DETAILED CONTROL ROOM DESIGN REVIEW PROGRAM PLAN
FOR PHILADELPHIA ELECTRIC COMPANY'S
LIMERICK AND PEACH BOTTOM PLANTS

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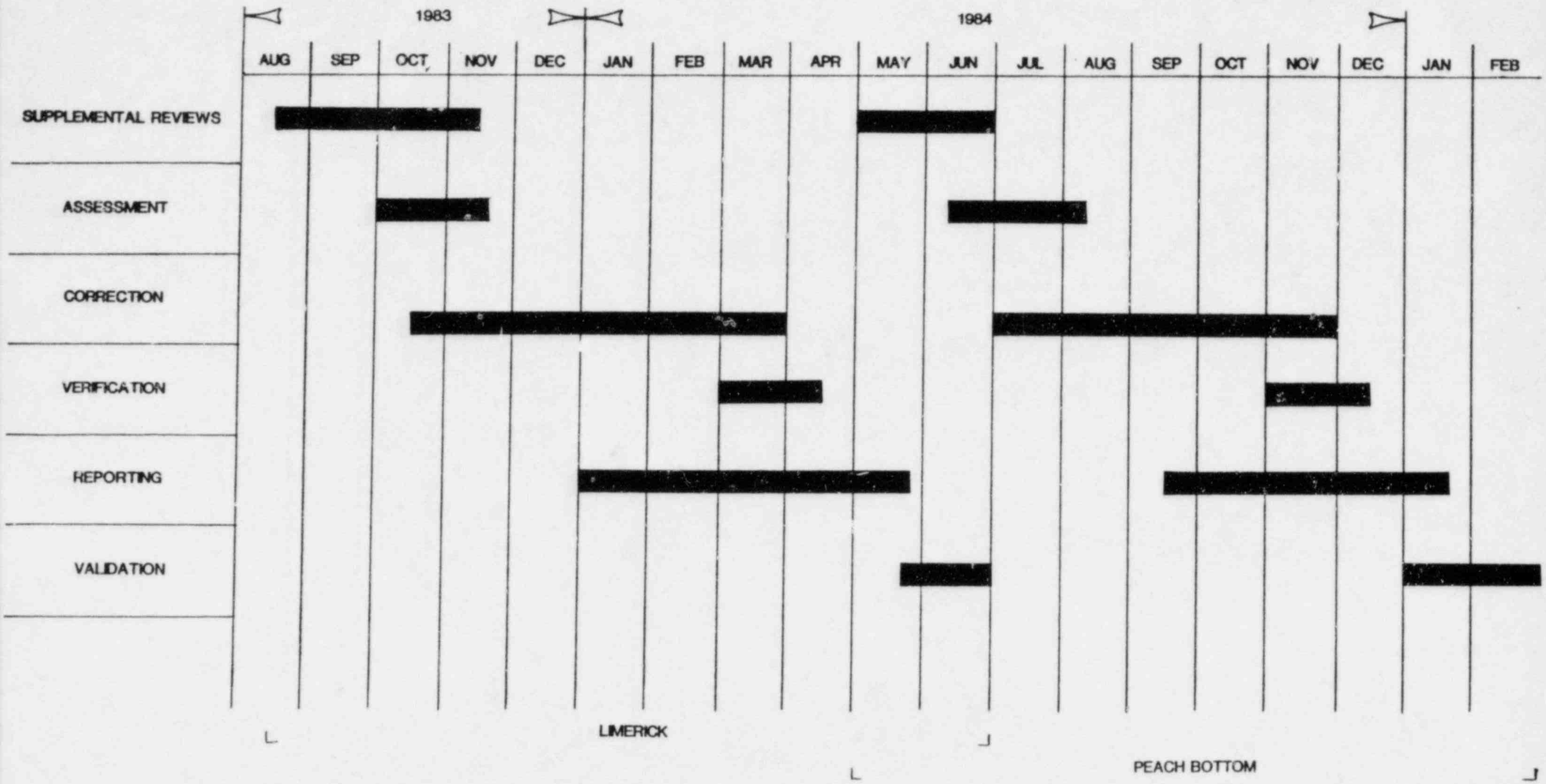
Resumes

1. INTRODUCTION

The control room design review (CRDR) is part of industry and the Nuclear Regulatory Commission's (NRC) requirements (Supplement 1 to NUREG 0737) to upgrade control rooms, emergency response facilities, and procedures. While the CRDR is directed toward the existing control room, other areas of concern, such as the design of a Safety Parameter Display System (SPDS), will be coordinated with the CRDR. Guidance for the CRDR and related activities has been provided by the NRC in the form of various NUREGs and Regulatory Guides.

The General Electric Boiling Water Reactor Owners' Group (BWROG) developed a generic program to partially address the DCRDR requirements. The Control Room Survey (CRS) conducted by that group on the Peach Bottom and Limerick plants was designed to include the planning and review phases of the NRC required CRDR. An NRC staff review resulted in acceptance of the generic program, as documented in Generic Letter 83-18.

A BWROG CRS was conducted at Peach Bottom in October 1981 and a report documenting the survey findings was issued in February 1982. A CRS of Limerick was completed in February 1982 and reported in April 1982. Since the BWROG survey program addressed only the planning and review phases of CRDR, requirements of the assessment and implementation phase, and the reporting phase remain to be completed. The purpose of this program plan is to describe how PECo plans to complete the balance of the CRDR requirements for both Limerick and Peach Bottom plants. The schedule, Fig. 1, shows the relative placement of certain activities in the CRS and the overall CRDR process for both plants.



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LIMERICK
PEACH BOTTOM

FIGURE 1

2. OVERVIEW

2.1 BWROG CONTROL ROOM SURVEY

Control Room Surveys were performed at Limerick and Peach Bottom as mentioned previously. The BWROG review methodology included analysis of plant LERs and scram reports, operator interviews, checklist evaluations, and task analysis/walkthroughs of emergency procedures.

2.1.1 BWROG CRS PERSONNEL

The program at Limerick involved the following personnel:

a. BWROG Survey Team

   4 operations and engineering personnel from four utilities

   2 human factors consultants

   2 representatives from General Electric Company

b. Plant operators interviewed by BWROG survey team:

   3 shift superintendents

   1 shift supervisor

   1 performance engineer

   1 technical engineer

   2 control operators

The program at Peach Bottom involved the following personnel:

a. BWROG Survey Team

   2 Philadelphia Electric Company

   4 Other Utility

   2 Human Factors Specialists

   1 General Electric Company.

b. Plant Operators Inteviewed by BWROG Survey Team

1 Shift Superintendant

2 Shift Supervisors

1 Electrical Supervisor

2 Control Operators

2 Assistant Control Operators

Qualifications of participants are appended to this plan.

2.1.2 BWROG CRS DEVIATIONS

The Peach Bottom and Limerick surveys were conducted substantially in accordance with the methodology of the BWROG CRS methodology deviating only in the following area.

a. The CRS methodology for operator interviews states that interviewers would not be employees of the host utility. In order to utilize the survey team efficiently, one of the eight operator interviews at Peach Bottom was conducted by a PECo employee. The interviewer, however, was from a different department than the operator and the two had no prior contact.

b. The procedure walkthrough portion of the review was not conducted for either Peach Bottom or Limerick during the CRS. This aspect was completed as a portion of the supplemental review of both plants. All steps listed in the BWROG Program Plan for procedure walkthroughs and task analyses were completed as part of the supplemental review effort. Plant specific EOPs were used. The process used for the supplemental review walkthroughs for both plants are described in Section 4.2.

2.2 CRDR OBJECTIVE

The purpose of the PECo CRDR is to ensure that the Limerick and Peach Bottom control rooms will support operation during emergency conditions. To fulfill its stated purpose, several objectives have been defined for the CRDR.

- o To complete the BWROG CRS that compares the existing control room design with accepted human engineering criteria.
- o To identify Human Engineering Discrepancies (HEDs).
- o To review relevant plant operational experience subsequent to the CRS using appropriate documentation and operator interviews.
- o To ensure the necessary controls and instrumentation are present to support control room operator tasks during emergency conditions.
- o To determine the extent and importance of any identified discrepancies.
- o To formulate and implement resolutions for significant discrepancies (as judged above).
- o To ensure that the proposed resolutions eliminate or mitigate the discrepancies for which they are formulated and do not create new discrepancies.
- o To Validate the changes necessary to ensure that control room operators can function adequately with the control room changes.

