DETAILED CONTROL ROOM DESIGN REVIEW

PROGRAM PLAN

FOR

CRYSTAL RIVER UNIT 3 GENERATING STATION

Florida Power CORPORATION

Prepared for

U.S. NUCLEAR REGULATORY COMMISSION

October 31, 1983

Florida Power Corporation

St. Petersburg, Florida

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EXECUTIVE SUMMARY

This plan for the detailed control room design review (DCRDR) describes the methodologies to be employed to meet the objectives of item I.D.1, NUREG-0660 and to improve the ability of nuclear power plant control room operators to prevent or mitigate the consequences of accidents. Tasks to be used to identify human engineering discrepancies are described. These include operating experience review, system function and task analyses, control room survey, verification of task performance capability, and validation of control room functions.

The identification of activities to be performed as a part of the DCRDR and the definition of the scope of these activities are based on a review of the DCRDR requirements and human engineering guidelines set forth in NUREG-0700, NUREG-0801, NUREG-0737, Supplement 1, and the NUTAC DCRDR implementation guidelines. Each requirement was addressed with regard to its applicability to the CR3 control room.

For each DCRDR activity the plan summarizes the purpose and scope, capability procedures to be employed, description of results of the activity, relation to other emergency response capability requirements, and operational constraints. The process for assessing human engineering observations (HEOs) and selecting corrective actions for human engineering discrepancies (HEDs) identified during the review is described. All activities described herein are structured to accommodate utility resources and operational constraints.

This plan allows for the integration of the activities performed as part of the DCRDR with similar human factors activities associated with development and implementation of the Safety Parameter Display System (SPDS), emergency response facilities, upgraded emergency operating procedures, Regulatory Guide 1.97, and training.

Project scheduling, data management requirements, project organization and management, and review team organization are covered.

Table of Contents

SECTION 1.0 INTRODUCTION AND SUMMARY

1.1 Requirement

The Detailed Control Room Design Review (DCRDR) is a requirement that emerged from Task I.D.1 of NUREG-0660, the NRC TMI-2 Action Plan, which specified that the Commission's Office of Nuclear Reactor Regulation will require that operating reactor licensees and applicants for operating licenses perform a detailed control room design review. In item I.D.1 of NUREG-0737, "Clarification of TMI Action Plan Requirements," the DCRDR requirement was described. Licensees were to be required to complete a DCRDR using NUREG-0700, "Guidelines for Control Room Design Reviews." NRC staff review methods for determining the acceptability of the DCRDR were set forth in NUREG-0801, "Evaluation Criteria for Detailed Control Room Design Review."

Supplement 1 to NUREG-0737 addressed the proposed basic requirements and implementation methods for the DCRDR and other emergency response capabilities (ERC) and facilities, including:

- Emergency Response Facilities
  - Technical Support Center (TSC)
  - Operational Support Center (OSC)
  - Emergency Operations Facility (EOF)

- Control Room Improvements
  - Safety Parameter Display System (SPDS)
  - Detailed Control Room Design Review (DCRDR)
  - Regulatory Guide 1.97 (RG 1.97)

- Operator Capability
  - Emergency Operating Procedures (EOPs)
  - Training

In general, the DCRDR requirements of Supplement 1 are more flexible than earlier versions. They recognize that plants are different and, to a large

degree, provide for tailoring of the DCRDR for each plant on the basis of the type of control room, operating history, prior human factors work, and the integration of the DCRDR with other emergency response items.

1.2 Purpose of Plan

The purpose of this plan is to provide information and guidelines sufficient and necessary for cost-effective performance of a DCRDR that will (1) result in enhanced nuclear power plant (NPP) safety and availability, and (2) meet the objectives of the NRC. Specifically, consistent with Supplement 1 guidance, the program plan describes the methods by which the control room design review will:

- Identify human engineering discrepancies;
- Assess which human engineering discrepancies are significant and should be corrected; and
- Verify that selected design improvements will provide the necessary correction without increased risk, and which are coordinated with changes resulting from other improvement programs (i.e., SPDS, operator training, new instrumentation, and upgraded emergency operating procedures).

This DCRDR plan addresses the implementation of the DCRDR at the Crystal River Unit 3 (CR3) generating station. Vital plant statistical data for CR3 is contained in Table 1.1. The plan provides the following information relevant to implementing the DCRDR:

- DCRDR tasks/subtasks
- Guidelines for performing tasks/subtasks
- Anticipated results and benefits
- Resources required to support tasks
- Operational considerations and constraints
- Personnel requirements

TABLE 1.1

CR3 PLANT CHARACTERISTICS

Florida Power Corporation

NUCLEAR UNIT	Crystal River-3
LOCATION	7 miles NW Crystal River
STATE	Florida
TYPE	PWR
CAPACITY, Mw NET	837
CONTAINMENT	Type 3b
COOLING	Gulf of Mexico
REACTOR SUPPLIER	B&W
TURBINE-GENERATOR MFR	Westinghouse
ENGINEER	Gilbert Associates, Inc.
CONSTRUCTOR	Ernst/Jones
NRC DOCKET NO.	50-302
ANNOUNCED	2-14-67
APPLIED TO NRC	3-10-67
CONSTRUCTION PERMIT	9-25-68
OPERATING LICENSE	12-2-76
CRITICAL FIRST TIME	1-14-77
COMMERCIAL OPERATION	3-77
CONSTRUCTION PROGRESS	Completed

- Project management and organization
- Activity schedules
- Data management requirements
- Reporting requirements

1.3 Organization of Plan

The plan is organized in the following manner. The remainder of the Introduction and Summary contains brief discussions of:

- DCRDR Objectives
- Relationship of DCRDR to other emergency response capability initiatives; e.g., Emergency Operating Procedures (EOPs), Safety Parameter Display System (SPDS), Regulatory Guide 1.97 (RG 1.97) and Emergency Response Facilities
- Summary of previous work
- Summary of DCRDR activities
- Schedule
- Project organization and management
- Data management

Following the Introduction and Summary are the sections of the plan that describe in detail requirements for performing the DCRDR. Sections 2.0 and 3.0 define the Review Guidelines (Phase II) and the Assessment and Correction Guidelines (Phase III), respectively. Section 4.0 presents the correction and implementation processes. Project organization and management are discussed in Section 5.0. Section 6.0 addresses information management.

