POINT BEACH NUCLEAR PLANT
CONTROL ROOM DESIGN REVIEW
PROGRAM PLAN

WISCONSIN ELECTRIC POWER COMPANY

Revision 0

July 31, 1984

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SECTION 1.0
INTRODUCTION

The control room design review (CRDR) is part of an extensive effort within the nuclear industry and the Nuclear Regulatory Commission (NRC) to evaluate control rooms and emergency operating procedures (EOPs). The goals of the CRDR effort for nuclear power plants currently in operation is to identify human engineering discrepancies within the context of the existing control rooms, evaluate the human engineering discrepancies for their possible impact on the safe operation of the plant, assess whether or not the impact is significant, and provide for adequate disposition of the human engineering discrepancies that are identified. In achieving these goals, care must be taken to avoid negating the safety characteristics of the existing control room design when practical considerations require that action be taken to upgrade the control room.

This program plan describes the manner in which Wisconsin Electric Power Company intends to conduct the review of its Point Beach Nuclear Plant (PBNP) control room. Wisconsin Electric has proceeded to work on certain elements of its program plan prior to NRC review. However, it is anticipated that the NRC staff will bring to Wisconsin Electric's attention in a timely manner any comments concerning the program plan.

This program plan will provide a basis upon which to judge that an adequate PBNP CRDR has indeed been conducted. It is intended that any audit of the PBNP CRDR by NRC personnel or contractors will use this program plan as its reference document and that the criteria for completeness and adequacy will be taken from this document.

In planning the PBNP CRDR, Wisconsin Electric was guided by NUREG-0700, NUREG-0801, Supplement 1 to NUREG-0737 and the documents provided by the Nuclear Utility Task Action Committee (NUTAC) on CRDR. The objectives of the CRDR are commensurate with the NRC's goal to ensure the safe and efficient operations of nuclear power plants. The procedures, surveys, checklists, questionnaire, and documentation requirements have been designed to fulfill project objectives and result in a systematic and effective CRDR.

SECTION 2.0
CRDR OVERVIEW

2.1 NRC Requirements

Wisconsin Electric has planned and will implement the PBNP CRDR in a manner consistent with the requirements for detailed control room design review (DCRDR) set forth by the Nuclear Regulatory Commission (NRC). A summary of the requirements, along with references to Supplement 1 to NUREG-0737, is as follows:

CONTENTS OF DCRDR

- Conduct a DCRDR to identify human engineering discrepancies (HEDs). The review shall consist of:
  (Suppl. 1 NUREG-0737 Par. 5.1.B)

  - Establishment of multidisciplinary review team and review program incorporating accepted human factors engineering (HFE) principles

  - Use of function and task analysis to identify control room operator tasks and information and control requirements during emergency operation

  - Comparison of information displays and control requirements with a control room inventory to identify missing displays and controls

  - Control room survey to identify deviation from accepted HFE principles

- Assess which discrepancies are significant and should be corrected
  (Suppl. 1 NUREG-0737 Par. 5.1.C)

- Verify that selected design improvement individually and collectively will correct discrepancy and will not create other safety problems.
  (Suppl. 1 NUREG-0737 Par. 5.1.D)

- Coordinate with EOP verification and validation program and other emergency response capability initiatives

DOCUMENTATION

- o Licensees shall submit a program plan within two months of start of DCRDR (Suppl. 1 NUREG-0737 Par. 5.2.A)

- o Licensees shall submit a summary report of the completed review outlining proposed control room changes including proposed schedules for implementation
  (Suppl. 1 NUREG-0737 Par. 5.2.B)

2.2 Purpose

The purpose of the PBNP CRDR is to ensure that the PBNP control room will support operation during postulated accident conditions. The operator tasks required during postulated accident conditions are contained in the new Emergency Operating Procedures being developed by Wisconsin Electric which, in turn, are based on Rev. 1 of the Emergency Response Guidelines (ERG) developed by the Westinghouse Owners Group (WOG). In order to fulfill this purpose, the following objectives have been set forth for the PBNP CRDR.

- o To establish a multidisciplinary team and review program incorporating accepted human factors engineering (HFE) principles

- o To identify human engineering discrepancies (HEDs)

  - -- To perform a control room survey that compares the existing control room design with accepted human engineering criteria

  - -- To review relevant plant operational experience using appropriate documentation and a survey of operators

  - -- To determine the input and output requirements of control room operator tasks during postulated accident conditions

- To determine the extent and importance of any identified discrepancies

- To formulate and implement resolutions for significant discrepancies (as judged above)

- To ensure that the proposed resolutions do, in fact, eliminate or mitigate the discrepancies for which they are formulated and to ensure that proposed resolution do not create new discrepancies

2.3 Description of PBNP

Point Beach Nuclear Plant (PBNP) consists of two Westinghouse-supplied two-loop PWRs with a common control room. In the control room, two panels contain all the instrumentation and controls (I&Cs) required to operate the Nuclear Steam Supply System (NSSS), Auxiliary Coolant System, and various secondary plant equipment for Unit 1. A mirror image of these panels is provided in the control room for Unit 2. One common control panel contains instrumentation and controls for the Unit 1 and 2 Engineered Safeguards System, and another common panel controls the Electrical Systems for both units. To accommodate new instrumentation requirements due to backfit modifications, two auxiliary safety instrumentation panels (ASIPs) were added, one associated with each unit. A monitoring, logging, and scanning computer is installed to assist the operator in the surveillance of plant parameters. This computer is also used to provide supplementary information about the NSSS and to help inform the operator of off-normal conditions. A new computer system will eventually replace the existing computer, and will consist of a Safety Assessment System (i.e., Safety Parameter Display System) and a Plant Process Computer System.

2.4 Description of CRDR Activities

To achieve the stated objectives, Wisconsin Electric shall systematically implement several human engineering review activities. A flow chart of the major activities is presented in Figure 2-1. This flow chart is not intended to show the start and stop times for each activity, but rather, the interrelationships of the information needed and obtained by each activity. Note that the CRDR has been split into six nominal phases: Planning, Execution, Assessment, Documentation, Correction, and Effectiveness.

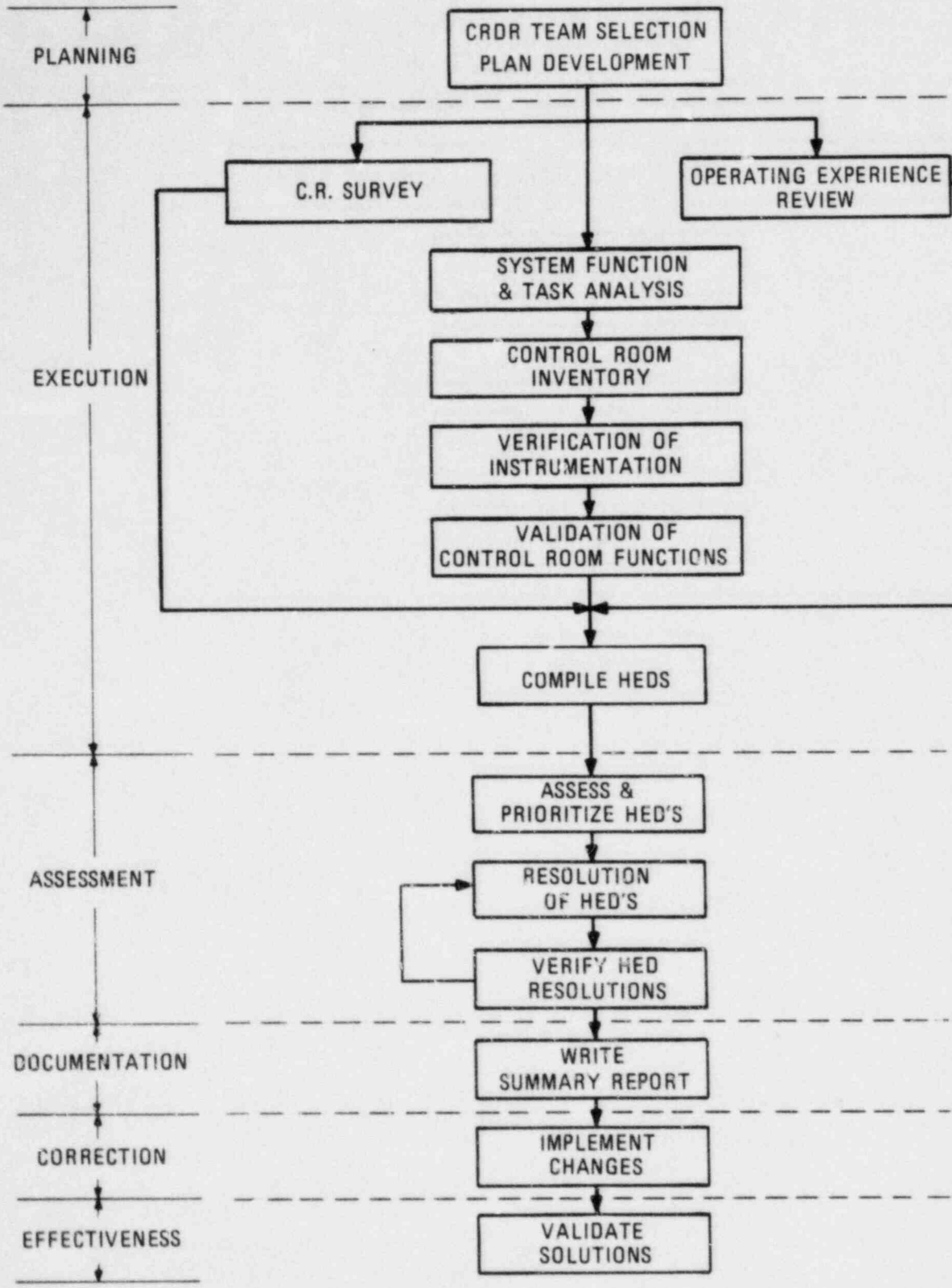


FIGURE 2-1. CRDR ACTIVITY FLOW

The activities within each phase will be described in more detail later, but a brief synopsis of these activities will help give a general picture of the review process.

2.4.1 Planning Phase

The Planning Phase effort is represented by this Program Plan in which subsequent phases of the CRDR have been defined and their implementation prescribed. The only planning phase efforts that have not been completed are (1) a human factors orientation to be given for the CRDR team members, (2) the selection of a human factors consultant (HFC), and (3) the procurement of a full scale mockup to be used during the CRDR.

CRDR planning and development of this Program Plan has been conducted by personnel from the Nuclear Systems Engineering and Analysis Section (NSEAS) of the Nuclear Power Department with assistance from a human factors consultant.

2.4.2 Execution Phase

The execution phase will constitute the investigative, data gathering portion of the CRDR. During this phase, a control room survey will compare the characteristics of the existing control room with appropriate human engineering design guidelines. An examination of PBNP operating experience will be conducted through a review of significant operating events (SOEs) and licensee event reports (LERs), administration of a control room operator questionnaire, and operator interviews. During the systems function review and task analysis (SFRTA), the new EOPs will be examined to determine the tasks required of operators during postulated accidents and the instrumentation and control requirements for those tasks. The completeness and suitability of existing instrumentation and controls, as well as the adequacy of the functional interface between the operator and control room, will be evaluated during CRDR verification and validation activities.

2.4.3 Assessment Phase

During the assessment phase, all discrepancies identified during the execution phase will be analyzed, and the potential impact of each discrepancy on emergency plant operation will be determined. Discrepancies will be classified according to their potential impact on emergency plant operation. Significant discrepancies will be resolved through control board enhancement, design modifications, or other means, such as changes to procedures, training, or utilization of the Safety Assessment System (SAS). Any actions proposed to resolve significant discrepancies will be analyzed for their effects on control room operations, operators, and operator training.

2.4.4 Documentation Phase

A summary report will be submitted to the NRC at the conclusion of the CRDR. It will summarize the overall review process, summarize the identified human engineering discrepancies, provide a summary justification for human engineering discrepancies with safety significance to be left uncorrected or partially corrected, describe control room design improvements implemented during the course of the review, and outline proposed control room improvements and their proposed schedules for implementation if those schedules are known at the time the report is written. For convenience, documentation is shown in Figure 2-1 as only occurring during the writing of the summary report. In reality, documentation will occur throughout the CRDR to provide supporting data and information for the summary report and for auditability of CRDR activities.

2.4.5 Correction Phase

Corrections to HED shall be implemented through existing PBNP design modification procedures and implemented by the departments that normally have cognizance over the type of activity specified in the HED resolution. A PBNP plant-specific schedule will be developed to ensure the integration of proposed control room modifications with the other programs included in Supplement 1 to NUREG-0737 as well as scheduled plant outages. When scheduling corrections, the following major items should be considered:

- o plant outage schedule (e.g., refueling)
- o manpower requriements
- o integration of corrections with other planned station design changes
- o integration of corrections with training requirements for those changes
- o development of procedural changes
- o time requirements for engineering, purchasing, installation, and testing

2.4.6 Effectiveness Phase

This phase is concerned with evaluating control room design enhancements, control room modifications, or other changes resulting from the CRDR or other activities. It will be accomplished by establishing and implementing a procedure to validate, as installed, changes resulting from the Assessment Phase during the CRDR and control room changes that are proposed/implemented after the CRDR is completed.

2.5 References

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

2. NUREG-0700, "Guidelines for Control Room Design Reviews," Sections 1.0-6.9, Final Draft, Washington, D.C., August 18, 1981.

3. NUREG-0737, "Clarification of TMI Action Plan Requirements," Washington, D.C., November 1980 (also Supplement 1 to NUREG-0737, December 17, 1982).

4. NUREG-0801, "Evaluation Criteria for Detailed Control Room Design Review," Draft Report, Washington, D.C. October 1981.

5. Institute of Nuclear Power Operations Report 82-014, "INPO/TVA Pilot Systems Review," June 1982.

6. Westinghouse Owners Group (WOG) Report, "ERG System Review and Task Analysis," April 1983.

7. Control Room Design Review Implementation Guideline, INPO 83-026 (NUTAC), July, 1983.

8. Control Rool Design Review Survey Development Guideline, INPO 83-042 (NUTAC), Novermber, 1983.

9. Human Engineering Principles for Control Room Design Review, INPO 83-036 (NUTAC), September, 1983.

10. Control Room Design Review Task Analysis Guideline, INPO 83-046 (NUTAC), December, 1983.

SECTION 3.0
MANAGEMENT AND STAFFING

3.1 CRDR Organization and Responsibility

The overall responsibility for the PBNP CRDR resides with the General Superintendent of the Nuclear Systems Engineering and Analysis Section (NSEAS). The day-to-day conduct of the review, however, will be the responsibility of a review team established specifically for the CRDR. Figure 3-1 illustrates the organization of the CRDR and identifies the key disciplines which will be represented on the team. In addition to the disciplines identified, the team will be supplemented, as required, by additional personnel in specialty areas such as: industrial engineering, training, procedures, licensing, health physics, and emergency preparedness.

The review team will provide the management oversight to ensure the fulfillment of the program objectives and full compliance with NRC requirements The review team is responsible for implementing and coordinating the total, integrated CRDR in accordance with this program plan. Changes to the program plan may be recommended by the review team. The General Superintendent, NSEAS, has the authority to approve changes.

Review team activities will include implementing the methodologies for the review and assessment of discrepancies, maintaining the schedule for the CRDR, acting as a resource for the departmental organizations, and integrating all action items. The review team will develop, or have developed, all reports relating to the CRDR and submit the appropriate reports to the General Superintendent, NSEAS for review and approval. The review team will ensure that adequate documentation is maintained throughout the CRDR.

3.2 Review Team Qualifications

The PBNP CRDR team consist of the individuals listed below. The disciplines represented and the Wisconsin Electric organizational component represented are also indicated.

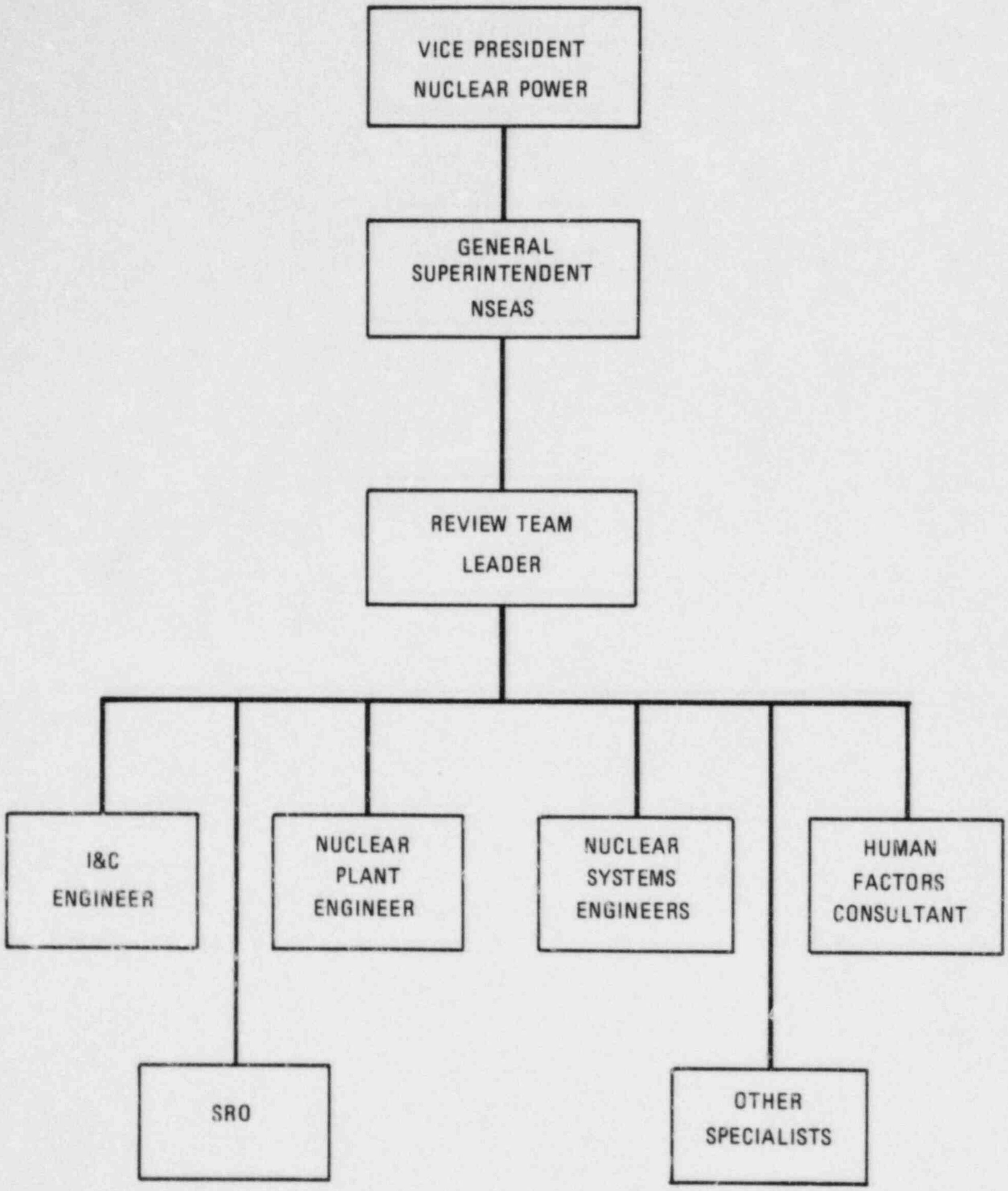


FIGURE 3-1. CRDR ORGANIZATION

Individual	Discipline	Organizational Component
Steven A. Schellin (Leader)	Nuclear Engineer	NSEAS
James C. Reisenbuechler	I&C Engineer	PBNP Technical Services
Thomas P. Sheley	Senior Reactor Operator	PBNP Operations
Gary R. Sherwood	Nuclear Plant Engineer	PBNP Operations
Richard K. Hanneman	Nuclear System Engineer	NSEAS
Dennis R. Blakely	Nuclear System Engineer	NSEAS
To Be Named	Human Factors Specialist	Contractor

The following paragraphs summarize the major responsibilities and qualifications of the team members.

3.2.1 Review Team Leader

The review team has the review team leader as its key person. This individual provides the administrative and technical direction for the project and has responsibility for the day-to-day activities. Access to information, facilities, and individuals providing useful or necessary input to the team is coordinated by the review team leader. This individual provides a cohesive force for the various Wisconsin Electric department personnel and the human factors consultant involved with this project.

It will be the responsibility of the review team leader to resolve any opinions on methodology, technique, review findings, assessment and HED corrective actions that dissent with the majority opinion of the CRDR Review Team. The review team leader is Mr. Schellin. His qualifications include:

Formal Education:

- o B.S., Nuclear Engineering, University of Wisconsin - 1964

- o M.S., Nuclear Engineering, University of Wisconsin - 1971

Advanced Graduate Studies:

- o Nuclear Engineering, Pennsylvania State University

- o Mathematics, University of Pittsburgh

- o Computer Science, University of Pittsburgh, Carnegie-Mellon University, Milwaukee School of Engineering

Professional Experience:

- o 1979 - Present
  - Wisconsin Electric Power Co.
    Responsible for development and implementation of TMI modifications

- o 1966 - 1979
  - Westinghouse Electric Corporation
    Nuclear Service Division - operator training and testing and simulator operations
    PWR Systems Division - Nuclear design, safety analysis, and licensing
    Advanced Reactor Division - Fast reactor design and computer methods
    Educational Center - Engineer training and placement

- o 1964 - 1966
  - University of Wisconsin
    Nuclear Engineering Department Teaching Assistant and reactor engineer

- o 1965 - Argonne National Laboratory - AMU
  Engineering Practice School Engineer

- o Registered Professional Engineer - Pennsylvania and California

Management Experience:

- o 1984 - Present
  - Wisconsin Electric Power Co.
    Nuclear Power Department, Superintendent Reactor Engineering

- o 1982 - 1984
  - Wisconsin Electric Power Co.
    Nuclear Power Department, Senior Project Engineer

- o 1979 - 1982
  - Wisconsin Electric Power Co.
    Nuclear Power Department, Project Engineer

- o 1977 - 1979
  - Westinghouse
    Startup and Training - Senior Audit Engineer

- o 1972 - 1977
  - Westinghouse
    Nuclear Safety - Senior Engineer

- o 1983
  Battelle Project Management Seminar (1.3 CEU)

3.2.2 Instrument and Controls (I&C) Engineer

The I&C Engineer 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 Engineer 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 review team I&C Engineer is Mr. Reisenbuechler. His qualifications include:

Formal Education:

B.S., Civil Engineering, Marquette University, 1971

Professional Experience:

- o 1982 - Present
  - Wisconsin Electric Power Co. - Superintendent of Technical Services. Supervise SNM activities, environmental concerns, and radiation control

programs. Supervise activities of the Radiochemistry and Health Physics, I&C and Reactor Engineering Sections.