2.3 DESCRIPTION OF CRDR ACTIVITIES

To achieve the stated objectives of the CRDR, several activities will be completed during the review. A flow chart of these

activites for Limerick is presented in Figure 2; Figure 3 presents activities for Peach Bottom. Several of these activities have been completed in the BWROG CRS; these are indicated by the shaded areas in Figures 2 and 3. The steps for completing the balance of the CRDR requirements is as follows:

- o Supplemental Reviews
- o Assessment
- o Correction
- o Verification
- o Report
- o Validation
- o Implementation

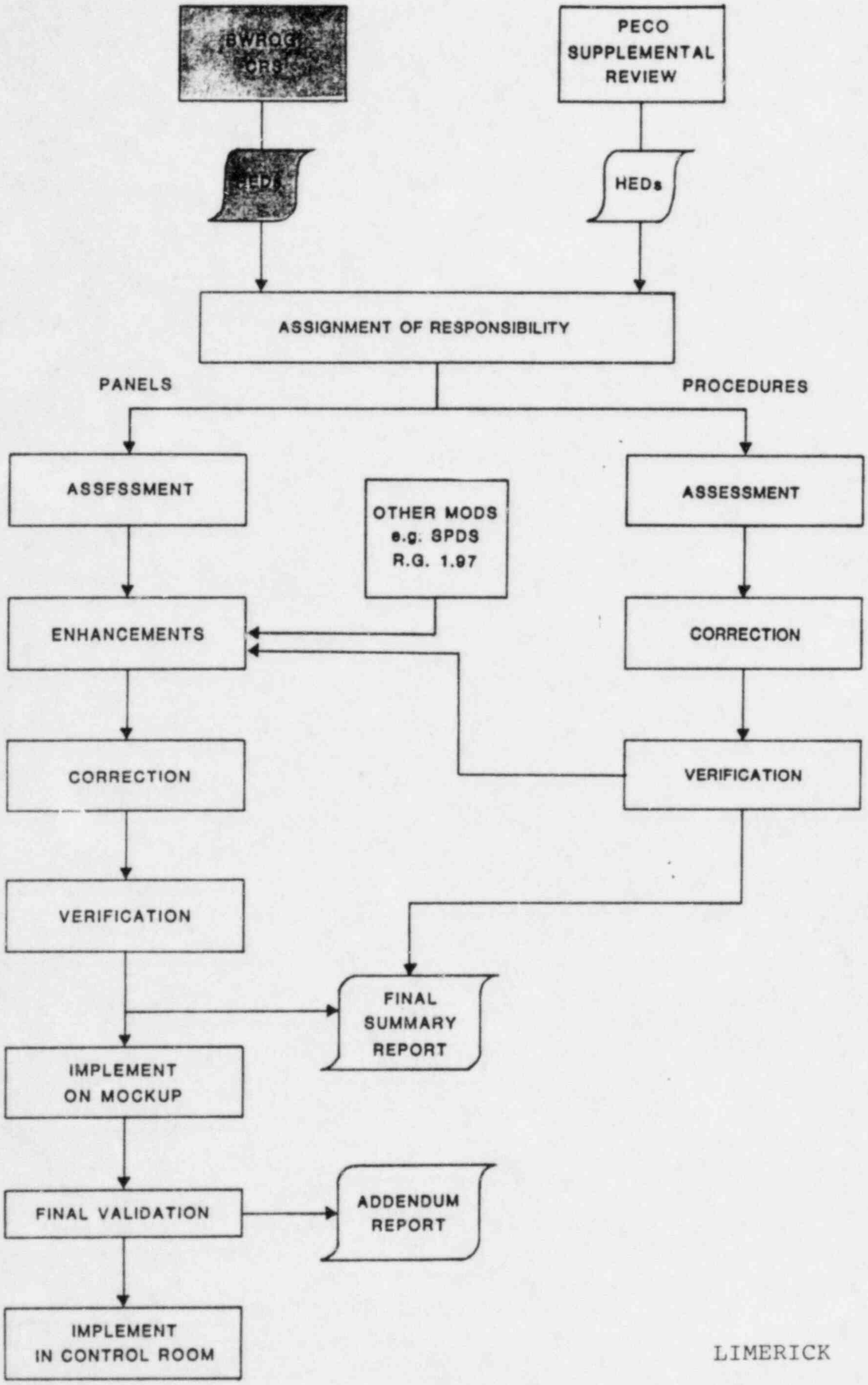
The activities within each step will be described in detail in subsequent sections. A brief synopsis of these activities will provide an overall perspective of the process.

2.3.1 SUPPLEMENTAL REVIEW

As a means to complete the BWROG CRS, a Human Factors Engineering Control Room Survey Supplement will be implemented in order to review the panel changes and operational experience gained since the CRS. New Human Engineering Discrepancies (HEDs) will be identified at this time.

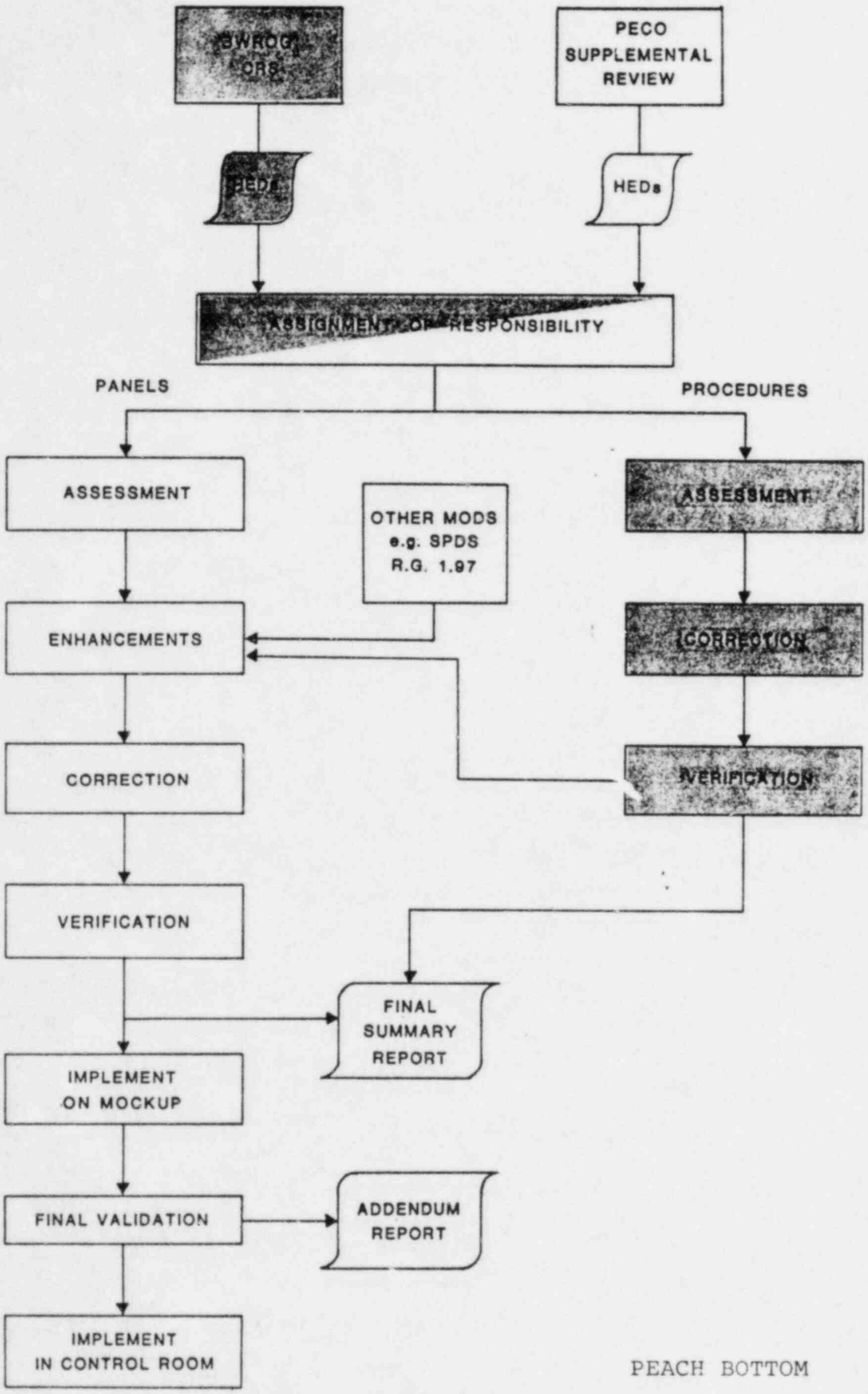
2.3.2 HED ASSESSMENT

A special analysis will be made to ensure continuity of work between the BWROG CRS, that has already been approved by the NRC Generic Letter 83-18, and the follow-on assessment, correction, and implementation phases. The existing HEDs from the CRS will be analyzed along with backup material to ensure that all information is carried over and an audit trail is maintained.



