUREG-0660, Item I.D.1 states that licensees 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." The need to conduct a DCRDR was reiterated in NUREG-0737 and Supplement 1 to NUREG-0737. The DCRDR requirements in Supplement 1 to NUREG-0737 replaced those in the earlier documents and required each licensee or applicant to negotiate a DCRDR schedule with the Nuclear Regulatory Commission (NRC).

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 will 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 (EOP's).



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 evaluates the organization, process, and results of the DCRDR. Results of the evaluation are documented in a Safety Evaluation (SE) which is prepared following receipt of the Summary Report.

Part of the basis for licensing Washington Nuclear Plant 2 (WNP-2) was prior completion of a preliminary design assessment (PDA) of the control room and remote shutdown panels. Pre-licensing correction of a number of HEDs was also required. Correction of the remaining HEDs identified by the PDA was governed by a license condition. One group of those HEDs was to be corrected prior to WNP-2 exceeding five percent power. A second group was to be corrected not later than four months after licensing. Washington Public Power Supply System (WPPSS) confirmed correction of those two groups of HEDs in letters dated March 19, 1984 and April 17, 1984.

Selection of corrections for some HEDs identified by the PDA was deferred to a post-licensing DCRDR. WPPSS was required to provide a Program Plan for that DCRDR at least six months prior to WNP-2's first scheduled refueling outage. Per commitment, the Program Plan was submitted February 17, 1984. NRC staff comments on the Program Plan were forwarded to WPPSS on May 5, 1985. WPPSS submitted a Summary Report for the WNP-2 DCRDR on November 1, 1985 and provided additional information by letters dated December 4, 1985 and June 3, 1986. Based on review of the information provided, the NRC staff planned a preimplementation audit of the WNP-2 DCRDR. That audit was conducted from July 15-18, 1986.

## 2.0 EVALUATION

The staff has evaluated the WNP-2 DCRDR based on all information available to date. The staff's evaluation was consistent with Section 18.1, Rev. 0, of the Standard Review Plan (NUREG-0800). A synopsis of that evaluation, arranged in order of the DCRDR elements identified in Supplement 1 to NUREG-0737, is provided below. The staff was assisted in its evaluation by Science Applications International Corporation (SAIC) personnel. A copy of the SAIC Technical Evaluation Report (TER), which contains a detailed evaluation of the WNP-2 DCRDR, is attached. The staff concurs with evaluations and conclusions in the TER.



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## 2.1 Establishment of a qualified multidisciplinary review team