1.4 DCRDR Objectives

FPC has adopted the control room review objectives set forth in NUREG-0700 as follows:

- To determine whether the control room provides the system status information, control capabilities, feedback, and analytic aids necessary for control room operators to accomplish their functions effectively.

- To identify characteristics of the existing control room instrumentation, controls, other equipment, and physical arrangements that may detract from operator performance.

- To analyze and evaluate the discrepancies that arise from observations of the above kinds and to analyze means of correcting those discrepancies which could lead to substantial problems.

- To define and put into effect a plan of action that applies human factors principles to improve control room design and enhance operator effectiveness. Particular emphasis should be placed on improvements affecting control room design and operator performance under abnormal or emergency conditions.

- To integrate the control room design review with other areas of human factors inquiry identified in the NRC Task Action Plan.

1.5 Integration of DCRDR With Other Emergency Response Capability Initiatives

The DCRDR is just one of several programs that make up a comprehensive emergency response program being promulgated by the NRC and the nuclear industry. A consideration in the development of this plan was to coordinate the DCRDR with related projects. The specification of DCRDR tasks was conducted within the framework of human factors-related work being, or previously, performed by FPC or identified as a future requirement. It was

found that (1) work previously performed had applicability to the DCRDR, and (2) projected DCRDR tasks could be integrated with other requirements.

Specific integration of tasks, exchanges of information, and other interfaces are summarized below:

1. System function and task analysis data employed in the development of upgraded EOPs and the B&W Anticipated Transient Operating Guidelines (ATOG) will be used as the basis for the DCRDR analysis of operator requirements.

2. EOP verification and validation is designed to account for DCRDR requirements including (1) confirm emergency operation task parameters, (2) verify emergency task performance capabilities, (3) validate control room functions, and (4) identify HEOs.

3. Procedures and training will be assessed as part of the DCRDR operator interviews. Interview results will be provided to those people responsible for procedures and training.

4. Procedural modifications, training, or SPDS capabilities, may be identified as a corrective action for an HED.

5. Control room modification must be reflected in the procedures and training.

6. The results of the DCRDR will be integrated via engineering studies with other control room modification requirements such as additional instrumentation that is necessary to implement RG 1.97.

1.6 Summary of Previous DCRDR Work

Two previous human engineering studies of the CR3 control room were reviewed prior to the DCRDR planning. The first study was performed by the Essex Corporation as part of a contract with the NRC to develop guidelines for

control room reviews. Specifically, the purpose of the Essex effort was to validate a portion of the guidelines (the control room survey) that they had developed. These guidelines were published as NUREG/CR-1580.

The second study was conducted by INPO with assistance from FPC. It consisted of a five-day review of the CR3 control room. The review was a pilot study being conducted by INPO in order to provide INPO with an evaluation of human engineering guidelines and methods developed from NUREG/CR-1580 and applicable military standards. The INPO review focused primarily on the control room survey, although procedures for (1) review of operating history, (2) personnel interviews, and (3) task analysis, were investigated.

Results from both reviews were published in final reports. The reports identify human engineering discrepancies (HEDs) from the control room surveys, and, in some cases, recommend control room improvements. FPC has, in fact, made several control room modifications based on the findings of these reviews.

Although the two control room surveys were conducted, a complete control room survey in accordance with NUREG-0700 and 0801 will be performed. There are four reasons for conducting another survey:

1. There is a large number of human engineering issues in NUREG-0700/0801 that were not addressed in NUREG/CR-1580.

2. Since the prior two studies were not funded by FPC, complete documentation of the surveys was not maintained and, therefore, is not available for an audit.

3. Developing and conducting a supplemental survey addressing the issues not previously covered and patching together the findings of all three would require an effort as great or greater than conducting a complete NUREG-0700 survey.

4. Conducting a complete NUREG-0700 survey will lay to rest any questions regarding the human engineering adequacy or inadequacy of the CR3 control room. Not only will the issue be resolved for FPC, but this action will demonstrate FPC's good faith to fully comply with the NRC requirements.

The findings of the two prior reviews will not be ignored during the DCRDR. The results of the control room survey and list of HEOs will be compared with the earlier findings.

1.7 Summary of Proposed DCRDR Activities

Figure 1-1 illustrates the organization and phasing of the CR3 DCRDR. As can be seen in the figure, the proposed phases and products are similar to those defined in NUREG-0700 with two exceptions. The first exception is that the major product of the review phase will be human engineering observations (HEOs) which are defined as any device, procedure, or other item under review that is not in compliance with the review criteria. However, although an item may not be in total compliance, it may not constitute a control room discrepancy. Discrepancies are defined during the Assessment Phase.

The second exception is that FPC views the implementation of the corrective actions as an activity that is separate and distinct from assessment, therefore the forth phase is Correction and Implementation. Reporting is viewed not as a separate phase but as the concluding task of the assessment phase. The planning phase, Phase I, has been conducted and is reflected in this DCRDR plan. The following subsections provide a summary of the tasks to be performed in the conduct of the DCRDR at CR3.