LIMERICK

FIGURE 2



PEACH BOTTOM

FIGURE 3

All identified HEDs will be assessed and prioritized for correction.

2.3.3 HED CORRECTION

All HEDs that are judged to require correction during the assessment phase will be investigated. Design improvements will be developed to resolve these HEDs.

2.3.4 VERIFICATION OF HED CORRECTIONS

The verification step is intended to provide a review of the proposed resolution for each HED and ensure that the modification will correct the discrepancy without creating any unacceptable side effects. It will also ensure that human factors requirements are adequately addressed. This analysis will look at the broader implications of the proposed resolution and will use computer matching to look for compounding effects.Each recommended HED correction will be verified by completing a HED verification form.

2.3.5 REPORTS

Results of all steps of the CRDR Program will be documented and a summary report will be prepared. The summary report will describe the methodology used and detail the resolutions from the assessment and correction steps. It will contain a schedule for implementing HED improvements.

2.3.6 VALIDATION

All phases of the control room improvement program will be assessed to ensure integration of enhanced and improved panels, TRIP procedures, accident monitoring instrumentation-R.G.1.97, computer displays and SPDS, and trained operators.

2.3.7 IMPLEMENTATION

The implementation of design improvements will be scheduled based upon priorities assigned during the assessment step and reviewed during the verification step.

2.4 INTEGRATION OF OTHER ACTIVITIES

Supplement 1 to NUREG 0737 requires the integration of these post-TMI initiatives.

- o Emergency Operating Procedures
- o Accident Monitoring Instrumentation - R.G. 1.97
- o Safety Parameter Display System
- o Emergency Response Facilities
- o Detailed Control Room Design Review

The first four of these initiatives have been completed or will be completed prior to the completion of the DCRDR. The results of these initiatives will be made available to the CRDR review team as shown in Figures 2 and 3. During the design of enhancements, and during the correction of other HEDs, the designs and requirements of the other initiatives will be reviewed and coordinated with the development of improvements to the control room panels.

Specifically, the operational manning, organization, and operating philosophy developed in conjunction with writing plant specific EOPs will be used in the design of improvements to the panels. SPDS displays will be used and integrated with the panels' design considerations. Accident monitoring instrumentation has been designed and will be part of the supplemental review and follow-on assessment and correction. Finally,

communication with the emergency response facilities will be examined in the process of the supplemental review and assessment phases.

Any difficulties found in the integration of these initiatives during the assessment and correction phase will be referred back to the original design group for resolution and coordination with the CRDR team. The final validation described in this plan is intended to provide a final overall review of the integration of all these initiatives by performing actual walkthroughs using all aspects of these initiatives that affect the control room performance.

2.5 GLOSSARY OF TERMS

- Control Room Design Review (CRDR)

  A post-TMI task listed in NUREG 0660, "Task Action Plan Developed as a Result of the TMI-2 Accident", and NUREG 0737, the Staff supplement to NUREG 0660, as Task 1.D.1.

- Control Room Survey (CRS)

  As approached by the BWROG program, the planning phase and the review phase of the Detailed Control Room Design Review (DCRDR) called for in Supplement 1 to NUREG 0737 and described in NUREG 0700.

- Supplemental Control Room Survey

  Those areas of the DCRDR not covered by the BWROG's CRS including the Assessment and Implementation Phase, and the Reporting Phase as called for in NUREG 0700.

- Emergency Procedure Guidelines (EPGs)

  Guidelines for the response to transients and accidents

developed by BWROG; these provide the bases for plant-specific emergency operating procedures. (See TRIP.)

- Function

  An activity by one or more system parts that contribute to a large activity or goal.

- Function Analysis

  An examination of the required functions and functional sequences with respect to available manpower, technology, and other resources, to determine how the functions may be executed.

- Human Factors Engineering (HFE)

  The science of optimizing the performance of human beings on high technology systems. Also, the science of designing equipment for efficient use by human beings.

- Human Engineering Discrepancy (HED)

  A characteristic of the control room that does not comply with human factors criteria.

- Operator

  A licensed individual who manipulates a control or device; e.g., Reactor Operator (RO), Senior Reactor Operator (SRO).

- Operational Experience Review

  One of the activities that constitutes a CRDR. The operating experience review screens plant operating document and operator experience to discover human engineering shortcomings that have caused actual operating problems (or near misses) in the past.

- Review Team

  A multidisciplined group of individuals responsible for

directing and enacting the CRDR of a specific control room.

- o Safety Parameter Display System (SPDS)

  An aid to the control room operating staff for use in monitoring the status of critical safety functions that constitute the basis for plant-specific, symptom-oriented emergency operating procedures.

- o System

  The organization of human-machine actions and interactions directed at the accomplishment of a given set of objectives.

- o Task

  A specific action or individual step that contributes to the accomplishment of a function.

- o Task Analysis

  A tool or method used to delineate system functions and the specific actions that must take place to accomplish those functions. In the CRDR context, task analysis is used to determine the individual tasks that must be completed to allow successful emergency operation. This activity checks the control room match to the emergency operating procedures.

- o Transient Response Implementation Procedures (TRIP)

  PECo plant specific emergency operating procedures.

- o Validation

  The process of bringing together all aspects of the control room improvement program including enhanced and improved panels, TRIP procedures, computer displays and SPDS, and trained operators.

- Verification

  The process intended to provide a review of proposed resolutions for each HED, thereby ensuring that any modification will correct the discrepancy without unacceptable side effects.

3. MANAGEMENT AND STAFFING

3.1 CRDR MANAGEMENT/REVIEW TEAM

The ultimate responsibility for the combined Limerick and Peach Bottom CRDRs will reside with the PECo Electrical Engineering Division.

The day-to-day conduct of each review will be the responsibility of a review team established specifically for each plant. The review team will provide the management overview to ensure the integration of the project objectives and to fulfill the intent of the review. The review team will be responsible for planning, scheduling, and coordinating the total, integrated CRDR. The review team will be comprised of members from PECo and human factors consultants from The Interlock Group. The Interlock Group will provide human factors and engineering expertise during all phases of each CRDR. Qualifications of review team members are included in resumes appended to this Program Plan.

3.2 REVIEW TEAM STRUCTURE

The review team is a multidisciplined team of individuals with the wide range of skills necessary to perform the design review. The team will include the following personnel:

- o Review Team Leader
- o Human Factors Specialists
- o Reactor Operator (or operations technical advisor with operating experience)
- o Instrumentation and Controls Engineer
- o Nuclear Engineer

In order to maintain continuity and carry over experiences from Limerick to Peach Bottom, most of the personnel will be the same for the two teams, including the human factors specialists.

The core team will be supplemented, as required, by other disciplines such as: mechanical, electrical, and industrial engineering, training, computer operations, procedures, and licensing. During the course of the review, any additional specialists (e.g., lighting, acoustics) required for specific tasks will be made available to the review team as needed.

3.2.1 REVIEW TEAM LEADER

The review team leader provides administrative and technical direction for the project. Access to information, facilities, and individuals providing useful or necessary input to the team is coordinated by the review team leader. Because of his detailed knowledge of Limerick and Peach Bottom systems and methods, this individual provides a cohesive force for the various PECo department personnel and vendor organizations involved with this project. Plant operations personnel provide input to the review team through contact with the review team leader.

As part of his responsibilities he will resolve human factors opinions on methodology. technique, review findings, assessment and HED corrective actions that dissent with the majority opinion of the CRDR Review Team. The qualifications for the review team leader include:

- o bachelors level degree (or equivalent) in an engineering discipline or SRO-certification and
- o five years' experience in nuclear plant operations or engineering

3.2.2 HUMAN FACTORS SPECIALISTS (HFS)

The human factors specialists, as members of the review team, will be involved in each phase of the control room design review, providing the human factors technical leadership for the entire CRDR project. The human factors specialists will coordinate all human factors activities and ensure project quality is maintained at a level necessary for a valid and comprehensive review.

The combined qualifications of the review team human factors specialists include:

- o bachelors level degrees in Pyschology
- o advanced studies in Human Factors Engineering
- o advanced degrees in Engineering
- o over 5Ø years combined experience in human factors including conducting of CRDRs

3.2.3 INSTRUMENT AND CONTROLS (I&C) SPECIALIST

The I&C specialist will assist in the identification of plant system design features and will serve as the review team expert on the capabilities and limitations of controls and instruments. The I&C specialist will also provide input to the team during the assessment phase of the review, especially when the review team considers proposals for mitigating HEDs.

