SUPPLEMENT TO THE

TECHNICAL EVALUATION REPORT

OF THE

DETAILED CONTROL ROOM DESIGN REVIEW

OF THE

TROJAN NUCLEAR PLANT

March 7, 1986

Prepared for:

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FOREWORD

This Supplement to the Technical Evaluation Report (STER) documents the findings of a review of Amendment 2 to the Detailed Control Room Design Review (DCRDR) Summary Report submitted by Portland General Electric (PGE) for its Trojan Nuclear Plant. SAIC previously participated in the review of PGE's Program Plan and Summary Report and in the in-progress and preimplementation audits of the Trojan DCRDR. SAIC's evaluation was performed in support of the Nuclear Regulatory Commission (NRC), under contract NRC-03-82-096, Technical Assistance in Support of Reactor Licensing Actions: Program III.

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

INTRODUCTION

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 inprogress 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 29, 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. The NRC concluded from the pre-implementation audit that the following elements of PGE's DCRDR for the Trojan Nuclear Plant were incomplete:

- 1. Function and task analysis
- Comparison of display and control requirements with a control room inventory
- 3. Control room survey
- Assessment of human engineering discrepancies (HEDs)
- 5. Selection of design improvements

6. Verification that HEDs are corrected and no new HEDs are introduced

7. Coordination with training

The NRC found that with the exception of the verification element, activities required to complete the above elements appeared minimal (Reference 11). The NRC recommended that PGE submit a supplement to the Summary Report which addresses the results of the activities required to complete the above DCRDR elements and which updates and clarifies information provided in the Summary Report. PGE submitted Amendment 2 to the Summary Report on December 31, 1985, in response to the NRC's recommendation (Reference 12). The findings from a review of Amendment 2 are presented for each element following a brief description of the DCRDR requirements. These findings represent the consolidated observations, conclusions, and recommendations of the NRC and SAIC.

BACKGROUND

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 and 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

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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 Supplement to the 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.
- Use of function and task analyses to identify control room operator tasks and information and control requirements during emergency operations.
- A comparison of display and control requirements with a control room inventory.
- A control room survey to identify deviations from accepted human factors principles.
- Assessment of human engineering discrepancies to determine which are significant and should be corrected.
- Selection of design improvements that will correct those discrepancies.
- Verification that selected design improvements will provide the necessary correction.
- Verification that improvements can be introduced in the control room without creating any unacceptable HEDs.

 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).

Qualifications and Structure of the DCRDR Team

The NRC concluded from the pre-implementation audit that the requirement for the establishment of a qualified multidisciplinary review team was currently being satisfied and that PGE should maintain multidisciplinary participation throughout the remainder of the DCRDR to satisfy the requirement fully. The NRC stated that "participation of human factors specialists and on-shift operators in the ongoing selection and verification of design improvements will be particularly important in ensuring that the DCRDR results in a consistent, coherent, and effective operator interface with the control room" (p. 2 of SER).

A review of Amendent 2 found that with the exception of the SPDS survey, PGE's description of the activities performed to complete that DCRDR did not mention the involvement of its human factors consultants. No mention was made of whether the human factors specialists were involved in the following activities required to complete the DCRDR:

- The identification of tasks and information and control requirements from the comparison of the Westinghouse Owners Group (WOG) Emergency Response Guidelines (ERGs), Revision 1-based Emergency Instructions (EIs) with Revision O-based EIs.
- The verification of controls and displays in the control room required to satisfy the information and control requirements identified in the above task analysis.
- 3. The annunciator study.
- The selection of design improvements.
- 5. The verification of design improvements in correcting HEDs.

In addition, although PGE mentioned that the DCRDR team completed the meter study, PGE should provide assurance that the human factors specialists were participants in this activity. In order to progress towards the completion of this requirement of Supplement 1 to NUREG-0737, PGE should describe the level of involvement of the human factors specialists in the activities discussed above.

Function and Task Analysis

The NRC concluded from the pre-implementation audit that completion of the following activities was necessary to satisfy this requirement of Supplement 1 to NUREG-0737:

- Compare WOG ERG Revision 1 based EIs with Revision O-based EIs to identify new or modified tasks.
- Identify information and control capabilities needed for performance of the above tasks.
- Identify displays and controls (including appropriate characteristics) required to satisfy the above information and control capability needs.

A review of Amendent 2 found that PGE has performed these activities. PGE's discussion of these activities in Amendent 2 (p. 3-9) was as follows:

"PGE reviewed all revisions to EIs and FRIs based upon WOG Revision 1 ERGs prior to their implementation in the fourth quarter of 1985. The review included a comparison of the Revision 1 based Plant-specific procedures with the Basic version based Plantspecific procedures to identify new or modified tasks, identification of information and control capabilities needed to perform those tasks, and identification and determination of suitability and availability of the controls and displays in the control room to perform those tasks. This review did not result in any new HEDS." Although PGE's documentation describing the completion of these activities could have been more detailed (e.g., by providing sample task analysis worksheets), PGE appears to have performed these activities satisfactorily. PGE has met the function and task analysis requirement of Supplement 1 to NUREG-0737.