1.7.1 Phase II: Review Phase

Six activities are involved in the identification of HEOs during Phase II of the control room review:

1. A review of operating experience.

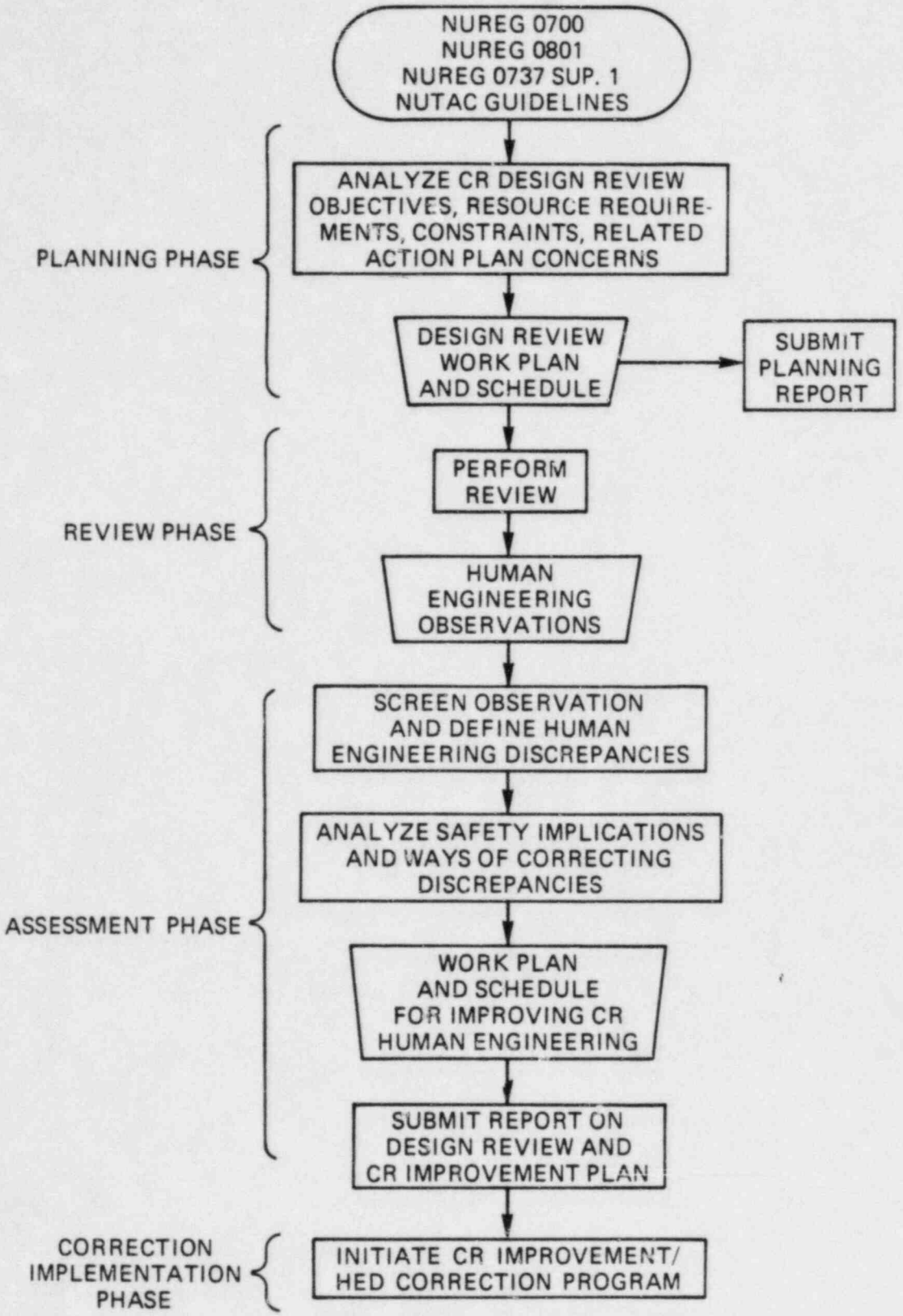

Figure 1-1 Overview of DCRDR Phases and Products

2. A survey of the human engineering acceptability of control room components and environmental conditions.
3. A review of system functions and operator tasks.
4. Verification of task performance capabilities.
5. Validation of control room functions.
6. Compilation of discrepancy findings.

Section 2.0, Review Phase, defines the purpose and scope, procedures, results, relation to other human factors requirements, reference material, documentation requirements, equipment, and operational constraints of each activity.

1.7.2 Phase III: Assessment Phase

The review process described in the previous subsection will result in the identification of human engineering discrepancies. This section of the plan describes the activities, tasks, and subtasks that will be performed in assessing the impact of the HEDs and implementing corrective actions. Phase III consists of three major activities: (1) assessment of HEDs, and (2) evaluation of alternative corrective actions, and (3) preparation of the summary report.

Assessment involves the process of identifying from the HEO database, those discrepancies which can affect operator performance with resultant unacceptable consequences. The process of assessing discrepancies also involves determining the priority of HEDs for correction and justifying any recommendations and decisions not to fully correct discrepancies.

Evaluation primarily involves designing and planning resolutions for HEDs. Corrective actions will be developed using the resources of the DCRDR team, other plant specialists, and emergency personnel. Recommended HED resolutions may take into account (1) the impact of the correction on operating effectiveness, (2) system safety, (3) acceptability of design, (4)

consistency with control room characteristics, (5) tradeoffs with training and procedures modification, and (6) cost/benefits analyses.

The design and evaluation of alternative corrective actions involves a major interface between the DCRDR and other emergency response capability initiatives and training. Not only will the HEDs be considered, but simultaneously, the discrepancies identified during the RG 1.97 compliance review and other upgrade requirements (e.g., environmental qualifications and fire protection) may be analyzed. Some solutions to HEDs may not involve hardware changes but may be attained through training, SPDS, or procedures.

A final DCRDR report shall be provided for submittal to the NRC at the conclusion of the assessment phase. The final report will include a description of review methodology, all identified HEDs, and proposed corrective actions. The report will also provide justification for HEDs that are to be left uncorrected or partially corrected.

Section 3.0 provides a detailed technical approach to Phase III, Assessment activities.

1.7.3 Phase IV: Correction and Implementation Phase

Modifications required to resolve significant HEDs will be implemented through the existing FPC engineering change process and by normal line organizations - not the DCRDR team.

1.8 Schedule

Figure 1-2 presents the project schedule. This schedule conforms to the FPC commitment to Supplement 1 to NUREG-0737.