- o 1978 - 1982
  - Wisconsin Electric Power Co. - PBNP - Nuclear Plant Engineer, I&C
    Design modifications to I&C systems, plan outage work, prepare procedures, supervise maintenance, develop maintenance programs, maintain equipment history, drawings, and index files

- o 1973 - 1976
  - U.S. Navy - Nuclear Power Program
    Lieutenant Auxiliaries, Interior Communications, Sonar, and Reactor Controls Division Officer, USS Narwhale (SSN-671), Supervision of maintenance and operation of S5G propulsion plant

Licensed Senior Reactor Operator at PBNP

3.2.3 Senior Reactor Operator (SRO)

Mr. Sheley, a SRO from PBNP will serve as a member of the review team. The SRO will assist in identifying operator tasks and will serve as the review team expert on the operational constraints for manipulations of plant systems. Mr. Sheley's qualifications include:

Formal Education:

Cathedral High School, 1963

Professional Experience:

- o 1978 - Present
  - Wisconsin Electric Power Co. - Operating Supervisor
    Direct and assist the operation of PBNP from control room, supervise Control Operators, coordinate and control maintenance on-shift

- o 1970 - 1978
  - Wisconsin Electric Power Co. - Control Operator

    Control operation of PBNP unit consistent with technical specifications, supervise operation of auxiliary operators

- o 1963 - 1970
  - U.S. Navy

    Nuclear Power Program - Machinist Mate First Class - Qualified to supervise and operate all mechanical, electrical, and reactor system onboard USS Patrick Henry (SSBN-599)

- o Licensed Senior Reactor Operator at PBNP

3.2.4 Nuclear Plant Engineer

Representing nuclear plant engineering will be Mr. Sherwood whose qualifications include:

Formal Education:

B.S., Mechanical Engineering, Lawrence Institute of Technology, 1976

Professional Experience:

- o 1982 - Present
  - Wisconsin Electric Power Co.

    Nuclear Plant Engineer Operations - Operating and testing procedure development, supervision of spent fuel disposal, supervision of equipment testing program.

- o 1980 - 1982
  - Wisconsin Electric Power Co.

    Nuclear Plant Engineer, Engineering, Quality and Regulatory Services - Nondestructive inspection program supervision and development, unit outage planning

- 1976 - 1980
  - U.S. Navy

    Nuclear Power Program - Lieutenant (junior grade) - Electrical Division Officer, USS Longbeach (CGN-9). Supervision of operation and maintenance of A2W and A1W propulsion plants.

3.2.5 Nuclear Systems Engineer

Two engineers have been selected from the NSEAS who will bring to the review team varied experiences directly applicable to the type of evaluations anticipated during the CRDR. These engineers hold responsible positions with Wisconsin Electric and will provide valuable assistance in the identification of plant system design goals and functions and the factors affecting design decisions at PBNP. Both have expertise in current design concepts, test procedures, operating procedures, and nuclear safety analysis. The Nuclear System Engineers are Mr. Hanneman and Mr. Blakely.

Richard K. Hanneman

Formal Education:

- B.S., Nuclear Engineering, University of Wisconsin, 1971
- Bachelor of Naval Science, University of Wisconsin, 1971
- M.S., Nuclear Engineering, Pennsylvania State University, 1979

Professional Experience:

- 1979 - Present
  - Wisconsin Electric Power Co.

    Senior Nuclear Engineer - Safety analysis, environmental qualification, fuel design

- 1971 - 1977
  - U.S. Navy
    Nuclear Power Program - Lieutenant
    Electrical and Reactor Control Officer, USS Spadefish (SSN-668), Supervision of operation and maintenance of propulsion plant
    Leading Engineering Officer of the Watch S1C facility

- Registered Professional Engineer - Wisconsin

Dennis R. Blakely

Formal Education:

- B.S., Nuclear Engineering, University of Michigan, 1978

Professional Experience

- 1984 - Present
  - Wisconsin Eelctric Power Co.
    Nuclear Engineer - environmental qualification, procedures development

- 1983 - 1984
  - Cincinnati Gas and Electric Co.
  - Associate Nuclear Engineer - fuel management and computer methods, procedures development

- 1978 - 1983
  - U.S. Navy - Nuclear Power Program - Lieutenant
    Auxiliaries Officer, USS Nimitz (CVN-68), Supervision of operation and maintenance of A4W/A1G, D2G, and S7G propulsion plants

3.2.6 Human Factors Consultant Personnel

A human factors consultant (HFC) has not been selected at this time but will be prior to initiating the Execution Phase activities. The HFC shall provide a Human Factors Specialist to service a member of the review team and provide additional human factors personnel to assist in implementing specified Execution Phase tasks. The minimum qualifications of the Human Factors Consultant will include:

- o M.A. or M.S. in human engineering or related discipline
- o Five years experience in human factors, one of which is in nuclear control room review

Other HFC personnel who participate in project tasks shall have the following qualifications:

- o B.A. or B.S. in human engineering or related discipline
- o Three years of experience in human factors, one of which is in nuclear control room review.

3.2.7 Other Specialists

As stated earlier, the CRDR Review Team will use other expertise available at Wisconsin Electric as required. It is anticipated that especially during the Assessment Phase, and in particular, during the identification, evaluation, and verification of resolution to HEDs, the Review Team will be soliciting support from the following groups:

- o Other NSEAS personnel
- o PBNP Operations
- o PBNP Technical Services
- o Training
- o Licensing
- o Procedures Group

Personnel from these areas will be used only on an as-required basis and will not become members of the Review Team.

3.3 Interface With Other Supplement 1 Activities

The CRDR will be closely integrated with the PBNP effort to upgrade EOPs. The interfaces between the projects will occur during the SFRTA, Verification of Instrumentations, and Validation of Task Performance Capabilities tasks during the Execution Phase. Also procedural modifications will be considered as possible corrections to HEDs.

A special task of the CRDR is to ensure proper integration of the SAS into the control room. This special task is described in Section 4.7. The SAS, or enhancements of it, also will be considered as an approach to correcting HEDs.

The Project Engineer for the CRDR, the EOP V&V effort and the SAS project are all in the Nuclear Systems Engineering and Safety Analysis Section. Thus, the integration of the projects is easily attained.

The CRDR also will interface with the Regulatory Guide 1.97 effort. Outputs from the system function and task analysis shall be submitted to the R.G. 1.97 project engineer for their review for impact on the evaluation of instrumentation for Type A variables. Also the R.G. 1.97 instrumentation requirements shall be considered during Assessment and Correction phases in terms of evaluating and scheduling corrective actions to HEDs.

3.4 Review Team Orientation

Each member of the review team will bring his or her own in-depth knowledge of specific topics to the team. It is important, however, that the review team be able to conduct the CRDR from a common basis of understanding. During its initial meetings, the review team will undergo an orientation program designed to provide each team member with certain basic knowledge requirements. The purpose of the orientation is to acquaint each team member with the other disciplines represented on the team, not to make each team member an expert in all specialties.

The following areas will be addressed in the orientation program.

- o Human Factors - Orientation will be provided for the review team to familiarize the team with principles of human factors and their application to the control room review. Included in this area will be a brief synopsis of the history of the CRDR requirement, its ultimate goals, and NUREGs setting forth the CRDR guidelines. This orientation area will be slanted toward those review team members with little or no background in human engineering.

- Program Plan - The orientation will provide for familiarization of the contents of the Program Plan and for specific implementation instruction on tasks that will by implemented by the CRDR team.

3.5 Use of Consultants

Wisconsin Electric personnel are being used for CRDR activities as much as possible. This high degree of involvement will enhance personnel development overall, increase awareness of human engineering methodology, and provide for a better understanding and acceptance of any proposed corrective actions. Therefore, consultant services will be retained during review activities only to provide those skills not represented within Wisconsin Electric and where manpower shortfalls dictate the requirement for additional support.

At this time, Wisconsin Electric recognizes the need for a human factors specialist to participate on the review team and assist with CRDR activities. A human factors consultant (HFC) will be retained. The HFC personnel shall be able to completely meet the qualifications set forth in Section 3.2.6.

SECTION 4.0
PROCEDURES FOR THE CRDR

The objective of the CRDR is to determine the extent which the PBNP control room provides the operators with sufficient information and controls to complete their required functions and task responsibilities efficiently under postulated accident conditions. The review will also determine the human engineering suitability of the designs of the instrumentation and equipment in the PBNP control room. This section of the program plan describes the procedures that will be applied to accomplish those overall objectives. This section is organized by the major project phases that were illustrated in Figure 2-1.

It should be noted that Wisconsin Electric intends to procure a full scale mockup of the PBNP control room. The mockup will be used to as great an extent as possible in support of CRDR tasks. Because of the availability of the mockup Wisconsin Electric will not photograph all HEDs.

4.1 Planning Phase

The Planning Phase, as discussed previously is completed with the exceptions of (1) selecting a human factors consultant, (2) conducting the human factor orientation, and (3) procuring the mockup.

4.2 Execution Phase

The Execution Phase consists of the following major tasks:

- o Operating Experience Review
- o Control Room Survey
- o SFRTA
- o Control Room Inventory
- o Verification of Instrumentation
- o Validation of Control Room Functions
- o Compilation of HEDs

The following subsections generally describe each of the tasks. Appendices A through I contain specific procedures for implementing the Execution Phase tasks.

4.2.1 Operating Experience Review

The review of operating experience will provide information on potential problem areas in the control room by studying actual occurrences in the plant. Two separate steps are involved in reviewing operating experience. The first is to review available and applicable historical documentation pertaining to plant-specific occurrences. The second step is to survey operating personnel. Operating personnel surveys will identify specific problem areas related to the PBNP control room and point out problems that occur during normal plant operation or that could occur during emergency operations.

4.2.1.1 Historical Document Review

The historical document review will cover PBNP-specific documentation including SOEs and LERs. SOEs are generated, by unit, whenever, in the opinion of the plant manager, normal operation is significantly disrupted. This may include actual or potential personnel injury, test failure, radiation exposure, or equipment damage. LERs are generated as required by PBNP Technical Specifications or 10 CFR 50.73, as applicable.

A detailed description of the historical document review procedures and documentation is contained in Appendix A.

4.2.1.2 Operating Personnel Survey

The most valuable source of data on operational problems are the personnel that have operated the plant. The intent of the operating personnel survey is to gain as much firsthand information as possible on actual and potential operational errors. The survey will consist of a self-administered questionnaire and followup structured interviews if clarification or additional information regarding questionnaire responses is required by the review team.

The following paragraphs describe the development and implementation of the questionnaires and structured interviews.

4.2.1.2.1 Questionnaire

An open-ended, confidential, self-administered questionnaire approach has been adopted. Wisconsin Electric feels that by employing this method, the majority of the operating personnel can be questioned. The questionnaire covers the following content areas:

- Workspace layout and environment
- Panel design
- Annunciator warning system
- Communications
- Process computers
- Corrective and preventive maintenance
- Procedures
- Staffing and job design
- Training
- Other areas for operator comment

The questions written have been evaluated for inclusion in the questionnaire using the following criteria:

Simplicity - Questions are direct, employ common everyday language, and are as brief as possible.

Clarity - Questions are unambiguous so that the response received will be unbiased and accurate.

Objectivity - Questions are free of emotionally charged words such as good/bad, strong/weak, etc.

Error Free - Surveys are susceptible to social desirability, leniency, central tendency, and halo-type errors. The questions are those that have the minimum tendency toward these error types.

A human factors consultant and personnel from NSEAS have assembled questions for each topic area of the questionnaire so that the area is sampled completely in item content. Each topic area contains sections in which suggestions for improvements are solicited. The list of the questions from which the questionnaire items will be selected is contained in Appendix B.

A cover letter to be attached to each questionnaire has been prepared. The cover letter (1) explains the purpose and gives background information, (2) describes the questionnaire and provides instructions, (3) assures respondent confidentiality, (4) conveys what will be done with the results, and (5) requests biographical information.

Questionnaires will be administered to duty shift superintendents, duty technical advisors, operating supervisors, and licensed control operators. Respondents will be instructed to return the completed questionnaire within three weeks after the issuance date stated on the cover letter.

The analysis of the questionnaire responses shall be performed by the HFC. As each questionnaire is retrieved, it will be assigned a code number. These code numbers will be used to trace item responses to individual respondents should it become necessary to do followup interviewing.

After the questionnaires have been completed, retrieved, and logged in, they will be examined and reviewed on an item-by-item basis. Responses will be compiled on an item-by-item basis and include responses and frequency of responses to each item. The HFC shall present the compilation of questionnaire responses to the other Review Team members for evaluation and disposition.

It is anticipated that both positive and negative control room features will be identified by the respondents. Further investigation will therefore be carried out for each item on the responses to determine whether they are in accordance with sound human engineering conventions and practices. Positive responses that are in accordance with sound human engineering conventions and practices will be recorded and disseminated to every member of the CRDR team for consideration in subsequent review processes (e.g., as possible recommendations for corrective action to HEDs). Negative responses will be investigated further in the interviews and in other phases of the CRDR as judged appropriate by the review team. To complete the documentation of this task the HFC shall prepare a Task Report describing the methods and findings.

A detailed description of the procedures, a copy of the cover letter, the biographical data sheet, and the list of possible questionnaire items are contained in Appendix B.

4.2.1.2.2 Structured Interviews

If required, structured interviews will be used as a followup to the questionnaire. As the name suggests, structured interviews are conducted according to a pre-designed outline. The outline will have specific questions that should be answered during the interview. A structured interview helps to reduce the variability of interview results caused by asking different questions of each interviewee or by allowing the interview topics to appear more or less randomly during the interview. The areas or items included in the structured interview will address specific problems identified in the historical document review or in the operator questionnaire.

The follow-up interviews shall be conducted by the human factors consultant instead of a Wisconsin Electric review team member. There are two principal reasons for contracting this activity. First, Wisconsin Electric does not maintain a technical staff of individuals proficient in interview techniques. Although some departments within the company do use interviews, e.g. personnel, the particular techniques used in operator interviewing are sufficiently unique to warrant using outside help.

The second reason for using contract personnel for the operator interviews is the belief that information will be more candidly provided during an interview if no additional company personnel are present. Since it is the intent of Wisconsin Electric to gain as much useful information as possible by encouraging control room operators to be completely frank and open, no other company personnel will be present during the interviews.

While a contractor will be used to conduct the operator interviews, it is essential that the interviewer be familiar with control room environments. Unless such familiarity is present, the importance of certain responses might be missed by the interviewer. Also, responses might lead an experienced interviewer to probe deeper in specific areas, seemingly unrelated to the response.

Procedures for developing and conducting the structured interviews are contained in Appendix C.

4.2.1.3 Operating Experience Review Documentation

Documentation for the Review of Operating Experience, which shall be prepared by the human factors consultant, shall include:

- o Copies of SOEs/LERs with identified control room problems
- o SOE/LER Review Report Forms
- o Event Review Summary indicating problem, comments, and disposition of Review Team
- o HEDs
- o Completed Operator Questionnaires
- o Questionnaire summaries indicating problems identified, comments, and dispositio of Review Team
- o Interview notes
- o Interview summaries
- o Task Reports

4.2.2 Control Room Survey

A human factors survey of the existing PBNP control room will be conducted during the CRDR. The purpose of the survey will be to compare the design features of the existing control room with applicable human engineering design guidelines. To facilitate the human factors survey, checklists and survey lists have been compiled for which direct observation and measurement of control room human factors features can be undertaken. The CRDR Survey Development Guideline published by the NUTAC on CRDR and NUREG-0700 have been used in developing specific PBNP control room surveys and checklists. The checklists and surveys, as well as the procedures for implementation, are contained in Appendix D.

The human factors consultant will be responsible for reviewing and revising the checklists and surveys and ensuring that they are adequate and based on sound human factors principles.

The actual survey with its extensive documentation requirements will be conducted by members of the review team directed by the human factors consultant. Personnel selected to conduct the survey will be instructed in the proper implementation techniques.

The human factors consultant shall be responsible for all documentation including recording and compiling checklist/survey data on summary forms, recording the review team disposition for each item and the action item, and completing HED Forms.

As a special emphasis of the survey, the HFC shall conduct a special study of the functional grouping of instruments and controls and recommend, if needed, demarcation, mimics, and color-coding control board enhancements.

4.2.3 System Functions Review and Task Analysis (SFRTA)

The primary purpose of the SFRTA is to systematically identify and assess operator tasks, information, instrumentation, and control requirements for postulated accident conditions. Subsequently the needed characteristics of instruments and controls required to support the implementation of the Emergency Operating Procedures are to be defined. The output of this task will be (1) the needed characteristics of instruments and controls which is the input to the related task, Verification of Instrumentation and (2) feedback into the EOP V&V effort.

The SFRTA clearly cuts across both EOP and CRDR activities. The NRC, (in a memo from N.B. Clayton to D.L. Ziemann, dated April 5, 1984) has recognized that system functions, operator tasks, and operator information requirements were analyzed at a generic level when the Westinghouse Owner Group (WOG), in accordance with NUREG-0737, Item I.C.1, performed a reanalysis of transients and accidents and prepared a set of Generic Emergency Response Guidelines (ERGs). The ERGs, in turn, were validated via simulator exercises on the Callaway simulator (Rev. 0 ERGs) and on the Seabrook simulator (Rev. 1 ERGs). Subsequently, operator tasks were further reviewed and instrumentation/control requirements were assessed in the development of the PBNP-specific EOPs.

The Clayton memo indicates that the two SFRTA objectives that remain to be achieved are:

1. Determining the needed characteristics of instrumentation and controls necessary to implement the EOPs and

2. Establishing an auditable record of how the needed characteristics of the instruments and controls were developed

To complete the SFRTA, the HFC will analyze each operator task, information requirement, and instrument and control requirement established in the generic ERG and/or the plant-specific background documentation. The plant-specific EOPs, as they are developed, will be the starting point. The objective of the analysis will be to compile the needed operator information by operator action and variable and then determine the needed characteristics of the instruments and controls.

The following information will be recorded into an SFRTA data base for each EOP task and subtask in both the Action/Expected Response and the Response Not Obtained column.

1. Step/substep number

2. Operator action (e.g., observe, start, check, etc.)

3. Variable (e.g., seal injection flow, RCS pressure, steam generator levels, etc.)

4. Expected value/position (e.g., 150 psig, 9 percent, close, etc.)

5. Control feedback (e.g., limit switch indicator - lit red)

6. System/Equipment responses (primary and secondary) (e.g., motor amps, discharge pressures, flows, tank levels, temperatures, pressures, etc.)

7. Expected value/position

To determine the needed characteristics of each instrument and control, the data base will be searched and for each variable (e.g., pressurizer pressure, RCP, etc.), all values/positions that are required for all operator tasks will be compiled. The compilation of this data is used to determine the needed ranges, positions, scale graduation, direct feedback, system/equipment response feedback, and backup or secondary indications of instruments and controls in the control room.

An auditable record of how the needed characteristics were determined will be developed by preparing lists of EOPs, steps, and substeps that are associated with each variable and maintaining a record of the display values and/or control requirements associated with the variable.

Appendix E contains procedures for performing the SFRTA and a sample data collection form.

4.2.4 Control Room Inventory

The control room inventory will produce a reference set of data which identifies and describes the characteristics of all controls, displays, and other components on the control boards, peripheral consoles, and ASIPs. The purpose of the inventory is to provide a data base against which the needed characteristics of instruments and controls identified in the SFRTA can be verified both in terms of the presence of appropriate instruments and controls in the control room and the human factors suitability of the existing instruments and controls. The data to be collected for each item are as follows:

- type of control or display
- nameplate data
- tag number
- location
- range/positions
- graduations/control precision

Appendix F contains the procedures for completing the inventory and a sample data collection form.

4.2.5 Verification of Instrumentation

The process of verifying that the PBNP control room contains appropriate instruments and controls will be based on the outputs of the SFRTA and the control room inventory. First, a determination will be made as to whether the instrumentation and controls necessary to display the information or take the control actions identified in the SFRTA are present in the control room. If not, an HED will be defined and documented accordingly.

The second step of the verification process consists of an examination of the existing instrumentation and controls identified in the first step to determine their human engineering suitability for the task action or decision they are to support. This will be done by comparing the needed characteristics of instruments and controls, as determined in the SFRTA, with actual characteristics of instruments and controls, as documented in the inventory.

Although the control room survey examined all control room instrumentation for conformance with human engineering design criteria, this verification step is required to determine if instruments and controls support operator requirements. For example, to check if a pressure indicator uses the same units of measurement and has the appropriate range and scale graduations to support all EOP tasks or system-specific task steps in which it is required.

Appendix G contains procedures for the Verification of Instrumentation.

4.2.6 Validation of Control Room Functions

The purpose of validating control room functions is to determine whether the control room's physical and organizational design has been integrated so that the functions allocated to the control room operating personnel can be accomplished effectively. Validation of functions should demonstrate that adequate manual controls, automatic controls, monitoring systems, and trained operators are provided to implement the EOPs.

The process of validation will provide an opportunity to identify discrepancies which may not have become evident in other review activities. Validation also will provide the opportunity to see how HEDs from earlier activities come into play during interactive plant operations. The process of verification of task performance capabilities will be conducted to assure that operator tasks are supported with control room instrumentation and controls. This process will evaluate the man-machine interfaces of individual work stations and operators. The tasks of validating system integration is distinct from verification of task performance capabilities because it places the emphasis on function execution and the interrelationship of the work stations and operating personnel.

It is the intent of Wisconsin Electric to integrate the CRDR with the verification and validation (V&V) of the Rev. 1 based EOPs. Therefore, when the EOP V&V walkthroughs are conducted the CRDR validation requirements can be met simultaneously.

The HFC will furnish observation personnel, and analyze the data in order to meet the following specific validation objectives:

1. Ensure that the procedures contain the necessary references to the instruments and controls required to support the operator actions called out in the procedure steps.

2. Ensure the availability and human engineering suitability of information; that instrumentation and control data are appropriately displayed to facilitate use of procedures.