Comparison of Display and Control Requirements With a Control Room Inventory

The NRC concluded from the pre-implementation audit that completion of the following activity was necessary to satisfy this requirement of Supplement 1 to NUREG-0737:

 Determine the availability and suitability of required displays and controls identified by the task analysis.

PGE's comments in Amendment 2 concerning this activity were included in its discussion of the activities performed to complete the function and task analysis requirement. As stated previously in the Function and Task Analysis section, although PGE's documentation describing the completion of this activity could have been more detailed (e.g., by providing sample task analysis worksheets), PGE appears to have performed this activity satisfactorily. PGE has met the Supplement 1 to NUREG-0737 requirement for a comparison of display and control requirements with a control room inventory.

Control Room Survey

The NRC concluded from the pre-implementation audit that completion of the following activities was necessary to satisfy this requirement of Supplement 1 to NUREG-0737:

- 1. Annunciator Study
- 2. Meter Study

PGE states in Amendment 2 that members from various plant departments met to determine the feasibility of extensive modification to or replacement of the annunciator system (p. 3-5). The meeting attendees scheduled a detailed study of available alternatives based on the results of the meeting. The study was conducted by the Nuclear Plant Engineering Electrical Branch and was completed in November 1985. PGE states that "as a result, the annunciator will be either replaced or modified to correct applicable HEDs. Implementation is scheduled to be completed by September 1989." A review of the HEDs associated with the annunciator system found the resolutions to be "the annunciator system will either be replaced or modified to correct this HED." No resolutions specific to each HED were given. This would seem to indicate that final resolutions had not yet been developed at the time Amendment 2 was submitted. If this is so and the objectives of the annunciator study include defining specific resolutions to HEDs, then the annunciator study has not been completed. An additional concern for the satisfactory completion of the annunciator study regards the involvement of the human factors specialists. Based on PGE's discussion, the human factors specialists do not appear to be involved in the study. PGE should indicate if human factors specialists were involved and describe how human factors principles were considered.

A review of PGE's description of the meter study has found it to be described and performed satisfactorily. PGE states in Amendment 2 (p. 3-3):

"HEDs 42, 50, 59, 283, 286, 287, 416, and 417, when combined as a generic group, provided the DCRDR team with a difficult review task. It was determined that a more detailed evaluation was required than previously envisioned to adequately address the generic meter issues encompassed by these HEDs. An evaluation guide sheet was developed to aid the team in further control room evaluation. All control room meters were reviewed and a final determination of corrective actions compiled. This evaluation was completed in 1985. No corrective action was taken on HEDs 42, 50, 283, and 286. Corrective action was identified for HEDs 59, 287, 416, and 417, and assigned to more appropriate HEDs 44, 49, 51, and 448."

The results of the review of the resolution of the HEDs above is discussed in the Selection of Design Improvements section of this report.

In summary, PGE has completed the meter study satisfactorily. However, concern remains regarding the adequacy of the annunciator study in involving human factors specialists and considering human factors principles. The

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concern for the resolution of annunciator HEDs is more appropriately associated with the requirement for selection of design improvements and will be further addressed in that section of this report. In order to progress towards resolution of the remaining concern regarding the annunciator study and the satisfaction of the control room survey requirements, PGE should indicate if human factors specialists were involved in the annunciator study and describe how human factors principles were considered.

Assessment of HEDs

The NRC concluded from the pre-implementation audit that PGE's HED assessment process was acceptable. The NRC also concluded that in order to close out this activity, PGE should assess any HEDs resulting from the review activities remaining to be completed. However, PGE did not identify any new HEDs from the remaining review activities and did not need to conduct further assessments. Therefore, PGE has completed this DCRDR activity and satisfied this requirement of Supplement 1 to NUREG-0737.

Selection of Design Improvements

The NRC concluded from the pre-implementation audit that PGE's process for selecting design improvements was acceptable. The NRC also concluded that completion of the following activities was necessary to progress towards the satisfaction of this requirement of Supplement 1 to NUREG-0737:

- Select design improvements for HEDs resulting from 1, 2, and 3 above.
- Select design improvements for HEDs for which no proposed correction was provided in the Summary Report (see Appendix E of the TER).
- When proposed corrections do not correct HEDs or introduce new HEDs, iterate selection and verification of design improvements until problems are resolved.