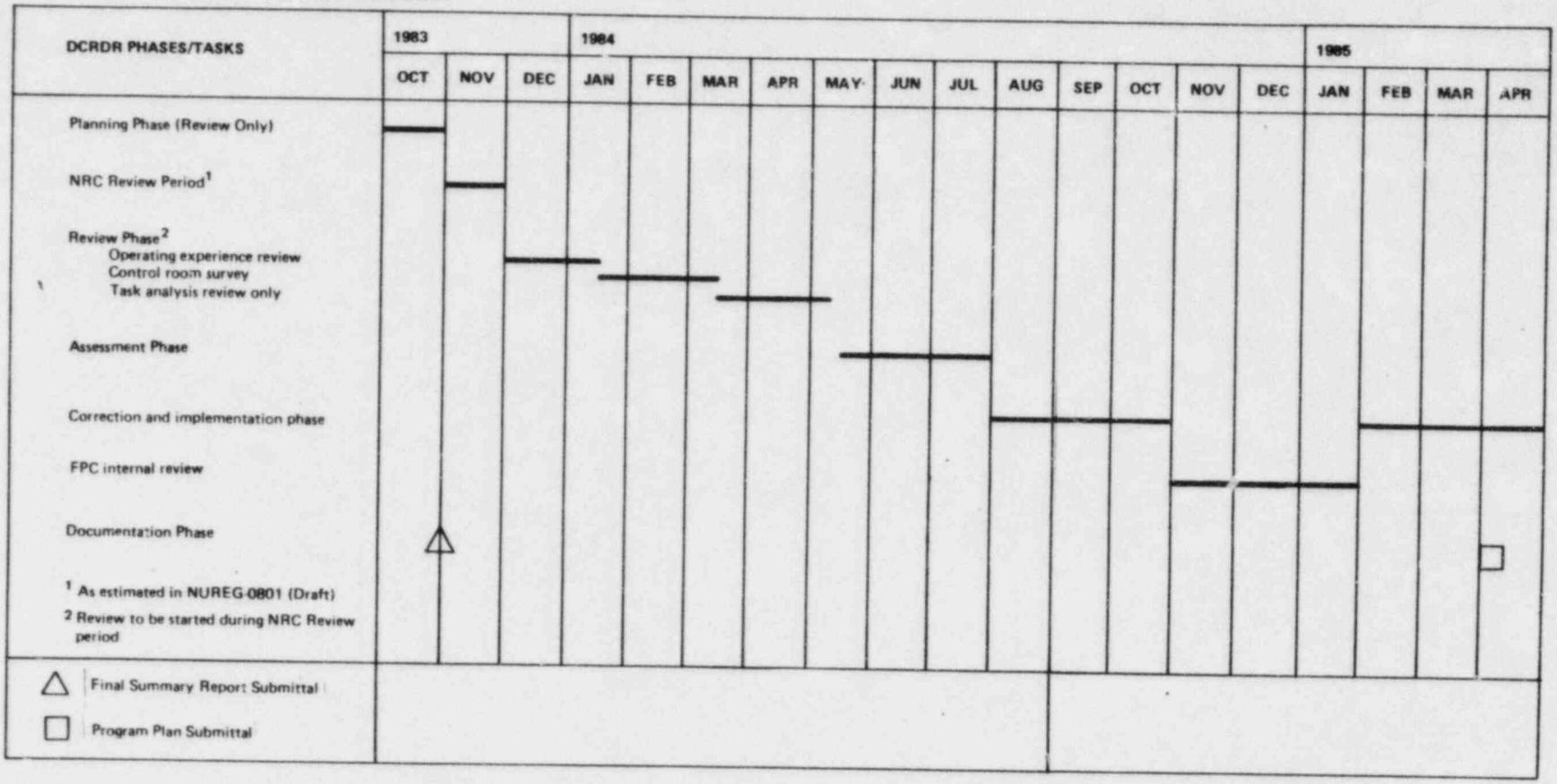

Figure 1-2 Project Schedule

1.9 Project Organization and Management

1.9.1 Project Organization

Figure 1-3 is a simple illustration of the proposed organization for the DCRDR. As is indicated in the detailed description of the DCRDR Review Phase (Section 2.0), each activity will require a different mix of engineering disciplines, operational expertise, and human factors expertise. General Physics Corporation will provide human factors and additional consulting expertise to the review team as needed during the project.

1.9.2 Project Management

Mr. C. B. Doyel is the DCRDR Project Manager. He is responsible for the development and implementation of all phases of the DCRDR and for the documentation and reporting of results. As required, he will coordinate DCRDR activities and other ERC initiatives. For all contract work, he will serve as the contract technical monitor.

1.10 Data Management

Data management includes (1) documents employed and/or generated during the DCRDR, and (2) data generated during the project. Section 6.0 describes the document control procedures for managing both.