3. Ensure that procedure task requirements are within the capability of the operating crew.

4. Ensure that the control room design supports the performance of time-critical tasks.

To meet these objectives operating sequence diagrams (OSDs) shall be developed and timeline, staffing, and traffic analyses conducted. In addition, observers will evaluate operator actions during the walkthroughs. As a final note, the operators shall be asked to discuss specific problems they experience in implementing the EOPs.

The walkthrough will be performed on the full scale mockup of the control room and/or in the control room. The OSD shall document operator action along a timeline and workstation usage by the control room crew. Appendix H contains an example of an OSD which provides the type of graphic representation of the walkthrough and the record keeping function that will be used.

Once a walkthrough has been conducted and an OSD completed, the following questions will be answered by the HFC.

1. Were controls reachable for the appropriate system/panel?
2. Was comparison of two or more displays in rapid fashion convenient?
3. Were particular displays monitored over prolonged periods accessible?
4. Were controls/displays easily discriminated from among similar components?
5. Are controls and displays arranged to facilitate traffic and implementation of procedure steps?
6. Were any time critical tasks not performed correctly due to CR and/or workstation layout?
7. Could the procedure actions be performed on the plant in the designated sequence?
8. Were the procedure instructions compatible with the shift manpower?
9. Could the procedure action be performed by the operating shift?
10. Did the procedure help coordinate the actions of the operating shift?
11. Could the operator obtain the necessary information from designated plant instrumentation when required by the procedure?

12. Did one operator consistently direct the activities of the other operators and was there a designation of responsibilities among the operators?

Upon completion of the HFC analysis, which shall include a description of each problem encountered, the CRDR team shall review the procedures and findings. The description of each problem encountered shall also be submitted to the EOP V&V Project Engineer.

Appendix H contains the procedures and forms for the CRDR validation.

4.2.7 Compilation of HEDs

The final task of the Execution Phase will be to complete all HED forms and to compile lists of the HEDS. This task shall be performed by the HFC. Procedures for completing the HED form and compiling HED data is contained in Appendix I.

As part of this task, the HFC shall review the documentation of the previous Execution Phase tasks to ensure that all problems identified, action items, procedures, etc., have been addressed and/or resolved.

4.3 Assessment Phase

4.3.1 Objectives

The objectives of this phase of the CRDR are as follows:

- o Evaluate the significance of the HEDs defined in the previous phases of the CRDR.
- o Where HEDs are found to be of minor significance, describe the technical and/or operational basis for such a finding.
- o Where HEDs are found to be potentially significant formulate changes to the control room, procedures, operator training, or any combination thereof to mitigate those HEDs.

4.3.2 Assessment Overview

The Assessment Phase will consist of the following six steps:

- o HED Screening
- o HED Categorization
- o Error Analysis
- o Definition and Verification of HED Resolutions
- o Definition of Relative Costs of HED Resolutions
- o Scheduling

Figure 4-1 illustrates the logic and flow of the assessment process. As can be seen, HEDs are characterized by whether or not they have been previously experienced and then, by their impact on operations (i.e., accident conditions, technical specification violation, or other operations). Then, each HED goes through a specific chain of assessment events, and a schedule priority for HED resolutions is determined on the basis of (1) impact on operations, (2) analysis of the error(s) to which the HED may contribute, and (3) costs/benefits analysis of the resolution.

The following sections describe each assessment step process in greater detail.

4.3.3 HED Screening

The HED screening process will take place in two steps. Only those HEDs that have not been previously experienced will be screened. HEDs found during the Execution Phase will first be evaluated to identify those which represent a problem in the control room. For those HEDs that are identified as invalid, the rationale for the decision shall be documented for the record. Reasons for screening out an HED are as follows:

- o HED has been corrected by an acceptable method.

- o Although a CRDR guideline or evaluation criterion was violated, no operator problem exists (e.g., when entering a command for the P-250 if the operator makes an error, the error cannot be individually corrected (which violates a computer survey evaluation criteria), and the entire command must be

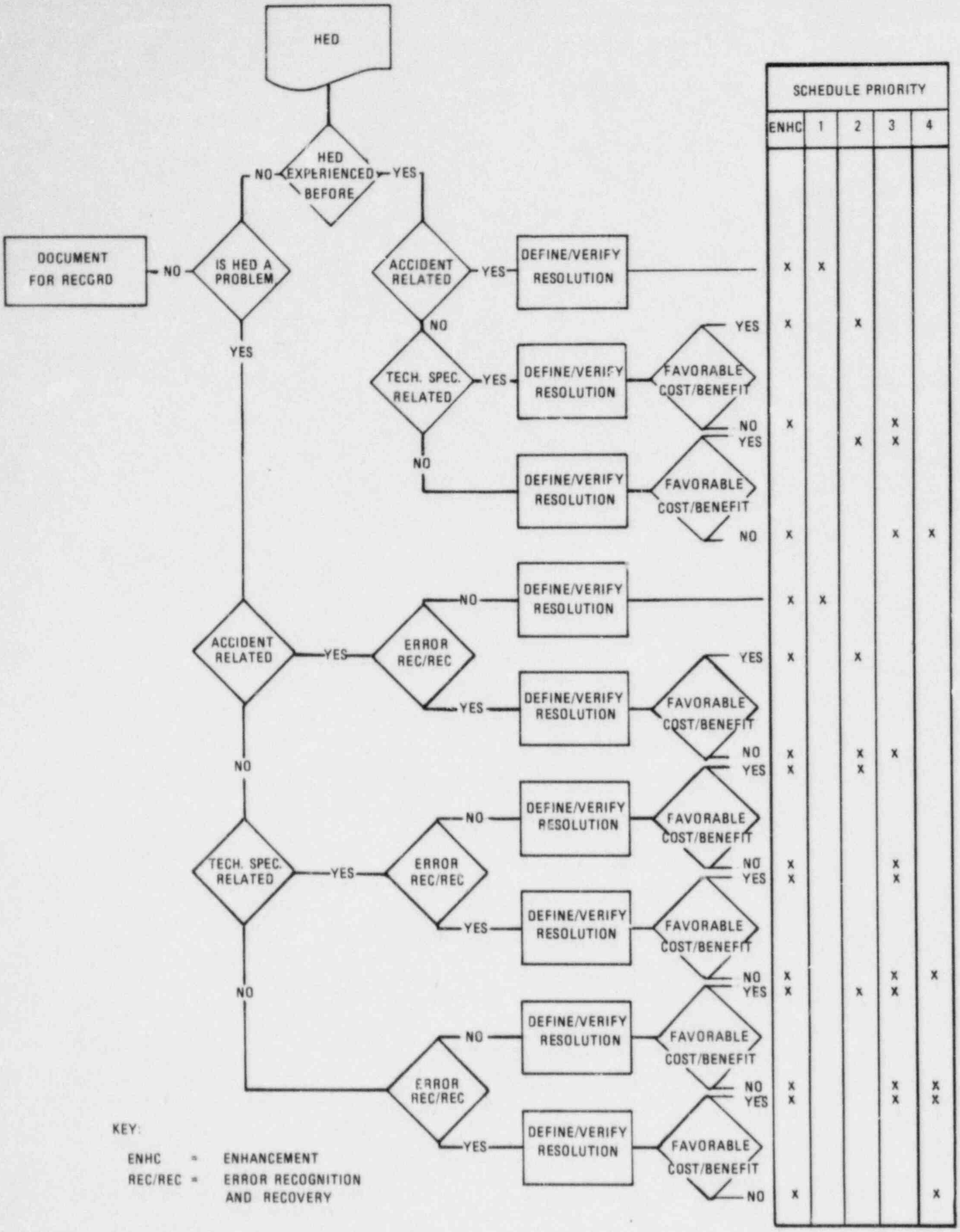


FIGURE 4–1. HED ASSESSMENT FLOW

re-entered. However, commands are made with function keys and no P-250 entry requires more than 6-8 keystrokes. Therefore the operator is not required to re-enter extensive amounts of information).

- o Although a CRDR guideline or evaluation criterion was violated, a different, yet logical and acceptable plant convention was followed.

The valid HEDs that remain will then be screened to identify those HEDs for which enhancement appears to offer an optimal resolution to the HED.

4.3.4 HED Categorization

The purpose of HED categorization is to clearly identify each HED in terms of its impact on operating conditions and to ensure that HEDs that have actually caused or contributed to an operator error are highlighted and assessed within that context. As can be seen in Figure 4-1, the category in which the HED falls effects its subsequent evaluation and contributes, along with other factors, to the scheduling priority assigned the HED resolution. The categories are as follows:

HEDs Experienced Before

- o HEDs that caused or contributed to an operator error related to accident conditions.
- o HEDs that caused or contributed to an operator error that resulted in a violation of a Technial Specification.
- o HEDs that caused or contributed to an operator error that was not related to accident conditions and has not resulted in a Technical Specification violation.

HEDs Not Experienced Before

- o HEDs that may cause or contribute to an operator error related to accident conditions.

- HEDs that may cause or contribute to an operator error that would result in a Technical Specification violation.

- HEDs that may cause or contribute to an operator error that is not related to accident conditions and would not result in a Technical Specification violation.

4.3.5 Error Analysis

The purpose of the error analysis is to determine first if the operator is made aware of an error before systems or operator performance degradation occurs. Secondly, the potential errors associated will an HED are analyzed to determine is the system will self-correct through its own design capabilities. As can be seen in Figure 4-1, HEDs that have previously caused or contributed to an operator error which was documented, do not undergo error analysis since it has already been demonstrated that any error recognition or self correcting protection did not work. Also as can be seen in Figure 4-1, the results of the error analysis contribute to the scheduling priority assigned to an HED resolution.

4.3.6 Definition and Verification of HED Resolutions

The Review Team will be resonsible for defining and verifying resolutions to the HEDs that have been identified and categorized. There are, in general, many ways to solve specific human engineering problems. In some cases, a simple change in training or procedures may suffice, although this solution is sometimes over-used and inadequate to address the root causes of a particular problem. Some HEDs may be corrected by simple surface enhancement techniques. Correction of other HEDs may require more extensive measures.

If it is determined that the correction must involve movement, modification, addition, or deletion of instrumentation, then these corrections will be verified with respect to their impact on the existing control room, including operator performance, training and procedures. Before any changes are approved proposed modifications will be evaluated to determine their effectiveness and to ensure that new HEDs do not result. Before any changes are made, even small-scale changes, a review by operations personnel will be obtained.

This step in the assessment process will be a relatively straightforward examination of each HED by the members of the CRDR team to define the type and extent of corrective action necessary to bring about a full and complete resolution of the HED. This "optimal solution" may be a design change to equipment or facilities, a change in procedures, a change in the training program, use of SAS or any combination of the four. The optimal solution may also be an enhancement.

4.3.7 Definition of Relative Costs

This dimension of assessment has the objective of establishing the relative cost of implementing the design solutions of each of the HEDs considered in the preceding step and evaluating costs in terms of the consequences of the potential errors associated with the HEDs. The evaluation will address costs associated with three distinct areas of resources most commonly utilized for HED resolution. Those areas are: (1) engineering and construction resources for physical changes, (2) plant operations resources for procedural changes, and (3) plant operations training resources for additional training. It is anticipated that most optimal solutions will involve more than one area.

For physical changes, the predominant criteria for evaluation involves the complexity of installation. Items such as new holes in the control board, rewiring, new cable, and new instrumentation will be reviewed to assess the magnitude of the solution. Engineering and material cost will not be directly evaluated because they usually are proportional to the magnitude of the installation. For the situations where this is judged not valid (e.g., an expensive component which will be easy to install) a subjective modifier will be applied to more accurately evaluate unusual engineering and/or material costs.

Procedural changes represent a smaller yet significant resource available for some HED solutions. In some instances, only the modification of an operating procedure represents the most cost-effective resolution of an HED. Conversely, physical changes may cause procedural changes which add to the total physical change cost.

Unlike procedural change costs, training costs associated with HED solutions can vary from one-time costs to recurring costs. In relation to a physical change, training costs would be associated with an initial retraining of operators if applicable. As an HED solution itself, recurrent training could represent substantial costs over the life of the plant. NSEAS will support the CRDR Team in defining costs associated with HED corrections.

Several inputs will be used by the review team when evaluating resolution costs along with consequences of errors. The following list includes criteria that will be considered:

- o Impact on operating effectiveness
- o System safety
- o Magnitude of cost and redesign
- o Impact on plant availability
- o Consistency with existing features
- o Compliance with regulatory design requirements
- o Impact on control room staffing
- o Impact on operator training programs
- o Consistency with implementation and integration of other emergency response activities

4.3.8 Scheduling HED Corrections

The CRDR Team will prioritize HED resolutions for corrective action based on the characteristics of the HED and on a judgement of the costs/benefits of the resolutions. The priority given to an HED resolution will determine the schedule for correction. Scheduling priorities are as follows:

Priority 1 - Correct as soon as possible.

Priority 2 - Correct as soon as practical.

Priority 3 - No specific completion date.

Priority 4 - No correction recommend.

ENHANCEMENT - Enhancement will be implemented as soon as possible.

4.4 Documentation Phase

The importance of data management before, during, and after the CRDR cannot be overemphasized. Adequate documentation and documentation control creates a traceable and systematic translation of information from one phase of the CRDR to the next. This section describes the documentation system and documentation management procedures that Wisconsin Electric will use to support its control room design review.

4.4.1 General Documentation Requirements

The documentation system will meet the following requirements:

- Provide a record of all documents used by the Review Team as references during various phases of the CRDR
- Provide a record of all correspondence generated or received by the review team during the review
- Provide a record of all documents produced by the review team as project output
- Allow an audit path to be established through the project documentation
- Retain project files in a manner that allows future access to help determine the effects of control room changes proposed in the future

4.4.2 References

The following documents have been identified as possible reference material to be used during the review project. As the review progresses, it is anticipated that additional material and references will be identified.

- PBNP Final Safety Analysis Report
- Westinghouse Emergency Response Guidelines (ERGs)
- NRC guidance documents (e.g., NUREG-0700)

- o Control room drawings (floor plan, panel layout, etc.)
- o Control Room Mockup
- o Human factors design information
  - -- Van Cott & Kinkade
  - -- McCormick
  - -- MIL-STD-1472
- o Operating Manuals, Procedures, and Instructions
- o EOPs
- o Piping and instrumentation diagrams (P&IDs)
- o INPO/TVA Pilot Systems Review Report (INPO 82-014)
- o NUTAC CRDR documents

4.4.3 Review Documentation

Throughout the review process, documents will be processed to record data, analyses, and findings. Wherever practical and appropriate, standard forms have been developed and will be used. The bulk of the documentation generated by the review process will be necessary to do the following:

- o Document the criteria used for each review activity
- o Record the results of the survey, operating experience review, and task analysis
- o Compile HEDs and associated data for review and assessment
- o Document disposition of problems identified and HEDs

In order to facilitate systematizing and recording CRDR data, Wisconsin Electric has developed the following standard forms.

- o SOE/LER Review Report
- o OSD Form
- o Inventory Form
- o SFRTA Form

- Surveys and Checklists
  - Overview Checklist
  - Operator Assisted Checklist
  - Labelling, Mimics, and Demarcation Checklist
  - General Panel Checklist
  - Control Room Computer Checklist
  - Lighting Survey
  - Noise Survey
  - Anthropometric Survey
  - Communication Survey
  - Color Coding Survey
- HED Form
- Biographical Data Sheet

Any or all of these forms may be revised on the basis of the experience gained during the CRDR.

4.4.4 Task Reports

At the conclusion of each Execution Phase task, a report will be generated. The purposes of each of the task reports are as follows:

- It forces full completion of each task in a timely manner.

- It provides full documentation of each task at the time it is being completed, thus there is no reconstruction of activities when the summary report is being prepared.

- It facilitates preparation of the summary report.

- It provides a complete summary of each task for review by the CRDR.

- It documents program progress for utility management.

- It constitutes being prepared for an NRC audit.

4.4.5 Summary Report

Upon completion of the CRDR, a detailed summary of the results will be prepared and submitted to the NRC for review. The summary report will describe the results of the CRDR. Wisconsin Electric intends to submit the summary report by October 31, 1985. This report will summarize the review process, provide descriptions of the identified human engineering discrepancies (HEDs), proposed corrective actions and proposed implementation schedules. Details of the CRDR, along with complete documentation, will be available for NRC evaluation and review.

The summary report will specify the personnel who participated in the CRDR and delineate their qualifications. It will also indicate any modifications or revisions made to the implementation plan submitted to the NRC. These may become necessary periodically throughout the CRDR and will be described by the review team in the report.

A summary of the Operating Experience Review processes and results will be contained in the report. The types of historical reports reviewed and the period of time they covered will be provided. The experience levels of the surveyed operators as well as the procedures used to conduct the survey will be summarized.

Samples of forms used in the control room survey will be provided. Procedures used for verification of task performance capabilities and validation of control room functions will be summarized.

Details of the assessment procedures will be summarized and supporting documentation provided. Changes that do not provide a full and complete correction of an identified HED, or decisions to allow a discrepancy to remain, will be justified, and information pertinent to such decisions will be provided.

The summary report will address findings at the individual control room system level based on the control room survey or task analyses. Further discussion will be directed to review findings and solutions identified during the operating experience review, task performance capability verification, and operating crew function validation.

Implemented or proposed design solutions and implementation schedules will be described. Such scheduling will be governed by priorities, and any departure from this prioritization will be explained. This tentative implementation schedule will include a plan to ensure adequate review of planned improvement. Any deviation from the proposed CRDR methodology described herein will be discussed and appropriate explanation provided.

4.5 Correction Phase

Control room modifications or procedure revisions required to resolve significant HEDs will be implemented through existing PBNP administrative procedures. The use of existing administrative procedures ensures that plant operators will be made aware of impending changes and trained to use the modified control panels, systems, or procedures.

4.6 Effectiveness Phase

In order to ensure adequate human factors considerations for control room changes that are implemented as a result of the CRDR and after the CRDR is completed, a human engineering review procedure shall be established to review all such changes during various design and implementation phases, including a post-implementation review. To evaluate the human factors acceptability of all proposed control room modifications, the procedure will have criteria and controls similar to those used during the CRDR. Any proposed control room change will have to be evaluated against the criteria before such change can be implemented. The human engineering review procedure shall be developed by the HFC after the Execution and Assessment Phases have been completed.

4.7 Additional CRDR Tasks

Wisconsin Electric intends to conduct the following two additional CRDR tasks that are not specifically called out in the NUTAC CRDR documentation, NUREG-0700, NUREG-0801, or Supplement 1 to NUREG-0737:

- o SAS Location Study
- o Operator Staffing Study

Each of the tasks will be conducted in accordance with good human engineering practices (drawing from NUREG standards and principles where appropriate) and will serve to increase the human factors focus of the PBNP CRDR.

It should also be noted that Wisconsin Electric intends to implement control board enhancements, if enhancements (e.g., mimics, demarcation, color-codes, etc.) will facilitate operator performance.

The procedures for conducting the two special tasks are contained in the following subsections.

4.7.1 SAS Location Study

4.7.1.1 Purpose

The purpose of the SAS location study is to ensure that positioning of the SAS displays meets the NRC requirement for SPDS that states that the SPDS should be located convenient to control room operators (Supplement 1 to NUREG-0737, paragraph 4.1.B) and to ensure maximum benefit from the SAS to operators. Wisconsin Electric would like to note that other NRC requirements from Section 4.1 of Supplement 1 have been or are being fulfilled.

4.7.1.2 Approach

The SAS location study is to be conducted by the HFC and includes the following tasks:

1. The HFC shall analyze the OSDs developed from the EOP walkthroughs to determine the primary positions and information requirements of each operator. Based on the review of the OSDs, the HFC shall recommend an optimal location(s) for the SAS displays on the vertical panels. The HFC shall also assess the impact of having to move or remove existing instrumentation on control room operations. The HFC shall evaluate less than optimal locations where the SAS also could be located in terms of (1) impact of implementing EOPs, (2) usability of SAS, and (3) dislocation of existing instrumentation and controls.

2. Upon identifying and documenting the advantages/disadvantages of the alternative locations, the HFC shall interview a sample of control room operators to determine their preference for the identified alternatives and their opinion of each location's impact on operations.

3. The HFC shall prepare a report to be presented to the CRDR team which documents the methods and findings of the SAS location study.

4.7.2 Operator Staffing Study

The purpose of the operator staffing study is to determine the personnel requirements for the PBNP control room when one unit is running and the second unit is in refueling or cold shutdown. Wisconsin Electric has requested an exemption from the NRC requirement for a third reactor operator when PBNP is in the situation described above. Wisconsin Electric believes that due to the compactness of the control room and plant designs, PBNP can be safely operated with two reactor operators and two senior reactor operators (i.e., Shift Superintendent and Operating Supervisor) under these conditions. The NRC staff has indicated that they will be willing to review the CRDR in support of the exemption results.

As a special focus of the CRDR, the HFC shall conduct an operator staffing study for the specified conditions. In completing the study, the HFC shall perform the following tasks.

1. Identify control room operator requirements associated with refueling and cold shutdown modes.

2. Identify control room operator requirements associated with accident conditions that are not included in the EOPs (e.g., requirements in the Emergency Plan).

3. Develop worst condition scenarios in terms of operator requirements associated with postulated accidents (to be based on results of EOP walkthroughs and OSDs analysis), refueling/cold shutdown requirements and/or contingencies, and ancillary requirements on personnel due to combinations of events for both units.

4. Evaluate/project manpower requirements for each scenario.

5. Prepare a final report, to be submitted to the CRDR Team, which describes methods and findings.

SECTION 5.0
CRDR SCHEDULE AND TASK PARTICIPATION

Figure 5-1 presents the CRDR schedule of activities through the development of the Summary Report. Correction and Effectiveness activities are not scheduled, although schedule guidelines are presented in Section 4.5. A proposed schedule for these activities will be submitted with the Summary Report.

Table 5-1 presents a summary of the Wisconsin Electric personnel/departments and HFC participation that is anticipated during the CRDR. The legend for the type of participation identified in Table 5-1 is as follows:

C - Responsibility for coordination and implementation.
W - Working participation in CRDR task.
RC - Review and comment role.
RA - Review and approval authority.
T - Technical support and/or input.

