ATTACHMENT TO SE
TROJAN NUCLEAR PLANT

SAIC-85/1034

TECHNICAL EVALUATION OF THE DETAILED CONTROL ROOM DESIGN REVIEW OF THE TROJAN NUCLEAR PLANT

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FOREWORD

This Technical Evaluation Report (TER) documents findings related to the Detailed Control Room Design Review (DCRDR) being conducted by Portland General Electric (PGE) for its Trojan Nuclear Plant. An evaluation of PGE's DCRDR Summary Report was previously provided to the NRC by SAIC as a draft TER. The current document encompasses findings from the evaluation of the Summary Report as well as findings from a pre-implementation audit, and a previously conducted Program Plan review and in-progress audit.

The pre-implementation audit was conducted by a three-man team comprised of one representative each from the Human Factors Engineering Branch of the NRC's Division of Human Factors Safety, Science Applications International Corporation (SAIC), and Comex Corporation, a subcontractor to SAIC. The pre-implementation audit consisted of control room and remote shutdown panel visits, document reviews, and extensive discussions during the week of February 25, 1985. Representatives of PGE and General Physics Corporation (GPC), PGE's human factors consultants, were available. DCRDR methodologies and resultant HEDs were reviewed. Where clarification of HEDs or corrective actions was needed, photographs and panel drawings were consulted.

SAIC's evaluation was performed in support of the Human Factors Engineering Branch, Division of Human Factors Safety, under Contract NRC-03-82-096, Technical Assistance in Support of Reactor Licensing Actions: Program III. SAIC previously participated in the Program Plan review and in-progress audit of the Trojan DCRDR.

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BACKGROUND

This report documents Science Applications International Corporation's (SAIC's) technical evaluation of Portland General Electric (PGE) Company's Detailed Control Room Design Review (DCRDR) of the Trojan Nuclear Plant. Licensees and applicants for operating licenses are required to conduct a Detailed Control Room Design Review. 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.1). The need to conduct a DCRDR was confirmed in NUREG-0737 and in 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 its DCRDR on a schedule negotiated with the NRC. Guidelines for conducting a DCRDR are provided in NUREG-0700 while the evaluation criteria for NRC review are contained in NUREG-0800. (The NUREG documents cited are listed as References 1 through 5.)

A DCRDR is to be conducted according to the applicant's or licensee's own Program Plan. That plan must be submitted to the NRC for review and comment. According to NUREG-0700, the DCRDR should include four phases: (1) planning, (2) review, (3) assessment implementation, and (4) reporting. One product of the last phase is a Summary Report which, according to Supplement 1 to NUREG-0737, must include an outline of proposed control room changes, their proposed schedules for implementation, and summary justification for human engineering discrepancies (HEDs) with safety significance to be left uncorrected or partially corrected. Upon receipt of the applicant's or licensee's Summary Report, the NRC must prepare a Safety Evaluation Report (SER) indicating the acceptability of the DCRDR. The safety evaluation is based on all available documentation as well as on any briefings, discussions, or audits, during the DCRDR.

The purpose of this Technical Evaluation Report is to assist the NRC by providing the findings of a technical evaluation of the PGE DCRDR organization, process, and results. Specific DCRDR requirements, as stated in Supplement 1 to NUREG-0737, can be summarized in terms of the nine specific elements listed below:

1. Establishment of a qualified multidisciplinary review team.

2. Use of 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 to determine which are significant and should be corrected.

6. Selection of design improvements that will correct those discrepancies.

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

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

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

DISCUSSION

The human factors engineering review of the Trojan control room and remote shutdown area began with a preliminary assessment in 1981 in response to NUREG-0660 (Reference 1). This preliminary assessment, which was conducted by PGE with human factors assistance provided by General Physics Corporation (GPC), is referred to as Phase 1 in PGE documents. The DCRDR (Phase 2) began with the submittal of the Program Plan to the NRC on July 28, 1983 (Reference 6). The NRC staff comments on the Program Plan were forwarded to PGE on November 17, 1983, with the recommendation that an in-progress audit be conducted (Reference 7). An in-progress audit was conducted at Trojan on December 12-16, 1983, and the findings of the audit were forwarded to PGE on February 16, 1984 (Reference 8). PGE submitted the DCRDR Summary Report for Trojan on December 31, 1984 (Reference 9). Review of the DCRDR Summary Report indicated the need for a pre-implementation audit. The purpose of the audit, which was conducted from February 25 to March 1, 1985, was to continue evaluation of the organization, process, and results of the DCRDR. Participants in the audit entry and exit meetings are identified in Appendix A. DCRDR requirements, set forth in NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability," December, 1982 (Reference 4) and summarized above, served as the basis for evaluating the Trojan DCRDR. Technical evaluation results are provided below.

PLANNING PHASE

The conclusion of the NRC staff in its review of PGE's DCRDR Program Plan was that "although Portland General Electric may be executing an appropriate review, there is insufficient information to allow NRC to provide definite comments on all the review elements." The NRC staff recommended that an in-progress audit be scheduled for the purpose of discussing the DCRDR Program Plan in detail. The current report addresses concerns that were identified but not resolved during the in-progress audit as well as concerns identified during review of the Summary Report and during the pre-implementation audit. A DCRDR element of particular concern during the planning phase is the qualification and structure of the DCRDR team. Our evaluation of that element is provided below.

Qualifications and structure of the DCRDR team. The Summary Report indicated that PGE had established a qualified, multidisciplinary review team. PGE management provided the overall administrative leadership for the DCRDR and gave the DCRDR team sufficient authority to carry out its mission. The core group of specialists comprising the DCRDR team represented the fields of human factors engineering, plant operations, instrument and control engineering, and nuclear engineering. Technical support to the core group was provided by PGE on an as-needed basis. Staffing for the DCRDR activities to date has been appropriate. Certain PGE members of the DCRDR team took coursework in human factors at a local university. In addition, PGE's human factors consultants (General Physics Coporation) provided a human factors orientation course for all DCRDR team members. Prior to PGE's submittal of the Summary Report, the following concerns regarding the qualifications and structure of the DCRDR team were identified during the in-progress audit:

1. There was a loss in continuity from Phase 1 to Phase 2 due to a large change in personnel and lapse in time.

2. There appeared to be insufficient integration and involvement between the PGE staff and its human factors consultants from GPC.

3. The DCRDR effort appeared to have little visibility and a low level of involvement on the part of management.

The in-progress audit team found PGE to be unfamiliar with Phase 1 activities and the rationale behind the recommendations made to correct HEDs identified in that phase. This unfamiliarity appeared to be due to an insufficient amount of integration and involvement between the PGE DCRDR team and its human factors consultants from GPC. At the time of the in-progress audit, PGE seemed to be overreliant on GPC to perform certain DCRDR activities, such as developing recommendations for correcting HEDs. However, based upon a review of the Summary Report and subsequent discussions with PGE during the pre-implementation audit, it is our judgment that PGE has (1) become adequately familiar with the Phase 1 activities; (2) integrated Phase 1 results (HEDs) in Phase 2; and (3) provided sufficient integration and involvement between itself and GPC in the DCRDR activities. Phase 1 activities, including an operating experience review and control

room survey, and Phase 1 results were updated and are included in the DCRDR (Volume 1, pp. 2-4 and 2-5). Review of the Summary Report and discussions during the pre-implementation audit indicated that PGE and GPC participated interactively in assessing HEDs and in selecting design improvements (Volume 1, pp. H-57 through H-59). The pre-implementation audit team recommended that close interaction between PGE and GPC continue for the DCRDR activities that remain to be completed.

Results of the in-progress audit indicated that there was a low level of management involvement in the Trojan DCRDR. At that time, management's lack of attention to the DCRDR was believed to have reduced the effectiveness of the recommendation/approval process. Recommendations for control room improvement were being submitted to management without prior management familiarization with the recommendations or with the DCRDR processes leading up to the recommendations. PGE appears to have resolved this concern. The Summary Report indicates that "Information copies of the Category I, II, and III and IV HEDs with GPC recommendations for resolution will be provided to Nuclear Division Management..." and that "This will enhance management awareness of problems and potential solutions early in the resolution phase" (Volume 1, p. H-57). PGE reaffirmed its commitment to ensure management involvement and familiarity during the pre-implementation audit.