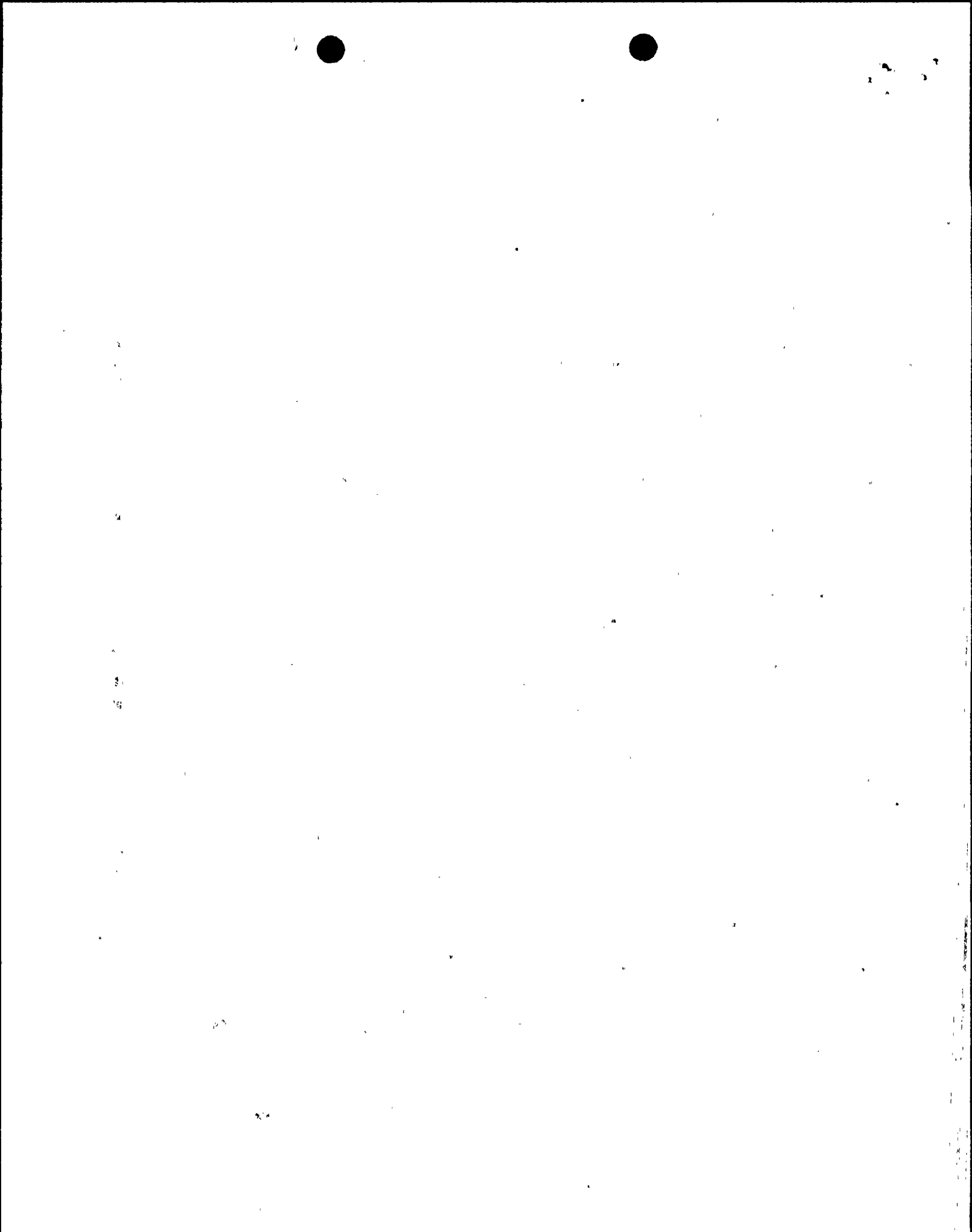
Evaluation criteria for this element relate to team leadership, delegation of authority, team composition, task assignments, and team orientation. To date the WNP-2 DCRDR has satisfied most of the above criteria. One concern is that trained human factors specialists participated in the pre-licensing PDA, but they did not participate in the post-licensing DCRDR. The attached TER identifies several DCRDR activities which may have been affected by not using human factors specialists. In the staff's judgment, WPPSS should ensure participation of human factors specialists in resolving concerns related to those activities. Inclusion of human factors specialists in activities required to complete the DCRDR should satisfy this DCRDR element.

## 2.2 Function and task analyses to identify control room operator tasks and information and control requirements during emergency operations

Evaluation criteria for this element relate to identification of operator tasks, identification of information and control capabilities required to perform those tasks, and identification of appropriate characteristics for displays and controls needed to satisfy the information and control capability requirements. Staff review of activities directed toward completion of this element identified one key concern. That concern involves use of what can be called "high level" EOPs as the basis for the task analysis. Such EOPs identify the plant functions to be performed in response to various symptoms associated with transients and accidents, but they do not typically identify all the operator tasks associated with those functions. Satisfaction of this element of the DCRDR requires that operator tasks be specifically identified. Furthermore, task identification must be detailed enough to allow an analysis which identifies all information and control capabilities required by the operators in performing the EOPs (including identification of appropriate characteristics for displays and controls to satisfy the information and control capability requirements).

Results of the July 15-18, 1986 preimplementation audit indicated that a detailed identification of operator tasks associated with the EOPs was not accomplished as part of the WNP-2 DCRDR. Despite that failure there was an effort to identify information and control capabilities required for operator performance of the EOPs. That effort, based on what was essentially a function level analysis, did identify an extensive list of information and control capabilities required to perform the EOPs. However, the completeness and accuracy of the list could not be confirmed because there was no reference to a list of all the operator tasks associated with the EOPs.