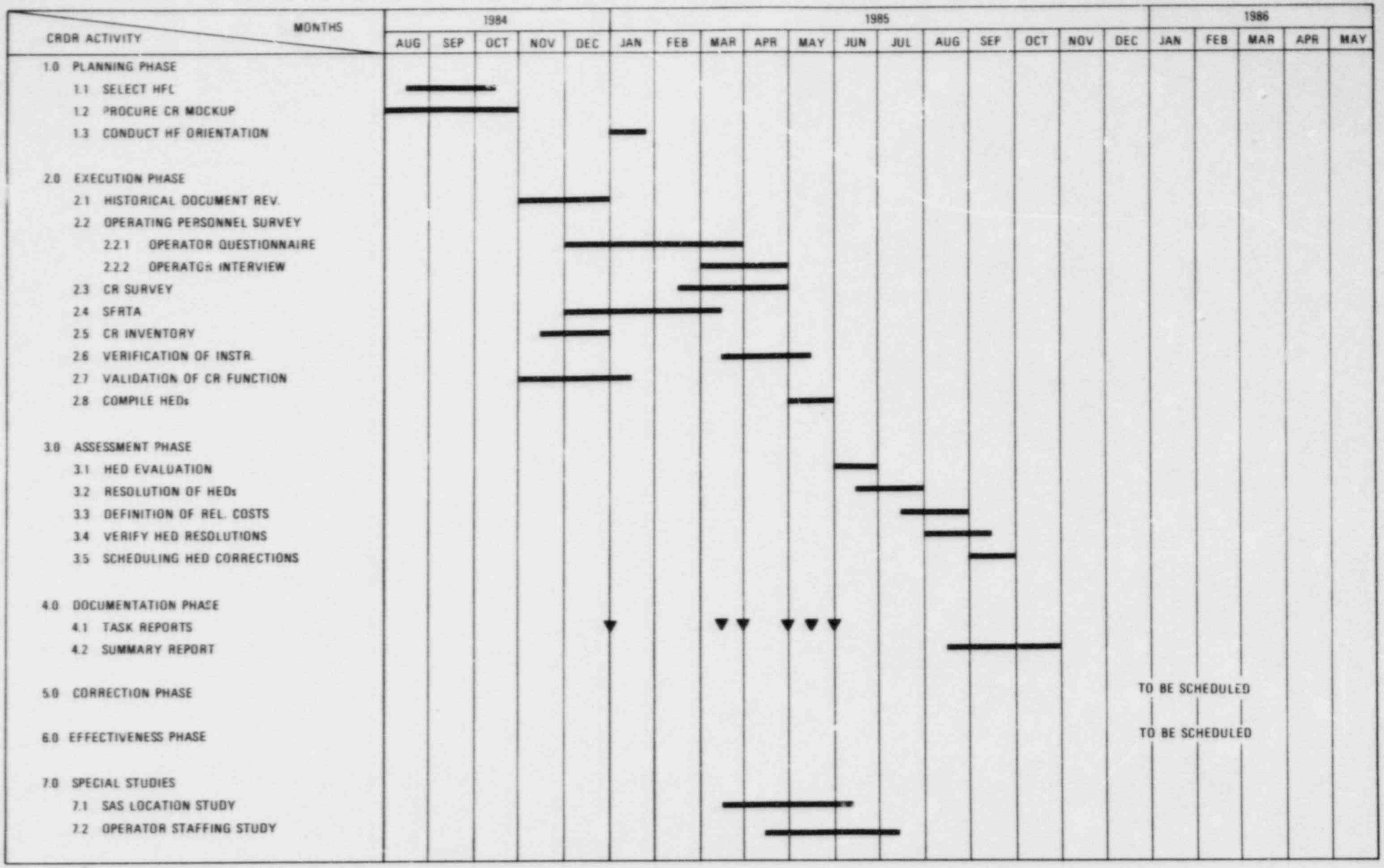


FIGURE 5–1. CRDR SCHEDULE

TABLE 5-1. LEVEL OF PARTICIPATION SUMMARY

PHASE/ACTIVITY	CRDR TEAM LEADER	HFC	CRDR TEAM I&C ENGINEERING	CRDR TEAM SRO	CRDR TEAM NUCLEAR SYSTEMS ENGINEERING	CRDR TEAM SUPPORT TRAINING	CRDR TEAM SUPPORT LICENSING	CRDR TEAM SUPPORT PROCEDURES	OPERATIONS (PNP)	PROJECT ENGINEER EOP V&V	NSEAS STAFF	OTHER DEPARTMENTS/ SECTIONS STAFF	GENERAL SUPERINTENDENT NSEAS	VICE PRESIDENT NUCLEAR POWER DEPARTMENT	OTHER CONTRACTED SERVICES	
1.0 PLANNING PHASE																
1.1 SELECT HFC	C/RA												RA			
1.2 PROCURE CR MOCKUP	C/RA														W	
1.3 CONDUCT HF ORIENTATION	C	W	W	W	W											
2.0 EXECUTION PHASE																
2.1 HISTORICAL DOCUMENT REVIEW	C/RA	W	RC	RC	RC								RA			
2.2 OPERATING PERSONNEL SURVEY																
2.2.1 OPERATOR QUESTIONNAIRE	C/RA	W	RC	RC	RC				W				RA			
2.2.2 OPERATOR INTERVIEW	C/RA	W	RC	RC	RC				W				RA			
2.3 CR SURVEY	W/C/RA	W	W/RC	W/RC	W/RC				W				RA			
2.4 SFRTA	C/RA	W	RC	RC	RC					W/RC			RA			
2.5 CR INVENTORY	C/RA	W	RC	RC	RC											
2.6 VERIFY INSTRUMENTS	C/RA	W	RC	RC	RC					RC			RA			
2.7 VALIDATE CR FUNCTIONS	C/RA	W	RC	RC	RC					RC			RA			
2.8 COMPILE HEDs	C/RA	W	RC	RC	RC											
3.0 ASSESSMENT PHASE																
3.1 HED EVALUATION	C/RA	W	W	W	W											
3.2 RESOLUTION OF HEDs	C/RA	W	W	W	W	T	T	T	T		T	T	T/RA			
3.3 DEFINITION OF RELATIVE COSTS	C/W/RA	W	W	W	W	T	T	T	T		T	T	T/RA			
3.4 VERIFY HED RESOLUTIONS	C/W/RA	W	W/RC	W/RC	W/RC	T	T	T	T		T	T	RA			
3.5 SCHEDULING HED CORRECTION	C/W/RA	W	RC	RC	RC	T	T	T	T		T	T	T/RA			
4.0 DOCUMENTATION PHASE																
4.1 TASK REPORTS	C/RA	W	RC	RC	RC											
4.2 SUMMARY REPORT	C/RA	W	RC	RC	RC								RA			
4.3 GENERAL DOCUMENTATION	C/W/RA	W											RA	RA		
5.0 CORRECTION PHASE													RA			
6.0 EFFECTIVENESS PHASE																
6.1 PREPARE HF PROCEDURE	C/RA	W	RC	RC	RC								RA			
7.0 SPECIAL STUDIES																
7.1 SAS LOCATION STUDY	C/RA	W	W/RC	W/RC	W/RC				T				RA			
7.2 OPERATOR STAFFING	C/RA	W	RC	RC	RC		T/RC		T				RA			

APPENDIX A

PROCEDURES AND FORMS
FOR THE
HISTORICAL DOCUMENT REVIEW

CONTENTS

PROCEDURES AND FORMS FOR THE HISTORICAL DOCUMENT REVIEW

1.0 INTRODUCTION

As a part of the Control Room Design Review (CRDR) for the Point Beach Nuclear Plant (PBNP), a review of plant documentation will be conducted. The purpose of the review is to identify instances of incorrect control room operation or design deficiencies that may have resulted in reported events at PBNP.

The primary documents that will be reviewed are SOEs and LERs. All reports, generated from date of commercial operation, will be examined.

The following subsections describe the methods and criteria to be used in the review and in reporting the results. As appropriate, human engineering discrepancies (HEDs) will be generated for further assessment and evaluation or other follow-up actions as prescribed.

2.0 PROCEDURES

The review of the SOEs/LERs will be conducted in x steps as follows:

1. Document Collection
2. Initial Screening
3. Human Factors Review
4. Evaluation and Disposition by CRDR Team
5. Task Report Preparation
6. Task Report Review and Approval

2.1 Document Collection

The Review Team Leader is responsible for acquiring copies of all SOEs and LERs for both units since the dates of commercial operation. Copies of the SOEs and LERs shall be provided to the HFC for further analysis.

2.2 Initial Screening

All of the SOEs/LERs that have been generated will be reviewed. The first step in the review was to screen the documents in order to eliminate unrelated documents.

The initial screening will be conducted by the HFC. The screening criteria are as follows:

- o Equipment referenced (valve/pump control display indicators, etc.) must be in the physical confines of the control room.

- c Procedural steps referenced shall be accomplished within the physical confines of the control room.

- o Personnel errors referenced must have occurred in the control room, on equipment in the control room, or entail a deviation from procedures that were to be accomplished in the control room.

2.3 Human Factors Review

The Human Factors Review shall consist of three steps. First, the cause of the incident will be determined and categorized. Categories of event causes will be structured as follows:

1. Equipment failure
2. Engineering error
3. Personnel error, and
4. Other (include items such as procedures, training, etc.)

Second, the type of error made will be categorized. The categories of errors are:

1. The omission of an action required to perform the task
2. The transposition between two actions or two components required to perform the task
3. Performing actions inappropriate to the situation
4. Non-required action in procedure
5. Failure in communication
6. Other

Finally, the error will be analyzed in order to determine its cause. Again, a categorization scheme will be used and the following categories of error cause are included:

1. Received or obtained inadequate information
2. Misunderstood the information
3. Failure in communicating or reporting of information
4. Procedural deficiency
5. Directive deficiency
6. Made an incorrect decision concerning the appropriate course of action
7. Incorrectly carried out decision
8. Workload too high
9. Normal reflex (in appropriate situation)

10. Disorientation (confusion between North and South, right and left, etc.)

11. Memory lapse or error in remembering

12. Decreased attention

13. Maintaining an erroneous conclusion

14. Poor coordination in manipulating controls, objects, etc.

15. Other

A log of all SOEs/LERs reviewed by the human factors consultant will be maintained. If the event cause is anything other than an equipment failure, an SOE/LER Review Report will be completed. An example of the SOE/LER Review Report is contained in Attachment A along with the guidelines to completing the record. The SOE/LER Review Report provides for the complete documentation of the event and its human factors review.

2.4 Evaluation And Disposition By CRDR Team

Copies of the SOE/LER Review Reports and the SOEs/LERs on which they were based will be presented by the human factors consultant to the other CRDR team members for final evaluation and disposition. The objective of the CRDR team evaluation and disposition is as follows:

- o To verify the accuracy and completeness of the error analysis.
- o For those incidents where there is a human factors-related problem or error, to identify corrective actions cited in the SOE/LER and to:

  1. Verify that the corrective action had been taken,
  2. Determine if corrective action had resolved the problem, and
  3. Determine if the corrective action posed additional human factors problems and/or increased the potential for human error.

The CRDR team shall review each of the SOE/LER Review Reports with the human factors consultant. The event and its implication for operations in the control room will be discussed and in many instances, with the help of the operations personnel, events will be reconstructed and evaluated. For each of the SOE/LER Review Reports, one of the following conclusions will be reached:

1. The event was caused by an equipment failure.
2. There are no implications for the CRDR (no control room operator errors or design deficiencies, including procedures and training, were involved), however, there is a problem. In this case, the proper personnel (e.g., maintenance) will be notified.

3. The cause of the event had been adequately corrected.

4. More information is needed, and the appropriate CRDR activity (e.g., operator interview, survey, or task analysis) will be identified so that the problem can be investigated further.

5. An HED exists.

2.5 Task Report And Documentation

Upon completion of the previous step, the HFC shall prepare a task report describing the methods and findings of the historical document review. The report shall be reviewed by the CRDR Team.

The HFC also shall maintain all other documentation for the task and submit the documentation along with the Task Report.

2.6 Task Report Review And Approval

Final review and approval of the Task Report shall be the responsibility of the Review Team Leader and the General Superintendent, NSEAS.

3.0 COORDINATION REQUIREMENTS

No special coordination is required. The Review Team Leader is responsible for ensuring that the HFC receives copies of the SOEs/LERs in a timely manner and for scheduling Review Team meetings for evaluation and disposition of findings.

ATTACHMENT A

Number IRR - ____________

CRDR DATA SHEET - OPERATING EXPERIENCE REVIEW

SOE/LER REVIEW REPORT*

A. Type of Report and Number: ________________ B. Date: ________________

C. Operating Status: __________________________ D. Result: ______________

E. Event Cause Category: ____

F. Significant Plant Conditions: ______________________________________

G. Discovery Description: ____

H. Items Involved in the Event:

Plant System ____________________ Plant Subsystem ____________________

Component ______________________ Equipment Item or Topic ______________

I. Did a Change Implementation Contribute to the Event? ________________

____

____

J. If Personnel Error Was Involved:

J1. The Error Was: ____

J2. The Error Occurred Because: ____

____

____

L. Corrective Action Cited By Event Report: _____________________________

____

____

M. Reviewer's Comments: ____

____

____

N. Prepared By: _______________________________ O. Date: ________________

P. Review Team Dispositioning and Date: __________________________________

____

____

____

____

Q. Control Room Human Engineering Discrepancy Number HED- ________________

R. Related or Interactive HED(s): _______________________________________

*Refer to Guidelines for information to be provided for Line Items.

CRDR DATA SHEET · OPERATING EXPERIENCE REVIEW
SOE/LER Review Report

Guideline to Line Items of Data Sheet

A. Enter the identification of report reviewed

B. Enter Report Date

C. Enter Operating Status of Plant at time of event, i.e., Mode 1 through 6, prefuel load, etc.

D. Enter one of the following as a result of the event.

1. An event with no consequence

2. An off-normal equipment status without damage

3. An operating limit was exceeded

4. An incident with consequence (i.e., on equipment or personnel, radiation release, etc.)

5. Reduced plant availability (i.e., reactor tripped, unit shutdown, unit derated for ________ hours.)

E. Enter one or more of the following event causes:

1. Equipment Failure

2. Engineering Error

3. Personnel Error. Include job category (i.e., operator, maintenance, I&C Tech.)

4. Other. Include items such as procedures, training, etc.

F. Enter any plant conditions which may be considered significant or unusually abnormal such as more than one component or equipment failure or unusual maintenance conditions.

G. Enter one or more of the following items by which the event was discovered.

1. Annunciators
2. Recorders
3. Indicators
4. Labels, Tags, Control Position
5. Documentation Review
6. Shift Turnover
7. Procedures
8. Consequences of the error such as area contamination

H. Definitive examples of items are given below.

Plant System:	Reactor Coolant, Pressurizer and Pressure Relief, Residual Heat Removal, etc.
Plant Subsystem:	Degasification or Evaporator Subsystem of the Boron Recovery and Primary Makeup System, Station Air, Station Instrument Air, Containment Instrument Air, Extraction Steam, etc.
Component:	Pump, valve, valve operator, etc. (Include Tag Number if known)
Equipment Item:	Control Board Panel Name and Number, Control Board Control or Display Name and Number, etc.
Topic Item:	Control Board Layout, Lighting, maintenance procedures, etc.

I. If a change implementation contributed to the error, identify and give a brief description of the change implemented. Changes include procedural, design, administrative, etc.

J1. The error was:

1. Omission of an action required to perform task.

   This refers to failure to perform a step in a task or an entire task.

   Failure to carry out a surveillance activity within the required time frame should also be included in this category.

2. Transposition between two actions or two components.

   This refers to either a "Wrong act executed on a correct component or equipment" or a "Correct Act carried out on a wrong component or equipment."

3. Performing actions inappropriate to the situation.

   This refers to an action that would be appropriate to another similar situation but is not appropriate to this particular situation.

4. Non-required act in procedure:

   This refers to an extraneous act not related to the task at hand. This includes inadvertent or accidental acts.

5. Failure in communication

   This refers to a task in which the person was required to coordinate with or report information to one or more persons.

J2. The error occurred because: (Inadequate training, poor design, and environmental factors are not treated here)

1. The person making the error received or obtained inadequate information.

   The information available was insufficient, poorly presented, inaccurate, or incorrect and hinders the person from reaching a correct decision in the time available. See also Item 4 below for written procedural deficiencies and Item 5 for directive deficiencies.

2. Misunderstood the information.

   This refers to an event where the information available was adequate and accurate to reach the correct decision but a wrong conclusion was arrived at and inappropriate action was taken. The wrong conclusion could be concerning the status or condition of the plant, system or component on which the person was working, etc.

3. Failure in communicating or reporting of information.

   This refers to someone failing to communicate or improperly communicating necessary information to the person making the error.

4. Procedural deficiency:

   Similar to Item 1 except that the error in performing the task was the result of a procedural deficiency. (i.e., missing step, etc.)

5. Directive deficiency:

   Similar to Item 1 except that the error in performing the task was the result of a deficiency in a directive relating to the task.

6. Made an incorrect decision concerning the appropriate course of action.

   The information available was sufficient, accurate, and correctly interpreted so that the person understood the overall situation or plant status. However, the person took an inappropriate action.

7. Incorrectly carried out decision.

   This means that the person decided to take a correct course of action but then incorrectly carried it out (i.e., inadvertent action).

8. Workload too high

   This pertains to having insufficient time to prepare for, implement or adequately check a task action.

9. Normal reflex

The error was caused by taking customary action that would normally be appropriate but because of some change or difference in the situation it was inappropriate.

10. Self-explanatory

11. Memory lapse or error in remembering

Person knew the required information or the action to take but, for some reason other than decreased attention, forgot the information or action.

12. Decreased attention

Person failed to pay sufficient attention to some aspect of the task.

13. Maintaining an erroneous conclusion (mind-set)

Person retains an erroneous conclusion to a diagnosis in spite of evidence supporting alternative conclusions. This can occur when early facts support the initial conclusion for a period of time.

14. Poor coordination in manipulating controls, objects, etc.

This refers to manual dexterity such as reaching for one control and erroneously manipulating another or turning a switch to a setting other than the intended one.

K. Control Room Problem Description

Provide a brief description of any problems that relate only to the control room or to operating personnel in the control room and are associated with the event.

L. Corrective Action Cited by Event Report

State the corrective actions already taken or to be taken as a result of the event and which are described in the incident report.

M. Reviewer's Comments

This item is provided for comments, pertinent to the incident, such as may come to mind because of the reviewer's personal experience, insights to the problem, relationship to other problems familiar to the reviewer or possible solutions to the problem.

N. Prepared by: Provide reviewer's name.

O. Date: Provide the completion date of the report by reviewer.

P. Review Team Dispositioning

This line item is for documenting any decisions made by consensus of the review team and the date of such decisions regarding the event report.

Q. Control Room HED Number

If it is decided that the event report describes a Human Engineering Discrepancy then a sequential HED Number will be assigned and a HED form will be completed.

R. Related or Interactive HEDs

This line item is for documenting other HEDs discovered during the SOE/LER Report Review which may be related in some way or interact with the HED(s) of this report. Particular attention should be given to HED interaction and the possible cumulative effect which they may have.

APPENDIX B

PROCEDURE, COVER LETTER, BIOGRAPHICAL DATA SHEET, AND ITEMS FOR THE OPERATOR QUESTIONNAIRE

TABLE OF CONTENTS

PROCEDURE, COVER LETTER, BIOGRAPHICAL DATA SHEET, AND ITEMS FOR THE OPERATOR QUESTIONNAIRE

1.0 INTRODUCTION

The operator questionnaire is part of the operating personnel survey which is designed to give firsthand information on actual or potential operational errors. Control room Duty Shift Superintendents, Duty Technical Advisors, Operating Supervisors, and Control Operators shall be requested to complete the questionnaire.

An open-ended, confidential, self-administered questionnaire approach has been adopted. Wisconsin Electric feels that by employing this method, a large number of the operating personnel can be questioned. The survey shall cover the following ten content areas.

- Workspace layout and environment
- Panel design
- Annunciator warning system
- Communications
- Process computers
- Corrective and preventive maintenance
- Procedures
- Staffing and job design
- Training
- Other areas for operator comment

2.0 PROCEDURE

2.1 Questionnaire Construction/Review

Each questionnaire shall consist of a sample of the items listed at the end of this procedure, a cover letter, and a biographical data sheet. The HFC shall review each of the items before inclusion in the questionnaire. Items that do not apply to PBNP or are redundant to other items shall be eliminated. The HFC shall add items or revise items if necessary. The questionnaire shall contain no more than 100 items.

The format of the questionnaire shall be to have one item per page. The item shall be listed at the top of the page--leaving the remainder of the page available for responses. On the right side of each page, the HFC shall include a column(s) in which the respondent may indicate, on a scale of 1 to 5, the need/desireability of eliminating any problem indicated.

Upon completion of a draft questionnaire the HFC shall submit it to the CRDR Team for review and comment. The HFC shall revise the questionnaire and submit 40 copies to the Review Team Leader.

2.2 Questionnaire Distribution

The Review Team Leader shall be responsible for distribution of the questionnaire. Distribution shall be as follows:

Duty Shift Superintendents	6
Operating Supervisors	6
Control Operators/Duty Technical Advisors	12

Prior to distribution, the Review Team Leader shall number each questionnaire. The name of each individual receiving a questionnaire will be listed along with the number of the questionnaire.

The Review Team Leader will be responsible for collecting completed questionnaires and providing them to the HFC.

2.3 Compilation/Analysis of Responses

The HFC shall be responsible for compiling the questionnaire response. The responses shall be compiled by the HFC on a blank questionnaire. Frequency of responses shall be indicated and the indications of need/desireability of changes summarized.

Also the number of respondents who did not respond and the number who indicated there were no problems associated with an item shall be indicated.

The HFC shall review the responses for both units and identify any major differences in reponses.

2.4 Evaluation and disposition by the CRDR Team

The HFC shall present the compilation of questionnaire responses to the other CRDR team members for final evaluation and disposition. The objectives of the CRDR team evaluation and disposition are as follows:

- To verify that the problem(s) identified actually exist and that it is CRDR-related.

- For those where there is a CRDR-related problem or error, to:

    1. Verify that the corrective action has been taken,

    2. Determine if the corrective action poses additional human factors problems and/or increased the potential for human error.

The CRDR team shall review each of the responses with the human factors consultant. The problem and its impliction for operators in the control room will be discussed and evaluated. For each of the problems, one of the following conclusions will be reached:

1. There are no implications for the CRDR (no control room operator errors to design deficiencies, including procedures and training, were involved), however, there is a problem. In this case, the proper personnel (e.g., maintenance) will be notified.