The NRC stated that PGE should select design improvements for any HEDs resulting from the review activities remaining to be completed. PGE did not

identify any new HEDs from the remaining review activities. However, the HEDs associated with the annunciator study do not appear to have final resolutions. The resolution of each of these HEDs is that "the annunciator system will be either replaced or modified to correct this HED." PGE needs to describe the specific final resolutions for each HED (e.g., what aspects of the replaced or modified annunciator system will correct each HED and how so) in order to progress towards resolution of this concern.

The HEDs listed in Appendix E of the TER were found to have no proposed corrections described in the Summary Report. A review of Volume 2 of Amendment 2 found that with the exception of the annunciator HEDs, final HED corrections were selected and described by PGE. For reasons to be discussed later in this section and in Appendices A, B, and C, the HED corrections described were not always acceptable.

As described in Amendment 2, PGE intends to perform an iterative selection and verification of design improvements to ensure that design improvements correct the HEDs without introducing new HEDs (p. 3-7 and 3-8). For reasons to be discussed in the Verification That Improvements Will Provide the Necessary Corrections Without Introducing New HEDs section of this report, there are concerns regarding this process. PGE states that this activity will be completed "as required after completion of corrective action" (p. 2 of Attachment A of the PGE cover letter). This statement indicates PGE's intention to complete this activity.

A review was conducted of Volume 2 of Amendment 2 to determine the adequacy of the resolution of the HEDs. Those HEDs listed in the appendices of the TER were reviewed to determine if the inadequacies previously identified in the resolutions were addressed satisfactorily. The review found that a large number of these HEDs have been resolved in an acceptable manner. However, a significant number of HEDs were still found to be inadequately resolved. In order to progress towards acceptable resolution to these HEDs, comments and concerns regarding the present resolutions are provided for each HED in Appendices A, B, and C, Section 1, of this report. HEDs found to have been acceptably resolved have not been listed. PGE should provide a response to the comments and concerns discussed for each HED. In addition, PGE should provide the HEDs listed in Appendix C, Section 2, of the report that were not included in Volume 2 of Amendment 2.

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The human factors survey of the operator interface of the SPDS produced a number of new HEDs. An evaluation of those HEDs and the resolutions was not conducted in order to await the proper coordination of the DCRDR and SPDS reviews. The HEDs generated from the survey of the SPDS are Tisted in Appendix E of this report.

Appendix F of the TER listed HEDs for which corrective actions were proposed and for which the schedules for implementation by PGE were found to be over extended relative to those of the HEDs from the same category. In the TER was a recommendation that PGE should provide the rationale behind the specific implementation schedules associated with these HEDs. A review of Amendment 2 found that no rationale was provided. In addition, the implementation schedules for 21 HEDs were changed to later dates and three HEDs changed from being corrected to not being corrected (HEDs 35, 58, and 332). In order to progress towards the resolution of the concerns regarding the implementation schedule for the HEDs listed in Appendix D of this report, PGE should provide the rationale behind the specific implementation schedules.

In summary, PGE's process for selecting design improvements was found to be acceptable. However, PGE needs to provide responses to the comments and concerns discussed for each HED given in Appendices A, B, C, and D for this report in order to progress towards the satisfactory completion of this requirement of Supplement 1 to NUREG-0737.

Verification That Improvements Will Provide the Necessary Corrections Without Introducing New HEDs

At the time of the pre-implementation audit, PGE had not verified the corrections for HEDs. PGE's plans as stated in its Summary Report and reiterated in Amendment 2 are to verify HED corrections after implementation. In the SER, the NRC stated the following regarding PGE's plans:

"The staff is concerned about PGE's schedule for the verifications. We recommend that PGE conduct the bulk of the verifications prior to implementation of corrections in the control room. The use of a mock-up is one way to achieve the majority of the required verification prior to implementation in the control room. If PGE follows its plan to verify after implementation, the staff recommends that the effect of control room changes on operator performance be monitored until verification is completed. 'Among other techniques, the monitoring process might include direct operator feedback and detailed walkthroughs by human factors and operations personnel. Any HEDs identified during verification process as having not been corrected or as having been introduced by correction of another HED should be subjected to the selection and verification of design improvements processes iteratively until problems are resolved."

PGE's description in Amendment 2 of its process for verifying design improvements does not contain an explicit response to the concerns voiced by the NRC. Implicitly, this indicates that PGE will continue with its plans to perform the verification process after implementation despite NRC recommendations. The underlying concern for PGE's plans is that 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.

PGE's plans to ensure that the design improvements provide the necessary corrections without introducing new HEDs are to verify the design improvements using human factors guidelines, "instrumentation and control requirements" identified from the task analysis, and operator feedback. PGE's plans do not include validation of the design improvements as recommended by NUREG-0700 (p. 4-6). A validation of design improvements is recommended since such a review would contribute to the assurance that the design changes are properly integrated with all other functions and systems in the control room.