In summary, PGE appears to have resolved NRC concerns identified during the in-progress audit regarding (1) the loss of continuity from Phase 1 to Phase 2; (2) the integration and involvement between PGE and GPC; and (3) the visibility of the DCRDR and management involvement. The pre-implementation audit team concluded that up to this point of the DCRDR, PGE has met the NUREG-0737, Supplement 1 requirement regarding the establishment of a qualified, multidisciplinary review team. PGE stated that it intends to retain GPC on a continuing services contract for any further necessary involvement.

REVIEW PHASE

PGE's review phase activities include:

1. Operating Experience Review
2. Control Room Survey

3. Systems Function Review and Task Analysis (SFRTA)
4. Verification of Task Performance Capabilities
5. Validation of Control Room Functions.

The above activities are those recommended by NUREG-0700 guidelines as contributing to the accomplishment of the review phase objectives. Activities 2 through 4 address specific DCRDR requirements contained in Supplement 1 to NUREG-0737. Although a review of operating experience is not required by Supplement 1 to NUREG-0737, the results of that review were integrated into required DCRDR activities and therefore will be given attention in this report. Due to the interrelation of the verification of task performance capabilities and the validation of control room functions with the SFRTA, these activities will be discussed together.

Operating experience review. PGE's review of operating experience consisted of two activities: (1) a documentation review, and (2) an operating personnel survey. The documentation review included a detailed examination of Licensee Event Reports (LERs) and Possible Reportable Occurrences (PROs) for the period of 1976 to April 1981 during Phase 1 and of those that occurred subsequent to April 1981 during Phase 2. Those incidents found to involve human factors issues were analyzed to identify the following:

1. The workstations, procedures, instruments, and plant systems that were involved
2. The nature of the human error (omission, commission, etc.)
3. The probable cause of the event
4. The consequences of the event
5. The corrective action taken by management or proposed
6. Any additional human factors related recommendations

PGE states that the results of each incident analyzed will be summarized on an LER/PRO form (Appendix A of Summary Report Volume 1), and HEDs identified in this process will be entered into the data base for assessment and resolution. The documentation review appears to be adequate for reviewing plant historical documentation and has identified seven HEDs according to Volume 2 of the Summary Report.

The operating personnel survey was accomplished by distributing a self-administering, 41-item questionnaire to eight operating personnel in Phase 1 and to five "newly licensed" operators who did not participate in Phase 1 to update the survey for Phase 2. When all questionnaires were returned, the Summary Report states that a human factors person from GPC conducted follow-up interviews to obtain needed clarification or elaboration of any items. The Summary Report further states that "survey findings which translate into HEDs will be noted as such in the summary." The methodology and questionnaire for survey operating personnel appear to be adequate and have identified eleven HEDs according to Volume 2 of the Summary Report.

In summary, the methodology and scope of the review of operating experience appear to be such that the review can make a useful contribution to DCRDR findings. The operating experience review has contributed to the identification of eighteen HEDs.

Control room survey. PGE has performed a systematic survey of the control room using the guidelines in Section 6 of NUREG-0700. During the in-progress audit, the audit team performed surveys on several panels in the control room and compiled a list of HEDs. A brief spot-check of the HEDs identified by PGE in its survey revealed that the HEDs identified by the in-progress audit team and PGE surveys were similar. Although the control room survey was systematic and used accepted human engineering guidelines, the following concerns regarding the control room survey were identified during the in-progress audit:

1. The control room survey was incomplete.

2. There was no human factors input into the PGE's list of standardized abbreviations and acronyms.

3. The current PGE DCRDR team was not adequately familiar with the Phase 1 survey work.

At the time of the in-progress audit, PGE had completed approximately 97 percent of the control room survey. At the same time, PGE had not completed the following activities:

1. Integration of the SPDS evaluations with the control room survey.

2. Evaluation of the D.C. Emergency Lighting System.

3. Evaluation of the new instrumentation to be added to the control room.

4. Evaluation of task-related checklist criteria.

In the DCRDR Summary Report, PGE's listing of HED groupings includes a discussion on HEDs related to the P-2500 computer for the SPDS (Volume 1, p. 3-6). Volume 2 of the Summary Report contains HEDs concerning the P-2500 computer (HEDs 358 through 363). The Summary Report states that "HEDs in this area will be referred to the Nuclear Plant Engineering Department for consideration in the SPDS verification and validation" but that "No action is planned for these HEDs..." Although several HEDs on the P-2500 computer have been identified, the SPDS survey has not been completed. During the pre-implementation audit, PGE stated that the SPDS is not yet considered operational and assured the audit team that the SPDS will be comprehensively surveyed. The pre-implementation audit team indicated that completion of the SPDS survey, along with assessment of HEDs and selection, verification, and scheduling of design improvements, is necessary to satisfy the coordination element of the DCRDR.

Since the in-progress audit, PGE has surveyed the D.C. Emergency Lighting System and identified one HED. HED Number 368 concerns the non-uniform distribution and low level of D.C. emergency lighting. PGE stated that a further survey of emergency lighting will be conducted after eight-hour lanterns have been installed as a result of a fire protection upgrade. Close-out of this item should be based on the results of the lighting survey completed after upgrade of emergency lighting. Remaining HEDs should be identified and assessed and a schedule for their correction provided to the NRC.

In reference to new instrumentation to be added to the control room, the Summary Report states that "New instrumentation added to the control room in accordance with NUREG-0737 initiatives has been evaluated as part of the DCRDR" and that "any Human Engineering Discrepancies noted in this

review have been documented as HEDs" (Volume 1, p. 2-3). PGE stated during the pre-implementation audit that checklists consisting of applicable NUREG-0700 criteria were used to evaluate new instrumentation and that human factors consideration has been given to all Request for Design Changes (RDCs) since the control room survey had been performed.

The evaluation of task-related checklist criteria appears to have been performed in the validation of control room functions. The Summary Report states that "Control room survey guidelines that call for a consideration of task sequence requirements and other aspects of operational dynamics will be reviewed following the walk-throughs" (Volume 1, p. H-43). PGE confirmed during the pre-implementation audit that task-related checklist criteria were addressed during the validation of control room functions and that these criteria were applied to all control room equipment, not just emergency-related equipment involved in the validation walk-throughs.

During the pre-implementation audit, a new concern about the completeness of the control room survey was identified. It was noted that at least three studies were in progress as a result of the HEDs identified in the control room survey. Annunciators, meters, and the remote shutdown area potentially have problems of such magnitude that PGE has determined to address each of those areas separately. The pre-implementation audit team indicated that such an approach is acceptable, but the separate studies are still properly a part of the DCRDR. Thus completion of the DCRDR requires that at least the annunciator and meter studies are completed and corrections for HEDs are selected, verified, and scheduled for implementation. PGE is encouraged, but not required, to include the remote shutdown area in the DCRDR.

At the time of the in-progress audit, PGE was relabeling the control room based upon a list of standardized abbreviations and acronyms. The in-progress audit team's review of this relabeling effort found that the labels produced were not standardized and that the list upon which the effort was based did not receive human factors input. The in-progress audit team recommended that a revised standard for abbreviations and acronyms be developed which incorporates human factors principles into label format, size, and location as well as into abbreviations and acronyms. The Summary Report responds to that concern with HED Number 142 which cites ten

different discrepancies associated with control room labeling. In addition, the Summary Report states that RDC No: 84-125 establishes and implements a standard label scheme and format which will correct these discrepancies (Volume 1, p. 3-2). In addition to incorporating this standard as part of the "Design Conventions Checklist" to be used in the review process for future engineering changes and design modifications to the control room, PGE stated during the pre-implementation audit that this standard for labeling will be applied to other relevant areas, such as procedures (i.e., Emergency Instructions), SPDS, the ERF SPDS, the remote shutdown area, and possibly some other plant/operator localities (e.g., the Rad Waste panels). In addition to these areas, we recommend that PGE perform a review of all other areas, such as training documentation and the emergency procedures at the ERF, where consistent labeling would reduce the probability of human errors with safety consequences.