2. The cause of the problem had been adequately corrected.

3. More information is needed, and the appropriate CRDR activity (e.g., operator interview, survey, or task analysis) will be identified so that the problem can be investigated further.

4. An HED exists.

In the event an HED is identified, the HFC shall complete the appropriate documentation.

2.5 Task Report and Other Documentation Preparation

The HFC shall prepare a Task Report describing the methods and findings of the operator questionnaire. The Task Report shall be reviewed by the Review Team.

2.6 Task Report Review and Approval

Final review and approval of the Task Report shall be the responsibility of the Review Team Leader and the General Superintendent, NSEAS.

3.0 COORDINATION REQUIREMENTS

The Review Team Leader shall be responsible for coordinating with PBNP Operations to ensure the required personnel to complete the questionnaire.

The Review Team Leader shall organize and schedule CRDR Team meetings required to support this activity.

PERSONNEL INFORMATION AND BIOGRAPHICAL DATA SHEET

Name: ______________________________

Title: ______________________________

OPERATIONAL EXPERIENCE

Navy Nuclear ________ Years   Fossil Plant ________ Years   Nuclear Plant ________ Years

Prior PBNP Positions: Auxiliary Operator _____   Control Room Operator _____
Operating Supervisor _____   Shift Superintendent _____

EDUCATIONAL BACKGROUND

HS: ______ College: ________ Years   Major: ________   Degree: ________ Y/N

Specialized Training or Technical Schools: ______________________________

QUESTIONNAIRE COVER LETTER

PURPOSE AND IMPORTANCE

The purpose of this questionnaire is to provide operational data to be used for the Control Room Design Review (CRDR) by the CRDR team. Some topics to be addressed in the upcoming CRDR will not be evident to an outsider's examination of the control room. They require direct experience in operating the equipment. The attached questions cover areas in which your experience is essential for an adequate review.

The importance of this questionnaire and the CRDR is that we want to help make the control room a better and safer place for you to work. To do this, your views, experiences, and insights are most critical. Also, we would like to point out that the CRDR is an NRC requirement. Therefore, significant discrepancies that you point out will be addressed and measures taken to improve the control room.

Background

Following the Three Mile Island (TMI) incident, the Nuclear Regulatory Commission issued recommendations to utilities in order to avoid these types of things which collectively caused or contributed to the TMI incident. By recent letter, No. 82-33, Office of Nuclear Reactor Regulation, utilities received further directives on the performance of a CRDR. 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." One element of the CRDR is the use of Human Engineering principles to evaluate human factors in the control room, i.e., the man-machine interface. Therefore, the control room will be evaluated for lighting, noise, control characteristics, instruments, displays, procedures, systems and other items that could impact on operator performance.

Description and Instructions

The questionnaire is open ended and self administered. The questions cover basic topics from workspace layout to training. They are designed to solicit most of your answers and comments. However, space is provided for any additional comments that you may have. Feel free to use it for pertinent information to this effort.

Please be as specific as possible in answering the questions by listing particular components, types of components, systems or panels, operating status, sequence of events or whatever information might be applicable to a particular question. No answers should be left as a simple "yes" or "no" but should include as much pertinent detail as you ca provide. Qualify your answers whenever they need be.

Read over the complete questionnaire before you start answering the questions. This will give you a better idea as to where certain answers fit since some of the questions may seem identical at first glance. Doing this will also help to control the specific content of a question-answer pair and to maintain the question groupings. It is suggested that the questions be completed in the control room.

Please return your completed questionnaire in the envelope provided within three (3) weeks of the issuance date given at the top of the cover letter. Fill in your name, date of completion and biographical information on the Personnel Information and Biographical Data Sheet (PIBD), only.

Confidentiality

Confidentiality will be maintained for you and the information you supply. This will be accomplished in the following way. Upon receipt of an envelope containing a completed questionnaire, a code number will be assigned to the PIBD sheet and the questionnaire. The PIBD sheet and the questionnaire will then be separated. If additional information or clarification of a particular response is required by the review team, the code number will be used to trace back to individual respondents. A follow-up interview may be required. Code numbers will be used only for this purpose and only by the review team. We will not identify the writer of any responses without your consent.

After the questionnaires have been completed, received and logged in, they will be examined and reviewed on an item for item basis. Responses will then be summarized on a Questionnaire Item Summary Form.

If you have any questions about the questionnaire, please feel free to contact Dennis Blakely at (414) 277-3965.

Thank you for your consideration and help.

OPERATOR QUESTIONNAIRE ITEMS

Workspace and Environment

OQ-1 What equipment or equipment arrangement has hindered your movement about the control room in the course of normal or emergency operations?

OQ-2 What peripheral console/cabinet arrangements are ineffective and/or obstruct your movement about the control room?

OQ-3 Does your specific work location station provide adequate access to storage or desk facilities?

OQ-4 Are you required to leave the primary control boards for instruments/displays in other areas? (How often, how long?)

OQ-5 What do you dislike about the arrangement of restrooms, kitchen, place to eat and break area?

OQ-6 Is the furniture arrangement adequate and/or convenient for your use?

OQ-7 How adequate is the control room lighting and illumination control?

OQ-8 Do you have problems with glare and/or reflections in the control room?

OQ-9 Were there incidents where lighting has been ineffective and/or interfered with job performance?

OQ-10 What specific times is the noise level in the control room at an unreasonable level and the cause of annoying distractions?

OQ-11 What problems do you have with the heating/air conditioning system, humidity, and ventilation system in the control room?

OQ-12 Has static electricity caused you any particular problems in the control room?

OQ-13 Do you have any problems controlling the number of people in the control room during normal or emergency operations?

OQ-14 Are there any operations in the control room where the actions of another operator interfere with your tasks?

OQ-15 What problems do you have in reaching any of the controls on the control board?

OQ-16 What important controls or displays are not easily visible to you?

OQ-17 Is the overall layout and shape of the control board/console adequate for effective monitoring and operations?

OQ-18 Which major systems are not organized properly around the control boards for both normal and emergency operation?

OQ-19 Have there been incidents where you had to be in two places at once because of board layout to control and monitor a specific plant evolution?

OQ-20 Describe features about the control board layout which have assisted you in job performance, i.e., color codes, etc.

Panel Design

OQ-21 What do you consider to be the three easiest systems to operate? Include system/panel location, why you feel they are easiest to use and any inadvertent activation of these systems.

OQ-22 What do you consider to be the three most confusing or difficult systems to operate and why? Give examples of incidents in which there was difficulty in operating the systems.

OQ-23 What systems do you operate that give you problems with a particular panel arrangement? Describe what you think is wrong with the arrangement.

OQ-24 Which controls and indications are difficult for you to recognize as a related group?

OQ-25 Which types of modifications (mimics, color codes, etc.) to the boards would you consider the most useful to you?

OQ-26 Which types of modifications to the boards have created a hindrance for you?

OQ-27 What controls and displays of particular systems are too far away from each other for proper operation?

OQ-28 Are there any controls that are difficult to adjust as precisely as they need to be adjusted?

OQ-29 Are there any switches that are operated differently but physically are identical to other switches?

OQ-30 Are there switches that are difficult to turn?

OQ-31 Which controls do you find too large or too small to operate easily?

OQ-32 Are there meters that are scaled in different units than the procedures you have to use with them? For example, do you have to use nomographs or conversion factors other than powers of 10?

OQ-32a Are there instrument indicators that are pegged low or high during normal operation making it impossible to monitor the steady state performance of a process?

OQ-33 Are there controls and displays that work together in unusual ways (i.e., containment temperature affecting seal leak off indication)?

OQ-34 Are there instruments that are difficult to compare with backups because of differences in scale units, elevated zeros, etc.?

OQ-35 Are there instruments that are hard to use because they have to be read more precisely than the scale allows?

OQ-36 Do you have any difficulties with lamp replacement such as shock, accidental activation, or need to replace from behind panel?

OQ-37 Are there important instruments on back panels that do not have either an alarm you can hear in the control room or their own annunciator?

OQ-38 Are there labels (on controls or displays) that are unclear about what is actually being controlled or displayed, what the control does, what position a control is in, or which could cause a mistaken identity with another control?

OQ-39 Are there key switches where the key can be removed when the switch is not in its "Off" or "Safe" position?

OQ-40 Has there been any interference to instrumentation by radio or walkie-talkie signals?

OQ-41 Are there any control devices which you find confusing or difficult to operate?

OQ-42 When operating controls, do you use any of the existing coding and how important is it to you as an operating aid, i.e., color, sound, shape, location, etc.? What coding schemes are most useful to you? What types of color coding would you like to see on controls or indicators (i.e., power supply coding on instruments)?

OQ-43 Are there any occurrences where the wrong control has been activated or where a control was activated inadvertently or incorrectly? Do you know what caused this to happen and how and when the error was discovered?

OQ-44 Are there controls where it is not always apparent as to what position they are turned to (i.e., pointer indicators are not obvious because of poor contrast due to design, location, level or glare)?

OQ-45 Are there emergency or other critical controls which are neither coded nor guarded (e.g., turbine trip push buttons, rod control startup push button)?

OQ-46 Are there controllers with inconsistent relationship between control effects and indicator (e.g., open is indicated by 0% and close by 100%)?

OQ-47 Are there multiple-position controls or speed changer controls which do not follow conventional use for right-center-left positions or clockwise movement (i.e., diesel generator ground switch deviates from normal convention)?

OQ-48 Are there positive means to determine indicator light failure?

OQ-49 Are display scales adequately marked for normal operating ranges or setpoints?

OQ-50 Is it always apparent to the operator when a vital indicator fails or becomes inoperative?

OQ-50a Are there recorders that cannot be viewed from several locations on the board where equipment is routinely controlled that heavily influence changes to the recorded parameters (i.e., pressurizer level, pressure, and T Recorders, etc.)?

OQ-50b Do you have significant operational problems with chart recorders?

Annunciator Warning System

OQ-51 Are nuisance alarms a significant problem? Please describe.

OQ-52 Do you get particular recurring invalid alarms? Please describe.

OQ-53 What alarms are insignificant from an operational point of view?

OQ-54 What significant problems has the existing annunciator system design caused you?

OQ-55 Are there any problems with identifying new alarms when they come in?

OQ-56 Are there features of the annunciator warning system that have resulted in inefficient or erroneous fault identification?

OQ-57 Does the annunciator system provide an adequate amount of information to you during a major transient?

OQ-58 Are visual and auditory alarms satisfactory?

OQ-59 Are auditory signals annoying? Can you easily differentiate between different auditory signals?

OQ-60 Are any important annunciators missing or located where they should not be?

OQ-61 Do you have problems reading or identifying annunciators while you are conducting normal or emergency operations?

Procedures

OQ-62 Do you have any problems finding or retrieving procedures that you need during emergency situations?

OQ-63 Are there adequate props for using procedures while you operate? What would be useful to you in this respect?

OQ-64 Are procedures maintained in good physical condition (e.g., are pages properly and securely inserted, are updates and changes handled properly, etc.)?

OQ-65 Do you feel there are too many procedures that operators are required to memorize? How does it affect operator performance during emergency operations?

OQ-66 What plant procedures (i.e., startup, shutdown) have insufficient detail or are not clearly written to the point that errors could be introduced?

Communications

OQ-67 Are there nuisance problems with unauthorized communications to the control room?

OQ-68 What problems do you have with the page phones, loudspeakers, and radios? Consider equipment condition, availability of the system to the operator and outside interference (noise level, people, etc.).

OQ-69 Are there situations where the lack of proper communications caused operational problems?

OQ-70 What characteristics of the control room communications systems do you find most ineffective in providing you timely, intelligible contact with other personnel?

Process Center

OQ-71 Does the process computer provide inaccurate data at any time? Consider operating conditions, important system parameters, etc.

OQ-72 Is the process computer data timely? Are there emergency situations in which you would be reluctant or hesitant to use the computer for information because of its response time?

OQ-73 Is there data on the computer which you do not find useful?

OQ-74 What computer program do you feel could be better utilized or eliminated?

OQ-75 Is there data on the computer which you find difficult to use? Consider format of printout, type of parameter trending, etc.

Staffing

OQ-76 Are there incidents in which the number of personnel on duty impeded your prompt response to an operational situation?

OQ-77 Are there incidents where workload requirements restricted your response to any operational situation?

OQ-77a Is the control room adequately staffed during normal, abnormal, and emergency periods and during all shifts?

OQ-78 Are job responsibilities clearly defined such that a response to a transient or an emergency situation proceeds smoothly?

OQ-79 List the three most desirable characteristics of the staffing program and job assignments which provide for smooth, continuous, system operation.

OQ-80 Do your procedures provide adequate coverage for turning over a shift to incoming personnel? Consider the amount of time allowed for shift turnover, information exchange, etc.

OQ-81 Are there incidents where your efficiency was significantly degraded because of shift work or overtime?

OQ-82 Are your duties explained to you such that you clearly understand what they are?

OQ-83 Are there other problems with staffing and/or job design on which you would like to comment?

Corrective and Preventive Maintenance

OQ-84 Are there incidents where an operator surveillance test caused an operational problem? Consider the cause, operational status, effect on operation and/or the operator, corrective action, etc.

OQ-85 Are there incidents where maintenance actions affected the safe operation of the plant? Consider the cause, operational status, effect on operation and/or the operator, corrective action, etc.

OQ-86 Are there control room preventive maintenance procedures and/or characteristics which are ineffective?

OQ-87 What is the most effective characteristic of the maintenance program?

OQ-88 What maintenance or surveillance test procedures would you like to see changed because of their negative impact on operations?

Training

OQ-89 Are there plant control, protection, electrical, or mechanical systems on which you would like more intensive training and in what respect (simulator, class, discussion, lecture)?

OQ-90 Has your training provided you with the confidence that you could perform successfully during an emergency situation? Are there situations about which you feel inadequately prepared?

OQ-91 What characteristics of your classroom training have been most effective in preparing you for control room operation?

OQ-92 Is the use of protective gear and equipment included in your training program?

OQ-93 Are you adequately trained in using the process computer to full advantage?

OQ-94 What characteristics of your requalification training or practice sessions have been most effective in preparing you for control room operations?

OQ-95 What aspects of your training do you feel were especially ineffective or need improvement?

OQ-96 What characteristics of simulator training have you found and/or do you think will be most effective in preparing you for control room operations?

Simulator Training

OQ-97 What aspects of simulator training do you feel should be eliminated or modified?

OQ-98 Are there specific operations on which more emphasis should be placed during simulator training?

OQ-99 What amount of time do you feel would be adequate for simulator training?

OQ-100 What situations, transients, etc. which have or could arise would you like to see run on the simulator?

Use the space below for additional comments on any of the topics covered herein or others that you may consider pertinent to this effort.

APPENDIX C

PROCEDURE FOR DEVELOPING AND CONDUCTING STRUCTURED INTERVIEWS

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of the structured interviews is to clarify issues or potential problem areas that may have been identified in (1) the operator questionnaire or (2) the historical document review. If there is no need for the interviews, they will not be conducted.

The structured interview items shall specifically address problem areas previously defined. The operators shall be interviewed by the HFC. No company personnel, other than the operators, shall be present during the interviews. This should ensure an objective approach toward the interviews and establish a situation where the interviewee should feel at liberty to comprehensively discuss the issues.

The HFC interviewer shall have experience in conducting structured interviews for CRDRs. The interviewer also shall be knowledgeable of the prior PBNP CRDR activities so that sufficient detail can be obtained during the interviews.

2.0 PROCEDURES

2.1 Interview Development

The HFC shall be responsible for developing the structured interview. The interview shall address each item identified in the operator questionnaire and the historical document review as needing clarification or additional information. The HFC shall structure an initial interview question and outline subsequent points to be probed in greater detail. After completion of the initial interview, the HFC shall submit the interview protocol to the other CRDR Team members for review and comment.

The interview shall be designed to require a maximum of two hours of time from any one interviewee.

2.2 Interview Implementation

The HFC shall conduct the interviews. Specific points to be clarified that resulted from the operator questionnaire will be followed up with specific individuals.

In general, the HFC shall conduct 12 interviews which should ensure comprehensive responses to each item. The interviews shall be conducted in an area where there is direct access to the mockup or the control room.

2.3 Compilation/Analysis of Responses

The HFC shall be responsible for compiling and analyzing the interviewee responses. Responses shall be compiled by item, and a summary of the responses prepared. The summary shall provide a description of the content and frequency of responses, a synopsis of the clarification/resolution of problems discussed, conclusions drawn by the HFC, and a listing of any new problem areas identified.

2.4 Evaluation and Disposition by CRDR Team

The HFC shall present the summary of interview responses to other CRDR team members for final evaluation and disposition. The objective of the CRDR team evaluation and disposition is as follows:

- o To ensure that adequate information has been obtained and all unresolved issues have been addressed.
- o To verify that any new problem(s) identified actually exist and that it is CRDR-related.
- o For those new problems where there is a CRDR-related problem or discrepancy, to identify if corrective actions have been planned and to:
  1. Verify that the corrective action has been completed, and
  2. Determine if the corrective action poses additional human factors problems and/or increased the potential for human error.

The CRDR team shall review each of the interview summaries with the human factors consultant. Any problems and their implication for operators in the control room will be discussed and evaluated. For each of the problems, one of the following conclusions will be reached:

1. There are no implications for the CRDR (no control room operator errors attributable to design deficiencies, including procedures and training, were involved), however, there is a problem. In this case, the proper personnel (e.g., maintenance) will be notified.

2. There is no problem.

3. The cause of the problem had been adequately corrected.

4. An HED exists.

In the event an HED is identified, the HFC shall complete the appropriate documentation.

2.5 Task Report and Other Documentation Preparation

The HFC shall prepare a Task Report describing the methods and findings of the operator interviews. The Task Report shall be reviewed by the Review Team.

The HFC shall organize, file and submit all interview notes, completed interview forms, HEDs, etc. to the Review Team Leader.

2.6 Task Report Review and Approval

Final review and approval of the Task Report shall be the responsibility of the Review Team Leader and the General Superintendent, NSEAS.

3.0 COORDINATION REQUIREMENTS

The Review Team Leader shall be responsible for (1) coordinating with PBNP Operations to schedule operators for the interviews, (2) arranging for space with access to the control room or the mockup for conducting the interviews, and (3) arrange for escorts, visitor badges, etc. for HFC personnel, as required.

The Review Team Leader shall organize and schedule CRDR Team meetings required to review the interview protocol and evaluate/disposition responses.

APPENDIX D

PROCEDURE, CHECKLISTS, AND SURVEYS FOR CONDUCTING THE CONTROL ROOM SURVEY

TABLE OF CONTENTS

1.0 INTRODUCTION

This appendix contains the procedures and itemized checklists and surveys to be implemented as the PBNP control room survey. Checklists and surveys include the following:

CHECKLISTS:

Tab 1	Overview
Tab 2	Operator-Assisted
Tab 3	Labelling, Mimics, and Demarcation
Tab 4	General Panel
Tab 5	Control Room Computer

SURVEYS:

Tab 6	Control Room Computer
Tab 7	Design Convention
Tab 8	Lighting
Tab 9	Noise
Tab 10	Anthropometric
Tab 11	Annunciator
Tab 12	Communication
Tab 13	Color-Coding

These checklists and surveys have been developed following the guidelines of the NUTAC on CRDR and NUREG-0700.

Implementation of the checklists and surveys shall involve the HFC and the CRDR Team members. The survey is to be conducted on both the full-scale mockup and in the PBNP control room, as appropriate, and in a manner that will minimize distractions to operators yet ensure a complete and effective survey.

2.0 PROCEDURES

2.1 HFC Review of Checklists and Surveys

The HFC shall review the checklists and surveys contained in this appendix to ensure that (1) all items are measurable, (2) no significant NUREG-0700, Section 6.0 evaluation criteria have been omitted, and (3) to eliminate any redundant or nonessential items. The HFC shall present the results of the review to the CRDR Team.

2.2 Preparation of Survey Material

The HFC shall be responsible for assembling the final checklists and surveys. Ten copies of the checklists and surveys will be prepared and submitted to the Review Team Leader.

The HFC also shall be responsible for providing all equipment required to implement the checklists and surveys, including lighting and noise measurement equipment.

As a final preparatory task the HFC shall identify which parts or items comprising the the survey can be implemented using the full-scale mockup and which parts must be completed in the PBNP control room.

2.3 CRDR Team Training

The HFC shall provide two personnel experienced in CRDR surveys to implement the PBNP survey. The HFC shall be assisted by other CRDR team members in conducting the survey. The HFC shall instruct to the other CRDR Team Members in the purposes, techniques, and documentation associated with the checklists and surveys. The instruction shall be conducted using the mockup.

2.4 Implementation

The HFC shall be responsible for completing all checklists and surveys. It is anticipated that two HFC personnel will be required. These personnel shall be assisted by the CRDR Team.

Each item in the checklists and surveys shall be checked, and all discrepancies completely documented.

2.5 Compilation of Results

After the completion of the control room survey, the HFC shall be responsible for compiling the HEDs identified and other information obtained. HED information, including criteria violated, a description of the HED, associated system, and location on the boards, shall be maintained in an automated data base management system (DBMS) so that HEDs may be readily sorted by criteria violated, panel, system, or by any other characteristic as required by the CRDR Team.

2.6 CRDR Team Review

The HED files and other relevant information obtained through the implementation of the checklists and surveys shall be reviewed by the CRDR team. The purpose of the review will be to ensure that the summary data (1) is in a complete form and no additional information is required to describe the HED or other findings, and (2) accurately presents the checklists and survey findings. The HFC shall be responsible for incorporating any changes or obtaining any additional information that is required.

2.7 Task Report and Other Documentation

The HFC shall prepare a Task Report describing the methods and findings of the control room survey. The Task Report shall be reviewed by the Review Team.

The HFC shall be responsible for organizing, filing, and submitting all other documentation to the Review Team Leader.

2.8 Task Report Review and Approval

Final review and approval of the Task Report shall be the responsibility of the Review Team Leader and the General Superintendent, NSEAS.

3.0 COORDINATION REQUIREMENTS

The Review Team Leader shall be responsible for coordinating with PBNP Operations for conducting those parts of the checklists and surveys required to be implemented in the control room.

The Review Team Leader shall organize and schedule CRDR Team meetings and participation in the control room survey.