The minimum qualifications for the I&C specialist will include the following:

- o B.S. degree (or equivalent) in engineering or applied science field
- o five years of I&C engineering experience, at least two of which are in the nuclear design area

3.2.4 REACTOR OPERATOR (RO)

At least one RO each from Limerick and Peach Bottom will serve as a member of the core review team. The RO will assist in identifying operator tasks and will serve as the review team expert on the operational constraints for manipulations of plant sytems.

The minimum qualifications for the RO include the following:

- o a reactor operator's license at Limerick and Peach Bottom
- o at least three years' experience as a licensed nuclear operator

3.2.5 DESIGN ENGINEER

The design engineer will assist in the identification of plant system design goals and functions and will serve as the review team expert on the factors affecting the design decisions at the plant. The design engineer will provide input to the review team during the analysis of functions and tasks for any plant systems and during the assessment, implementation, and effectiveness phases of the CRDR.

The minimum qualifications for the design engineer will include:

- B.S. degree in an engineering or applied science field
- five years of design experience, at least two of which are in the nuclear design area

3.3 REVIEW TEAM ACTIVITIES

Review team activities will include developing the methodologies for the review and assessment of discrepancies, establishing the overall plan and schedule for the CRDR, draw upon the resources of the line organizations, and integrating all action items. The review team will develop, or have developed, all reports relating to the CRDR and ensure that appropriate reports are submitted to PECo management for review and approval.

4. PROCEDURES FOR THE CRDR

The objective of the combined Limerick/Peach Bottom CRDR effort is to provide a coordinated approach to completing the supplemental review, and designing consistent company-wide improvements. The resulting control rooms should provide operators with sufficient information to complete their required functions and task responsibilities efficiently under emergency conditions. The review will also determine the human engineering suitability of the designs of the instrumentation and equipment in these control rooms, with consistency being maintained in the resolution of discrepancies in the two plants. The experience gained from the Limerick review, to be completed first, will be carried over to the Peach Bottom review. Continuity with the owners' group study will be maintained, ensuring complete integration of all phases of the review. This section of the implementation plan describes the procedures that will be applied to accomplish those overall objectives, at both plants or the specific plant indicated.

4.1 SUPPLEMENTAL REVIEW

As specified by Generic Letter 83-18, the BWROG CRS will be supplemented by the completion of the Human Factors Engineering Control Room Survey using supplemental checklist sheets issued by the BWROG. In addition, changes to the panels that have occurred since the completion of the CRS will be evaluated against the original BWORG checklists. Also, a supplementary experience review will be performed in a manner similar to the BWORG methodology to update experience since the completion of the CRS.

4.2 SUPPLEMENTAL TASK ANALYSIS

A supplemental task analysis and walkthrough was completed for the Limerick and Peach Bottom plants using plant specific Transient Response Implementation Procedures (TRIP). The TRIP was developed first for Peach Bottom because it is an operating plant, and then converted to the Limerick plant. The process for conducting this supplementary analysis for the Peach Bottom plant and then the subsequent analysis for the Limerick plant is detailed in chronological order in the following paragraph.

4.2.1 SUPPLEMENTAL TASK ANALYSIS - Peach Bottom

A preliminary task analysis was performed by the BWROG CRS using the methodology described in the owner's group submission to the NRC and approved by Generic Letter 83-18. This included steps equivalent to the functional and task analysis, and verification of availability. Validation walkthroughs were not performed. The task analysis for Peach Bottom used the owner's group guidelines, Rev. Ø. The subsequent Rev. 1 made extensive changes, while Rev. 2 made only minor changes. Rev. 2 of the EPGs was accepted by the NRC for use in Generic Letter 83-Ø5. Because Peach Bottom is an operating plant, a supplementary task analysis was performed first on that plant, updated to Rev. 2.

A supplementary task analysis has been completed for Peach Bottom. It meets all requirements for NUREG Ø7ØØ for the functional and task analysis, verification of availability, and validation of control room functions. It was conducted in a more extensive process than could be expected from a normal CRDR, and

the methodology was every bit as rigorous. The process used is discussed below.

A team was formed of four engineers, each an experienced SRO on the Peach Bottom plant; J. Doering, Limerick Operations Engineer with 6 years experience at Peach Bottom; G. Madsen, Assistant Operations Engineer at Limerick with 2 years experience there; J. Winzenried, Technical Engineer at Peach Bottom with 13 years experience; and A. Wasong, Test Engineer at Peach Bottom with 10 years experience. This team used the BWROG EPSs Rev. 1 and 2 to perform a detailed functional analysis and task analysis. This process consisted of developing functional and task flow diagrams to a very detailed level, then developing written descriptions of every step, including the detailed basis for each step and appropriate cautions. Each step was compared against the plant instrumentation to ensure that the necessary controls and instrumentation was available. The final result of this process was the formulation of the Transient Response Implementation Procedures (TRIP), which are plant specific EOPs for Peach Bottom. The TRIP was audited against the Rev. 2 of the EPGs and differences were recorded. These differences were verified to be required by the design of the Peach Bottom plant.

The team then walked through the procedures on the Limerick simulator (which is similar to the Peach Bottom control room.) During this verification process, the procedures were judged effective in meeting the objectives of EOPs, and the controls and instrumentation were verified as available and suitable for the required steps. The verification of instrumentation was

rigorous, verifying detector source, instrument range, accuracy of reading, and dynamic response. This process revealed that one temperature instrument was not available and resulted in a change of the procedure to obtain the required information in another way. Because the team was thoroughly familiar with the Peach Bottom control panels, they were able to adjust for the differences between the Limerick simulator and the Peach Bottom control room panels. Subsequent to the following review process described below, the TRIP procedures were verified directly on the Peach Bottom panels for proper instrumentation by M. Manski, an experienced Shift Technical Advisor, under the direction of A. Wasong.

A process more extensive than a normal validation walkthrough was performed. The personnel responsible for training were instructed in the use of the TRIP procedures. Then experienced Peach Bottom operators were exercised on the simulator using the TRIP procedures. The team of engineers observed the exercises, took extensive data and notes, and interacted directly with the operators. Operator feedback was used extensively in adjusting the procedures, primarily in wording and formatting, and exercises were repeated to verify the changes. Thirty operators experienced on the Peach Bottom plant were used in these validation exercises. This process met all requirements for the NUREG 0700 validation and included the assessment and correction phases for the TRIP procedures. TRIP has been implemented in the Peach Bottom plant.

4.2.2 FOLLOW-ON SUPPLEMENTARY ANALYSIS FOR LIMERICK

The BWROG CRS on Limerick was conducted after the CRS on Peach Bottom. The preliminary task analysis for Limerick was performed using the first revision of the Peach Bottom TRIP. The same team performed an engineering analysis of the TRIP, and made changes to it to account for design differences between the Peach Bottom and Limerick plants. This analysis also identified specific controls and instrumentation requirements. The process revealed that a temperature detector was not sensing the proper location and the level detector was not sensing the proper range, both resulting in a plant change. The resulting procedures became the plant specific TRIP for Limerick. This step met all requirements for the functional and task analysis.

The verification and validation walkthrough was conducted in a manner similar to the process used for Peach Bottom. A group of 36 operators were exercised on the Limerick simulator, which is identical to the Limerick control room. The exercises were observed by G. Madsen, a Technical Engineer for Limerick, an assistant to J. Doering, and was conducted under the direct supervision of J. Doering. Data and notes were taken and the observer received direct feedback in interaction with the operators during and after the exercises. All instrumentation was verified to be present and have the correct ranges and accuracy of reading for all steps and for decision making. Proposed changes were assessed by J. Doering before they were implemented. This process met all requirements for the verification and validation steps for the Limerick plant.

The process for the development and assessment of the TRIP procedures was investigated by a senior human factors specialist (expe ienced in conducting CRDRs) in the prepartion of this Program Plan. It was found that the process meets the requirements specified in NUREG 0700 for the System Functions/Task Analysis, Verification, and Validation portion of the CRDR. In addition, the Final Validation phase described in this plan will further validate the TRIP in conjunction with the improvements resulting from the CRDR (See Section 4.5).

4.3 PANEL HEDS

All HEDs will be reviewed and divided into two groups: Panel HEDs and Procedural HEDs. Those not concerned with procedural discrepancies will be assessed and correctd as described here. Procedural HEDs are discussed in Section 4.5.