In conclusion, the NRC's concerns regarding PGE's plans for verifying HED corrections still exist. The Trojan DCRDR will not be considered complete until the verification process and any necessary reiteration of the process for selecting design improvements are completed. At that time, PGE should document and submit to the NRC the results of the verification process including any deviations from the proposed methodology and changes to the specific corrections/resolutions of HEDs as documented thus far.

Coordination of the DCRDR With Other Improvement Programs

The NRC concluded in its SER that the "coordination requirements are currently being satisfied with respect to EOP upgrade, SPDS development, and Reg. Guide 1.97 implementation" (p. 7). However, the following activities were found to be necessary in order to progress towards satisfaction of the requirements.

- Compare the operator interface with the SPDS against accepted human factors standards.
- Verify that HEDs to be corrected by training provide the necessary corrections and do not result in new HEDs.
- Provide all operators with training on changes to the control room resulting from the DCRDR prior to implementing those changes.

In Amendment 2 (p. 3-6), PGE provides the following information regarding the P-2500 computer for the SPDS:

"P-2500 computer for SPDS - Due to improved availability of the Trojan SPDS, a GPC human factors specialist was able to survey it in November 1985. HEDs in this area were added to the data base and categorized as having no safety significance. The resulting corrective actions and implementation dates are as described on HED forms 358-363, 449-451, 453-462, and 464-472."

This information demonstrates that the operator interface of the SPDS has been surveyed from a human factors perspective.

In reference to the NRC's concern regarding the verification of training solutions to HEDs, PGE states that this activity is complete. The two HEDs PGE referred to in Attachment A of the cover letter to Amendment 2 were reviewed to verify that this is the case. Although HED 401 was found to have been adequately resolved and coordinated with training, the resolution described for HED 403 did not indicate the specific, final disposition of the problem cited and whether training would be a factor in addressing the problem. More information which addresses the involvement of training (or the decision not to do so) is needed to progress towards resolution of this concern.

In reference to the NRC's concern regarding operator training on changes to the control room resulting from the DCRDR prior to implementing those changes, PGE states that "operators received lectures on the objectives and conclusions of the DCRDR, control board enhancement scheme and forthcoming design changes in April/May 1985" (p. 2 of Attachment A of the cover letter to Amendment 2). PGE did not provide further details as to whether the lectures included interaction or hands-on training with the changes, such as conducting walk-throughs on drawings or mock-ups. Also, the effectiveness of lectures conducted in April/May 1985 to train operators on changes implemented after a much later time (if this is the case in some or all instances) is in doubt. Training that is timely, interactively involves the operators, and allows feedback to be exchanged is superior and acceptable relative to a straight lecture format occurring at a time much earlier than the implementation of the changes for which operators are being trained. PGE should provide more information which addresses this concern.

In summary, PGE has resolved the concern regarding the human factors evaluation of the SPDS operator interface. However, PGE should provide more information which addresses (1) the involvement of operator training (or the decision not to do so) in the resolution of HED 403, and (2) the content and timeliness of the lectures conducted to train operators on changes to the control room resulting from the DCRDR. This information is needed in order to progress towards the satisfaction of the coordination requirement of Supplement 1 to NUREG-0737.

SUMMARY AND CONCLUSIONS

The documentation provided in Amendment 2 to the Summary Report for the Trojan Nuclear Plant DCRDR has resolved some but not all of the concerns of the NRC that were discussed in the SER. Through the revisions in Amendment 2 to the description of the "ongoing human factors maintenance plan" and in HED descriptions and resolutions, PGE has indicated that it is no longer including the remote shutdown panels in the DCRDR. In order to progress towards the satisfactory completion of the CCRDR requirements of Supplement 1 to NUREG-0737, PGE should provide responses to the remaining concerns discussed in this report. The following is a description of the status of each of the requirements with the information PGE should provide:

Qualifications and Structure of the DCRDR Team

This requirement is presently unsatisfied. PGE should describe the level of involvement of the human factors specialists in the following activities:

- The identification of tasks and information and control requirements from the comparison of the Westinghouse Owners Group (WOG) Emergency Response Guidelines (ERGs), Revision 1based Emergency Instructions (EIs) with Revision O-based EIs.
- The verification of controls and displays in the control room required to satisfy the information and control requirements identified in the above task analysis.
- The annuciator study.
- The selection of design improvements.
- 5. The verification of design improvements in correcting HEDs.
- Function and Task Analysis

PGE has satisfied this requirement.

 Comparison of Display and Control Requirements With a Control Room Inventory

PGE has satisfied this requirement.

Control Room Survey

This requirement is presently unsatisfied. PGE should indicate whether the human factors specialists were involved in the annunciator study and describe how human factors principles were considered. In addition, PGE should provide the final, specific resolutions for each of the HEDs associated with the annunciator study.