As stated in the qualifications and structure of the DCRDR team section of this report, at the time of the in-progress audit the current PGE DCRDR team did not seem to be adequately familiar with the Phase 1 survey work. However, a review of the Summary Report found discussion which leads us to conclude that PGE has now become adequately familiar with the Phase 1 survey and has integrated the HEDs resulting from the Phase 1 survey into the DCRDR assessment phase. Discussions with PGE during the pre-implementation audit confirmed this conclusion.

In summary, most concerns about the control room survey identified during the in-progress audit have been resolved; but some areas of the survey still need to be completed. The areas are (1) an evaluation of the SPDS within the scope of the DCRDR, and (2) the surveys of the annunciators and meters (and at PGE's option the remote shutdown area). HEDs should be identified and assessed, and design improvements should be selected and verified as in the main portion of the DCRDR. An auditable record of those activities should be maintained. Summary Report requirements should also be satisfied for the incomplete areas identified above.

Systems function review and task analysis and comparison of display and control requirements with a control room inventory. The following concerns regarding the SFRTA and comparison with the control room inventory were identified during the in-progress audit:

1. An a priori, comprehensiveness analysis of emergency-related tasks to identify information and control requirements was not performed.

2. The selection of five scenarios for the walk-throughs performed in the validation of control room functions was too limited to exercise all emergency-related control room/operator interfaces.

Through discussions held with the PGE and GPC personnel involved in conducting the SFRTA, the in-progress audit team concluded that the task analysis was not, at that time, being conducted at the depth necessary to determine information and control requirements independently of the control room as it existed. The task analysis worksheet column headed "I&C Requirements" was being used to record which of the existing instruments and controls the operators would use in each task. The instruments and controls (I&C) identified were subsequently verified or corrected during the scenario walk-throughs. The methodology did not constitute an a priori/independent comprehensive analysis of emergency-related tasks or identify information and control requirements associated with these tasks.

Complete NRC evaluation of the Trojan SFRTA and comparison of display and control requirements with a control room inventory was not possible during the in-progress audit. Complete evaluation was dependent upon the outcome of an NRC meeting with the Westinghouse Owners Group (WOG) to discuss the adequacy of the WOG Emergency Response Guidelines (ERGs) and background documentation (including the generic system review and task analysis) with respect to the function and task analysis requirement of NUREG-0737, Supplement 1. That meeting was held March 29, 1984. The NRC concluded from the meeting with the WOG that "it appears that Revision 1 of the ERG and background documents do provide an adequate basis for generically identifying information and control needs" (Reference 10). The NRC also concluded that "Each licensee and applicant, on a plant-specific basis, must describe the process for using the generic guidelines and background documentation to identify the characteristics of needed instrumentation and controls." The NRC continued by stating that "For each instrument and control used to implement the emergency operating procedures, there should be an auditable record of how the needed characteristics of the instruments and controls were determined" and that "these needed characteristics should be derived from the information and control needs identified in the

background documentation of Revision 1 of the ERG or from plant-specific documentation."

NRC conclusions about the WOG ERGs were based upon a review of Revision 1 of that document. PGE based its SFRTA on Revision 0 of the WOG ERGs. To account for any differences between Revision 0 and Revision 1 of the WOG ERGs, PGE stated that it would perform a comparison of the two versions. For any task differences found, PGE stated it would analyze the tasks to determine the information (at the parameter level) and control requirements. Based upon the NRC's conclusions from its meeting with the WOG and on PGE's comparison of task differences between Revision 0 and Revision 1 of the WOG ERGs, it appears that PGE has, to date, used the WOG generic system review and task analysis to identify all operator tasks and the needed information (at the parameter level) and controls required to perform operator tasks during emergency operations. However, neither PGE's analysis of tasks, as reviewed during the in-progress audit, nor the analysis to be performed for the differences found between Revision 0 and Revision 1 of the WOG ERGs identifies the required characteristics of necessary I&C. The implications for the comparison of display and control requirements with a control room inventory is that (1) the verification of I&C availability appears to be based upon an a priori, comprehensive set of information (at the parameter level) and control requirements; but that (2) the verification of I&C suitability does not appear to be based upon an a priori, comprehensive set of required characteristics of needed instruments and controls. At the time of the in-progress audit, the NRC stated that PGE would have to demonstrate that an expanded analysis of I&C suitability would be adequate to compensate for not having performed an a priori, comprehensive analysis of required characteristics of needed instruments and controls.

Since the in-progress audit, PGE and GPC personnel have performed an evaluation of instrument and control suitability using the process illustrated in Figure 4-6 on page H-51 of Volume 1 of the Summary Report. In addition, they have committed to perform an evaluation of suitability of those instruments and controls involved in the tasks found to differ between the two versions of the WOG ERGs. The evaluation of instrument and control suitability is based upon the answers to a series of questions referred to as "criteria for decisions." Conformance and nonconformance to these criteria are recorded in the "Verification" and "EQ" columns of the task

analysis worksheet (Volume 1, p. H-49 and Figure 2-4). Instances of non-conformance are expanded upon in the "Equipment Suitability HEDs" form (Volume 1, p. H-52 and Figure 2-5). Based upon a review of the criteria and discussions with PGE and GPC personnel, it appears that the relevant characteristics of instruments and controls are considered. The process used by PGE to verify I&C suitability is not based upon an a priori analysis and identification of required characteristics of instruments and controls, but, in our judgment, the approach used by PGE has adequately compensated for this.

PGE used the control room itself as the control room inventory against which display and control requirements were compared. The NRC has found this to be an acceptable alternative.

In addition to the lack of an a priori, comprehensive analysis of emergency-related tasks, the NRC audit team expressed a concern at the time of the in-progress audit regarding the selection of scenarios for the validation of control room functions. The selection of five scenarios for the walk-throughs performed in the validation of control room functions appeared to be too limited to exercise all emergency-related control room/operator interfaces. At the NRC's suggestion, PGE agreed to broaden the scope to cover all emergency-related control room/operator interfaces. The NRC review of the information provided during the pre-implementation audit concerning the scenarios selected (Volume 1, p. 2-6 and Appendix D of the Summary Report), the Task/System Matrices (e.g., Figures 2-1 and 2-2 of the Summary Report), and the analysis of residual tasks (e.g., Figure 2-4 of the Summary Report) concluded that the selection of scenarios was adequate for exercising all emergency-related control room/operator interfaces.

In summary, concerns related to the SFRTA and comparison of display and control requirements with a control room inventory identified during the in-progress audit appears to have been resolved. In our judgment, the upgrade of the task analysis to be consistent with Revision 1 of the WOG ERGs and verification of task performance capabilities will satisfactorily complete the NUREG-0737, Supplement 1 requirements for (1) a function and task analysis, and (2) a comparison of display and control requirements with a control room inventory. For new and revised tasks (as identified by the comparison of Revision 0 and Revision 1 ERGs), the update should include identification

of information and control needs, identification of appropriate characteristics for required instruments and controls, and determination of availability and suitability of required instruments and controls.

ASSESSMENT AND IMPLEMENTATION PHASE

Assessment of HEDs. The following concerns related to the assessment of HEDs were identified during the in-progress audit:

1. The HED assessment methodology was not finalized, and the criteria used to categorize HEDs were ambiguous.

2. Based on low estimated potential for error, some HEDs would not be completely assessed for safety impact.

3. Assessment of Phase 1 HEDs was not integrated with the Phase 2 HED assessment process.

The HED assessment methodology is described in Appendix H of the Summary Report (pp. H-54 through H-57). The approach taken by PGE was to allow operations, I&C, and engineering representatives, the GPC human factors Project Manager, the DCRDR Project Coordinator, and at least one licensed operator to assess all HEDs independently for the potential for operator error and impact upon plant safety. The DCRDR Project Coordinator collected the independent evaluations, determined the predominant category assignment for each HED, and distributed the results of these determinations to the evaluators. If no disagreement occurred concerning the predominant category assignment, this assignment became the consensus. Evaluators who disagreed with the predominant category assignment for any HEDs were allowed to defend their choice of category in a meeting attended by all the evaluators. A final category assignment was determined by vote at that meeting for the HEDs in question. Remaining disagreements do not appear to have been documented, but review of the results of the assessment process (provided in the Summary Report) did not identify areas of concern. The criteria used to determine the potential for operator error and impact upon plant safety are listed in Table 5-1 and Table 5-2, respectively (Volume 1, pp. H-61 and H-62). Although the judgment required in using these criteria is subjective, the criteria in both tables appear to lend reliability to the

process by providing a rigorous and systematic assessment of HEDs. Issues which could compromise the judgment of impact upon plant safety, such as the means and potential cost of correcting HEDs, were not among the assessment criteria. The categories into which HEDs are classified are defined as the following:

Category 1 - HEDs associated with documented errors which resulted in unsafe conditions or Technical Specification violations.