4.3.1 ASSESSMENT OF PANEL HEDS

During this review step, those human engineering discrepancies that may adversely affect operator performance will be assessed and the process of correcting them initiated. Assessment involves determining the safety significance of discrepancies and analyzing them to design panel improvements.

In order to ensure continuity of work between the BWROG CRS, already approved by the NRC Generic Letter 83-18, and the follow-on assessment, correction, and implementation phase, a special analysis will be conducted. The existing HEDs from the CRS will be analyzed along with supporting material to ensure that all information is carried over and to ensure an audit trail. The detailed analysis of HEDs will be aided by the use of the HED

Assessment Form shown in Figure 4. This will be primarily a human factors analysis, assisted by appropriate technical experts. A summary top-down analysis of the control room panels will be conducted to identify the context of the HEDs and to understand their specific meanings. Upon completion of this analysis, the normal assessment of HEDs will be performed, and the HED Assessment form completed.

4.3.2 PRIORITY EVALUATION CRITERIA

Human engineering discrepancies identified during the control room survey and the supplementary review will be evaluated according to their safety significance. This will be judged mainly on their potential to affect emergency operation adversely. The following four categories of priorities have been designed so a consensus from the team as to which category each HED should be assigned can be reached.

<u>Priority 1 (High Safety Significance)</u>

HEDs that are documented or judged likely to adversely affect the management of emergency conditions by the control room operators. This priority includes all HEDs that have high safety significance that could result in unsafe operation, any that have resulted in unsafe operation, as well as any that could result in errors of serious consequences. (Ø8Ø1 Cat.IA,B,C, Cat.IIA, Cat.III.)

<u>Priority 2 (Low Safety Significance)</u>

HEDs that have caused problems or appear likely to cause problems during normal and off-normal operations that could

HED ASSESSMENT

HED No. _______________

TITLE:

COMMENT:

Item: Ref.: Source:

IDENTIFICATION: Panel:
Component Name:
ID or Number:

DESCRIPTION OF PROBLEM:

MITIGATING CONSIDERATIONS:

POSSIBLE SOLUTIONS:

RESOLUTION: (Code) (Priority) (Sched:)

TRAINING REQUIREMENTS:

PROCEDURE REQUIREMENTS:

Approval Signature: Date:

[ ] Additional page(s) attached

FIGURE 4

not result in unsafe operations. (Ø8Ø1 Cat.ID, Cat.IIB,C.)

Priority 3 (Operational Reliability)

HEDs that are not safety significant but could degrade operational efficiency and reliability, either singularly or in combination with other HEDs. This priority includes HEDs that are individually of minor consequence, but in combination with other HEDs or other conditions could degrade operator effectiveness under stress.

Priority 4 (No Significant Improvement)

HEDs judged by the review team to have no significant effect on operations and are not documented as causing problems during operation. This priority includes all HEDs that do not fit into any of the above categories.

4.3.3 DESIGN IMPROVEMENTS

4.3.3.1 PANEL ENHANCEMENTS

It has been experienced throughout the industry that large numbers of HEDs can be corrected through panel enhancements, including labeling and swapping of like components. More specifically, enhancements include a number of techniques that involve surface improvements, such as demarcation lines, shading, and improved labeling. Also included in the enhancement category is the technique of component swapping. This involves changing the location of a control or indicator with a like unit within the same panel, usually within the same grouping. Swapping involves simple exchanges of locations without the need for panel modifications. In some cases, this technique can greatly improve

the effectiveness of surface improvements, and can resolve many more HEDs than would otherwise be possible with enhancements alone.

Terminology used on control room panels is normally taken from design documents and system prints. These engineering terms are not always adequate when transferred to control panels. A review of terminology with the control room review team will identify specific terminology to be used on control room panels. The approved terminology will be documented in a manual.

4.3.3.2 COMPONENT IMPROVEMENTS

As indicated previously, enhancement techniques can correct many panel discrepancies. In addition to enhancements other approaches to problem solutions are necessary. In general terms, there are two approaches to component improvements:

- Class Improvement
  A combination of minor changes to a particular type of control or indicator that will correct a whole class of problems.

- Individual Discrepancy Corrections
  A solution or combination of solutions that will correct one particular discrepancy.

A discussion of each technique is provided.

4.3.3.2.1 CLASS IMPROVEMENTS

The objective of this method is to consolidate classes of

discrepancies that pertain to one type of control or indication, and design improvements for that class. The enhancements discussed previously pertain to the panels and panel labeling, but do not include changes to the individual control or indicator. It is usually possible to make direct changes to a control or indicator, thereby correcting a whole group of problems. Labeling on an indicator, scale improvements, scale enhancements, the deletions of extraneous markings are examples. Discrepancies on annunciators is a class of problems that will result in class improvement designs.

4.3.3.2.2 INDIVIDUAL DISCREPANCY CORRECTION

The objective of this method is to correct all remaining discrepancies.

A large percentage of discrepancies can be corrected through panel enhancements and class improvements. The remaining HEDs must be corrected one by one using the most performance/cost-effective method or combination of methods. All resolutions that do not meet accepted, good human engineering practice will then be further analyzed to determine acceptable improvements.

Additional solution methods that may be used individually or in combination, if necessary, are as follows:

- o Operator organization and communications.
- o CRT display alternatives.
- o Procedural and administrative solutions.
- o Special training requirements.
- o Component replacement and panel alteration.

4.3.4 DOCUMENTATION AND DISPOSITION OF HEDS

Documentation

Documentation of the HEDs will be accomplished using the HED Assessment Form (Figure 4) for each HED.

A HED Status Summary will be made and maintained in a computer file. It will be updated as changes occur and will be printed for distribution to team members periodically and on request. The summary will indicate the current assignment, the status, and action required. This will be an important quality control tool for completion of work.

Criteria for the satisfactory completion of HEDs is provided in NUREG 0801. These criteria have been consolidated and assigned a resolution code and as HEDs are resolved, will be assigned to one of these codes.

Code	Description
A	Meets Human Factors Engineering (HFE) guidelines originally or as improved.
B	Minor deviation, but satisfies the underlying performance principle implied by HFE guidelines.
C	Meets HFE guidelines through a combination of solutions.

D Meets HFE guidelines through other means that are judged to satisfy the intent of the guidelines.

E Does not meet HFE guidelines; a correction may increase potential for error.

F Solutions do not meet all guidelines, but are judged to be acceptable for safe operation for the reason stated.

Disposition

The documentation previously described will be compiled in a class format to be included in the summary report.

The resolutions will be incorporated into the design document panel prints as well as included and verified on the control room mock-up.

Following final approval by the Limerick (Peach Bottom) Project and PECo management, any recommended changes will be implemented by PECo in accordance with their normal change process with the architect/engineer.

4.3.5 VERIFICATION OF PANEL HEDS

The verification step is intended to provide a review of the proposed resolution for each HED and ensure that the modification will correct the discrepancy without creating any unacceptable side effects. It will also ensure that human factors requirements are adequately addressed. This analysis will look at the broader

implications of the proposed resolution and will use computer matching to look for compounding effects. The HED Verification Form in Figure 5 will be used for this review. HED solutions that are found inadequate will be reassessed and solutions will be revised to meet the criteria.

This step will also identify the schedule for implementation of panel enhancements and modifications.

4.4 PROCEDURAL HEDS

4.4.1 ASSESSMENT OF PROCEDURAL HEDS - LIMERICK

An assessment of procedural HEDs will be conducted by a review team consisting of human factors personnel and Engineering Production personnel using the HED Assessment Form in Figure 4. The assessment will be performed in a manner similar to the assessment of panel HEDs.

4.4.2 CORRECTION OF PROCEDURAL HEDS - LIMERICK

The correction of procedureal HEDs will be accomplished by revisions or changes to the TRIPS. These changes will be worked out by the review team based upon the material developed in the Supplemental Review, and will be coordinated with the activities of the Correction of Panel HEDs section for the Limerick plant. The primary liaison between these two efforts will be provided by the human factors personnel who will be the same people for both processes. In addition, Engineering Production personnel will also be involved with the control room review team for panel improvements. This coordination will be designed to ensure compatibility between these two aspects of HEDs corrections.