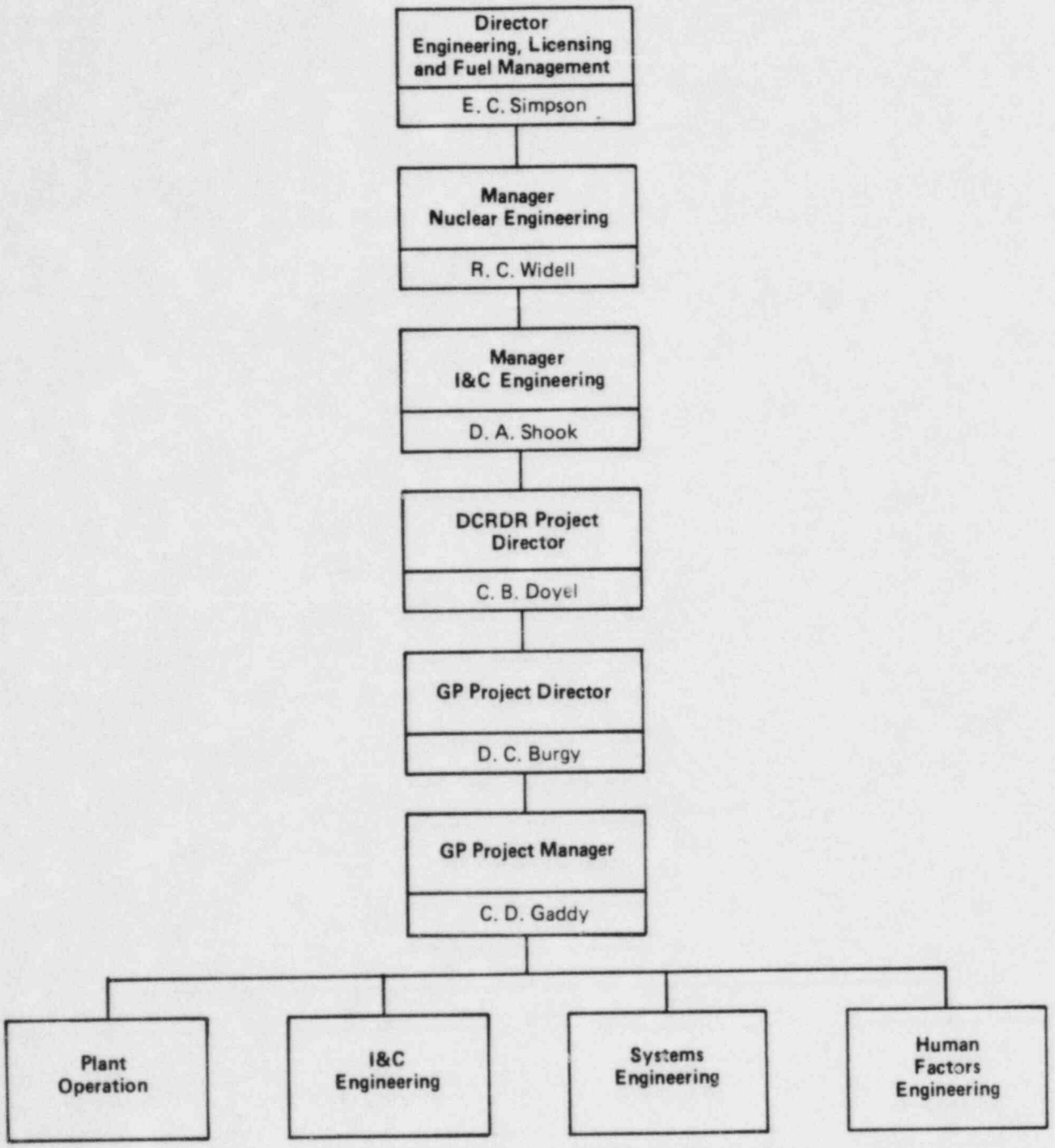

Figure 1-3 Project Organization

SECTION 2.0 REVIEW PHASE

This section contains a detailed description of the requirements or status for each of the activities in Phase II of the DCRDR and the methodology to be implemented in meeting those requirements. Phase II consists of the following six activities:

1. Operating experience review
2. Control room survey
3. System function review and task analysis
4. Verification of task performance capabilities
5. Validation of control room functions
6. Compilation of observations

For each of these activities, the following information is provided:

1. Purpose
2. Scope for CR3
3. Procedures
4. Description of results
5. Relation to other emergency response capability initiatives
6. Reference material
7. Documentation requirements
8. Equipment requirements
9. Operational constraints

2.1 Operating Experience Review

2.1.1 Purpose

A review of plant operating experience will be conducted to identify human engineering observations (HEOs). The review of operating experience will consist of an analysis of utility documents, such as LERs, UOERs, and a survey of plant operating personnel.

2.1.2 Scope for CR3

This task will be performed as part of the CR3 DCRDR. The data from both the review of transient documentation and the operator interviews are necessary to a complete DCRDR.

2.1.3 Procedures

Operating experience review procedures include (1) document review and analysis, and (2) operator interviews.

2.1.4.1 Document Review and Analysis

Plant documents will be reviewed to identify and document human engineering observations associated with operating events. The following documentation is to be reviewed.

- Licensee Event Reports (LERs)
- Unplanned Operating Event Reports (UOERs)

Emphasis of the review will be on operator actions that caused or resulted from the event. Historical Documentation Review forms will be used to summarize the event (see Figure 2-1). Operator corrective actions which have been proposed or made in the control room to reduce the probability of recurrence of the event will be verified. Human engineering observations unresolved as a result of these actions or created by modifications to the operator-control board interface will be identified and documented on HEO forms.

2.1.4.2 Operator Interviews

A questionnaire (see Appendix A) will be given to a majority of control room operating personnel in advance of the interview so that information can be collected and interview questions can be finalized. Then, a sample of approximately 50% of control room operating personnel will be interviewed in

HISTORICAL DOCUMENTATION REVIEW
HED Candidate Summary

LER _____ Other (specify) _____

Report Number: Report Date: Occurence Date:

Error Categorization: Work Station:

Instruments Involved: Procedures Involved:

Major Systems Involved:

Identification of Occurrence:

Summarize Events Preceding Occurrence:

Summarize Events During Occurence:

Summarize Consequences of Occurrence:

Identification of Probable Cause:

Corrective Action Taken/Proposed:

Additional Recommendations:

Figure 2-1 Historical Documentation Review Form

order to obtain first-hand data on plant-specific human factors issues. The sample of personnel to be interviewed includes licensed reactor operators, senior reactor operators, shift technical advisors, and supervisors, each representing varying levels of experience. Interviews with plant personnel will be scheduled to minimize interference with work schedules.

The results of the survey will be used in several ways. First, when examined in light of human engineering performance criteria, potential human engineering observations may be identified. Second, operating problems and control room procedures may be identified as areas to be investigated during subsequent phases of the DCRDR. Third, operating problem areas that are identified may serve as inputs to the specification of other emergency response capability initiatives such as SPDS, EOPs, and training. Fourth, operating personnel may have found low cost solutions or alternatives to problem areas. Fifth, solutions to operating problems may have general application and help resolve problems in other areas.

2.1.5 Results

Results will be in the form of recorded HEOs and statistical descriptions of responses as appropriate.

2.1.6 Relation to Other Emergency Response Capability Initiatives

The interviews may yield operator opinions of procedures, training, and staffing as well as judgements regarding the adequacy of displays and controls.

2.1.7 Reference Material

- Questionnaire and format
- HEO forms

2.1.8 Documentation Requirements

Task documentation will consist of the following:

- Completed interview forms
- List of documents reviewed
- HEO forms
- Historical documentation review forms

2.1.9 Equipment Requirements

None.