Category 2 - HEDs associated with high potential errors which may result in unsafe conditions or Technical Specification violations.

Category 3 - HEDs associated with low potential errors which may result in unsafe conditions or Technical Specification violations.

Category 4 - HEDs not important to safety.

These categories appear to be acceptable for classifying and prioritizing HEDs for implementation of planned corrections. PGE's assessment methodology was further evaluated through review of Category 4 HEDs listed in Volume 2 of the Summary Report. Based only on a paper review, the category assignments appeared, with a few exceptions, to be acceptable and to have considered aggregate effects of HEDs. Discussion with PGE during the pre-implementation audit indicated that the exceptions were also satisfactorily categorized.

Another concern that surfaced during the in-progress audit was that PGE would not continue to assess HEDs for impact upon plant safety once HEDs are considered not to have resulted in a documented error or contributed to the potential for operator error. The in-progress audit team indicated that PGE should continue to assess HEDs for impact upon plant safety regardless of the estimated potential for operator error since the probability of operator error, however low, always exists and that potential for error judgment is subjective. In response to the in-progress audit team's comment, the Summary Report states that "HEDs considered to have resulted in documented errors or contributing to the potential for error will be assessed according

to impact upon plant safety..." (Volume 1, p. H-55). Although not specifically stated in the Summary Report, discussions with PGE during the pre-implementation audit indicate that PGE has assessed all HEDs for impact upon plant safety.

In order to integrate the Phase 1 HEDs into the Phase 2 HED assessment process, the in-progress audit team indicated that PGE should reassess Phase 1 HEDs. In response to the in-progress audit team's comment, the Summary Report states that the findings of the Phase 1 survey were "carried forward for consideration in the HED Assessment Phase of the DCRDR" (Volume 1, p. 2-5). During the pre-implementation audit, PGE indicated that Phase 1 assessment values were modified to be consistent with the assessment process used for Phase 2. In our judgment, the concern was adequately resolved.

In summary, the methodology and criteria used by PGE to assess HEDs appear to be acceptable. We believe that PGE has successfully met this requirement of NUREG-0737, Supplement 1.

Selection of design improvements. The following concerns related to the selection of design improvements were identified during the in-progress audit:

1. Insufficient involvement by management early in the process.

2. Insufficient exchange of background information from GPC to PGE regarding GPC's recommendations for HED resolution.

3. Integration of Phase 1 recommendations for resolving HEDs with Phase 2 recommendations.

As discussed in the "qualifications and structure of the DCRDR team" section of this report, the in-progress audit team concluded from discussions with PGE concerning proposed control room improvements (e.g., the relabeling work and color padding study) that these efforts seem to have suffered because of lack of management and/or operations involvement early in the process. PGE responded to the concern in its Summary Report by stating "Information copies of the Category I, II, and III [and IV] HEDs with GPC recommendations for resolution will be provided to Nuclear Division

Management (Technical Functions General Manager, Nuclear Plant Engineering Manager, Nuclear Safety and Regulation Manager, and Trojan Plant Manager)" and that "This will enhance management awareness of problems and potential solutions early in the resolution process" (Volume 1, p. H-57). From this statement it appears that PGE, in addition to including operations at the DCRDR team level of review, has provided plans for management involvement earlier in the resolution process. Discussions with PGE during the pre-implementation audit confirmed that management was now adequately aware of and involved in the DCRDR.

At the time of the in-progress audit, the audit team found that GPC apparently made recommendations for resolving HEDs without providing PGE with the rationale behind the recommendations. The in-progress audit team recommended that GPC provide PGE with the rationale for its initial as well as subsequent recommendations for resolving HEDs. The Summary Report indicates that GPC's involvement in selecting design improvements is limited to providing initial recommendations. From that point in the resolution process, the Summary Report indicates that engineering and operations representatives of the PGE DCRDR team perform a "feasability and scope" review of GPC's recommendations. Finally, the Summary Report indicates that the PGE DCRDR team (not including human factors engineers) develops a final list of HEDs and resolutions. In contrast to the Summary Report indications, discussions with PGE and GPC during the pre-implementation audit indicated that GPC was involved beyond providing initial recommendations in the design improvement selection process. GPC participated in resolving major integration or change issues (e.g., color padding) and provided human factors input when HEDs were to be resolved in a way other than GPC initially recommended. PGE stated that GPC was being retained on a continuing services contract to ensure adequate human factors consideration in the selection of design improvements. We believe that GPC involvement in the continuing selection of design improvements effort provided needed human factors expertise.

The in-progress audit team indicated that Phase 1 recommendations should be reviewed by PGE to ensure integration with Phase 2 recommendations. Although the Summary Report does not specifically state that PGE reviewed Phase 1 recommendations, the integration of Phase 1 HEDs into the HED Assessment Phase of the DCRDR (Phase 2) implies that PGE has adequately

considered and ensured the integration of Phase 1 recommendations with Phase 2 recommendations.

In summary, all of the concerns about selection of design improvements raised at the time of the in-progress audit have been resolved as documented in the Summary Report or as discussed during the pre-implementation audit. However, the pre-implementation audit indicated that the selection of design improvements is unfinished. Continuing human factors and operations involvement is necessary for the remaining HED resolutions to be adequately developed and reviewed. We recommend that resolutions to all HEDs consider the established conventions for the Trojan control room. To this end, we further recommend that PGE complete its documentation of control room conventions and apply this documentation to the HED resolution and verfication processes. Both the conventions and the control room should be improved as a result of following the above recommendations.

Verification that improvements will provide the necessary corrections without introducting new HEDs. The following concerns related to the verification process were identified during the in-progress audit:

1. The need to conduct a post-implementation follow-up as part of the improvement verification process.

2. The need to use a mock-up to assist in verifying improvements before implementation.

The first concern was that PGE would ensure that the changes being made do provide adequate correction of the HEDs without introducing new HEDs. Based on a review of the Summary Report, it appears that a rigorous verification process which addresses this concern will be conducted. PGE states that "The modified main control room instrumentation and controls design will be evaluated to assure that the selected design improvements, both individually and collectively, adequately correct their respective discrepancies and do not create other safety problems" (Volume 1, p. 3-7). PGE lists the following steps as those which will accomplish the verification process:

1. Comparison of the modified main control room design with the control room human factors design guidelines.

2. Comparison of the modified main control room design with the instrumentation and controls requirements identified during the control room survey and task analysis.

3. Obtaining feedback from licensed operators on proposed modifications.

PGE did not indicate in the Summary Report how the modified main control room design will be depicted for the verification processes. Through discussions during the pre-implementation audit, it was learned that beyond illustrating the color padding and demarcation scheme on control panel drawings, no depiction of the modified main control room design will be developed prior to implementing the modifications in the control room. Although the three verification steps listed above represent one approach to ensuring the correction of the HEDs without introducing new HEDs, we believe PGE should carefully review proposed modifications to the control room prior to implementation to ensure that the integrated package of corrections do not introduce new HEDs or result in operational difficulties. Both the in-progress and pre-implementation audit teams recommended that mock-ups be used to depict the modified main control room design for the verification process. Use of a mock-up would avoid undue interference with operations and would allow easy iteration of solution and verification of design improvements until integration of all improvement was achieved.