HED VERIFICATION

HED No(s) ____________________

VERIFICATION STATUS:
Approved __ Code __
Safety priority __
Unit: #1 #2
Applicable __ __
Schedule ____ ____

RESOLUTION ANALYSIS | SAT / REV

		SAT	REV
1. Code correct? yes / no Should be: __		___	___
2. Addresses discrepancy identified by code?		___	___
3. Meets human factors requirements?		___	___
4. Safety considerations:			
	a. Safety questions not addressed?	___	___
	b. Cause temporary reduction in safety?	___	___
	c. Increase risk of failure or misoperation?	___	___
5. Compounding effect:			
	a. Causes another discrepancy?	___	___
	b. Adversely combines with other resolutions?	___	___
6. Cause negative retraining?		___	___

SCHEDULING

	Unit #1	Unit #2
1. Circle applicable unit:	Unit #1	Unit #2
2. Assigned priority:	___	___
3. Schedule: Prior to first fuel load	___	___
First refueling outage	___	___
Second refueling outage	___	___
Not implemented	___	___

Team Review Action:

FIGURE 5

4.4.3 VERIFICATION OF PROCEDURAL HEDS - LIMERICK

The verification of HED corrections will be conducted in the same manner as described in Verification of Panel HEDs.

4.4.4 ASSESSMENT, CORRECTION, VERIFICATION OF PROCEDURAL HEDS - PEACH BOTTOM

This portion of the Assessment and Implementation phase has been completed for Peach Bottom, which is an operating plant. Each HED identified was assessed for seriousness by completing an assessment form shown in Figure 6. The form was developed to address the requirements of Supplement 1 to NUREG Ø737 and the agreements reached in various meetings between the BWROG and the NRC. HED corrections were generated where assessed to be necessary. Those judged not to warrant correction were analyzed for safety significance. Verification of HED corrections was performed using the form in Figure 7. The form was designed to assure that the modification corrects the discrepancy without creating any unacceptable side effects. The two forms used in this process for HED Assessment and for HED Verification contain essentially the same information that will be used for the Limerick plant assessment and verification.

The results of this portion will be reviewed by the control room review team, which will include a member of the Electric Production Department, during the Enhancement and Class improvement sections of panel HED correction. The purpose of this review is to ensure that human factors have been adequately considered in the specified procedural corrections. In addition, the review is

PBAPS Units #2 and #3
Control Room Design Review
HED Assessment

HED # ______
Assessment Priority ______
Type of Correction ______
Extent of Correction ______
Safety Implications ______

1.) Description and Preliminary Assessment ______

______

2.) What is frequency of use? ______

______

3.) Is the HED offset by other control room characteristics or operating practices?

______

______

4.) How can the HED be corrected or mitigated? ______

______

5.) Would corrections necessitate operator retraining? Impact of retraining?

______

______

6.) Preliminary recommended solution ______

______

IF CORRECTION RECOMMENDED, SKIP TO STEP 8.

7.) What are the safety implications? ______

______

8.) Final recommended solution ______

______

9.) Priority ______

10.) Comments ______

______

Prepared by: ______ Date: ______

Reviewed by: ______(EE) Date: ______ Disposition: ______

______(EP) Date: ______ Disposition: ______

______(HFE)Date: ______ Disposition: ______

FIGURE 6

PBAPS Units #2 and #3
Control Room Design Review
HED Solution Verification

HED # ____________
Type of Solution ____________
Extent of Solution ____________
Approved/Disapproved-Resp. ____________
Implementation Schedule - Unit #2 ____________
Unit #3 ____________

1. Does the improvement bring the HED into conformance with the affected CRDS checklist item? To what extent?

____

____

2.) Does the improvement create an HED for other items?

____

____

3.) Does the improvement create an unreviewed safety question?

____

____

4.) Does the improvement increase the risk of failure or misoperation?

____

____

____

5.) Does the improvement cause a temporary reduction in safety?

____

____

6.) Improvement Approved/Disapproved? ____________

7.) Comments ____________________________

____

Prepared by: ____________ Date: ________ Disposition: ________

Reviewed by: ____________ (EE) Date: ________ Disposition: ________

____________ (EP) Date: ________ Disposition: ________

____________ (HFE) Date: ________ Disposition: ________

FIGURE 7

intended to ensure that the operating philosophy reflected by the procedural phase of the control room review are integrated with the panel improvement approach.

4.5 FINAL VALIDATION

A final validation step will be conducted in the form of a dynamic walkthrough using either an enhanced simulator or mockup. The purpose of this phase is to bring together all aspects of the control room improvement program, including the enhanced and improved panels, the TRIP procedures, computer displays and SPDS, and trained operators. The TRIP procedures will be walked through under controled conditions, with the supervision and review of the control room review team. Video and audio recordings will be made, and operator actions and comments will be recorded by the team. Additional HEDs that result from the analysis of these walkthroughs will be assessed, and corrections will be developed and verified as previously described.

In order to bring together all these aspects for a final validation, it is likely that it will not be completed in time for submission of the Final Report to the NRC. In this case, an addendum report will be submitted upon completion of the Final Validation. It will describe the methodology used and will summarize the results in a manner similar to the Final Report.

4.6 IMPLEMENTATION

The implementation schedule will be determined by severity of the discrepancy, plant construction priorities, refueling outage schedules, the availability of materials. Scheduling priority

will follow the criteria of NUREG Ø8Ø1, the priorities determined during assessment or as revised during the validation of resolutions. These priorities will be recorded on each HED sheet.

CRDR REVIEW TEAM

HUMAN FACTORS CONSULTANTS FROM THE INTERLOCK GROUP

JOSEPH A. BRESLIN

For 25 years Mr. Breslin has been engaged in human factors research and training analysis and design, under U.S. Navy, Air Force, Army and industrial contracts.

Mr. Breslin has had previous diversified management and technical experience in private industry, including senior positions with Rand Corporation, System Development Corporation, Boeing Corporation and Bell Telephone Laboratories.

Mr. Breslin has been instrumental in the areas of training analysis and personnel subsystem development including training organization and management, training needs analysis, training evaluation and material development, manpower requirements, and facility requirements definition.

Task Analysis

- Conducted a detailed task analysis as part of a DCRDR for a major utility
- Orchestrated a comprehensive control room validation walkthough
- Developed and implemented function, link, and task analysis
- Participated in critical incident studies
- Managed and conducted man-machine function allocations, demographic studies, manpower analysis and forecasts, and job design projects

Panel Design

- Assisted in the design and implementation of control panel design improvements as related to CRDR efforts
- Conducted anthropometric studies and applications in workspace design including cockpit layout, and auxiliary support equipment design
- Participated in computer generated display design and evaluation

Training

- Developed and implemented multi-media training programs
- Reviewed and evaluated computer based simulation systems for the Trident training facility
- Involved in computer assisted and aided instruction, programmed texts, and interactive audio/visual projects
- Developed and implemented instructional systems development (ISD) techniques
- Developed and implemented computer based, command and control systems

Education

B.S. Psychology and Management, St. Joseph's University (1955)
Graduate Studies, Operations Research and Computer Science, MIT

Professional Affiliations

Sustaining Member, Human Factors Society
Charter Member, Society of Learning Technology
Member, American Nuclear Society

RALPH E. CHIDLEY (Lead Human Factors Specialist)

Mr. Chidley has been directly involved in human factors and training for 29 years. He has broad experience in operation and design of control systems with hands-on application of human factors in systems design. His work has covered workspace design and environmental conditions analysis, panel design, operational computer display concepts and design, procedures development, and training. He has had extensive experience in operation of submarine systems including nuclear plant operation, missile fire control and launching, inertial navigation, torpedo fire control, command and control, and ship control. Specific experience is listed below.

Task Analysis

- Designed a comprehensive 'top-down' task analysis for a major utility's CRDR
- Developed innovative techniques in 'top-down' systems analysis and task analysis
- Developed detailed team training task analysis in military and commercial contexts

Panel Design

- Designed control panel improvements as part of a CRDR
- Designed Trident SSBN control room layout
- Designed Polaris SSBN ship control and ballast control panels
- Designed an integrated CRT operational concept and display content as part of a CRDR
- Designed and integrated CRT displays for submarine fire control systems and associated training systems
- Contributed to the design layout for the 680 class SSN

Procedures and Training

- Developed procedure writing guidelines for the preparation of normal and emergency operating procedures as part of a DCRDR project
- Directed the systems analysis design and integration of Navy training simulators into the Trident training facility

- Directed development of entire Trident training system including curricula for 140 courses representing 22,000 class hours

- Designed team training curriculum development strategies and techniques

- Developed a team training curriculum for submarine sonar crews

- Member of evaluation team specifying simulator training requirements for Coast Guard Academy cadets in shiphandling

Education

B.S. Engineering, U.S. Naval Academy (1954)
Naval Nuclear Power School
Commanding Officer, two nuclear submarines

ATHOS C. MACRIS

Mr. Macris has both educational and professional experience in the areas of human factors engineering, experimental design, and industrial engineering.