The preimplementation audit also indicated that appropriate characteristics for displays and controls to satisfy the information and control capability requirements were not specifically identified as part



of the task analysis effort. Determination of appropriate characteristics for required displays and controls requires prior identification and analysis of all operator tasks associated with the EOPs. As indicated above, detailed identification of operator tasks was not accomplished as part of the WNP-2 DCRDR.

The attached TER indicates that WPPSS exerted considerable effort related to this element and that the results of the effort do have value. However, a basic flaw, failure to identify all operator tasks associated with the EOPs, resulted in the element not being satisfied. In the staff's judgment, the existing task analysis effort should be augmented. That augmentation should build on the results already obtained and should include detailed identification of all tasks operators must perform to accomplish the EOPs, confirmation that all information and control capabilities required to perform those tasks have been identified, and identification of appropriate characteristics for displays and controls which are needed to satisfy the information and control capability requirements. Completion of such an augmentation should satisfy this DCRDR element.

### 2.3 Comparison of display and control requirements with a control room inventory

Evaluation criteria for this element relate to determination of the availability and suitability of displays and controls to satisfy the information and control capability requirements identified by the task analysis. Unavailable or unsuitable displays and controls should be documented as HEDs.

There are two key inputs to this element. They are a complete list of displays and controls required by operators in performing EOP tasks (including appropriate characteristics for those displays and controls) and a control room inventory. As indicated in 2.2 above, the existence of a complete list of displays and controls required by operators in performing EOP tasks could not be confirmed because neither the operator tasks associated with the EOPs nor the appropriate characteristics for the required displays and controls were identified. The attached TER indicates that WPPSS did develop a comprehensive control room inventory as part of the DCRDR. That inventory is maintained in a computer file which includes information about the characteristics of displays and controls in the inventory. Thus the adequacy of one of the two key inputs to the comparison process is of concern. The attached TER also indicates concern with the comparison process itself. In the staff's judgment, WPPSS should conduct a complete and systematic comparison of display and control requirements with the control room inventory after augmentation of the task analysis. The comparison should be used to confirm the availability and suitability of displays and controls to satisfy all EOP related needs for information and control capabilities. Needed displays and controls found to be unavailable or unsuitable should



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be recorded as HEDs. Completion of such a comparison should satisfy this DCRDR element.

#### 2.4 A control room survey to identify deviations from accepted human factors principles

Evaluation criteria for this element relate to use of accepted human engineering guidelines and completeness of the survey. Differences between the control room and guidelines should be documented as HEDs. The attached TER indicates that WPPSS control room survey process satisfies the criteria. The preimplementation audit did, however, identify several HEDs not previously addressed by the DCRDR. Those HEDs are identified in Appendix 2 of the attached TER. In the staff's judgment, this element of the DCRDR has been satisfied, but WPPSS should address HEDs identified in Appendix 2 of the TER in completing subsequent elements of the DCRDR (e.g., assessment, selection of design improvements, and verification).

#### 2.5 Assessment of HEDs to determine which are significant and should be corrected

Evaluation criteria for this element relate to HEDs' potentials for causing operator errors and the safety consequence of such errors. The attached TER indicates that WPPSS' process for assessing HEDs in the WNP-2 control room was generally acceptable. However the process did not include an assessment of the cumulative/interactive impact of HEDs. In the staff's judgment, this element of the DCRDR will not be satisfied until the cumulative/interactive impacts of HEDs are assessed. HEDs stemming from the comparison of display and control requirements identified by the augmented task analysis with the control room inventory and HEDs in Appendix 2 of the attached TER should be assessed in order to fully satisfy this element.

#### 2.6 Selection of design improvements

Evaluation criteria for this element relate to bringing the control room into agreement with accepted human engineering guidelines (including application of existing, modified, or new control room design conventions). The attached TER indicates that the process for selecting design improvements has resulted in acceptable modifications to the WNP-2 control room. The process is not, however, complete because resolutions for four HEDs have not been determined.