Assessment of HEDs

PGE has satisfied this requirement.

Selection of Design Improvements

This requirement is presently unsatisfied. PGE should provide responses to the comments and concerns discussed for each HED given in Appendices A, B, and C of this report. In addition, PGE should provide its rationale for the implementation schedules assigned to the HEDs in Appendix D of this report.

 Verification That Improvements Will Provide the Necessary Corrections Without Introducing New HEDs

This requirement is presently unsatisfied. The Trojan DCRDR will not be considered complete until the verification process and any necessary reiteration of the process for selecting design improvements are completed. At that time, PGE should document and submit to the NRC the results of the verification process including any deviations from the proposed methodology and changes to the specific corrections/resolutions of HEDs as documented thus far.

Coordination of the DCRDR With Other Improvement Programs

This requirement is presently unsatisfied. PGE should provide more information which addresses (1) the involvement of operator training (or the decision not to do so) in the resolution of HED 403, and (2) the content and timeliness of the lectures conducted to

train operators on changes to the control room resulting from the DCRDR.

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REFERENCES

- 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.
- NUREG-0737, "Requirements for Emergency Response Capability," USNRC, Washington, D.C., November 1980.
- NUREG-0700, "Guidelines for Control Room Design Reviews," USNRC, Washington, D.C., September 1981.
- 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.
- 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.
- "Detailed Control Room Design Review Program Plan for Trojan Nuclear Power Plant," Portland General Electric Company, July 28, 1983.
- "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.
- "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.
- "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.

- "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.
- "Human Factors Engineering Branch Detailed Control Room Design Review Input to the Safety Evaluation Report for the Trojan Nuclear Plant," attachment to Memorandum from D.H. Beckham, USNRC, to T.M. Novak, USNRC, dated June 26, 1985.
- "Detailed Control Room Design Review (DCRDR) Summary Report for the Trojan Nuclear Plant, Amendment 2," enclosure to letter from B.D. Withers, PGE, to S.A. Varga, USNRC, dated December 31, 1985.

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APPENDIX A

HEDs for which corrective actions were proposed but were found to be inadequate.

 The proposed corrective action only partially corrects the discrepancy.

87, 250 and, 428

HED 87 (Category 3) - PGE has not mentioned the disposition of the Main Turbine Cold Lube Oil indication in this discrepancy.

HED 250 (Category 3) - No HED form was provided in Volume 2 of Amendment 2 to enable an evaluation to be performed of PGE's response to the inadequacy cited.

HED 428 (Category 4) - A review of the photographs of the drawings depicting the color-padded panel C-19 could not locate MO-8716A/B. PGE should indicate where this switch is located.

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

10, 15, 35, 107, 119, 136, 156, 226, 230, 319, and 321

HED 10 (Category 1) - PGE should indicate if the convention of Train A on left and Train B on right is followed without exception in the control room for adjacent pump controls. If so, then operator training should familiarize the operators to the convention. If not, PGE should rearrange the controls to meet the convention.

HED 15 (Category 3) - PGE should indicate what additional control movement/step is necessary to cause the pump to trip and whether pushing the overspeed trip button is just to activate the capability to trip.

HED 35 (Category 4) - PGE's response is different from that given in the Summary Report: "The current printwheel type of recorder has inherently inconsistent print quality. Plant staff replace via speer." PGE should clarify whether the printwheel was actually replaced.

HED 107 (Category 1) - A review of the photographs of the panel drawings depicting the enhancements did not find demarcation and white/blue cross-matching. The drawings may not have included this at the time when the photographs were taken during the pre-implementation audit. PGE should supply an illustration depicting the enhancements described. PGE should also investigate applying red color padding to distinguish visually the evacuation siren and containment evacuation horn switches.

HED 119 (Category 3) - PGE should clarify how this color padding makes it easier to realign the values and what additional information the SI status panel provides.

HED 136 (Category 2) - PGE should specify what action the plant staff has taken, how the design changeout is expected to improve the level control system, and how the annunciator system replacement or modification should allow one to remove the nuisance alarms selectively.

HED 156 (Category 2) - PGE should describe how color padding clarified the flow paths and describe a representative example of the content and location of the labels.

HED 226 (Category 4) - PGE should indicate whether the operator is still able to communicate with the phone or a suitable alternative from the rod motion control workstation, even though the phone cord has been shortened.

HED 230 (Category 3) - PGE should specify how RDC 80-081 resolved the discrepancies listed.

HED 319 (Category 1) - PGE should describe where the second RCS level indicating column has been added relative to the location of the RCS controls and displays.

HED 321 (Category 1) - PGE should specify what was done about the SFP Low Level annunciator and SFP Level indication. Also, PGE should describe where the new SFP Level switch was installed relative to the RHR and SFP controls and displays.