In the pre-implementation audit team's judgment, the verification process should pay particular attention to color usage. PGE currently plans to use color padding along with color in mimics, labels, and demarcation. Although the number of colors to be used in color padding is within the NUREG-0700 color usage guidelines for an enhancement (n=11), the number, types, and variations of colors used in color padding when integrated with the number, types, and variations of colors used in mimics, labels, and demarcation violates the guidelines for color usage. In the pre-implementation audit team's judgment, this concern should be addressed thoroughly during the verification process. If safety-significant problems are identified during verification, PGE should reevaluate the use of color padding.

For a detailed list of color usage for color padding and other enhancements in the control room, refer to Appendix B of this document. Appendix B also contains several recommendations which might improve the process of verifying enhancements implemented in the control room.

In summary, PGE has identified steps to be taken in verifying design improvements. PGE has not finalized its plans for performing these steps, but it appears they will be conducted after implementation in the control room. In contrast, we recommend that PGE develop a methodology for verifying design improvements prior to implementation in the control room. The methodology should be designed not only to verify that the improvements make the necessary corrections of individual HEDs without introducing new HEDs, but also to verify that the whole integrated control room improvement package works and does not create any new human factors or operational problems. PGE should involve human factors engineers extensively in this effort as well as operations specialists. Although PGE's current plans for post-implementation verification can be made to work, changes which do not correct HEDs or which introduce new HEDs are more likely to be introduced into the control room than if verification is conducted prior to implementation. The result may require extra time and expense, and, more important, may increase rather than decrease risk to the public. The DCRDR should not be considered complete until verification that improvements correct HEDs without introducing new HEDs is complete. Any HEDs not corrected or new HEDs introduced should be subjected to iterative selection and verification of design improvements until resolved.

Coordination of the DCRDR with other improvement programs. PGE indicated in discussions held during the in-progress audit and in the Summary Report that it was coordinating the DCRDR with other improvement programs. The coordination of the DCRDR with the EOP upgrade effort and the review of Reg. guide 1.97 appeared to be adequately performed. However, the following concerns related to the coordination of the DCRDR with other improvement programs were identified during the in-progress audit:

1. The training department had not been directly involved in the process of recommending or reviewing HED corrections or had there been feedback given to the training department on changes to be made to the control room and remote shutdown area.

2. No verification of SPDS parameters was attempted based on the information requirements identified in the task analysis.

Through discussions with PGE during the pre-implementation audit, the NRC audit team found that the coordination of the DCRDR with training had been improved. The training supervisor currently receives copies of HEDs thought by the DCRDR team to be correctable by training. In addition, the training department receives notices of changes resulting from the DCRDR (via System Change Descriptions). However, there apparently is still no formal integration of changes resulting from the DCRDR into an operator training program. Although some operators have been involved in developing enhancement schemes, this is not an adequate substitute for formal training. Since the overall control room improvement scheme is currently expected to be first seen and reviewed in the control room itself and the magnitude of the changes is relatively high, a program which trains the operators on the modified control boards appears imperative. To be most effective, that training should begin prior to changes being implemented.

Although the SPDS had received human factors input in the selection of the SPDS location in the control room, the in-progress audit team found no other areas of coordination or overlap between the DCRDR and the SPDS program. The in-progress audit team recommended that a verification and suitability review be performed and that this review should verify the presence and suitability of needed SPDS parameter information and be based upon the information requirements identified in the systems function review and task analysis. A review of the Summary Report found no discussion concerning the use of the results of the systems function review and task analysis to verify the adequacy of the SPDS parameter selection and presentation. Through discussions held with PGE during the pre-implementation audit, it was learned that the SPDS has not incorporated the results of the systems function review and task analysis because the EOPs, upon which the systems function review and task analysis is based, do not take into consideration the SPDS. This explanation was found to be acceptable by the NRC as justification for not performing a verification and suitability review that is based upon the results of the systems function review and task analysis. PGE has committed to performing a survey of the SPDS, however.

In summary, a concern still exists regarding the coordination of the DCRDR with the training department. In order for PGE to meet successfully the NUREG-0737, Supplement 1 requirement regarding the coordination of the DCRDR with other improvement programs, PGE needs to ensure that all operators receive training on changes to be made to the control room and on the operational impact of those changes.

REPORTING PHASE

Satisfaction of the reporting phase requirement involves submission of a DCRDR Program Plan and Summary Report. PGE submitted the DCRDR Program Plan for Trojan on July 28, 1983. NRC comments on the Program Plan were forwarded to PGE on November 17, 1983. The Program Plan serves as initial input to the evaluation of the DCRDR. That input is confirmed or updated through information in the Summary Report and through various audits. Although the current report makes little specific reference to the Program Plan, concerns initially raised during review of that document have been carefully reviewed throughout the technical evaluation.

As previously noted, the Summary Report must:

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.

That information is needed to complete the technical evaluation of the organization, process, and results of the DCRDR. PGE submitted a Summary Report for the Trojan DCRDR on December 31, 1984. Previous sections of the current report have provided a technical evaluation of the organization and process of the DCRDR. Technical evaluation of the results is provided below.

PGE documents over 370 HEDs in Volume 2 of the Summary Report. Approximately 3% of the HEDs were classified in Category 1, 10% in Category 2, 50% in Category 3, and 37% in Category 4. PGE has completed or proposed

corrective actions on approximately 92% of the HEDs classified in Category 1, 73% in Catetory 2, 72% in Category 3, and 38% in Category 4. The remaining HEDs are either being studied further (approximately 18% of the total number of HEDs) or are not slated for correction. A review of the number and categorization of HEDs in Volume 2 found inconsistencies between the listing provided in the front of Volume 2 and the HEDs that followed. Although the difference of one HED (373 HEDs in the listing, 374 HEDs that follow) is minor, other inconsistencies exist that are relatively significant. HED Number 132 is an example of an HED classified in Category 1 in the listing and classified in Category 3 in the HED form that follows. In our judgment, PGE should review its HED records to update either the HED listing or forms to resolve inconsistencies that may exist within any of the fields of the HED data base.

Since corrective actions to resolve a significant number of HEDs have yet to be developed by PGE, a complete evaluation of DCRDR results could not be performed. However, our evaluation indicates that about 45% of all HEDs are adequately addressed by proposed corrective actions or justifications for not taking corrective actions. HEDs for which corrective actions appear to be inadequate are discussed below and are listed in Appendix C, sections a and b. HEDs requiring more information or a visual examination to assess the adequacy of the proposed corrective actions are listed in Appendix C, sections c and d. HEDs for which justifications for not taking corrective action appeared to be inadequate are also discussed below and are listed in Appendix D. Those HEDs described by PGE as requiring further study are listed in Appendix E. Proposed correction actions and implementation schedules or justifications for not correcting or partially correcting all other HEDs appear adequate.

Proposed corrective actions. Appendix C, sections a and b of this report contains the complete list of HEDs for which proposed correction actions appear to be inadequate. The three reasons/categories for the apparent inadequacies are discussed below with examples.

a. The proposed corrective action only partially corrects the discrepancy. No justification for partial rather than complete correction is provided.

HED 45 - Some meter scales have major interval markings which are not numbered and scale intervals which are unequal (e.g., auxiliary feedwater flow meters). GPC's recommendation is to review these scales in terms of importance and chance of error, use banding and setpoints where possible to reduce chance of misreading, replace scales with scales of equal intervals on the most important meters, and number every tenth interval. PGE's proposed corrective action (via RDC 84-044) is to replace the existing flow meter scales with linear scales that have equal intervals. Although PGE's proposed corrective action should correct the discrepancy existing with the auxiliary feedwater flow meters, it doesn't appear to address other meters with unequal scale intervals or meters with unnumbered major interval scale markings.

HED 102 - The reactor trip switch is nested in the CVCS subsystem. Operation of this switch requires only one step. GPC's recommendation is to color pad this switch red; and to provide a mimic through its breaker status indicator lights and use a deep collar or a locking collar on this switch to help prevent accidental activation. Furthermore, the reactor trip switch should not be mimicked to the breakers. PGE's proposed corrective action (via RDC 84-125) is to include the reactor trip switch as part of the color padding enhancement scheme. PGE stated that a restraining device is not appropriate since immediate action is required. Although color padding may or may not relieve the visual embeddedness of the switch, there is no action taken to minimize or prevent the accidental activation of this one-step operation switch. Depending on the type of switch used for the reactor trip function, a deep collar may provide protection from accidental activation without hindering the operability of the switch.