The selection of design improvements process also resulted in development of a Human Factors Engineering Standard. The standard should help to assure a consistent interface between the control room and the operator, but concerns identified in Appendix 5 of the attached TER indicate that development of the standard should continue.



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WPPSS has an acceptable process for selecting design improvements for HEDs. This element should be satisfied upon selection of design improvements for HEDs stemming from comparison of display and control requirements identified by the augmented task analysis with the control room inventory, selection of design improvements for the four HEDs whose resolution has not been determined, and upgrade of the Human Factors Engineering Standard.

2.7 Verification that selected improvements will provide the necessary correction and will not introduce new HEDs

Evaluation criteria for this element relate to the systematic use of appropriate verification processes and to iterative performance of those processes with selection of design improvements to assure that HEDs are corrected and that new HEDs are not introduced. Preimplementation audit results indicated that several techniques were used to conduct the required verifications. However, the attached TER identifies a concern about the systematic application of those techniques. Several of the findings identified in Appendixes 2, 3, and 4 of the attached TER would not be expected to survive an adequate verification effort.

In the staff's judgment, the verification process should be augmented to assure that selected improvements provide the necessary correction and do not introduce new HEDs. Design improvements selected for the HEDs stemming from comparison of display and control requirements identified by the augmented task analysis with the control room inventory and for the four HEDs whose resolution has not been determined should also be verified. This element will not be satisfied until the above activities are completed.

2.8 Coordination of control room improvements with changes from other programs such as the safety parameter display system, operator training, Reg. Guide 1.97 instrumentation, and upgraded emergency operating procedures

Evaluation criteria for this element relate to the consistency of the operators' interface with the control room following modifications resulting from the DCRDR and other required activities. The criteria also relate to the ability of the control room to support complete and technically adequate EOP's, the adequacy of training corrections for HEDs, and the adequacy of plans to counter short term degradation of operator performance resulting from control room modifications. The attached TER indicates that mechanisms for achieving the required coordination were part of the DCRDR program. Review of DCRDR results supported the effectiveness of the majority of those mechanisms. However, there is concern about the degree of coordination between the DCRDR and the EOP upgrade effort. This element of the DCRDR will not be satisfied until that concern is resolved.

## 2.9 Other DCRDR activities

Licensees and applicants may perform activities in addition to those required by Supplement 1 to NUREG-0737 as part of the DCRDR. Results of those activities should be used to augment or extend the benefits of the DCRDR.

The remote shutdown facilities were reviewed as part of the WNP-2 DCRDR. The attached TER notes that a number of changes to the remote shutdown facilities resulted. However, the staff is aware that a recent fire protection audit raised concerns about lighting, communications, and some portions of the operator's interface with displays and controls at the remote shutdown facilities. The staff recommends that those concerns be addressed in a manner consistent with the DCRDR.

WPPSS has also performed a licensee event report (LER) review as a supplement to other DCRDR activities. The LER review identified several HEDs. Those HEDs were found to be adequately addressed by corrections resulting from the normal LER process. In the staff's judgment, performance of the LER review enhanced the value of the WNP-2 DCRDR.

As noted previously, many HED corrections have already been implemented in the WNP-2 control room. During a visit to the control room, the preimplementation audit team noted that implementation of those corrections was not always adequate or complete. Appendixes 2-5 of the attached TER provide examples. WPPSS indicated that resolution of several of the problems noted by the audit team were receiving further consideration (e.g., noise levels in the control room). However, the staff is concerned that the effort to improve the operator interface with the control room may not be receiving adequate attention during implementation of HED corrections in the control room. Failure to attend to detail in implementing even the simplest HED correction (e.g. failure to label properly newly installed equipment) may degrade the operator interface with the control room. In the staff's judgment, assurance of an acceptable operator interface with the control room requires increased management attention.

## 2.10 DCRDR results

The Summary Report must provide DCRDR results in terms of proposed control room changes and schedules for implementing those changes. The Summary Report must also provide justification for not correcting or partially correcting significant HEDs. Those results are evaluated in terms of their effects on risk and the safety of operation.