 Although the proposed corrective action should correct the HED, suggestions are given.

7, 21, 52, and 172

HED 7 (Category 3), 21 (Category 3), and 52 (Category 3) - The discrepancies described concern the reverse-of-convention control movement of left to open and right to close in flow controllers. PGE's corrective action is to provide a small tag, information plate, or information plaque on the controllers indicating OPEN or CLOSED. It is suggested that the tags or information plates/plaques be made highly distinctive and obvious to attract operator attention, especially since memory and mental concentration are not totally reliable.

HED 172 (Category 3) - If not done already, an investigation should be conducted of the applications of group labeling to color-padded and demarcated groups of components to identify the group. Color padding and demarcation differentiates groups or individual components from each other but does not necessarily provide direct identification of group content.

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APPENDIX B

HEDs for which justifications for not taking corrective action were provided but were found to be inadequate.

 The justification is too brief, general, or ambiguous, or does not sufficiently address the discrepancy to allow an adequate evaluation to be made.

8	260	301	311	400
23	278	302	317	402
31	279	303	332	403
42	280	304	346	406
46	281	305	353	410
50	284	307	369	420
58	288	308	386	437
66	289	309	387	440
91	298	310	398	447
138	299			

HED 8 (Category 3) - The problem is not the differentiation of pumps versus valves but throttleable versus non-throttleable valves. The fact that there are few trottleable valves in the control room does not alleviate the problem. The PGE response in the Summary Report is that new switch labels will be provided per RDC 84-125 that indicate throttleable valves. This does not appear to be PGE's commitment now. Some means of indicating throttleable valve control switches is needed.

HED 23 (Category 4) and 369 (Category 3) - PGE should specify what the other indications are on C-13 and C-19 that are available to verify the loads have started and which of the indications ("XMAS tree" versus those on C-13 and C-19) the procedures direct the operator to use.

HED 31 (Category 4) - PGE should indicate whether low flow is alarmed in the control room since the flow rate indications are displayed in the auxiliary building only.

HED 42 (Category 3) and 332 (Category 3) - PGE should describe the conclusions and recommendations of the DCRDR team's evaluation of the use of nonreflective coating (only hoods are addressed in discussion on glare problem).

HED 46 (Category 3), 279 (Category 3), and 288 (Category 3) - PGE should describe how often "current checks" are made to verify or diagnose indicating light bulb failure and how the checks are controlled (e.g., through administrative or maintenance procedures).

HED 50 (Category 3) - PGE should indicate whether the meter study included input from the task analysis (i.e., information and control requirements such as the needed reading accuracy of precision for decision making). If not, these inputs should be made and the meters associated with the tasks from the task analysis should be evaluated.

HED 58 (Category 3) - PGE should indicate if any enhancement techniques were evaluated to associate PRM-14 with associated components on C-41, such as a label on C-41 referencing PRM-14 location (if there are sequential operations involving PRM-14 and components on C-41).

HED 66 (Category 3) - PGE's response does not address the readability of the meters for which the discrepancy was written. PGE should describe how high and adequate the ladder is for reading and what kind of parallax effects are present (especially if these meters are vertically oriented).

HED 91 (Category 4) - PGE's response to the discrepancy appears to state that the UI-500 meter presents a demand signal (versus actual status). Although the actual discrepancy involving the UI-500 meter is acceptably resolved, PGE should describe whether demand is what the UI-500 meter should be indicating (versus status) and why.

HED 138 (Category 4) - PGE appears to discount part of the intent of NUREG-0700 guideline 6.3.3.3.D. The intent includes grouping

annunciators by proximity (i.e., adjacent to one another), not just to reduce tiles by creating multialarm tiles. PGE should address the entire intent of the guideline and investigate tile grouping by subsystem, function, or other logical organization with possible provisions for group labeling to minimize the redundancy of tile information and enhance search and recognition of the needed channel.

HED 260 (Category 4) - PGE should describe how much less than 50 inches the distance is between the back of the printers console and adjacent vertical panels. In addition, PGE should indicate what safety-related controls may be on these vertical panels.

HED 278 (Category 4) and 289 (Category 4) - PGE should describe what the Trojan control room labeling standard allows for legend message format and content (in each line of lettering). PGE should clarify whether the particular standard accounts for adequate letter height, width, etc., for four lines of lettering.

HED 280 (Category 3) - This HED is not insignificant if any legend pushbuttons or legend lights that are safety-related exist in the control room. There will be some potential for accidental interchanging of legend covers. PGE should indicate if any safetyrelated legend pushbuttons or legend lights are in the control room. PGE should consider, at a minimum, establishing an administrative or maintenance procedure for removing legend covers (e.g., removing only one at a time) coupled with operator and/or maintenance technician training. Equipment numbers can be used as keys by having these engraved on both the legend cover and the hardware with which the cover is associated. PGE should describe its consideration of these alternatives.