HED 103 - The Boric Acid tank South and North Pressure indicators could be better associated with Boric Acid Level and Temperature. GPC's recommendation is to provide some means of association of these indicators. PGE's proposed corrective action (via RDC 84-125) is to color pad the Level and Temperature indicators. PGE does not appear to provide color padding to the pressure indicators.

b. The proposed corrective action does not correct the discrepancy.

HED 104 - The boric acid system controllers and indicator lights along with the primary water and boric acid flows to blender (recorder FR-110) and VCT level (meter LI-185) on panel C-02 are not readily associated with the boric acid system parts on panel C-12. GPC's recommendation is to tape these displays and controls to correspond with related components on panel C-12. PGE's proposed corrective action (via RDC 84-125) is to provide enhancements to aid in associating various controls. A review of the photographs of the drawings depicting the enhancement scheme for panels C-02 and C-12 found that line demarcation has been applied to the boric acid system controllers on panel C-02 while dark green color padding has been applied to the associated components on panel C-12. The demarcation used does serve to visually segregate components on panel C-02, but it does not provide adequate visual association of the related components between the two panels. To improve the visual association of the related components on these two panels and to remain consistent with the established color padding convention, we recommend that PGE investigate the application of dark green color padding to the pertinent components on panel C-02. Additions to the color padding scheme should, however, take into consideration and adequately integrate with the overall enhancement scheme.

HED 413 - The trip valve indicators for MO-3071 are difficult to distinguish from the start valve indicators (MO-3170) in the neighboring section of panel C-05. GPC's recommendation is to consider using panel surface enhancement techniques (paint-tape-label). PGE's proposed corrective action (via 84-125) is to provide "enhancements." A review of the photographs of the drawing depicting the enhancement scheme for panel C-05 shows that color padding is being applied to the section of panel C-05 which includes the trip valve and start valve indicators. The application of color padding here does not segregate or in any way differentiate these indicators but serves only to associate these indicators. These indicators do not appear to be any less difficult to distinguish with color padding.

c. Appendix C, section c of this report contains a complete list of HEDs that need more information in order to be evaluated. The description of the proposed corrective action is too brief, general, or ambiguous to allow an adequate evaluation. More information is needed regarding the discrepancy and/or the proposed corrective action.

HED 1 - The "CIS" Reset button is presently in the Accumulators section of the control panel. GPC's recommendation is to move the CIS Reset button to the "spare" location to its right and cap the remaining hole of this and the other spare button on this panel. PGE's proposed corrective action (via RDC 84-136) is to remove the spare button and cap the remaining hole. However, no mention is made of moving the CIS Reset button to the spare location to its right. PGE needs to provide more information describing whether the CIS Reset button will be moved.

HED 7 - The selected flow controllers on panel C-12 are arranged to open (increase flow) on the left and close (decrease flow) on the right. This design is contrary to convention. GPC's recommendation is to change all such flow controllers, as well as other valves, to comply with the convention of close on the left and open on the right. PGE's proposed corrective action (via RDC 84-125) is to add a "caution plate" to the controller to provide operator aids in controlling parameters. To assess the adequacy of this proposed correction, we need to know what the caution plate will say, where it will be located, and its size and color.

d. In addition to the list of HEDs for which corrective actions were proposed but were found to be inadequate, Appendix C, section d contains a list of HEDs for which corrective actions were proposed but could not be evaluated due to the necessity of visually examining the HEDs and the corrections. The control panel drawings depicting the color padding and demarcation scheme were photographed during the pre-implementation audit. A review of the photographs and the HEDs resolved by enhancements found that not all panels to incorporate enhancements were among the control panel drawings presented during the pre-implementation audit. Also, the

control panel drawings present did not always depict the enhancements to be made. Below are examples of such HEDs.

HED 62 - On panel C-11 there are more than five meters banked together. GPC's recommendation is to use tape to distinguish groups of meters. PGE's proposed corrective action (via RDC 84-125) is to provide demarcation and hierarchical labeling. Although these enhancements are an appropriate means to resolve this HED, the intended application of the enhancements for resolving this HED and its incorporation into the entire control room enhancement package must be seen to be adequately evaluated. Panel C-11 was not represented by the control panel drawings present at the pre-implementation audit and thus was not available for review.

HED 78 - The annunciator test, reset, acknowledge, and silence buttons on panel C-19 are not well marked. GPC's recommendation is to color pad these buttons white or off-white. PGE's proposed corrective action (via RDC 84-125) is to provide demarcation. An examination of the photographs of the control panel drawing depicting the demarcation intended for panel C-19 does not show any demarcation applied to these buttons. The question is whether the drawing does not show all the enhancements intended for this panel or PGE does not intend to apply demarcation to these buttons. In either case, this HED resolution could not be evaluated.

Proposed schedules for implementing HED corrections. An implementation schedule accompanies each HED reported in Volume 2 of the Summary Report. PGE states that "The development of a schedule for modifications to correct HEDs is dependent on HED categorization, and complexity of the modifications and resource requirements, and engineering and equipment lead time requirements and plant scheduling constraints" (Volume 1, p. 3-6). Given this, there appears to be some HEDs which have an overextended implementation schedule relative to HEDs of the same category. Without more justification than is provided in the Summary Report, delayed implementation of corrections for the HEDs listed in Appendix F appears unsatisfactory. Although PGE's overall implementation scheduling appears to be acceptable, PGE should provide the rationale behind the specific implementation schedules associated with the HEDs listed in Appendix F.

Justifications for HEDs left uncorrected. Appendix D of this report contains the complete list of HEDs for which justifications for not taking corrective actions were provided but appeared to be inadequate. The two reasons/categories for the apparent inadequacies are discussed below with examples.

a. The justification (or HED description, component description, etc.) is too brief, general, ambiguous, or does not sufficiently address the discrepancy to allow an adequate evaluation to be made.

   HED 11 - The primary water flow integrator has a setpoint from which it counts down; the setpoint is set on a rotary wheel, but when flow starts, the digit farthest to the left (e.g., 3 if 300 is the setpoint) jumps up one number giving a false indication, although flow stops when the original setpoint is reached. GPC's recommendation is to investigate permanent changes or replacement feasibility; if replacement is inadvisable, install permanent caution labels. PGE's justification for not taking corrective action is that the function of the integrator is to set gallons into the system and that the totalizer provides information for gallons actually injected. The justification does not describe where the totalizer is located in reference to the integrator and task relevant components or discuss the potential of operator reliance upon the integrator versus the totalizer to provide the needed information.

   HED 166 - There is no standard graphic symbol to distinguish between valves and pumps in mimics. GPC's recommendation is to employ distinct graphic symbols to indicate valves and pumps. PGE's justification for not taking corrective action is that the "current method is considered adequate." PGE needs to describe this current method and how it is adequate in distinguishing between valves and pumps.

b. The basis of the justification is not adequate (e.g., the justification does not address operational or behavioral factors).

HED 32 - Scale units are not indicated on Refuel Water Storage Tank Level. GPC's recommendation is to mark scale units on this meter. PGE's justification for not taking corrective action is that this discrepancy is minor and that operators are trained that level is in percent on all tank levels indicated in the control room. This is not an adequate justification because it does not address the discrepancy's impact upon the operations involving this indicator. The fact that this HED has an estimated potential for impact upon plant safety (Category 3) raises some concern that PGE believes the HED to be minor. In addition, training does not take into account behavioral responses to stress induced by emergency situations and cannot be relied upon in such situations to counteract inadequate design.

HED 238 - The light levels in the shift supervisor's office range from 180 to 220 foot-candles. These levels are well above the maximum levels recommended in NUREG-0700. GPC's recommendation is to reduce the light levels in the shift supervisor's office to 60 foot-candles, but no lower than 50 foot-candles. PGE's justification for not taking corrective action simply states "insignificant HED." This is not a sufficient justification since it does not address the discrepancy or address performance factors.