OVERVIEW CHECKLIST

ITEM	N/A	YES	NO
OC-1: Sanitary facilities and drinking water are easily accessible.			
OC-2: The snift supervisor's (SS) office is near the control room or a dedicated communications link is provided is SS location interferes with voice contact.			
OC-3: The visual and physical path from the operator's desk to the control board is unobstructed. Possible obstructions include the following: o Tripping hazards o Poorly positioned filing cabinets and storage racks o Maintenance equipment			
OC-4: Sufficient storage space exists for the crew's personal belongings.			
OC-5: Cords are positioned in a way that avoids entangling critical controls or endangering passing traffic.			
OC-6: There are status displays for shared equipment in each control room (for multiple plants only).			
OC-7: There are no broken, chipped, or crumbled control surfaces.			

COMPLETED BY: ______________________ DATE ______________

OPERATOR-ASSISTED CHECKLIST

ITEM	N/A	YES	NO
A. Administrative Procedures and Practices			
List procedure numbers for the following procedures controlling both temporary and permanent changes (such as labeling) to control board:			
OAC-1: Method of label application.			
OAC-2: Language (acronyms and abbreviations).			
OAC-3: Typestyle or font.			
OAC-4: Color.			
OAC-5: Periodic review.			
OAC-6: Incorporation in procedures if made permanent.			
List procedure numbers for the following:			
OAC-7: Procedure for out-of-service annunciator tiles.			
OAC-8: Procedure for identifying annunciator tiles lit for an extended period during normal operations.			
OAC-9: Procedure controlling loudness adjustment for annunciator system (if adjustable).			

COMPLETED BY: ______________________ DATE ______________

OPERATOR-ASSISTED CHECKLIST

ITEM	N/A	YES	NO
OAC-10: Procedure(s) controlling annunciator window and legend light/switch removal to ensure replacement in correct location (N/A if hinged or keyed).			
OAC-11: Procedures for control room emergencies involving fire or containment.			
OAC-12: Instructions for use of personnel protective equipment.			
OAC-13: Procedure controlling the use of equipment shared between two or more units (N/A single unit).			
OAC-14: Procedure calling for the periodic cleaning of labels.			
OAC-15: Procedure that ensures infrequently activated auditory alarms are tested periodically.			
OAC-16: Access by nonessential personnel is not a problem; operators have authority to limit access.			
B. Relevant Documents			
List procedure numbers and frequency of periodic inspection/checks for each of the following:			
OAC-17: Annunciator test.			
OAC-18: Control room fire-fighting equipment.			

COMPLETED BY: ____________________ DATE ____________________

OPERATOR-ASSISTED CHECKLIST

ITEM	N/A	YES	NO
OAC-19: Portable radiation monitoring equipment.			
OAC-20: Control room personnel protective equipment.			
OAC-21: Control room communication equipment.			
OAC-22: Periodic chart marking (once/shift and speed change).			
C. Storage/Spare Parts			
The following are true for storage of spare parts:			
OAC-23: Expendables and spare parts are readily accessible and should include items such as fuses, bulbs, ink, inking pens, recorder charts, printer paper, batteries (i.e., if walkie-talkies used), special tools (as needed to install parts), and items for emergency equipment, such as filters.			
OAC-24: Spare parts are identified clearly and distinctively, and an inventory system maintains an adequate supply of spare parts described in OAC-23.			
OAC-25: Sufficient storage space exists for expendables and spare parts.			
OAC-26: A well-marked, accessible place should be provided for headset storage.			

COMPLETED BY: ____________________ DATE ____________

OPERATOR-ASSISTED CHECKLIST

ITEM	N/A	YES	NO
D. Protective Equipment			
The following should exist for protective equipment:			
OAC-27: Accessible storage in or near the control room.			
OAC-28: A supply adequate to outfit the shift crew, including breathing apparatus.			
OAC-29: Face masks have speech diaphragm or microphone.			
E. Emergency Equipment			
Accessible storage in or near the control room is available for the following:			
OAC-30: Fire-fighting equipment			
OAC-31: Portable radiation monitoring equipment.			
OAC-32: An automatic system warns operators of control room fires.			
F. Organization of Procedures			
OAC-33: Operating procedures and reference documents are readily accessible, stored separately for each unit, and are separate from other documents.			

COMPLETED BY: ____________________ DATE ____________________

OPERATOR-ASSISTED CHECKLIST

ITEM	N/A	YES	NO
OAC-34: Documents are protected from wear so they do not become dog-eared, dirty, loose, torn, or difficult to read.			
OAC-35: Annunciator response procedures are indexed by panel identification and window position.			
OAC-36: Documents are not fixed in racks and are bound so they can be opened fully and remain opened at the desired place without holding.			
OAC-37: Clearly visible title labels identify specific documents.			
OAC-38: Documents should be labeled clearly so they are easily distinguished from one another.			
OAC-39: Instructions for use of personnel protective equipment are available, and operators have received training and are practiced in their use.			
OAC-40: Training is given on the use of each communication system, including familiarity with suggested alternatives if a system becomes inoperable.			
OAC-41: Procedures are established for handling communications during an emergency, and these procedures must be known by all operators.			
OAC-42: Operators are trained in the use of emergency equipment.			

COMPLETED BY: ____________________ DATE ____________________

LABELING, MIMICS, AND DEMARCATION CHECKLIST

ITEM	N/A	YES	NO
A. Labeling			
LMD-1: Labels are consistent in type style. Letters appearing on control boards are all uppercase, simple, without prominent serifs or slants, have separations between letters, words, and lines approximating samples and have type styles somewhere between these samples.			
NOT THINNER THAN THIS (Stroke width to character height = 1:8 letter width to height = 3:5			
NOT THICKER THAN THIS (Stroke width to character height = 1:6 letter width to height = 1:1			
Style for numbers is similar to 1 2 3 4 5 6 7 8 9 0			

COMPLETED BY: __________ DATE __________

LABELING, MIMICS, AND DEMARCATION CHECKLIST

ITEM	N/A	YES	NO
LMD-2: Labels are hierarchically coded by size for panels, systems/subsystems, functional groupings/mimics, components, and position indiction and do not repeat information contained at higher levels (an exception is component identification numbers). Alphanumeric characters are of the following minimum heights:			

	Maximum Viewing Distance	Minimum Height
Position indications	36"	5/32"
Component labels	50"	7/32"
Annunciator windows (locally acknowledged)	57"	1/4"
Labels for functional groupings small mimics and subsystems (if present)	72"	5/16"
Labels for panels, systems, large mimics, annunciator windows (globally acknowledged)	115"	1/2"

ITEM	N/A	YES	NO
LMD-3: Labels are consistently positioned either above (preferred to avoid visual obstruction when operting control) or below devices they describe and are readily associated with corresponding controls and displays.			
LMD-4: Roman numerals are not used.			

COMPLETED BY: ______________________ DATE ______________

LABELING, MIMICS, AND DEMARCATION CHECKLIST

ITEM	N/A	YES	NO
LMD-5: Labels in close proximity cannot be confused easily due to highly similar words, abbreviations, or acronyms (example: Effluent/Influent).			
LMD-6: Panel access openings used by control room operators are labeled to identify, by function, the items accessible through them.			
LMD-7: Labels, legend plates, and escutcheons are used to identify each component's function.			
LMD-8: Labels are succinctly and accurately worded with respect to function or input signal.			
LMD-9: Labels are horizontally oriented to read from left to right.			
LMD-10: Adjacent labels are sufficiently separated so they are not read as one continuous label.			
LMD-11: Displays, indicator lights, and labels are free from visual obstruction by hand or arm when the switch is operated or from obstruction by other controls and displays.			

COMPLETED BY: ________________ DATE ____________

LABELING, MIMICS, AND DEMARCATION CHECKLIST

ITEM	N/A	YES	NO
LMD-12: Control board tags to identify out-of-service equipment are affixed securely to the associated component and do not obscure labels or adjacent components.			
LMD-13: Labels are sturdy and mounted securely.			
LMD-14: Labels have dark characters on a light background.			
LMD-15: Each control position is marked clearly, as is direction for increase.			
LMD-16: When meaning is not obvious, light indicators and other displays are labeled clearly.			
B. MIMICS			
LMD-17: Mimic lines are marked clearly with arrows to show direction of "flow." NA If no flow directions (e.g., electrical mimics)			
LMD-18: Mimic lines are identified with starting and end points. NA If no starting/end points (e.g. electrical mimics)			

COMPLETED BY: ______________________ DATE ______________

LABELING, MIMICS, AND DEMARCATION CHECKLIST

ITEM	N/A	YES	NO
LMD-19: Component representations on mimic lines are identified.			
LMD-20: No more than four mimic lines of the same color should run parallel in close proximity.			
LMD-21: Mimics are consistent in the application of symbols for pumps, valves, and other process elements.			
LMD-22: Mimic lines depicting flow of the same fluid should have the same easily discriminable color throughout the control room.			
LMD-23: Mimic lines do not overlap.			
C. DEMARCATION			
LMD-24: Lines or color patches used for demarcation are visually distinctive, permanent, and well-maintained.			
LMD-25: Strings of six or more components or on matrices of greater than 4 X 4 similar components are demarcated in functional groups or are mimicked.			

COMPLETED BY: ______________________ DATE ________________

LABELING, MIMICS, AND DEMARCATION CHECKLIST

ITEM	N/A	YES	NO
LMD-26: Repetitive groupings such as separate trains are identically demarcated.			
LMD-27: If display(s) are not mounted above or to the left of their control(s), the grouping is demarcated.			

COMPLETED BY: ____________________ DATE ____________________

GENERAL PANEL CHECKLIST

ITEM	N/A	YES	..O
A. General			
G-1: Controls and displays (indicating lights, meters, recorders, indicators, annunciators) generally are grouped by system and function, with identical layout for repetitive groups.			
G-2: Components of similar function are consistently ordered, preferably from left to right or top to bottom. Correct: A-B-C; 1, 2, 3 Incorrect: B-C-A; 2, 3, 1			
G-3: Control surfaces promote ease of use. Knurls or serrations are used for knobs, rocker, and slide switches and indentations or slip resistant surface for pushbuttons.			
G-4: Rocker and toggle switches are oriented consistently either vertically (preferred) or horizontalyy.			
G-5: Toggle switch and rocker switch displacements are between those shown in Figure G-1.			

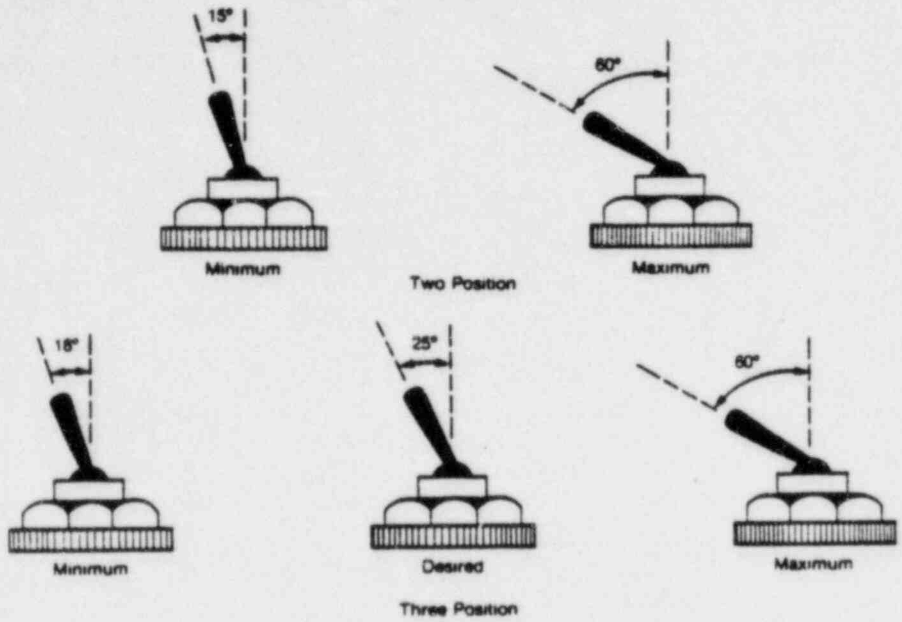
COMPLETED BY: ______________________ DATE ________________

GENERAL PANEL CHECKLIST

ITEM	N/A	YES	NO

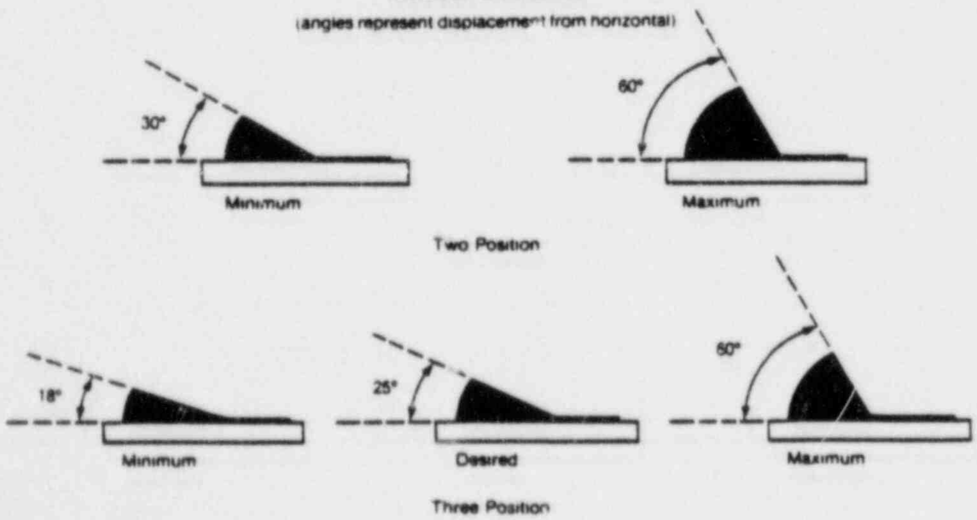
Toggle Switches

(angles represent displacement from vertical)



Rocker Switches

(angles represent displacement from horizontal)



COMPLETED BY: ______________________ DATE ______________

GENERAL PANEL CHECKLIST

ITEM	N/A	YES	NO
G-6: Handles or knobs are shaped or marked clearly to indicate position, without obstruction of legends or confusion of direction.			
G-7: Glare does not interfere with reading meters when they are viewed from operator's station at control panel.			
G-8: There are no uncovered openings in panels.			
B. Meters			
1. <u>General</u>			
G-9: Parallax does not interfere with reading meters when they are viewed from the operator's station at the control panel.			
G-10: Moving scale indicators are not used.			
G-11: In groups of similar displays, meters are aligned to promote visual comparision and provided with identical scales to facilitate comparative reading.			
G-12: Meter scales are in commonly used engineering units and are in the same units as the associated controller if one exists.			
G-13: Scales should normally have black markings on a white background or provide good contrast.			

COMPLETED BY: ______________________ DATE ______________

GENERAL PANEL CHECKLIST

ITEM	N/A	YES	NO
2. Conformation			
G-14: Circular scales are symmetrical about their vertical axis, with the break centered at the 6 o'clock position, unless they are multi-revolution type.			
G-15: If circular meters have multi-revolution or both positive and negative values, zero is located in the 12 o'clock position.			
G-16: Meters are designed so the pointers do not obscure graduation marks or numerals.			
G-17: No more than 1/16" separation exists between pointer tip and scale.			
G-18: Sufficient visual contrast exists among scale graduations, process units, numerals, background, and pointer.			
G-19: Meter scales contain a maximum of nine intermediate graduations between numbered markings. Intermediate and minor graduations are shown if there are five or more graduations between numerals.			
G-20: Meters are scaled with subdivisions in decimal multiples of 1, 2, or 5.			
G-21: Scales are marked with numerals oriented in an upright position, circular as well as linear.			

COMPLETED BY: ______________________ DATE ______________

GENERAL PANEL CHECKLIST

ITEM	N/A	YES	NO
3. Operation			
G-22: Control/display operation conforms to control room design conventions (see Design Convention Survey).			
G-23: Scales are marked to show normal and abnormal, safe and unsafe, or expected and unexpected ranges of operation, where applicable (pressures, flows, levels, etc.). These markings do not interfere with reading of meter.			
G-24: Meters have not been rescaled using temporary means (e.g., embossed tape).			
G-25: Multirange meters are marked or color-coded to differentiate among range scales.			
C. Indicator Lights Not Included In Design Convention Survey			
G-26: Sets of displays are in alignment to facilitate comparison between related system elements.			
G-27: Color of indicator lights is clearly identifiable (good contrast with background).			

COMPLETED BY: ____________________ DATE ____________________

ITEM	N/A	YES	NO
D. Legend Lights/Switches			
G-28: Legends for annunciators and status lights and legend pushbuttons have engraved dark lettering on a light backing, are readable under ambient lighting, and contain no more than three lines.			
G-29: To prevent accidental activation, barriers are present when legend pushbuttons are contiguous.			
G-30: Barriers have rounded edges to prevent injury.			
G-31: Legend switches are easily discriminable from status lights.			
G-32: Printed chart recorder values are read easily.			
G-33: Current data is readable through the window.			
G-34: Printed value corresponds to scale value (i.e., proper chart paper is being used).			
G-35: On multiple pen recorders, parameters are listed in the same order as their pens. Each pen prints with a different color ink.			
G-36: If the chart recorder has switchable channels, a procedure or standard operating practice exists for marking channels, and use of different channels does not cause confusion because of different scale requirements.			

COMPLETED BY: ______________________ DATE ________________

GENERAL PANEL CHECKLIST

ITEM	N/A	YES	NO
G-37: Single-point select capability is available on multipoint recorders.			
F. Counters			
G-38: Mechanical counters use black numbers on a white background and have a matte or flat finish or have adequate character to background contrast; electronic counters ("Nixie" tubes, light-emitting diodes, etc.) use alphanumerics that are easily read and have adequate character-to-background contrast.			
G-39: To maximize viewing angle and minimize shadows, mechanical counters are mounted so the display is not recessed.			
G-40: Mechanical counters and electronic counters should be oriented so they can be read horizontally from left to right.			
G. Emergency Controls			
G-41: Switches for emergency or abnormal use (such as turbine trip, scram, emergency trip, etc.) are clearly marked.			
G-42: Emergency controls and other important controls are protected from inadvertent operation.			
G-43: Emergency controls are readily accessible.			

COMPLETED BY: ______________________ DATE ______________

GENERAL PANEL CHECKLIST

ITEM	N/A	YES	NO
G-44: The purpose of key switches is not defeated by having keys in their locks.			
G-45: Key switches are "off" or "safe" in the vertical position. They are nearly horizontal when operated (judge by position labels).			
G-46: For display types that have indirect indication and any controls without associated indicator lights, readable backup displays are within view (example: a meter for pumps).			
G-47: Color use conforms to the attachment from color-coding survey.			
G-48: Abbreviation/acronym use is standard.			

COMPLETED BY: ______________________ DATE ______________

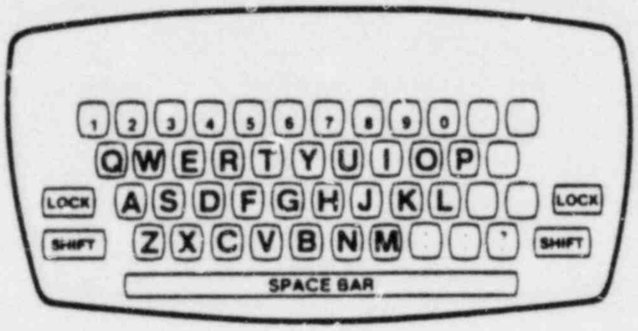
CONTROL ROOM COMPUTER CHECKLIST

ITEM	N/A	YES	NO
Indicate how the following items apply to the computer(s) listed below by placing the corresponding number(s) in the columns at right.			
1. 2. 3. 4. 5. 6. 7. 8.			
CRCC-1: The system has protection provisions to ensure that only authorized personnel can make changes in setpoints, constants, or system software.			
CRCC-2: A record of changes to setpoints, constants, and software affecting the operator is provided.			
CRCC-3: There is a procedure(s) in the control room with instructions suitable for the control room operator to operate the computer.			
CRCC-4: A listing of computer data points, cross-indexed by alphanumeric code, system/subsystem, and functional group, is provided in the control room.			
CRCC-5: Keyboards contain only those keys used by operators.			

COMPLETED BY: ______________________ DATE ________________

ITEM	N/A	YES	NO
CRCC-6: Alphanumeric keyboards have QWERTY arrangement; number pads have telephone or calculator arrangement (see Figure CRCC-1).			

QWERTY Keyboard Arrangement



Numeric Keyboard Arrangement

COMPLETED BY: ______________________ DATE ______________________

ITEM	N/A	YES	NO
CRCC-7: If function keys are used, they have the following characteristics: a. grouped together b. labeled consistent with the nomenclature for the computer function they perform c. laid out identically at all locations			
CRCC-8: Key size, resistance, and displacement allow easy keying in of commands, while minimizing inadvertent activation of keys and providing positive key movement feedback.			
CRCC-9: Computer controls are operable from locations where the operator needs to interact with the computer.			
CRCC-10: Computer controls provide both rapid and accurate positioning of cursors or selection of choices.			
CRCC-11: Abbreviations are used in place of long strings of alphanumerics to minimize operator input requirements.			
CRCC-12: Alphanumeric codes used to call up displays do not exceed seven characters, unless acronyms are employed.			

COMPLETED BY: ______________________ DATE ________________

CONTROL ROOM COMPUTER CHECKLIST

ITEM	N/A	YES	NO
CRCC-13: Response time for any query is not appreciably greater than three seconds (preferred), or a delay message is presented to maintain the operator's attention.			
CRCC-14: The operator has some capability for controlling the amount, format, and complexity of information displayed (e.g., core dumps, program outputs, error messages).			
CRCC-15: Invalid entries result in error messages that indicate required corrective action.			
CRCC-16: Operators are able to correct individual errors easily without having to retype the entire query or entry.			
CRCC-17: Operators have a specific command to terminate functions or actions that are no longer needed.			
CRCC-18: The operator has an unobstructed view of the CRT screen from the normal work station.			
CRCC-19: CRT luminance (brightness), contrast, and color are adjustable.			
CRCC-20: Information displayed on CRTs is easily readable from the normal work station, with respect to color, contrast, character size, etc., under all lighting conditions. (Comment: NUREG 0700 item 6.7.2.1.C is also covered by this item.)			