HED 281 (Category 4) - PGE should describe how much less than 3.75 inches the J-handle length is and what interactive effect torque has upon operability of J-handles.

HED 284 (Category 4) - PGE did not respond but should to that portion of the discrepancy concerning transformation indications.

HED 298 (Category 4) and 299 (Category 4) - PGE should describe what operations are typical with the P-250 computer, how continuous the monitoring can be, and the effects of visual fatigue on performance relative to the monitoring requirements.

HED 301 (Category 4) - PGE's response that only one page of data is available to be placed on the CRT seems to contradict the discrepancy found that there is no indication of page number and total number of pages displayed when data are contained on multiple pages. PGE should address this apparent contradiction.

HED 302 (Category 3), HED 303 (Category 4), 304 (Category 4), 305 (Category 4), and 311 (Category 4) - PGE should describe the typical operations in which the P-250 program controlled annunciator system are involved. In addition, PGE should describe where else in the control room the same information is provided (e.g., highlighting of urgent messages, error messages, etc.). PGE should also describe what kind of training the operators receive for use of the P-250 and how often training occurs.

HED 307 (Category 4) - PGE should describe how comparable the alarm typewriter is to the functions of the P-250, where the alarm typewriter is located, which of the two (alarm typewriter or P-250) is used in operations, and what other information is coming in on the alarm typewriter and how it is integrated with or differentiated from the primary alarms.

HED 308 (Category 4) - PGE should clarify which printer is referred to in the justification.

HED 309 (Category 4) - PGE should clarify what it identifies as important alarms and why all alarms should not be recorded.

HED 310 (Category 4) - PGE should describe how the SPDS will improve the capability to obtain printouts by alarm group.

HED 317 (Category 1) - PGE should describe how additional emphasis has been placed on proper watch turnover of critical items as

compared with before the violation of the technical specification limit occurred. Improved counseling as the sole means of providing emphasis is not considered adequate. PGE should indicate if it took corrective measures such as procedural modifications, annunciator provisions, and/or banding of meter operating ranges.

HED 346 (Category 4) - Even though a cross-reference index chart is supplied by the data logger and the information obtained is not needed immediately by the operator to make decisions, errors still seem to be committed. PGE should describe whether training is correcting this problem, and if so, how.

HED 353 (Category 4) - The discrepancy is described as low contrast of red LEDs on black background. PGE's response is that adequate contrast exists. PGE should clarify the apparent contradiction between the discrepancy described and its response and describe how it determined (from what basis) contrast was adequate.

HED 386 (Category 4) - PGE should indicate what safety systems are annunciated on C-42 (if any).

HED 387 (Category 4) - PGE should indicate how much over 70 inches above the floor those displays are located, and describe why the discrepancy was not deemed to be a problem in the walkthroughs.

HED 398 (Category 4) - PGE should describe why the discrepancy was not deemed to be a problem in the walk-throughs.

HED 400 (Category 4) - PGE should indicate what the actual viewing distance(s) is for operations involving TR-3498.

HED 402 (Category 3) - PGE should describe how this problem is being corrected and coordinated with plant procedures and crew training. This problem is an HED and should be addressed within the scope of the DCRDR. HED 403 (Category 2) - This problem is an HED and should be addressed within the scope of the DCRDR. PGE should provide the resolution to this problem.

HED 4C6 (Category 3) - PGE should describe how the alarm on C-151 is reflashed to the control room, as what alarm, and where in the control room the alarm is located relative to associated/same system components.

HED 410 (Category 4) - PGE should describe who has been assigned responsibility to develop workable solutions, when solutions are scheduled to be finalized, and what progress has been made up to this point to resolve the problem. This problem is an HED and should be addressed within the scope of the DCRDR.

HED 420 (Category 3) - PGE should explain why the task requirements are subjective and why operator judgment is sufficient. The potential for operator misjudgements due to stress and time constraints during an emergency event such as a LOCA should be addressed. In addition, PGE should clarify at what accuracy flow rate must be determined and if there are any aids to the operator in converting RWST level to flow rate.

HED 437 (Category 4) - PGE should explain why the switch is not difficult to operate and how the operator is able to make an association between switch position and recorder pen.

HED 440 (Category 3) - PGE should describe the following: (1) the EI that is mentioned in its response, (2) what the operator is waiting for (e.g., avoidance of thermal shock), (3) the steps the operator takes after looking for an indication of vessel head temperature, and (4) the secondary or indirect indication(s) for vessel head temperature. PGE should address the potential for things to go wrong in the interval in which the operator is waiting, especially if the indication really needed is a vessel head temperature of less than 200 degrees farenheit. HED 447 (Category 4) - PGE should describe any requirements there may be for sequential operations involving these indicators and what the operator information requirements are. Although mimicking can improve the layout of indicators such as these, no mimicking appears to be used in this case.