2.1.10 Operational Constraints

Completion of operator interviews is contingent upon availability of plant operations personnel. Interviews will be scheduled to minimize disruption of normal operating duties of utility personnel.

2.2 Control Room Survey

2.2.1 Purpose

The control room survey will be conducted to ascertain whether or not the control room design meets the human engineering guidelines presented in Section 6 of NUREG-0700.

2.2.2 Scope for CR3

The NUREG-0700 survey criteria will be addressed at CR3. The checklist used in the survey will reflect each of the applicable items.

2.2.3 Procedures

The control room survey will be conducted through the use of a human engineering checklist. The checklist will represent all applicable guideline items of NUREG-0700 Section 6.0, which cover the following general areas:

- Control room workspace
- Communications
- Annunciator warning systems
- Controls
- Visual displays
- Labels and location aids
- Process computers
- Panel layout
- Control-display integration

Various ambient measurements will be taken in addressing those guidelines concerning the control room environment. Illuminance and luminance measurements will be taken in an overall lighting survey. Sound level measurements will be taken in a control room-wide noise survey. Temperature and humidity measurements will be recorded as part of this environmental assessment. Where possible, these measures will be recorded when the plant is operational.

2.2.4 Results

The result of the control room survey is a body of data collected in checklist format as well as recorded on HEO forms. HEOs identified as a result of the control room survey will be entered into the database management system. The control room survey results provide another assessment of how control room design features adhere to accepted human engineering practices and conventions. The results from previous human factors reviews (i.e., FPC/INPO Pilot and Essex Study) will be compared against these results to check survey results.

The control room survey will also define the human factors design basis for the control room (i.e., conventions, principles, acceptance criteria). A specific output of this task is a list of the design conventions and criteria.

2.2.5 Relation to Other Emergency Response Capability Initiatives

The design basis for SPDS will be considered in evaluating HEOs and HEDs during the Assessment Phase.

2.2.6 Reference Material

- NUREG-0700
- NUREG-0801
- Bills of Materials
- Cut-out Drawings

2.2.7 Documentation Requirements

- Completed checklists
- Control room photographs of identified HEOs or potential HEOs
- Design basis conventions and criteria

2.2.8 Equipment Requirements

In addition to the checklists mentioned above, equipment items for recording environmental measurements will be necessary. This may include the following:

- Anemometer
- Thermometer
- Hygrometer
- Angle finder
- Protractor
- Ruler
- Sound level meter

- Tape measure
- Torqueometer
- Spot photometer
- Illuminance meter

A full-scale photographic mockup of the Crystal River-3 control room will be used during this task to supplement survey work performed in the control room.

2.2.10 Operational Constraints

- Outage schedule
- Availability of plant operations specialist

2.3 Systems Function and Task Analysis

2.3.1 Purpose

The purpose of the system function review and task analysis portion of the Detailed Control Room Design Review is to determine the input and output requirements of the control room crew for emergency operation and to ensure that required systems can be efficiently and reliably operated under the conditions of emergency operation by available personnel.

2.3.2 Scope for CR3

The activities which normally comprise the system function review and task analysis for the DCRDR are:

- Identification of systems
- Preparation of system function descriptions
- Identification and analysis of operator tasks

These activities were completed as part of the EOP upgrade program at CR3, and were limited to systems and tasks associated with emergency operation in accordance with Supplement 1 to NUREG-0737.

2.3.3 Procedures

Since the system function and task analysis has been completed as part of the development of upgraded EOPs at CR3, General Physics and FPC team members will only review the output documentation from the EOP upgrade program at CR3 and make a determination if any further work is required.

2.3.4 Results

The results of the systems function and task analysis effort will be a description of the input and output requirements of the control room crew for emergency operation. The task analysis data will be evaluated in the DCRDR Verification and Validation steps described in the next sections. HEOs identified as a result of the systems function review and task analysis will be entered into the database management system.

2.3.5 Relationship to Other Emergency Response Initiatives

The upgraded EOPs and ATOGs will be used as the basis for the systems function review and task analysis.

2.3.6 Reference Material

- B&W ATOGs
- CR3 Plant-specific EOPs
- CR3 EOP Validation Procedure

2.3.7 Documentation Requirements

- Documentation of Task Analysis

2.3.8 Equipment Requirements

None.

2.3.9 Operational Constraints

Completion of the systems function and task analysis is contingent on availability of personnel and the EOP V&V upgrade schedule.

2.4 Verification of Task Performance Capabilities

2.4.1 Purpose

The purpose of this task is to verify the availability and human engineering suitability of the information and equipment present in the control room for individual operator task performance.

2.4.2 Scope for CR3

The verification of task performance capability is composed of (1) verification of the availability of the instrumentation and controls associated with emergency operations, and (2) verification of the human engineering suitability of the identified instruments and controls. The verification of availability will be performed as a part of the EOP V&V program and the results will be reviewed by the team to determine if any further work is required for the DCRDR purposes. The verification of human engineering suitability will be accomplished during the control room survey and the task analysis phases.

2.4.2.1 Results

The results of the verification of task performance capabilities effort will be a compilation of HEOs related to the availability and/or suitability of the instrumentation and controls present in the control room.

2.4.2.2 Relation To Other Emergency Response Capability Initiatives

The upgraded EOPs and ATOGs will be used as an input to the verification of task performance capabilities.

2.4.2.3 Reference Material

- Completed TA forms
- B&W ATOGs

2.4.2.4 Documentation Requirements

- HEO forms

2.4.2.5 Equipment Requirements

None.

2.4.2.6 Operational Constraints

- Availability of plant operations specialist
- EOP Upgrade V&V Schedule

2.5 Validate Control Room Functions

2.5.1 Purpose

The purpose of this task is to determine the ability of the operating crew to execute control room emergency functions with the existing control room design and emergency operating procedures.

2.5.2 Scope for CR3

The validation of control room functions will be accomplished as a part

of the EOP V&V program and the results will be reviewed by the team to determine if any further work is required for DCRDR purposes.