In the commercial nuclear industry, Mr. Macris managed one of the earliest independent systems-based control room design reviews. This project involved the design and construction of a full-scale mockup of control room panels, a systematic human engineering panel evaluation, operational talkthroughs and walkthroughs using the mockup, and the drafting of the first NUREG 0700 Program Plan Report to receive a favorable NRC review. Subsequent to the Program Plan Report, the project became integrative, involving a top-down task analysis, control panel improvement design, control room team organization definition, and procedure writing guidelines, all in preparation for plant licensing. The Final CRDR Report was submitted to the NRC in the spring of 1983. This effort and associated commercial nuclear human factors work totals over 3 years experience.

Mr. Macris' related professional experience involves extensive application of human factors engineering, systems and task analysis and performance evaluation of command and control systems, and submarine control-display operational systems. Specific experience is listed below:

Task Analysis

- Conducted comprehensive task analysis as part of a DCRDR for a major utility
- Conducted various task analyses for several operational submarine sonar systems as part of human performance specifications
- Participated in performanced based curriculum developments based on task analysis
- Participated in team performance requirements and subsequent curriculum development for complex command and control simulation systems

Panel Design

- Conducted and managed design improvements related to control room design review efforts
- Reviewed initial designs and redesigned a major utility's Waste Gas Monitoring panel

- o Redesigned analog display faces to meet HFE standards
- o Participated in CRT display format design and review for operational displays
- o Contributed to tactical and operational sonar and fire control decision making display reviews
- o Assisted in evaluation of computer generated ship-handling displays

Procedures and Training

- o Assisted in the development of procedure writing guidelines as part of a DCRDR project
- o Directed and managed the operational training systems development for a major shipboard-shorebased simulator based training system
- o Participated in detailed curriculum development for the submarine force's newest sonar systems
- o Developed operational team training curriculum for submarine sonar crews

Education

B.S. Mechanical Engineering, University of Illinois (1971)
M.S. Ocean Engineering, University of Connecticut (1978)
M.A. (current) Industrial/Organizational Psychology, University of New Haven
Qualified as Engineering Officer of Watch S5W Naval reactor system

ELAINE M. KUHN

Ms. Kuhn has over 12 years experience in education and human performance systems development. Ms. Kuhn has recently been directly responsible or has assisted the CRDR team in documentation of control room inventory, survey administration, verification, and validation of control room functions.

Ms. Kuhn's specific experience is listed below:

Task Analysis

- Assisted in the analysis and documentation of a detailed CRDR
- Participated and assisted in various task analyses efforts associated with U.S. Navy ISD specifications

Panel Design

- Developed and documented a comprehensive CRDR inventory
- Assisted in the administration of a control room survey
- Assisted in the verification and validation efforts of a CRDR

Education

B.A. English, Annhurst College (1965)
M.A. Education, University of Connecticut (1971)
M.A. (current) Industrial/Organizational Psychology, University of New Haven

NICHOLAS TSOULFANIDIS

EDUCATION: B.S. PHYSICS, UNIVERSITY OF ATHENS
M.S. NUCLEAR ENGINEERING, UNIVERSITY OF ILLINOIS
PH. D. NUCLEAR ENGINEERING, UNIVERSITY OF ILLINOIS

WORK EXPERIENCE:

- 20 YEARS EXPERIENCE NUCLEAR ENGINEERING
- SENIOR ENGINEER, GAS COOLED FAST BREEDER REACTOR
- NUCLEAR FUEL MANAGEMENT GROUP, ARKANSAS POWER CO.
- HEAD NUCLEAR ENGINEERING DEPT., UNIVERSITY OF MISSOURI-ROLLA

CRS TASK ANALYSIS - PLANT PERSONNEL PARTICIPANTS

J. DOERING

- B.A. Engineering
- currently Operations Engineer, 6 years nuclear experience at Limerick
- 6 years nuclear experience at Peach Bottom prior to assignment at Limerick

J. WINZENREID

- B.A. Engineering
- currently Technical Engineer at Peach Bottom
- 13 years nuclear experience at Peach Bottom
- 5 years Navy nuclear experience

A. WASONG

- B.A. Engineering
- currently Reactor Operator at Peach Bottom
- 10 years nuclear experience at Peach Bottom

G. MADSEN

- B.A. Engineering
- currently Assistant to Limerick Operations Engineer
- 2 years nuclear experience at Limerick as Technical Advisor
- 2 years nuclear experience at Vermont Yankee
- 5 years Navy nuclear experience

BWR OWNERS GROUP

CONTROL ROOM SURVEY TEAM MEMBERS

- LIMERICK -

THOMAS B. SHERIDAN

Currently Professor of Engineering and Applied Psychology at MIT. He heads the Man-Machine Systems Laboratory and for many years has taught a graduate course in man-machine systems as well as control and design courses. He helped develop a new interdepartmental graduate degree program in Technology and Policy for that program.

Dr. Sheridan's research has been on mathematical models of human operator and socio-economic systems, on man-computer interaction in supervising robotic systems, and on technology for group decision- making. He is author, with W. R. Ferrell, of Man-Machine Systems: Information, Control and Division Models of Human Performance, M.I.T. Press. 1974, and co-editor of a 1976 Plenum Press book, Monitoring Behavior and Supervisory Control.

His industrial consulting activities have included: The General Motors Corp. (auto safety); General Electric Co. (telemanipulators); C. S. Draper Laboratory (design of astronaut iterface for Apollo guidance system, industrial robots); Group Dialog Systems, Inc. (group meeting and decision technology); Babcock and Wilcox Co. (industrial instrumentation); Lockheed and General Physics Corporations and Electric Power Research Institute (man-machine aspects of nuclear reactor safety).

Dr. Sheridan received his B.S. from Purdue University, his M.S. from the University of California, and his Sc.D. from M.I.T.

KENNETH C. ROSS

Currently Program Manager with General Electric.

Experience includes nine years in the nuclear industry -- four years as an instructor in the U. S. Navy nuclear power program, two years as an instructor for General Electric Company, and three years as a program manager for General Electric Company. SRO licensee. Certified by NRC to teach all phases of BWR operation.

General Electric program manager for BWROG Control Room Survey Program. Provided program management support for eighteen BWR control room design reviews. Principal author of nine control room design review summary reports, co-author or additional seven. Developed, organized and presented BWROG Control Room Survey Program Workshop. Attended MIT summer seminar on human factors engineering and INPO workshop on control room evaluations. Co-author of training appendices to BWROG EPG's.

BRYON THIBODEAUX

B.S. Electrical Engineering from Louisiana State University

Presently Systems Engineer with Gulf States Utilities where major responsibilities include:

Direct the testing of the Power Generation Control Complex at the NSS vendor's manufacturing facility.

Witness and approve the fabrication of the Power Generation Control Complex as a representative of the utility.

Provide technical support to the Plant Staff Operations Department

Participate in BWR Owners Group control room surveys pursuant to satisfaction of NRC requirements

Coordinate A/E, NSS vendor, and utility activity so as to support Power Generation Control Complex fabrication, testing, and installation.

Utility experience since 1978:

Systems Engineering in Relay Design and coordination

Engineer - System Protection

Assistant Maintenance Supervisor

GERALD RAINEY

Currently Instrumentation and Controls Engineer - Limerick. Mr. Rainey received his B.S. in Electrical Engineering from Weidner University.

His experience includes 6 years nuclear experience at Limerick and 6 years nuclear experience at Peach Bottom. His duties have included:

Coordinating the activities of the Research and Testing Division personnel assigned for checkout, test and calibration of instruments and control loops related to system components under the control of the Electric Production Department.

Assigning priorities for Instrument and Control Loop calibration, maintenance and surveillance testing.

Coordinating the activities for outside contractors employed by the Peach Bottom Maintenance Department assigned duties and responsibilities to personnel in the Vendor Coordinator Group. This group consisted of 4 to 8 maintenance supervisors. Contractor forces varied from 60 to 250 personnel.

RONALD S. BUNKER

Currently Program Engineer with General Electric

B.S. in Nuclear Engineering, Arizona State University, May 1980. M.S. in Mechanical Engineering, University of California - Berkeley, June 1983. Experience includes 3 years in the nuclear industry with General Electric -- assignments in ECCS performance analysis, generic control room licensing, program management, and plant performance engineering.

Member of survey teams for control room design reviews of Vermont Yankee, Limerick and Nine Mile Point 2. Co-author of four control room design review summary reports.