HED 262 - Procedures are not bound so that they can be fully opened and remain open at the desired place without holding. GPC's recommendation is to use appropriate ring binders to hold the procedures. PGE's justification for not taking corrective action is that sets of procedures in binders are available if desired. If procedures in binders are available, it would seem a small matter of making the procedures in binders the most accessible so that operators would be inclined to use these rather than the unbound set. PGE's lack of corrective action is not sufficiently justified.

HED 290 - There are no commas separating groups of numerals on drum controls (where there are more than four digits). GPC's recommendation, which is cited by PGE as its justification for not taking corrective action, is that the deviation from the guidelines is

considered insignificant. Citing the deviation from guidelines, rather than addressing such issues as the accuracy with which the drum counters must be read or adjusted, is not a satisfactory justification.

CONCLUSIONS AND RECOMMENDATIONS

The documentation provided in the Summary Report demonstrates PGE's commitment toward meeting the DCRDR requirements of NUREG-0737, Supplement 1. Most of the concerns expressed by the NRC audit team during the in-progress audit have been resolved as documented by PGE in its Summary Report or confirmed by discussions held during the pre-implementation audit. However, some concerns or uncompleted items still exist after the review of the Summary Report and conduct of the pre-implementation audit. In order to meet the requirements of Supplement 1 to NUREG-0737, PGE should complete the following activities:

1. Control room survey

   - Evaluate the SPDS within the scope of the DCRDR.

   - Conduct studies for the annunciators and meters (and at PGE's option the remote shutdown area).

2. Systems function review and task analysis

   - Upgrade the SFRTA to Revision 1 of the WOG ERGs.

3. Comparison of display and control requirements with a control room inventory

   - Upgrade the Verification of Task Performance Capabilities to the SFRTA based on Revision 1 of the WOG ERGs.

4. Selection of design improvements

   - Select design improvements for HEDs listed in Appendix E and for HEDs resulting from ongoing review phase activities (e.g., SPDS survey, SFRTA upgrade, and lighting survey).

5. Verification that improvements will provide the necessary corrections without introducing new HEDs

   - Verify individual HED corrections (including those for which design improvements have yet to be selected) and the whole integrated control room modification package.

6. Coordination of the DCRDR with other improvement programs

   - Coordinate the DCRDR with the operator training program.

7. Reporting phase

   - Resolve inconsistencies in HED data base.

8. Proposed corrective actions

   - Resolve inadequacies in the proposed corrective actions for HEDs listed in Appendix C, sections a and b.

   - Develop and verify detailed corrections for HEDs listed in Appendix C, sections c and d.

9. Proposed schedules for implementing HED corrections

   - Revise implementation schedules for HEDs listed in Appendix F to be consistent with other HEDs in the same category or provide justification for the delay and information about any interim corrections that would support that delay.

10. Justifications for HEDs left uncorrected

- Provide better justifications for not taking corrective actions for HEDs listed in Appendix D (in terms of operational or behavioral factors) or select, verify, and implement design improvements for these HEDs.

In the audit team's judgment, completion of the above activities is essential for satisfaction of the requirements of Supplement 1 to NUREG-0737. To encourage the fullest possible benefit from the DCRDR, we suggest that PGE consider the following recommendations:

1. Review the application of the standard for labeling in all relevant areas.

2. Develop control room conventions documentation.

REFERENCES

1. NUREG-0660, Vol. 1, "NRC Action Plan Developed as a Result of the TMI-2 Accident," USNRC, Washington, D.C., May 1980, Rev. 1, August 1980.

2. NUREG-0737, "Requirements for Emergency Response Capability," USNRC, Washington, D.C., November 1980.

3. NUREG-0700, "Guidelines for Control Room Design Reviews," USNRC, Washington, D.C., September 1981.

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

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

6. "Detailed Control Room Design Review Program Plan for Trojan Nuclear Plant," Portland General Electric Company, July 28, 1983.

7. "NRC Comments on Trojan Power Company Detailed Control Room Design Review Program Plan Submittal," attachment to Memorandum from W.T. Russell, USNRC, to G.C. Lainas, USNRC, dated November 17, 1983.

8. "Results of the NRC In-Progress Audit of the Detailed Control Room Design Review for the Trojan Nuclear Plant Conducted December 12-16, 1983," attachment to Memorandum from V.A. Moore, USNRC, to J.R. Miller, USNRC, dated February 16, 1984.

9. "Detailed Control Room Design Review Summary Report for Trojan Nuclear Plant, Volume 1: Methodology and Approach, Volume 2: Human Engineering Discrepancy Data Base," Portland General Electric Company, December 1984.

10. "Meeting Summary - Task Analysis Requirements of Supplement 1 to NUREG-0737, March 29, 1984 Meeting with Westinghouse Owners Group (WOG) Procedures Subcommittee and Other Interested Persons," Memorandum from H.B. Clayton, USNRC, to D.L. Ziemann, USNRC, dated April 5, 1984.

Trojan
TAC Number 51212
SAIC 1-263-07-557-75
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APPENDIX A

Attendees of the Meetings Held During the Pre-Implementation Audit of Trojan Nuclear Plant DCRDR

PGE Representatives

Scott Bauer	PGE
Eddie Davis	PGE
Jerry Dunlop	PGE
Lief Erickson	PGE
Jack Lentsch	PGE
Dave Modeen	PGE
Don Pearson	PGE
Alex Roller	PGE
Rich Russell	PGE
Lothar Schroeder	GPC
Pat Sheppard	PGE
Robert Steee	PGE
Gary Zimmerman	PGE

USNRC Representatives

Tim O'Donoghue	SAIC
Dave Schultz	Comex
Dennis Serig	USNRC
Charles Trammell	USNRC

APPENDIX B

The following is a list of colors used in the color padding scheme and the plant systems associated with each color. Such a list for mimics, labels, and demarcation was not available at the time of this writing.

1. Blue - Auxiliary Feedwater
2. Light Yellow - Reactor Coolant System
3. Medium Yellow - Containment Spray
4. Light Brown - Component Cooling Water
5. Medium Brown - Residual Heat Removal
6. Light Grey - Service Water System (C-18) and Common Train in Safety Injection (C-19)
7. Dark Grey - Safety Injection
8. Light Green - Accumulators (C-19)
9. Dark Green - Charging
10. Red - Actuation of: Safety Injection, Reactor Trip, Containment Isolation (i.e., protective actuations/functions)
11. Off-White - Main Steam

Cross Hatching:

Black - Lockout switches
White - Main generator trip and breakers (C-05)

According to our understanding of color usage in the modified main control room design as illustrated by photographs of the Trojan control room and the depiction of color padding on control panel drawings, the following table is an approximate description, by panel, of colors to be used. A diagram of the control layout is included in this appendix.

Outer Panels	Color Padding	Mimics	Labels	Demarcation
C-18 (SERV WTR)	Medium Yellow Light Grey	Yellow Blue	Yellow Blue Grey (or Green)	

Outer Panels	Color Padding	Mimics	Labels	Demarcation
C-12 & C-13 (CVCS & RHR)	Light Yellow Red Dark Green Medium Brown Medium Brown (x-hatch)	Yellow Red Green Light Blue Blue	Yellow Red Green Light Blue Blue	
C-16 (CIRC WTR CLG TWR)	Light Yellow			Blue
C-14 (STM GEN CONT)	Off-White Blue		Green Red	Blue
C-15 (TURB INDIC)	Blue		Blue Green Red	Blue
C-17 (MISC)	Blue Grey (x-hatch)	Not apparent in Photograph	Blue Yellow	Blue
C-19 (ECCS)	Blue Blue (x-hatch) Light Green Dark Grey Light Grey Light Yellow Light Brown Light Brown (x-hatch) Red		Blue Yellow Red	Blue