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

65, 228, 238, 282, 290, and 296

HED 65 (Category 3) - PGE's response does not address the discrepancy concerning the difficulty of setting log scales at set points called for in the procedures. PGE's response cites the control of the setpoints by procedure, not how it will resolve the difficulty at setting the setpoints called for in the procedures. PGE needs to respond to the actual discrepancy or to explain better its previous response.

HED 228 (Category 4) - PGE should explain why the direct discharge of air on the operators is not considered a significant problem relative to operator performance and health.

HED 238 (Category 4) - High levels of lighting may have an adverse effect upon personnel in the Shift Supervisor's office, especially in the long term. Even though personnel in the office at any one moment may not find the lighting particularly harsh on their eyes, PGE should reconsider this problem and the potential effect of it upon personnel health and performance in the long term. Additional response by PGE is needed.

HED 282 (Category 4) and 290 (Category 4) - PGE should provide a justification that cites more than just insignificant deviation from guidelines, such as the effect of the discrepancy upon operations requirements and operator performance.

HED 296 (Category 4) - PGE should explain why the discrepancy is insignificant in terms of the potential for operator accidental

actuation and corresponding consequences upon plant performance and safety. PGE should consider using tag outs which prevent accidental actuation, such as plastic covers rather than paper tags.

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 Although the justification for not taking corrective action is adequate, suggestions are provided.

14, 29, and 47

HED 14 (Category 4) - Even though PGE intends to replace switches presently found to be flimsy and weak when they eventually fail, preventative maintenance or replacement is preferable to avoid switch and system inoperability.

HED 29 (Category 3) and 47 (Category 3) - Even though the meaning attached to white indicator lights is standard (i.e., power on), there does not appear to be any label which tells the operator what is powered. PGE should provide a small label (if space is available) next to each power-on indicator light which will inform the operator of what is powered (e.g., spring motor, local bus select).

APPENDIX C

HEDs for which resolutions could not be evaluated.

 The HED resolutions were not finalized or described in final form

125	134	270
126	135	271
127	137	276
128	139	277
129	234	345
131	235	357
132	236	364
133	269	368

All of the above HEDs (except HED 368) - The annunciator system upgrade was not complete (or started?) at the time of the submittal of Amendment 2. Until this effort is completed and the final, specific HED resolutions reported to the NRC, the evaluation of the acceptability of the resolution of these HEDs cannot be completed. In the interim, PGE should submit a milestone schedule for completion of the annunciator system upgrade effort.

HED 368 - PGE should report the results of lighting level measurements and the final resolution of the HED.

2. The HED forms were not found in Amendment 2.

470, 471, and 472

APPENDIX D

HEDs for which corrective actions are proposed and which have been assigned implementation schedules by PGE, which appear to be overextended relative to those of HEDs from the same category. PGE should provide its rationale for the implementation schedules assigned for these HEDs.

Category	1:	131	(9/30/88)	and	318	(9/30/87)	
Category	2:	9	(9/30/87)		136	(9/30/89)	
		134	(9/30/89)		261	(9/30/87)	
		135	(9/30/89)		269	(9/30/89)	
Category	3:	1	(9/30/87)		128	(9/30/89)	
		40	(9/30/87)		132	(9/30/89)	
		55	(9/30/87)		133	(9/30/89)	
		57	(9/30/88)		137	(9/30/89)	
		87	(12/31/87)		139	(9/30/89)	
		96	(9/30/87)		235	(9/30/89)	
		109	(9/30/88)		236	(9/30/89)	
		115	(9/30/87)		270	(9/30/89)	
		116	(9/30/87)		271	(9/30/89)	
		117	(9/30/87)		276	(9/30/89)	
		120	(9/30/88)		345	(9/30/89)	
		125	(9/30/89)		405	(9/30/87)	
		126	(9/30/89)		444	(9/30/88)	
		127	(9/30/89)		445	(9/30/88)	

NOTE: HED 87 will be corrected by changing the location of some components in the AFW system. HEDs 86 and 88 will be corrected by providing demarcation and hierarchial labeling to the same area on C-14. However, the implementation schedule for HED 87 (12/31/87) is much later than that for HEDs 86 and 88 (12/31/85). The apparent problem here is that these corrections are not integrated. Specifically, moving components in an area previously demarcated and labeled hierarchially may cause these enhancements to be changed to accommodate the moves. PGE should clarify whether this is the case. .. (>

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448	456	464
449	457	465
450	458	466
451	459	467
453	460	468
454	461	469
455	462	

HEDs identified from the human factors survey of the operator interface of the SPDS.

NOTE: HEDs 470, 471; and 472 were not found in Amendment 2.