Review of WPPSS November 1, 1985 Summary Report and the additional information provided by letters dated December 4, 1985 and June 3, 1986 indicated that proposed control room modifications and the schedule for

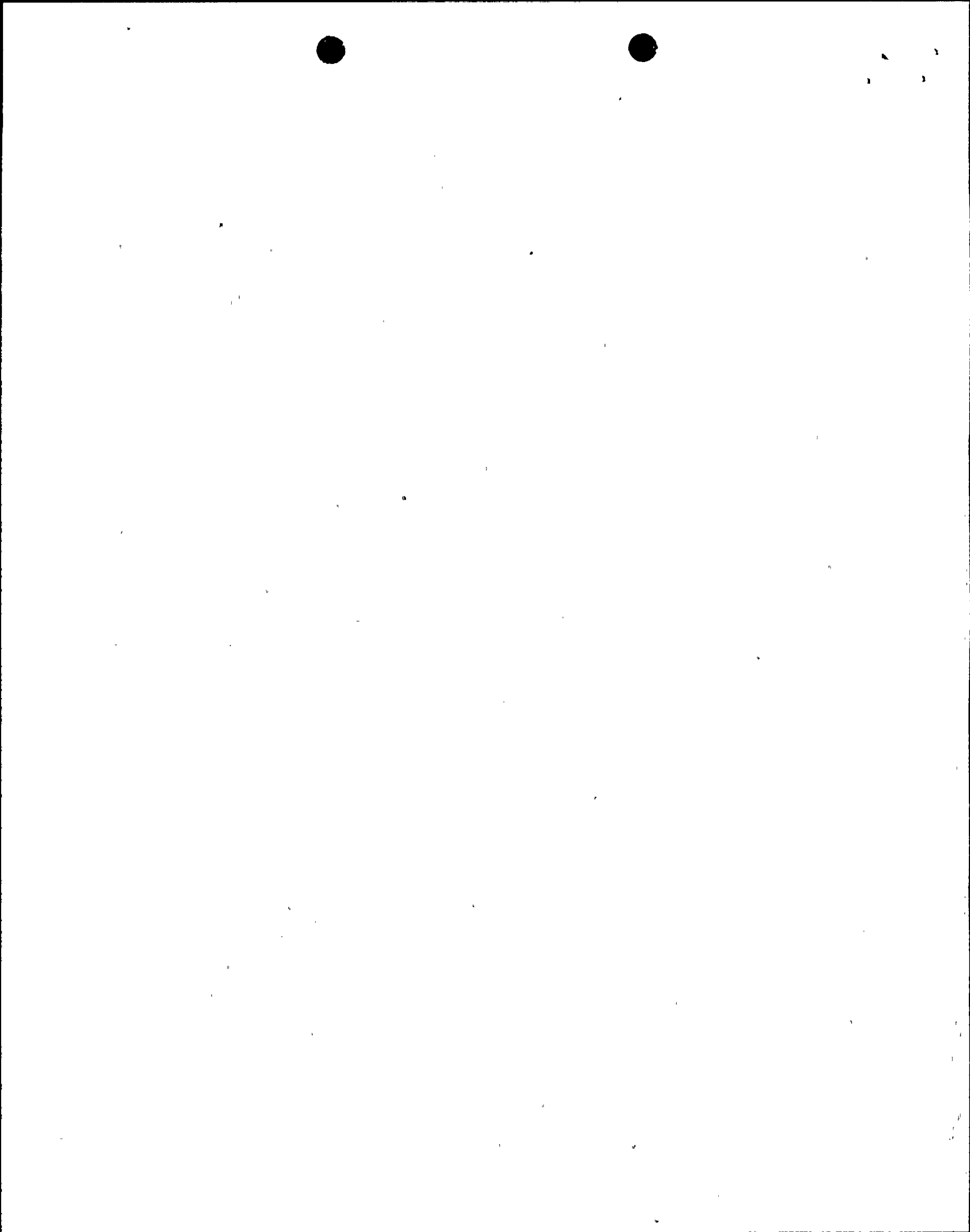


implementing those modifications were generally acceptable. Justifications for not correcting HEDs were also generally acceptable. The attached TER does, however, indicate three concerns related to Summary Report Requirements. The first concern is that resolutions for four HEDs have not been determined. The second concern is that other HEDs may be identified as the result of activities discussed in 2.3, 2.7, 2.8, and 2.9 above. The third concern is that complete satisfaction of the justification requirement can not be confirmed because the Summary Report did not identify which HEDs were determined to be significant by the DCRDR's assessment process. Summary Report requirements will not be satisfied until the above concerns are resolved.