WALLACE J. COLVIN

Presently a Unit Supervisor with Cleveland Electric Illuminating Company. His activities include systems operating instruction review and evaluation of control room human factors.

Formal education and training includes:

Attended Ohio State University, College of Engineering, 1964-1967

Attended Kent State University, College of Education, 1967

Twenty-week Academic Program for Nuclear Power Plant Personnel (General Physics Corporation), 1979

Two-week Research Reactor Training Program, University of Wisconsin, (General Physics Corporation), 1979

Five-week Dresden Nuclear Plant Technology Course (GE), 1979

Two-week Operators Training Course, Dresden Simulator (GE), 1979

Four-week BWR Observation Training, Millstone Nuclear Power Plant (GE), 1979

One-Week BWR Control Room Survey Workshop (GE), 1980

Degree candidate, Cleveland State University, College of Engineering, 1980-1983

MICHAEL M. DANCHAK

Presently Director of Studies, Computer and Information Science, The Hartford Graduate Center. Ph.D. in Nuclear Engineering, Rensselaer Polytechnic Institute; M.S. in Nuclear Engineering, Rensselaer Polytechnic Institute; B.S. in Engineering, Princeton University.

Recent professional activities include:

Reviewer of human factors related papers for Nuclear Safety, 1978.

Invited participant, Man-Machine Interface Forum sponsored by Foxboro Corporation, June 10, 1978.

Member of the Implementation Subgroup, Association for Computing Machinery Special Interest Group for Graphics (SIGGRAPH) CORE System.

Consultant to the Idaho National Engineering Laboratory on computer display design for nuclear power plant control.

Received a research contract from Idaho National Engineering Laboratory to study display of multivariate data on Cathode Ray Tubes (1980).

Participated in a research contract to study the role of the operator in Nuclear Power Operations with RPI faculty, funded by Oak Ridge National Laboratory (1980).

Received a research contract from INEL to study the static and dynamic design considerations of Process Control Alarm displays (1981).

WARREN BABCOCK, JR.

Currently Senior Electronic Engineer, Nuclear Engineering Dept. at Boston Edison Co.

Nuclear experience since 1968:

Lead engineer, control room design review for Pilgrim Station. Other duties include design and/or specification of electronic/electrical control systems and instrumentation; control panel design; studies of existing systems in order to improve reliability or maintainability; operator training; equipment qualification; test procedure preparation.

Participated in BWROG control room design review program as a team leader.

BWR OWNERS GROUP

CONTROL ROOM SURVEY TEAM MEMBERS

- PEACH BOTTOM -

PAUL J. NICHOLSON

Mr. Nicholson received his B.S. in Mechanical Engineering from MIT and his M.A. in Physics from Boston University.

Mr. Nicholson is currently an independent consultant servicing the nuclear power industry in the areas of instrumentation and control and related topics. Twenty three years of professional experience include 12 years in the aerospace electronic industry and the remainder in nuclear research and advanced reactor instrumentation and dynamics. For the past four years, while principal scientist at the C. S. Draper Lab, he has been guest lecturer in the MIT Nuclear Engineering Department, associate lead investigator for the MIT advanced Reactor Control Project, and supervisor for a number of nuclear engineering graduate thesis projects.

JOSEPH L. SEMINARA

Mr. Seminara received his B.A. and M.S. in Psychology from NYU.

He has over 25 years experience as a human factors specialist. He has applied human factors engineering principles in the design and evaluation of a wide range of complex systems, extending from the Polaris missile checkout equipment to lunar vehicles. Over the past nine years he has concentrated primarily on human factors issues relating to the operation and maintenance of nuclear power plants. He has served as project leader and principal investigator on a series of research projects funded by the Electric Power Research Institute:

EPRI NP 309: Human factors review of nuclear power plant control room design

EPRI NP 1118: Human factors methods for nuclear control room design

- Vol. I. Control room enhancement
- Vol. II. Design practices survey
- Vol. III. Design of conventional control rooms
- Vol. IV. Design of advanced control boards.

EPRI NP 1567: Human factors review of power plant maintainability.

EPRI NP 2360: Human factors methods for assessing and enhancing power plant maintainability.

GERALD RAINEY

Currently Instrumentation and Controls Engineer - Limerick. Mr. Rainey received his B.S. in Electrical Engineering from Weidner University.

His experience includes 6 years nuclear experience at Limerick and 6 years nuclear experience at Peach Bottom. His duties have included:

Coordinating the activities of the Research and Testing Division personnel assigned for checkout, test and calibration of instruments and control loops related to system components under the control of the Electric Production Department.

Assigning priorities for Instrument and Control Loop calibration, maintenance and surveillance testing.

Coordinating the activities for outside contractors employed by the Peach Bottom Maintenance Department assigned duties and responsibilities to personnel in the Vendor Coordinator Group. This group consisted of 4 to 8 maintenance supervisors. Contractor forces varied from 60 to 250 personnel.

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Experience includes nine years in the nuclear industry -- four years as an instructor in the U. S. Navy nuclear power program, two years as an instructor for General Electric Company, and three years as a program manager for General Electric Company. SRO licensee. Certified by NRC to teach all phases of BWR operation.

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WARREN BABCOCK, JR.

Currently Senior Electronic Engineer, Nuclear Engineering Dept. at Boston Edison Co.

Nuclear experience since 1968:

Lead engineer, control room design review for Pilgrim Station. Other duties include design and/or specification of electronic/electrical control systems and instrumentation; control panel design; studies of existing systems in order to improve reliability or maintainability; operator training; equipment qualification; test procedure preparation.

Participated in BWROG control room design review program as a team leader.

DAN MASTERS

Currently Electrical Engineer, Technical Supervisor for the TVA.

Mr. Masters received his B.S. in Electrical Engineering from the University of Tennessee.

His experience includes:

Coordinated main control room design for General Electric supplied boiling water reactor, merging TVA BOP design with GE NSSS design. Developed CRT formats. Coordinated finalization of instrumentation and controls design for all plant systems. Chairman of main control room design review teams for Hartsville, Phipps bend, and Browns Ferry Nuclear Plants. Coordinated instrumentation and controls and main control room modifications and upgrades for Browns Ferry Nuclear Plant.

Developed requirements, prepared specifications, and coordinated contracts for multiplexer based data acquisition systems. Developed operator interface techniques and designed main control rooms for nuclear power plants. These designs and techniques included control panel layouts, device selection, CRT displays, and operability analysis, including the utilization of full scale mock-ups and operational "walk throughs" using licensed plant operators.

JOHN N. MCGRATH

Mr. McGrath received his B.S. in Electrical Engineering from Villanova University and has had graduate level courses in Nuclear Engineering.

He is currently Supervising Engineer, Electrical Engineering Fossil-Hydro Generation.

His experience includes:

One year (1981-1982): Electrical Project Engineer, Peach Bottom Poject, responsible for design, procurement, and modifications of the electrical power systems for Peach Bottom Atomic Power Station.

Three years (1977-1980): Senior Engineer in Electrical Engineering Division of the Engineering and Research Department responsible for Design and Procurement of Instrumentation and Controls Systems for Fossil, Hydro, and non-nuclear portions of Nuclear Generating Stations.

Eight years (1969-1977): Engineer and Senior Engineer in Electrical Engineering Division of the Engineering and Research Department responsible for design review of Engineered Safeguards, reactor protection systems, and Nuclear Plant Controls and Instrumentation.

One and a half years (1967-1969): Engineer in Station Operating Department with responsibility for reporting on operations of PBAPS No. 1 to AEC and others, and liaison with Plant Staff.

Four years (1963-1967): Engineer at Peach Bottom Atomic Power Station, Unit No. 1, during construction and start-up to full power.

Four years (1959-1963): Engineer in Electrical Engineering Division, Protective Relay Branch.

ROBERT G. DAVALLE

Mr. DaValle has a B.S. in Engineering and has worked for Washington Public Power Supply System since 1973.

He is currently a Specialist, Systems Operations Planning Engineer. Responsible for developing plant maintenance and refueling outage philosophy and programs for the Supply System and assisting in coordinating with BPA and Northwest Utilities for plant outage planning and resource control.

DONALD J. MATTHEWS

Mr. Matthews has been employed with Niagara Mohawk Power Corporatiion since 1946.

His nuclear power experience includes:

Nine Mile Point Unit #1 BWR 2 -- participated in every phase of plant start-up. From initial critically up to and including full power operation with all attendant variations. Brought the reactor critical as many as 75 times. Participated in the first documented reactor shut-down from full power to cold shut-down without a reactor scram.