2.5.2. Results

The results of validation of control room functions will be a compilation of HEOs related to the ability of the operating crew to execute control room emergency functions using the existing control room design and upgraded EOPs.

2.5.2.2 Relation To Other Emergency Response Capability Initiatives

The upgraded EOPs and ATOGs will be used as an input to the validation of control room functions.

2.5.2.3 Reference Material

- Task Analysis Data
- B&W ATOGs
- CR3 EOPs

2.5.2.4 Documentation Requirements

- HEO Forms

2.5.2.5 Equipment Requirements

None.

2.5.2.6 Operational Constraints

- Availability of Plant Operations Specialist
- EOP Upgrade V&V Schedule

2.6 Compile HEOs for Assessment

2.6.1 Purpose

The purpose of this task is to assemble all HEOs for assessment.

2.6.2 Scope for CR3

HEOs will be derived from various sources as outputs of the data collection processes 2.1 to 2.5. These will be compiled in accordance with the data management plan for easy access during the formal assessment phase.

2.6.3 Procedures

HEOs will be compiled in accordance with the data management plan coding system, as described in Section 6.0. HEOs will be sorted and reviewed for inconsistency or redundancy. HEOs will be compiled by human engineeirng guidelines reference (from Section 6, NUREG-0700).

2.6.4 Results

The results of this task will be a compilation of HEOs from all data collection processes in a form easily used for the assessment activities described in Section 3.0 (see Figure 2-2).

2.6.5 Relation to Other Emergency Response Capability Initiatives

Compiled HEOs will be used as inputs for the assessment and implementation phase.

2.6.6 Reference Material

- NUREG-0700

2.6.7 Documentation Requirements

- HEO forms

* HUMAN ENGINEERING DISCREPANCY RECORD * PLANT: PAGE:

REVIEWER: DATE: 03/02/82 NO.:

PANEL IDENTIFIER * COMPONENT IDENTIFIER

SECTION CODE: 5. DISPLAYS *** GUIDELINE NO.: 6.5.1.5a-1

DESCRIPTION OF DISCREPANCY:

HED CATEGORY CODE: 1___ 2___ 3___ 4___ LEVEL: A___ B___ C___ D___

IMPLEMENTATION SCHEDULE:

RECOMMENDATIONS:

COMMENTS/JUSTIFICATION FOR NON-CONFORMANCE:

Figure 2-2. Sample HEO Form

2.6.8 Equipment Requirements

- Computerized database management system

2.6.9 Operational Constraints

None.

Section 3.0 ASSESSMENT PHASE

This section contains a detailed description of the activities constituting the Phase III, Assessment, activities. These activities are (1) evaluate HEOs and identify HEDs, (2) assess HEDs, (3) identify, select, and evaluate corrective action, and (4) prepare a summary report, including the implementation plan. This phase will fulfill the requirements set forth in NUREG-0737, Supplement 1, and, generally, will follow the guidelines identified in NUREG-0700 and NUREG-0801.

It should also be noted that although general criteria for the evaluation of HEOs and assessment of HEDs are described, the specific criteria will be established during the review phase by the DCRDR team.

3.1 Evaluate HEOs

The purpose of this step is to determine which HEOs among those identified during the review process are significant. An HEO, by definition, represents a potential source of operator error with significant plant operation consequences; safety-related and non-safety related. The term significant has two applications. It is applied to HEOs which have the potential to compromise plant safety, and to HEOs which affect plant operability/availability in a manner unacceptable to plant management. Accordingly, all HEOs of safety importance will be considered significant and categorized as HEDs. Some non-safety-related HEOs of concern to plant management will also be considered significant and categorized as HEDs. Significant HEDs must be analyzed for correction while non-significant HEOs need not be.

To determine significance for those HEOs associated with non-safety-related systems, three actions are required:

1. To estimate the potential of an operator error,

2. To estimate the likelihood of the error being corrected without consequences, and

3. To identify the consequences of the error.

The expertise of the review team will be the basis for rating error potential and impact/consequences of the error. The specific rating procedures and criteria will be developed by the DCRDR team.

3.2 Assess HEDs

The purpose of the HED assessment is to evaluate the nature and severity of operational impact of identified HEDs. HEDs will be assessed on the basis of:

- Safety significance
- Potential for operator error (as determined in HED evaluation)
- Association and identification with previous operating problems or errors

Human engineering discrepancies will be evaluated to determine their implications for procedures and training as well as for plant safety and availability. The objectives of this process are (1) to identify those discrepancies which have potential to negatively affect plant safety or can be associated with high probability for operator error, and (2) to determine what corrective actions are warranted. In addition, the aggregate effects of discrepancies will be analyzed for impact on operator performance and plant safety. The use of the automated database management system for HED records will facilitate this analysis. Discrepancies will be assessed by the review team consisting of human factors engineers, plant operations specialists, instrument and controls engineers, and nuclear engineers.

The prioritization of HEDs is described in the subsections that follow.

3.2.1 Priority I HEDs

Priority I HEDs are those identified with safety-related systems; e.g., normal operating systems for controlling the reactor, primary system, and heat removal equipment or functions, or non-safety-related systems for which misoperation would result in unsafe conditions or violation of technical specifications. Priority I HEDs also include serious hazards or error-likely situations which could lead to plant shutdown, radiation release, or plant conditions which, if not corrected immediately, will result in automatic plant shutdown or radiation release, or will require manual plant shutdown. HEDs associated with systems or equipment classified as safety grade or Class 1E, according to ANSI or IEEE standards, may be classed as Priority I discrepancies.

HEDs affecting availability or operation of any of the following plant systems should be considered Priority I HEDs:

- Engineered safeguards actuation system
- Reactor protection system
- Emergency feedwater system
- Auxiliary systems supporting the above systems
- Systems for monitoring the course of an accident (Regulatory Guide 1.97)
- Systems for monitoring the availability of safety-related systems (Regulatory Guide 1.47)
- High pressure and low pressure injection systems

3.2.2 Priority II HEDs

Priority II HEDs include HEDs representing serious hazards which could lead to technical specification violations, which if not corrected, will require plant shutdown. It also includes HEDs which have a high probability for operator error, which if not corrected, may lead to plant shutdown or radiation releases. These HEDs may involve non-safety-related or balance-of-plant (BOP) systems associated with power generation.