### 3.0 CONCLUSION

The WNP-2 DCRDR is incomplete. In the staff's judgment, several activities must be completed in order to satisfy the DCRDR requirements in Supplement 1 to NUREG-0737. Those activities are:

1. Multidisciplinary review team - Ensure participation of human factors specialists in resolving staff concerns about the WNP-2 DCRDR.
2. Function and task analysis - Augment the task analysis as discussed in 2.2 above.
3. Comparison of display and control requirements with a control room inventory - Conduct a complete and systematic comparison of display and control requirements identified by the augmented task analysis with the control room inventory.
4. Assessment of HEDs - Assess HEDs for cumulative/interactive effects and assess HEDs stemming from comparison of the display and control requirements identified by the augmented task analysis with the control room inventory.
5. Selection of design improvements - Select design improvements for HEDs whose resolution is still being evaluated and for HEDs stemming from comparison of the display and control requirements identified by the augmented task analysis with the control room inventory. Upgrade the Human Factors Engineering standard as discussed in 2.6 above.
6. Verification that HEDs are corrected and that new HEDs are not introduced - Augment the verification process as discussed in 2.7 above. Include verification of HED corrections discussed in 2.4 above.
7. Coordination with improvements from other programs - Enhance coordination with the EOP upgrade effort to resolve concerns addressed in 2.2 and 2.8 above



8. Other DCRDR activities - Increase management attention to assure that implementation of HED corrections is complete and adequate.

WPPSS is required to maintain an auditable record of all activities necessary to complete the WNP-2 DCRDR. WPPSS should also submit a Summary Report supplement which:

1. Identifies actual staffing and methods for each of the above activities
2. Confirms completion of those activities
3. Provides information about the results of activities in terms of proposed control room modifications, implementation schedules, and justification for not correcting or partially correcting significant HEDs.

Evaluation of the WNP-2 DCRDR will continue through completion of the above activities. Final staff evaluation will be reported in a supplement to this SE.

Principal Contributor: Dennis Serig

Dated: October 31, 1986

## REFERENCES

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

NUREG-0700, "Guidelines for Control Room Design," September 1981.

NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980; Supplement 1, December 1982.

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

Letter from G.C. Sorenson (WPPSS) to A. Schwencer (NRC). Subject: "Nuclear Plant No. 2 Detailed Control Room Design Review Program Plan and Addendum to the Procedures Generation Package," dated February 17, 1984.

Letter from G.C. Sorenson to A. Schwencer. Subject: "Nuclear Plant No. 2 Licensing Condition (16)," dated March 19, 1984.

Letter from G.C. Sorenson to A. Schwencer. Subject: "Nuclear Project No. 2 Operating License NPF-21 Licensing Condition (16)," dated April 17, 1984.

• - Memorandum from W.T. Russell (NRC) to T.M. Novak (NRC). Subject: "Review Comments on Washington Public Power Supply System's Detailed Control Room Design Review Program Plan for Nuclear Project No. 2," dated May 3, 1984.

Letter from G.C. Sorenson to W.R. Butler (NRC). Subject: "Nuclear Plant No. 2 Detailed Control Room Design Review (DCRDR) Summary Report, Submittal of," dated November 1, 1985.

Letter from G.C. Sorenson to E.G. Adensam (NRC). Subject: "Nuclear Plant No. 2 Detailed Control Room Design Review (DCRDR) Summary Report, Submittal of," dated December 4, 1985.

Letter from G.C. Sorenson to E.G. Adensam. Subject: "Nuclear Plant No. 2 Detailed Control Room Design Review (DCRDR) Summary Report, Supplemental Information," dated June 3, 1986.