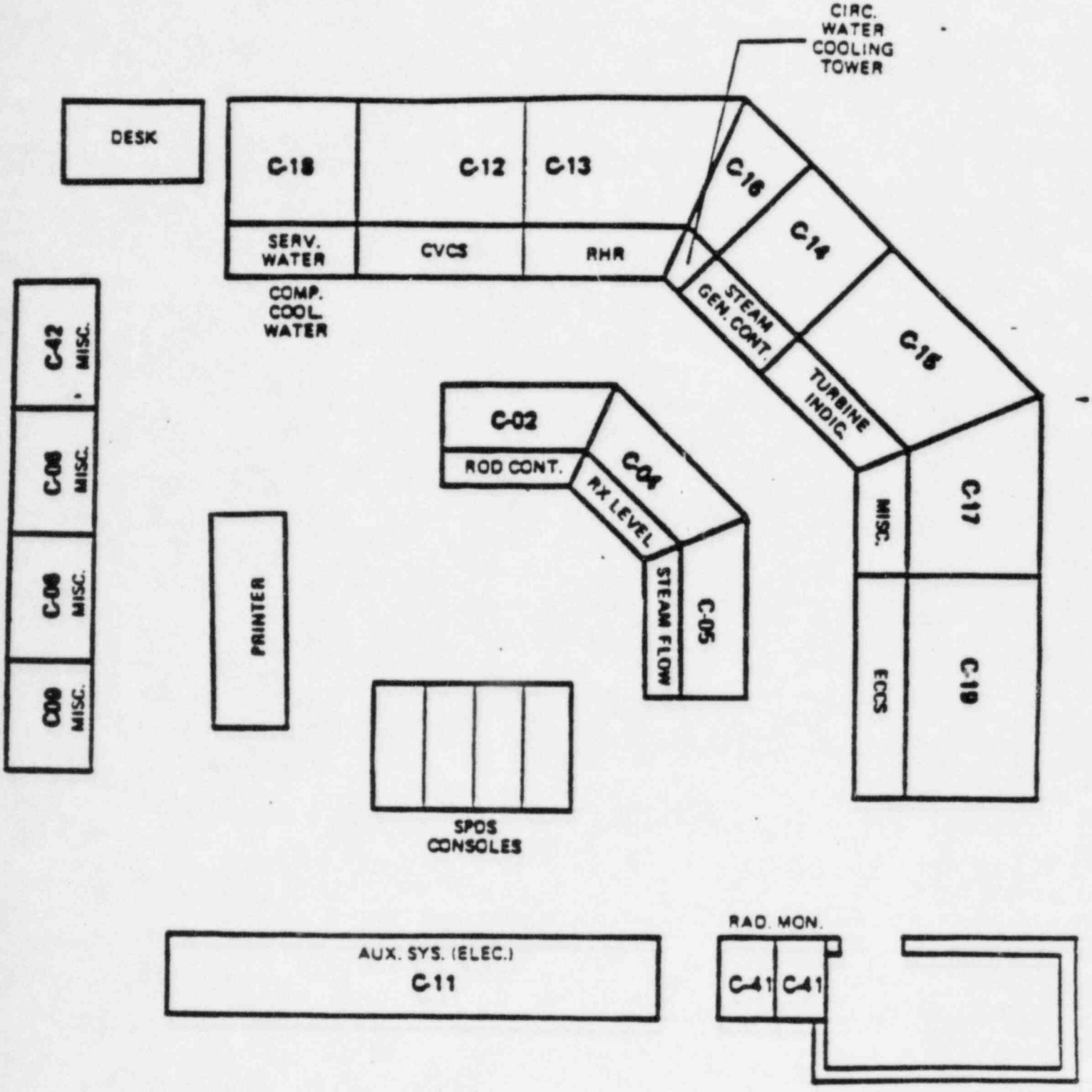
Inner Console	Color Padding	Mimics	Labels	Demarcation
C-02 (ROD CONT)	Red Light Yellow			
C-04 (RX LVL)	Blue			
C-05 (STM FLOW)	Blue		Red Yellow	
Vertical Panel				
C-11 (AUX SYS (Elec))		Yellow Silver (or white) Black (apparent)	Yellow	

Based on a review of the photographs of the control panel drawings which depict the intended color padding and demarcation scheme, the following suggestions are made for PGE to consider in its verification of enhancements implemented in the control room:

- Ensure that components involved in mimics which will also be color padded have mimic lines that are not obsured by the color padding and that extend to the component as originally intended. The mimic lines should not end at the boundary of the color padding.

- Where demarcation is applied to groups of components, be sure to include hierarchical/group labels. Where hierarchical/group labels are applied, individual labels within the group of components should be reviewed for unnecessary redundancy in information.

- Review all color applications across enhancement types and locations. How do the colors used in color padding agree with other color usage? Are there any instances where minimal component movement will simplify or eliminate the need for color padding?



Trojan Control Room Layout

APPENDIX C

HEDs for which corrective actions were proposed but were found to be inadequate for one of the following reasons/categories:

a. The proposed corrective action only partially corrects the discrepancy.

45, 70, 87, 102, 103, 130, 164, 172, 250, 312, 415 and 428

b. The proposed correction action does not correct the discrepancy.

79, 104, 118, and 413

c. The description of the proposed corrective action is too brief, general, or ambiguous to allow an adequate evaluation to be made.

1	39	119	176	334
7	41	122	177	335
8	52	136	180	336
10	55	151	226	340
12	57	156	230	341
15	61	161	274	346
17	92	165	319	352
18	96	168	321	368
21	107	173	329	408
24	117	175	331	412
35				

d. The proposed corrective actions for the following HEDs could not be evaluated due to the necessity of visually examining the HEDs and the corrections. Drawing available during the audit did not show corrections for the following HEDs:

62, 77, 78, 80, 81, 85, 111, and 112

APPENDIX D

HEDs for which justifications for not taking corrective action were provided but were found to be inadequate for one of the following two reasons/categories:

a. The justification (or HED description, component description, etc.) is too brief, general, ambiguous, or does not sufficiently address the discrepancy to allow an adequate evaluation to be made.

11	163	289	386
23	166	301	398
28	243	304	400
29	246	307	402
31	248	308	403
46	259	309	406
47	260	310	407
53	263	314	410
66	275	315	420
91	278	317	440
138	281		

b. The basis of the justification is not adequate (e.g., the justification does not address operational or behavioral factors).

2	238	296	353
14	252	298	369
16	262	299	373
32	280	302	387
36	282	303	437
65	290	305	447
228	291	311	

APPENDIX E

HEDs for which dispositions were not provided and described by PGE as requiring further study.

42	129	235	270	345	374
44	131	236	271	357	375
50	132	241	276	358	380
58	133	242	277	359	382
59	134	244	279	360	385
63	135	245	283	361	389
121	137	249	284	362	390
125	139	253	286	363	404
126	145	255	287	364	416
127	231	269	288	372	417
128	234				

APPENDIX F

The following HEDs for which corrective actions are proposed have been assigned implementation schedules by PGE which appear to be overextended relative to HEDs of the same category.

Category 1:	131 and 318		
Category 2:	9 and 261		
Category 3:	1	96	120
	40	109	133
	57	115	405
	58	116	444
	87	117	445

ENCLOSURE 2

HUMAN FACTORS ENGINEERING BRANCH

SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE

FOR

TROJAN NUCLEAR PLANT

The Division of Human Factors Safety/Human Factors Engineering Branch (DHFS/HFEB) Systematic Assessment of Licensee Performance (SALP) input for Trojan Nuclear Plant for the period covering submittal of the Detailed Control Room Design Review (DCRDR) Summary Report (December 31, 1984) and conduct of the pre-implementation audit (February 25-March 1, 1985) is provided for your use.

HFEB SALP ratings for Trojan are:

1. Management involvement and control in assuring quality. Interaction with the licensee during the subject SALP period indicated prior planning and general understanding of policies related to the DCRDR.

   Rating: Category 2

2. Approach to resolving technical issues from a safety standpoint. The licensee has demonstrated a general understanding of issues raised during conduct of the DCRDR. Proposed resolutions of those issues generally exhibit conservatism.

   Rating: Category 2

3. Responsiveness to NRC initiatives. The licensee is conducting the DCRDR in a generally timely manner.

   Rating: Category 2

Other areas not evaluated due to insufficient information.