COMPLETED BY: ____________________ DATE ____________________

CONTROL ROOM COMPUTER CHECKLIST

ITEM	N/A	YES	NO
CRCC-21: CRT alphanumerics are of a consistent style. Letters are all uppercase, simple, without prominent serifs or slants; have separations among letters, words, and lines approximating samples; and have styles falling somewhere among these samples. NOT THINNER THAN THIS (Stroke width to character height = 1:10 letter width to height = 3:5) **NOT THICKER THAN THIS** (Stroke width to character height = 1:5 letter width to height = 1:1)			
CRCC-22: If CRTs can be operated by a centrally located master control, a positive indication is provided at both locations to identify when the local display is under master control.			
CRCC-23: Operating mode is displayed on CRT or printer if operation is not dedicated (e.g., alarm printer).			
CRCC-24: When a menu item or an option is selected, it should be highlighted or otherwise acknowledged by the system.			
CRCC-25: Lists of options (such as in a menu) have high probability items presented first, and are displayed in a consistent, recognizable format.			
CRCC-26: Lists and data presented in tabular form are left-hand justified and aligned vertically; numeric data are right-hand justified with decimal points aligned.			

COMPLETED BY: ______________________ DATE ______________

CONTROL ROOM COMPUTER CHECKLIST

ITEM	N/A	YES	NO
CRCC-27: Data are separated into groups for long columns, and is arranged in a logical manner.			
CRCC-28: Data subgroups are demarcated by spaces, lines, etc.			
CRCC-29: Each page of multiple-paged data has both page number and total number of pages, with data sequentially numbered.			
CRCC-30: Trend plot scales are consistent with intended functional use of data.			
CRCC-31: Graphs and charts are concise and easily read.			
CRCC-32: If the following information is presented, standardized fields are used: a. telephone (area code) 000-0000 b. time HH:MM:AA, HH:MM, MM:SS:(.S) c. date MM/DD/YY			
CRCC-33: Data relevant to an operator entry are displayed on a single page, when possible.			
CRCC-34: Data groups or messages have descriptive titles that reflect their content.			

COMPLETED BY: ______________________ DATE ______________

CONTROL ROOM COMPUTER CHECKLIST

ITEM	N/A	YES	NO
CRCC35: CRT screen labels are oriented horizontally and are consistently located with respect to items they describe.			
CRCC-36: Highlighting methods (brightness, flashing, etc.) are used in a consistent fashion to attract operator attention to important or action items.			
CRCC-37: Flashing of a symbol or message is reserved for items requiring prompt operator action, such as emergency conditions, and attracts attention easily.			
CRCC-38: The computer contains a sequential file of operator entries available on request.			
CRCC-39: If pages are hierarchically organized allowing different paths through the series, an audit trail of choices is available upon operator request.			
CRCC-40: When scrolling or panning a large frame or list, the location is shown; sectional coordinates are used when large schematics are panned or magnified.			
CRCC-41: System provides messages on change in status, including system malfunction, (e.g., "STATUS LOG UNAVAILABLE").			
CRCC-42: Printer(s) with capabilities to record alarms and status data and printer or strip record(s) to record trend data are in the primary operating area.			

COMPLETED BY: ____________________ DATE ____________________

CONTROL ROOM COMPUTER CHECKLIST

ITEM	N/A	YES	NO
CRCC-43: Alarm messages should be printed along with event times in the order of their occurrence.			
CRCC-44: If an alarm corresponds to an annunciator tile, the message uses the wording of the annunciator tile and specifies the setpoint(s) violated.			
CRCC-45: Alarm messages should be readily distinguishable from other messages.			
CRCC-46: Printouts are legible.			
CRCC-47: Printouts can be read and annotated as they are printed.			
CRCC-48: Instruction for reloading paper, ribbon, etc., are posted on the printer.			
CRCC-49: If it is possible to print hard copy of a CRT page, it is done without altering the screen content.			
CRCC-50: Printers recording trend data, computer alarms, and critical status information have a high-speed printing capability.			
CRCC-51: The collection device for the printer has a capacity adequate for the fastest printing speed.			
CRCC-52: No significant degradation of computer can be caused by making a single keystroke.			

COMPLETED BY: ______________________ DATE ______________

CONTROL ROOM COMPUTER CHECKLIST

ITEM	N/A	YES	NO
CRCC-53: There are no displays for which illustrations or pictures could be used to better describe text or alphanumeric material.			

COMPLETED BY: ____________________ DATE ____________________

CONTROL ROOM COMPUTER SURVEY

ITEM	N/A	YES	NO
CRCS-1: Operators know how to initiate and we all computer functions associated with CR operation (have operators demonstrate ability to use computer)			
CRCS-2: Abbreviations and acronyms in computer displays are consistent with others uses in CR and procedures.			
CRCS-3: Display graphics and codes are consistent.			
CRCS-4: Display graphics and codes are easily understood by operators.			
CRCS-5: Alarm printouts are consistent with annunciator legends.			
CRCS-5a: Messages and other display information is in a form usable by operator.			
CRCS-6: Under both emergency and normal lighting conditions, check to see that the following are true:			
a. CRT screen flicker is not perceptible.			
b. Alphanumeric and graphic characters are easily readable by the operator from the normal work station.			
c. Glare does not interfere with reading CRT screens at normal operator viewing angles.			

COMPLETED BY: ____________________ DATE ______________

CONTROL ROOM COMPUTER SURVEY

ITEM	N/A	YES	NO
CRCS-7: CRT screens are located and oriented so they can be read easily by operators from their normal work station, representative criteria being the following:			
a. The minimum viewing angle between the operator's line of sight and the plane of the CRT screen should be 45^{o} or greater, as measured from the operator's normal work station.			
b. For screens that require continuous or frequent monitoring or display important information (e.g., alarms), the screens comply with the following:			
o not more than 35^{o} to the left or right of the operator's normal line of sight			
o not more than 20^{o} above or 40^{o} below the operator's horizontal line of sight (seated operator) or more than 35^{o} above and 25^{o} below the operator's horizontal line of sight (standing operator)			

COMPLETED BY: ____________________ DATE ____________________

DESIGN CONVENTION SURVEY

ITEM	N/A	YES	NO
A. Design Conventions - Controls			
DS-1: If used while wearing emergency equipment controls are			
a. Easy to identify			
b. Easy to activate			
DS-2: Control movements should conform to the following population sterotypes:			
<u>Function</u> — <u>Control Action</u>			
a. On, Start Run, Open — Up, right, forward clockwise, pull			
b. Off, Stop Close — Down, left, backward, counterclockwise, push			
c. Right — Clockwise, right			
d. Left — Counterclockwise, left			
e. Raise — Up			
f. Lower — Down			

COMPLETED BY: ____________ DATE ____________

DESIGN CONVENTION SURVEY

ITEM	N/A	YES	NO
g. Increase — Forward, up, right clockwise			
h. Decrease — Backward, down, left, counterclockwise			
DC-3: Pump and valve switches are coded (i.e., type of control) consistently.			
DC-4: There is a clear indication of control position.			
DC-5: There is a clear indication of status of system/equipment associated by control.			
B. Design Convention - Displays			
DC-6: It is clear whether display information is demand or status information.			
DC-7: Types of displays and scales are consistent for similiar functions/status reported.			
DC-8: Displays are readable from usual operator position(s).			
DC-9: Displayed information does not require transformation; if so, the operation required is clearly indicated (e.g., multiply by 10).			

COMPLETED BY: ____________________ DATE ____________________

DESIGN CONVENTION SURVEY

ITEM	N/A	YES	NO
DC-10: Scale values increase with clockwise movement of pointer on circular scales.			
DC-11: Scale values increase with upward movement of pointer on vertical scales.			
DC-12: Scale values increase with pointer movement to the right in horizontal scales.			
C. Design Convention - Control/Display Integration			
DC-13: Displays that are monitored during control manipulation are located in close proximity.			
DC-14: Displays are not obscured during control operation.			
DC-15: Related controls and displays are easily identified as being associated.			
DC-16: Display selectors clearly related selector position with display label.			
DC-17: Control selection clearly related selector position with control label.			

COMPLETED BY: ______________________ DATE ______________

DESIGN CONVENTION SURVEY

ITEM	N/A	YES	NO
DC-19: Response of displays are consistent, predictable, and compatible with the following:			
a. Rotary controls turn clockwise to cause an increase in display parameter value.			
b. Linear controls move up in to the right to cause an increase in display parameter value.			
DC-21: Display parameter values are distinctly affected by control manipulation.			

COMPLETED BY: ______________ DATE ______________

COLOR CODING SURVEY

ITEM	N/A	YES	NO
The purpose of this survey is to compile a list of dominant color-coding conventions used in the control room and determine violations. It is suggested that this survey be conducted with the assistance of an operator. If no single convention is clearly dominant for a particular color meaning, this should be noted as well. The survey should include the following as a minimum: indicator lights, legend lights and switches, control handles, labels, any markings on meter faces, chart recorders, board coloring, demarcation lines, mimic lines, annunciator windows, and computer-generated displays. The operator should be asked to supply additional uses of color. Any meanings found for color not included in the attached list should be added. Text should be used freely to explain or qualify any of the recorded meanings. Copies of this list should be attached to the panel checklists so deviations may be noted.			

COLOR	MEANING	COMMENTS
_____	Valve Open	________
_____	Valve Closed	________
_____	Breaker Open	________
_____	Breaker Closed	________
_____	Mid-or Transitional Position	________
_____	On or Operating	________
_____	Off or Not Operating	________
_____	Start	________
_____	Stop	________
_____	Danger or Warning	________

COMPLETED BY: ______________________ DATE ______________

COLOR CODING SURVEY

ITEM	N/A	YES	NO
____ Caution, Trouble, or Pre-trip ____			
____ Trip or Failure ____			
____ Automatic Operation or Control ____			
____ Manual Operation or Control ____			
____ Limit Condition ____			
____ General Status ____			
____ Hot ____			
____ Cold ____			
____ Channel ____			
____ Train ____			
____ Bus ____			
____ Other (specify) ____			

COMPLETED BY: ____________________ DATE ____________

COMMUNICATIONS

ITEM	N/A	YES	NO
CS-1: Handsets/cords should be examined to ensure the following:			
a. Handsets are easily held, with ear contact being maintained while speaking.			
b. Cords are of sufficient length to permit operator mobility.			
c. Cords are nonkinking or self-retracting.			
CS-2: Sound-powered telephone system headsets are comfortable and held firmly in place.			
CS-3: If used, walkie-talkies or portable communication devices are light, easy to carry, and allow manipulation of plant controls, when required.			
CS-4: If gain adjustment can be made with an accessible control, it cannot be set so low that the device cannot be heard.			
CS-5: Speaker volume is adjusted to ensure that speaker communications will not prevent detection of annuniciator, telephone, or other audible signals.			
CS-6: To preclude wrong instrument system connections, jacks for the system being examined should differ from those used for other communication systems in the control room; otherwise, another means should be employed to make plugging into the wrong circuit obvious.			

COMPLETED BY: ______________ DATE ______________

COMMUNICATIONS

ITEM	N/A	YES	NO
CS-7: Patch panels are conspicuously marked, accessible, and provided with a complete set of cords (N/A if not sound-powered phone).			
CS-8: Switching for conventional-powered phones is maintained during emergency conditions.			
CS-9: P.A. speaker coverage is provided at the following locations:			
a. Control Room			
b. Control Room Rest Room			
c. Computer Room			
d. Plant Rest Rooms other than Control Room			
e. Lunch/Conference Room			
f. Locker Room			
g. Plant Office			
CS-10: AE the following locations, which have more than one telephone; 1) telephones that are ringing can be easily identified; and 2) dedicated telephones, are distinctively and uniquely identified.			
a. Control Board Computer Console 1)			
2)			
b. Shift Supervisor's Desk 1)			
2)			
c. EPP Comm. Console in NSS Office 1)			
2)			

COMPLETED BY: ______________________ DATE ________________

ITEM	N/A	YES	NO
CS-11: Coding by sound intensity is not employed. a. Standby and Emergency Alarms b. Annunciators			
CS-12: Plant communication systems are redundant (not subject to common cause failures) e.g., P.A. and walkie-talkies or conventional and sound-powered phones.			
CS-13: Observe operators on at least two shifts using page and PAX system and identify problems encountered.			

COMPLETED BY: ______________________ DATE ______________

ANNUNCIATOR SURVEY

ITEM	N/A	YES	NO
ANS-1: Are tiles grouped functionally?			
ANS-2: If alarms are prioritized by location, is that practice followed on the panel being reviewed?			
ANS-3: List titles with the following traits:			
a. They employ multiple-choice indication.			
b. They have legends that do not unambiguously specify alarmed point or use unfamiliar abbreviations or acronyms.			
c. They are not associated with controls and displays on same panel segment.			
ANS-4: List tiles that are normally or frequently on during normal operation.			
ANS-5: Annunciator windows are prioritized.			
ANS-6: Annunciator window positions are labeled to facilitate access to procedures.			
ANS-7: Annunciator controls are set off from other controls through some form of coding (describe).			
ANS-8: Annunciator controls are arranged consistently (for example, functions should be in the same order).			

COMPLETED BY: ______________________ DATE ________________

ANNUNCIATOR SURVEY

ITEM	N/A	YES	NO
ANS-9: Annunciator controls are "nondefeatable" (for example, not encircled by a ring in which a coin might be inserted to defeat the control).			

COMPLETED BY: ______________________ DATE ______________

ANTHROPOMETRIC SURVEY

ITEM	N/A	YES	NO
Anthropometric criteria as presented in Section 6 of NUREG-0700 correspond in intent to Principle 3.2.2.5 of the Human Engineering Principles for Control Room design Review, "controls should be located so they are reachable and accessible," and to principle 3.3.2.1, "Displays should be readable to the required accuracy from the operating locations." The proliferation of criteria measurements in NUREG-0700, Section 6, conflicts with NUREG-0700's injunction that "compliance with most of the workspace guidelines can be determined by inspection" (p. 3-26). For this reason, the Section 6 criteria have been condensed into a smaller number of screening measurements similar to placement limits in MIL-STD 1472C. This condensation is intended to facilitate inspection. Viewing angle, reach envelope, etc., are reformulated in terms of simple placement limits for a prototypical control room. These dimensions have been derived from NUREG-0700, Section 6, criteria based on a benchboard depth of 25" and the anthropometric dimensions for fifth percentile females and ninety-fifth percentile males used by NUREG-0700. Allowable bench board depth has been relaxed from 25" to 28" to accommodate arm reach including shoulder flexion (functional extended reach) as listed in MIL-STD-1472C for fifth percentage females. Measurements based on displacement of the face plane from the bench board when operating annunciator controls as recommended in 6.1.2.2.3 are felt reasonable and are applied to dimensions derived from 6.1.2.2.b, as well.			

COMPLETED BY: ______________ DATE ______________

ITEM	N/A	YES	NO
Annunciator heights for vertical boards are based on acknowledgement with the face plane displaced from the panel by 24."			
The recommended anthropometric criteria for bench boards, vertical boards, and sitdown consoles are illustrated in Figure AS-1, "Anthropometric criteria for bench boards, vertical boards, and sitdown consoles." Panels and consoles in the control room should be checked for compliance with these screening criteria.			
Bench Boards			
AS-1: Depth (max) 28"			
AS-2: Control Depth (min) 3"			
AS-3: Base indentation (min) (footroom) 4"			
AS-4: Controls (min) 27"			
AS-5: Controls (max) 63"			
AS-6: Displays (min) 31" 56"-70" for mechanical counters			

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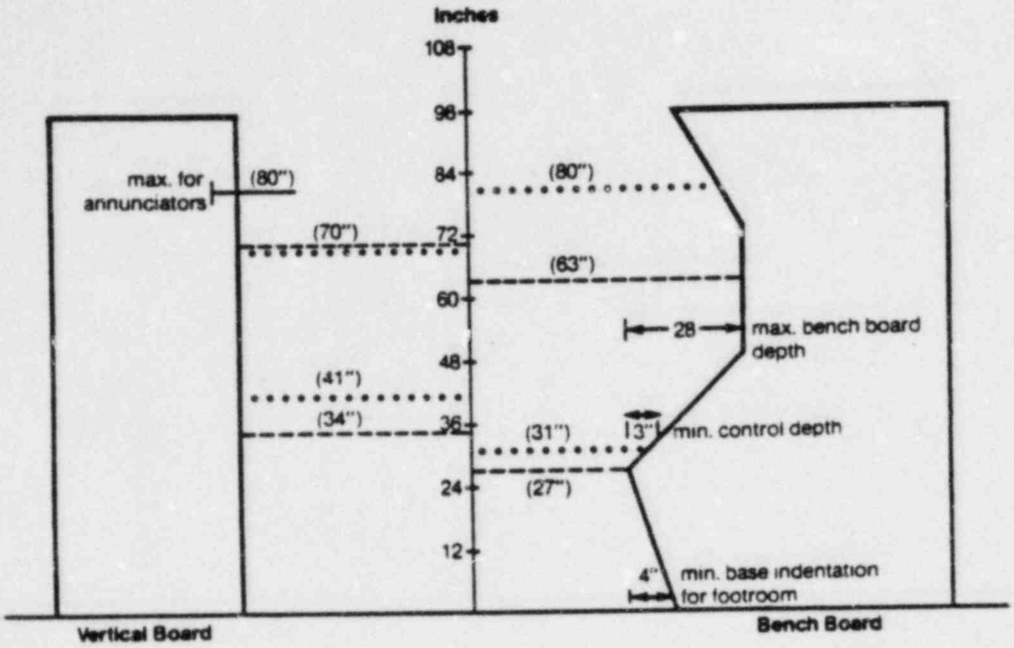
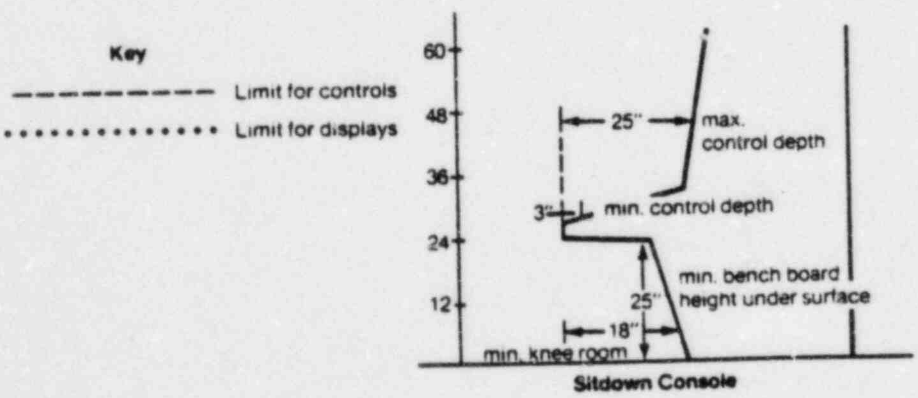
ANTHROPOMETRIC SURVEY

ITEM	N/A	YES	NO
			

COMPLETED BY: ______________________ DATE ______________

ANTHROPOMETRIC SURVEY

ITEM		N/A	YES	NO
AS-7: Displays (max)	80"			
Vertical Boards				
AS-8: Controls (min)	34"			
AS-9: Controls (max)	70"			
AS-10: Displays (min)	41"			
As-11: Displays (max)	70"			
As-12: Annunciators (max)	vertical 80" 15° forward tilt 90" 30° forward tilt 95"			
Sitdown Console				
AS-13: Knee room (min)	18"			
AS-14: Bench board height under surface (min)	25"			
AS-15: Control depth (min)	3"			
AS-16: Control depth (max)	25"			

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ANTHROPOMETRIC SURVEY

ITEM	N/A	YES	NO
AS-17: Measure smallest rotary control separations. Record separations of less than 4" (center to center) for "J-handles" and less than 2" for other controls.			
AS-18: Distance from back of desks to opposing surface(s) is adequate.			
AS-19: Displays including annunciator tiles are located and oriented so they can be read by operators.			
AS-20: From a seated position, instruments and controls on other panels can be seen over the console.			

COMPLETED BY: ______________________ DATE ______________

NOISE SURVEY

ITEM	N/A	YES	NO
The noise survey covers items that could interfere with verbal communication or reception of auditory alarms.			
NS-1: Take sound pressure level (SPL) readings at desks, each panel, and other control room operating stations. Note readings higher than 65 db(A).			
NS-2: Take readings of annunciator alarms at locations used in NS-1. Note if alarm is not 10 db(A) above ambient at any location.			
NS-3: Take readings adjacent to ventilation duct(s), printer(s), and door(s). Note if readings are 6 db(A) above average ambient level.			

COMPLETED BY: ______________________ DATE ______________

LIGHTING SURVEY

ITEM	N/A	YES	NO
This survey consists of a series of luminance and illuminance readings taken with a light meter/spot photometer. The control room layout should be sketched labeling all panel sections, operator' desks, alarm printer, and other work stations. Two vertical and two horizontal illuminance readings should be taken for each labeled section of benchboard. Two luminance readings, taken in the plane normally viewed, should be recorded for other operating stations. This process should be repeated under emergency lighting conditions, taking single measurements. There should be no apparent change in the discriminability of colors under emergency lighting conditions. (See also "Control Room Computer Survey," CRCS-7, for additional measurement requirements.) Evaluation There is some latitude in assessing the adequacy of illumination. NUREG-0700, 6.1.5.3a, specifies Illuminating Engineering Society (IES) criteria for recommended illumination levels. The IES criteria for a power plant control room specified below are more appropriate. The recommended illumination level for a power plant control room, 50 footcandles, allows reading printed material, meter reading, and ordinary seeing tasks (IES, MIL-STD-1472C).			

COMPLETED BY: ____________________ DATE ____________

LIGHTING SURVEY

ITEM	N/A	YES	NO

Illuminating Engineering Society (IES) Criteria For Power Plant Control Room (Footcandles)

	Emergency	Minimum	Recommended
Panels	20	20	50
Desks	20	50	75
Printer	20	50	75

Note: It is assumed that only typed or printed material will need to be read under emergency lighting and that annotation may be used on alarm copy. If little writing is done at desks, lowering these minimum levels may be justified.

Assessment

LS-1: Note on sketch any illumination readings falling outside specified range (normal and emergency lighting).

LS-2: Note on sketch all instances in which any of the following are true:

a. Paired readings exceed a ratio of 3:1.

COMPLETED BY: ______________________ DATE ______________

ITEM	N/A	YES	NO
b. Horizontal and vertical readings from a benchboard section exceed a ratio of 3:1.			
c. Adjacent panel sections exceed a ratio of 3:1 (NORMAL LIGHTING).			
LS-3: Compare highest and lowest illuminations recorded. Note if a ratio of 10:1 has been exceeded (NORMAL LIGHTING).			
LS-4: Compute luminance ratios for indicator, legend, and annunciator lights measured.			
Note any contrast of less than 10 percent. If contrasts are found inadequate, take additional readings of the dimmest of the remaining luminaries. Repeat until all luminaries with inadequate contrast have been identified.			
LS-5: Are colors used in coding recognizable under both normal and emergency lighting conditions?			
Green: a. Closed position b. Normally actuated annunciator			
Red: a. Open position or on status b. Flashing - Actuared annunciator c. Acknowledged annunciator			

COMPLETED BY: ______________________ DATE ________________

LIGHTING SURVEY

ITEM	N/A	YES	NO
White: a. Off status			
b. Flashing - Resetting annunciator			
c. Acknowledged Reset			
SSPS Status Lights			
Steam Dump Valve Status Lights			
Demarcation of Systems on Control Board			
Normal Indication Markers on Indicators			

COMPLETED BY: ____________________ DATE ____________

APPENDIX E

PROCEDURE AND FORMS FOR CONDUCTING THE SFRTA

TABLE OF CONTENTS

1.0 INTRODUCTION

The primary purpose of the SFRTA is to systematically identify and assess operator information, instrumentation, and control requirements for postulated accident conditions. Subsequently, the needed characteristics of instruments and controls required to support the implementation of the Emergency Operating Procedures are to be defined. The output of this task will be the needed characteristics of instruments and controls which is the input to the related task, Verification of Instrumentation.

A second purpose of the SFRTA will be to provide feedback regarding EOP compliance with specified writers guidelines. Although the SFRTA is not intended to be a complete human factors review of the EOPs, any discrepancies in the EOPs shall be documented and reported to the project engineer in charge of EOP verification and validation.

To determine the needed characteristics of each instrument and control, an SFRTA data base shall be developed and searched; and for each variable (e.g., pressurizer pressure, RCP, etc.), all values/positions that are required for all operator tasks will be compiled. The compilation of this data is to be used to determine the needed ranges, positions, scale graduation, direct feedback, system/equipment response feedback, and backup or secondary indications of instruments and controls in the control room.

An auditable record of how the needed characteristics were determined will be developed by preparing lists of EOPs, steps, and substeps that are associated with each variable and maintaining a record of the display values and/or control requirements associated with the variable.

2.0 PROCEDURES

2.1 Data Collection

The HFC shall be responsible for reviewing each EOP and Attachments and completing the SFRTA form. The information identified on the form shall be collected for each step and substep in both the Action/Expected Response and the Response Not Obtained columns of the EOPs. In addition, the HFC shall collect the data for (1) any Cautions or Notes which require an operator action and (2) any substeps not explicitly identified that may be a part of a system/equipment operation.

2.2 Data Analysis

The SFRTA data shall be analyzed by the HFC to develop composites of the information and control requirements associated with each variable and to identify the needed characteristics of instruments and controls. The Needed Characteristics of Instrumentation and Verification of Instrumentation form will be used for this purpose. In column one, the variable and all information and control requirements associated with it shall be listed. The HFC shall then analyze this data to determine the information range and control positions that are necessary to support the tasks associated with each variable and enter this data in the Task Requirements column under the heading RANGE/POSITIONS. The HFC shall further analyze the data in column one to determine the information graduation or precision and the control precision necessary to support the EOP tasks. This data shall be listed in the Task Requirements column under the heading GRADUATION/PRECISION.

No other information will be listed on the form during this task. The remainder of the form will be completed during the Verification of Instrumentation task.

2.3 CRDR Team Review

The results of the SFRTA shall be submitted to the other Review Team member for review. The purpose of the review shall be to (1) verify that data collection has been completed and (2) check that the needed characteristics of controls have been identified.

2.4 Task Report and Other Documentation

The HFC shall be responsible for preparing a Task Report and maintaining other task documentation which includes completed forms. The Task Report shall be submitted to the Review Team for review. All documentation shall be organized, filed, and submitted to the Review Team Leader.

2.5 Task Report Review and Approval

Final review and approval of the Task Report shall be the responsibility of the Review Team Leader and the General Superintendent, NSEAS.

3.0 COORDINATION REQUIREMENTS

The Review Team Leader shall be responsible for providing the HFC with copies of the EOPs and plant-specific background documentation, the Rev. 1 ERGs and background, and the generic SFRTA developed by the Westinghouse Owner Group (WOG).

The Review Team Leader shall organize and schedule Review Team meetings required to support the SFRTA.

SFRTA FORM

EOP: ______________________

STEP	SUB STEP	OPERATOR ACTION	VARIABLE	EXPECTED VALUE/CNTR.POS.	CONTROL FEEDBACK	SYSTEM/EQUIPMENT RESPONSE	EXPECTED VALUE/CNTR. POS

NEEDED CHARACTERISTICS OF INSTRUMENTATION AND VERIFICATION OF INSTRUMENTATION FORM

VARIABLE VALUE/POSITION	RANGE/POSITIONS		GRADUATION/PRECISION		PRIMARY CNTR/INDICATOR	SYS. EQUIP. RESPONSE/ ALTERNATE INDICATOR	EVALUATION SUMMARY						
	TASK RQMT.	INSTR. CHAR.	TASK RQMT.	INSTR. CHAR.			DR	DU	CR	CP	CT	CF	SR

APPENDIX F

PROCEDURE AND FORMS FOR CONDUCTING CONTROL ROOM INVENTORY

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of the control room inventory is to produce a reference set of data which identifies and describes the characteristics of all controls, displays, and other components on the control boards, peripheral consoles, and other panels. The inventory will be used to verify that the control room instruments and controls are adequate to support EOP task requirements both in terms of the presence of appropriate instruments and controls in the control room and the human factors suitability of the existing instruments and controls.

2.0 PROCEDURES

2.1 Conduct Inventory

The HFC shall be responsible for preparing the control room inventory. The inventory form will be used to record the inventory data. The inventory shall be conducted on the control room mockup to as great an extent as possible. In the event additional inventory data is required, the control room will be used as the data source.

All information needed to complete the inventory form is available on the control boards. It is not expected that any information source, other than the mockup or actual control boards, will be required.

2.2 CRDR Team Review

The CRDR Team shall review the data developed by the HFC to ensure the completeness of the inventory. Team members will verify the accuracy of the inventory by checking samples of inventory data against the mockup.

2.3 Task Report and Other Documentation

No Task Report is required. Task documentation shall consist of the completed inventory form.

2.4 Inventory Review and Approval

Final review and approval of the inventory shall be the responsibility of the Review Team Leader and the General Superintendent, NSEAS.

3.0 COORDINATION REQUIREMENTS

The Review Team Leader shall be responsible for coordination and access for the HFC to the mockup and the control room.

The Review Team Leader shall be responsible for organizing and scheduling Review Team meetings necessary to support the task.

INVENTORY FORM

PANEL: ______________________

SEQ. NO.	TYPE C/D	NAMEPLATE DATA	I.D. NUMBER	LOC.	RANGE/POSITIONS	GRADUATIONS/CONTROL PRECISION

APPENDIX G

PROCEDURE FOR VERIFYING INSTRUMENTATION

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1.0 INTRODUCTION

The process of verifying that the PBNP control room contains appropriate instruments and controls will be based on the outputs of the SFRTA and the control room inventory. First a determination will be made as to whether the instrumentation and controls necessary to display the information or take the control actions identified in SFRTA are present in the control room. If not, an HED will be defined and documented accordingly.

The second step of the verification process consists of an examination of the existing instrumentation and controls identified in the first step to determine their human engineering suitability for the task action or decision they are to support. This will be done by comparing the needed characteristics of instruments and controls, as determined in the SFRTA, with actual characteristics of instruments and controls, as documented in the inventory.

2.0 PROCEDURES

2.1 Identify Appropriate Instruments/Controls and Document Chracteristics

The HFC shall be responsible for identifying the existing control room instrumentation that can be used to display the information and/or implement the control action associated with each variable identified in the SFRTA. The Needed Characteristics of Instrumentation and Verification of Instrumentation form will be used for recording the identification number of the appropriate instrument/control and for recording its characteristics. This information shall be recorded in the two columns for instrument characteristics.

The source of the instrument/control data shall be the control room inventory. The HFC also shall identify the same information for instruments/controls that (1) display system response information after a control action (2) may serve as an alternative display of information, or (3) may serve as an alternative control action.

2.2 Determine Human Engineering Suitability

Upon completion of procedure 2.1, the HFC shall determine the human engineering suitability of existing instruments/controls by comparing the needed characteristics associated with task requirements with existing instrument/control characteristics. The HFC shall evaluate current instrument/controls for human engineering suitability in terms of the following:

- o Display range (DR)
- o Display units (DU)
- o Control range (CR)
- o Control precision (CP)
- o Control type (CT)
- o Control feedback (CF)
- o System response (SR)

The HFC shall record a summary of this evaluation in the appropriate columns on the verification form.

2.3 Prepare List of Discrepancies

The HFC shall prepare a list of discrepancies that include identifying (1) information and control requirements for which there is no existing instruments or controls and (2) information and control requirements for which existing instruments and controls are not suitably human engineered.

2.4 Evaluation and Disposition by CRDR Team

All discrepancies identified by the HFC shall be reviewed by the CRDR Team. The purpose of the review will be to:

1. Confirm that a discrepancy actually exists.

2. Define the nature of the discrepancy (i.e., if in fact an instrument is inadequate, additional instrumentation is required, alternative

instrumentation is required, or if the precision of the information required should be reviewed).

3. Identify any actions required if additional information is needed.

4. Identify HEDs.

In the event action items are defined, members of the CRDR Team shall be assigned responsibility for the items by the Review Team Leader.

2.5 Task Report and Other Documentation

The HFC shall prepare a Task Report describing the methods and findings of the verification of instrumentation effort. The Task Report shall be reviewed by the CRDR Team.

The HFC shall be responsible for all other task documentation including completing forms, evaluation and disposition results, and recording action items and reponses. All documentation shall be submitted to the Review Team Leader.

2.6 Task Report Review and Approval

Final review and approval of the Task Report shall be the responsibility of the Review Team Leader and the General Superintendent, NSEAS.

3.0 COORDINATION REQUIREMENTS

No special coordination requirements. The Review Team Leader shall organize and schedule Review Team meetings required to support the task.

NEEDED CHARACTERISTICS OF INSTRUMENTATION AND VERIFICATION OF INSTRUMENTATION FORM

VARIABLE VALUE/POSITION	RANGE/POSITIONS		GRADUATION/PRECISION		PRIMARY CNTR/INDICATOR	SYS. EQUIP. RESPONSE/ ALTERNATE INDICATOR	EVALUATION SUMMARY						
	TASK RQMT.	INSTR. CHAR.	TASK RQMT.	INSTR. CHAR.			DR	DU	CR	CP	CT	CF	SR

APPENDIX H

PROCEDURE AND FORMS FOR VALIDATING CONTROL ROOM FUNCTIONS

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1.0 INTRODUCTION

The purpose of validating control room functions is to determine whether the control room's physical and organizational design has been integrated so that the functions allocated to the control room operating personnel during postulated accident conditions can be accomplished effectively. Validation of functions should demonstrate that adequate manual controls, automatic controls, monitoring systems, and trained operators are provided to implement the EOPs.

The process of validation will provide an opportunity to identify discrepancies which may not have become evident in other review activities. Validation also will provide the opportunity to see how HEDs from earlier activities come into play during interactive plant operations. The process of verification of task performance capabilities will have been conducted to ensure that operator tasks are supported with control room instrumentation and controls. This process will evaluate the man-machine interfaces of individual work stations and operators.

2.0 PROCEDURES

2.1 Data Collection and Recording

The source of the data that is to be collected, recorded, and analyzed will be the EOP walkthroughs that will be conducted as part of the EOP V&V effort. All the EOPs will not be reviewed unless significant man-machine interface problems are identified in the sample that is reviewed. The sample shall consist of approximately 25% of the EOPs. At this time, the specific EOPs to be analyzed have not been determined, but the initial list includes the following:

- Reactor Trip or Safety Injection
- Rediagnosis
- Loss of Reactor or Secondary Coolant
- Post LOCA Cooldown and Depressurization
- Faulted Steam Generator Isolation
- Steam Generator Tube Rupture

Post-SGTR Cooldown Using Backfill
Post-SGTR Cooldown Using Blowdown
Post-SGTR Cooldown Using Steam Dump
Loss of All ac Power
Loss of All ac Power Recovery With SI Required
Loss of Emergency Coolant Recirculation
Uncontrolled Depressurization of All Steam Generators
SGTR Without Pressurizer Pressure Control
Response to Nuclear Power Generation/ATWS
Response to Inadequate Core Cooling
Response to Loss of Secondary Heat Sink
Response to Imminent Pressurized Thermal Shock Condition
Response to High Containment Pressure
Response to Voids in Reactor Vessel

Each EOP shall be reviewed by the HFC, and the operating sequence diagram (OSD) form shall be completed. The OSDs identify operator actions, the location of the operators, the control room panel or console involved, the time of the action, and observations or comments made by the HFC for operator actions.

The HFC shall use the OSDs to document the procedure, step, and time initiated. Procedure notes, cautions, or instructions regarding timing requirements for operator actions shall be indicated where applicable. Operator actions are coded as follows:

- C - control action
- P - procedure or ERG reference
- M - monitoring boards
- T - telephone communications
- A - annunciator acknowledgment
- R - CRT request or observation

Operator task information and control requirements will be coded as above by control room panel location where the information is physically displayed or located. The physical location of the operators shall be separately coded at the appropriate work station by the numerical designation as follows:

1 - 1st control operator
2 - 2nd control operator
3 - operating supervisor
DTA - Duty Technical Advisor

In addition, the subscripts "1", "2", "3", and in some cases, "DTA" shall be used to indicate which member of the control room crew was performing a particular action. Note that the physical location of the operators may not always correspond to the location of the parameter being monitored.

The OSDs shall be annotated to identify unusual operator actions and also to reference where potential problems were observed. These reference notes will be then used in further evaluating the appropriateness of operator actions, procedures use, and the human engineering suitability of control room instrumentation, controls, and layout.

2.2 Data Analysis

The OSDs shall be analyzed to determine (1) facility of control room crew interaction and function performance, (2) if work station design and component location facilitated the required action, (3) availability and suitability of instruments and controls required to support the procedural task requirements, (4) ability of control room crew to handle any time critical action sequences, and (5) adequacy of procedural requirements for operator tasks and procedures use.

A set of criteria expressed in the following list of questions, shall be used to evaluate the OSDs:

1. Were controls reachable for the appropriate system/panel?

2. Was comparison of two or more displays in rapid fashion convenient?

3. Were particular displays monitored over prolonged periods accessible?

4. Were controls/displays easily discriminated from among similar components?

5. Are controls and displays arranged to facilitate traffic and implementation of procedure steps?

6. Were any time critical tasks not performed correctly due to CR and/or workstation layout?

7. Could the procedure actions be performed on the plant in the designated sequence?

8. Were the procedure instructions compatible with the shift manpower?

9. Could the procedure action be performed by the operating shift?

10. Did the procedure help coordinate the actions of the operating shift?

11. Could the operator obtain the necessary information from designated plant instrumentation when required by the procedure?

12. Did one operator consistently direct the activities of the other operator and was there a designation of responsibilities among the operators?

The HFC shall prepare responses for each question for each EOP sequence and then prepare a summary of the responses and a list of problem areas and discrepancies.

2.3 Review by CRDR Team

The HFC shall present the list of problems an HEDs identified in the validation to the CRDR Team for Review. The purposes of the review are to (1) verify that problems or HEDs identified by the HFC actually exist, (2) determine if the problem or discrepancy is associated with CRDR criteria or is a function of the EOP, and (3) to define HEDs that exist.

In addition, the CRDR Team shall review the results and determine whether additional EOP sequences should be analyzed.

2.4 Task Reports and Other Documentation

The HFC shall prepare a Task Report describing the methods and findings of the validation effort. The Task Report shall be reviewed by the Review Team.

The HFC shall complete and submit to the Review Team Leader all completed OSDs and evaluation results.

2.5 Task Report Review and Approval

Final review and approval of the Task Report shall be the responsibility of the Review Team Leader and General Superintendent, NSEAS.

3.0 COORDINATION REQUIREMENTS

The Review Team Leader shall be responsible for coordinating with the EOP V&V effort.

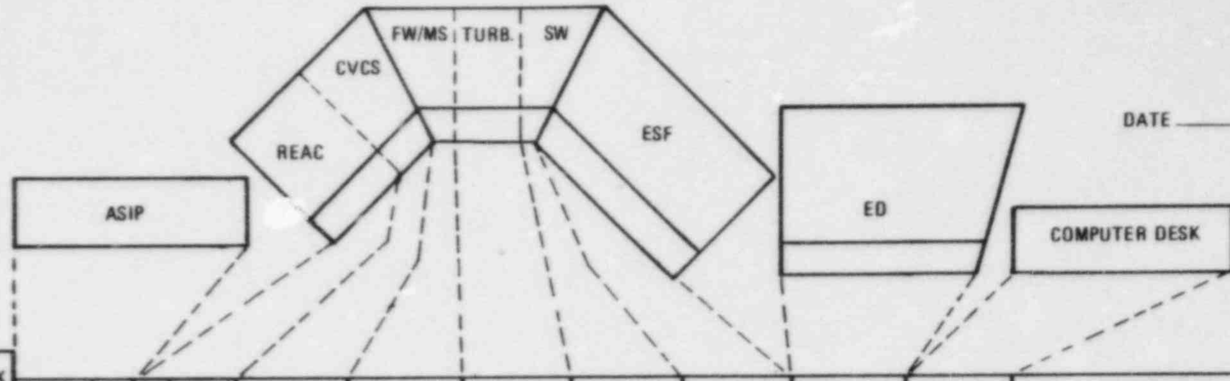
The Review Team Leader shall organize and schedule Review Team meetings required to support the validation effort.

OPERATING SEQUENCE DIAGRAM

EVENT NO. ______________

PROCEDURE ______________

DATE ______________



STEP	TIME STEP STARTED	TIME SENSITIVE STEP (YES/NO)	SIDE/BACK PANEL	ASIP	REAC	CVCS	FW/MS	TURB	SW	ESF	ED	CD	COMMENTS

KEY:
C – CONTROL ACTION
P – PROCEDURES REFERENCE
M – MONITOR
T – TELEPHONE COMMUNICATIONS
A – ANNUNCIATOR ACK.
R – CRT REQUEST

NUMBER:
1 – 1ST CONTROL OPERATOR
2 – 2ND CONTROL OPERATOR
3 – OPERATING SUPERVISOR
DTA – DUTY TECHNICAL ADVISOR

SUBSCRIPT:
1 – 1ST CONTROL OPERATOR
2 – 2ND CONTROL OPERATOR
3 – OPERATING SUPERVISOR
DTA – DUTY TECHNICAL ADVISOR

PAGE ______ OF ______

APPENDIX I

PROCEDURE AND FORMAT FOR COMPILING HEDs

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1.0 INTRODUCTION

The final task of the Execution Phase shall be to (1) ensure that no action items from previous tasks are outstanding, (2) ensure that all identified HEDs are documented on HED Forms, and (3) compile HEDs by certain common characteristics (e.g., panel location, human engineering criteria violated, etc.) in order to facilitate subsequent CRDR activities. The HFC shall be responsible for all of these items.

2.0 PROCEDURES

2.1 Review Execution Phase Documentation

The HFC shall review all documentation from previous tasks. The purpose of the review is to ensure that documentation is complete and no action items are outstanding. Any actions items not completed shall be reported to the Review Team Leader.

2.2 Complete HED Forms

The HFC shall complete HED forms as each Execution Phase task is completed and task documentation prepared. The purpose of this item is to have the HFC review each form to ensure that they have been completely and accurately completed. If during the review of previous task documentation an HEDs that are not recorded on HED Forms are identified, the HFC shall complete the forms.

2.3 Compile HEDs

The HFC shall place HED information in an automated DBMS. Data inputed into the DBMS includes HED number, location, human engineering criteria violated, a description of the HED, associated plant system and source of the HED (Execution Phase task). From this DBMS, the HFC shall generate lists of HEDs by (1) panel, (2) criteria violated, (3) plant system, and (4) numerical sequence. These lists shall be submitted to the Review Team leader.

The HFC shall maintain the DBMS for use during subsequent phases of the CRDR.

3.0 COORDINATION REQUIREMENTS

The Review Team Leader shall organize and schedule Review Team meetings required to support the tasks.

HED REPORT

POINT BEACH NUCLEAR PLANT	UNIT:	NO:
REVIEWER:	CRDR PROCESS:	DATE:

WHAT IS THE DISCREPANCY?

PROBLEM STATEMENT:

GUIDELINE:

DESCRIPTION:

WHERE IS THE DISCREPANCY?

PHYSICAL LOCATION	PERFORMANCE AFFECTED
SYSTEM:	FUNCTION:
EQUIPMENT:	PROCEDURE:
CR AREA:	EVENT:
PANEL:	TASK:
COMPONENT:	ACTION:

ADDITIONAL INFORMATION:

NOTES:

(front)

HED ASSESSMENT	NO.

HISTORICALLY DOCUMENTED? YES ☐ NO ☐

- ACCIDENT CONDITION? YES ☐ NO ☐
- VIOLATES TECH SPECS? YES ☐ NO ☐

- IS HED A PROBLEM? YES ☐ NO ☐

- ACCIDENT CONDITION? YES ☐ NO ☐
- VIOLATES TECH SPEC? YES ☐ NO ☐

HED CORRECTION	PHOTO:
☐ NONE ☐ ENHANCEMENT: ☐ ON-LINE CHANGE: ☐ REDESIGN: ☐ PROCEDURE CHANGE: ☐ TRAINING CHANGE: ☐ OTHER:	EXPLANATION:

SCHEDULE PRIORITY 1☐ 2☐ 3☐ 4☐ ENHC.☐

RELATED EFFECTS

☐ PROCEDURES: ☐ TRAINING: ☐ TASK ANALYSIS: ☐ CREW INTERACTION:	EXPLANATION:

COMMENTS:

(back)