3.2.3 Priority III HEDs

Priority III HEDs are those which represent less serious hazards with low probability for operator error or plant conditions representing problems (e.g., system degradation) which affect plant operability or availability, but should not lead to plant shutdown, radiation release, or violation of technical specifications. Priority III HEDs may be related to BOP systems not covered under Priority I or II. Priority III HEDs should be scheduled for long-term implementation of corrective action.

3.2.4 Priority IV HEDs

Priority IV HEDs are HEDs not affecting plant availability, with little or no potential for operator error or hazard, but which deviate from accepted human factors engineering guidelines or practice. These HEDs are candidate for long-term corrective action or no corrective action, based on cost-effectiveness analyses.

Interactive effects of HEDs should be considered at all levels of priority, since a lower priority HED may interact with or impact a higher priority HED, and thus warrant higher priority for corrective action. Aggregate effects of HEDs impacting several systems, some of which may be safety-related, should all be classified with the higher priority.

An important input to the process of assessing the significance of HEDs will be the control room requirements as defined from system and task analyses. These requirements for task performance and system functions will be used as benchmarks for evaluation of the significance of HEDs. Additional considerations for assessing HEDs are the role of identified HEDs in documented operating problems, as determined from a review of plant or industry reports, operator interviews, or observation of operator-instituted control room enhancements.

3.3 Corrective Actions Selected

3.3.1 Purpose and Scope

Human engineering discrepancies selected for correction must be further evaluated to determine the preferred method of correcting the discrepancies. The process of selecting and verifying corrective actions includes identification of alternative solutions and their implications for training, procedures, crew structure and management as well as costs and benefits of control room modifications. Selection of corrections for HEDs also includes consideration of criteria such as system availability, reliability, safety and operational input of alternative means of correcting HEDs.

The scope of this activity will include coordinating with other upgrade/modification implementations such as R.G. 1.97, 10 CFR 50, Appendix R, and environmental qualifications. By integrating these efforts, FPC can more efficiently design and implement necessary changes and ensure that modifications made to correct human engineering problems do not violate other standards or criteria.

3.3.2 Procedures

The procedure for implementing this activity involves three steps. First, corrective actions are identified. Second, if the proposed corrective action requires control room modifications, then prior to implementation, it must undergo verification and validation. Third, the results of this activity will be a part of the DCRDR Report if feasible within the time frame of the DCRDR final report submittal.

The following subsections describe the first two steps.

3.3.2.1 Identification of Corrections

Alternative means of correcting HEDs to be considered and evaluated include:

- Operator training modifications
- Operator aids (e.g., SPDS, computer aids)
- Control room modifications
- Procedures modifications
- Operating crew/staffing changes
- Enhancements

Proposed corrective actions should conform to human engineering practice as described in NUREG-0700, Chapter 6. Interactive and aggregate effects of proposed corrections will be considered in order to prevent introducing any new discrepancies. Proposed modifications will be integrated with the existing control room configuration in order to enhance operator effectiveness and performance of tasks and functions. Operator recommendations from interview data will be considered and evaluated.

Some discrepancies may be corrected fairly quickly and simply by enhancement techniques. Examples of surface enhancements include application of paint and labels for functional demarcation, improving annunciator legends, or enhancing control-display arrangements with mimics.

3.3.2.2 Verification/Validation of Proposed Changes

Some corrections for HEDs may involve physical changes to the control room configuration. Proposed corrective actions will be evaluated prior to implementation. Validation of design solutions may include walkthroughs of operating procedures to assure compatibility with function and task requirements and to assess operator performance and response related to each proposed correction.

There may be some HEDs for which corrective action is not warranted on the basis of safety, reliability, cost-effectiveness or other considerations. These instances will be documented.

3.4 Summary Report

Upon completion of the Assessment Phase, a detailed summary of the results will be prepared and submitted to the NRC for review. The final report will summarize the review process, provide descriptions of the identified HEDs, detail proposed corrective actions and present implementation schedules for each action.

The summary report will identify the personnel who participated in the Control Room Design Review and delineate their qualfications. It will also indicate any modifications or revisions made to the program plan submitted to the NRC. Details of the DCRDR, along with complete documentation, will be available for NRC evaluation and review.

Findings of the DCRDR in the form of HEDs will be organized according to NUREG-0700 guidelines. 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. Identified design improvements, whether safety-related or not, will be described.

When scheduling corrections, the following major items will be considered:

- Plant outage schedule (e.g., refueling)
- Manpower requirements
- Integration of corrections with other planned station design changes
- Integration of corrections with training requirements for those changes
- Development of procedural changes
- Requirements for engineering, purchasing, installation, and testing

Developing a schedule for HED corrections is a separate and distinct task from HED prioritization. Many corrections can be implemented quickly regardless of their assigned priority. Corrections for some of the highest priority HEDs may require a good deal of time for engineering design, purchasing, and installation. If the safety significance of such an HED is determined to be high, an interim temporary correction will be considered to reduce the priority of the ultimate change.

SECTION 4.0 CORRECTION AND IMPLEMENTATION PHASE

Modifications required to resolve significant HEDs will be implemented through existing FPC engineering change processes and will be the responsibility of normal line organizations. The schedule for corrections and implementation will be based on plant operational constraints.

In order to ensure adequate human factors considerations for control room changes that are considered after the DCRDR is completed, a procedure will be established as part of the FPC engineering procedures, that provides for a general human factors review. The procedure, based on the design basis established during the DCRDR, will include completing a human engineering checklist.

SECTION 5.0 REVIEW TEAM ORGANIZATION

5.1 Review Team Staffing and Qualifications

The DCRDR team will consist of a core group of specialists for performing the review activities described in Section 2.0. As a minimum, the disciplines represented on the review team will include human factors engineering, plant operations (reactor operator/senior reactor operator), systems engineering, and instrumentation and controls engineering. Other subject matter experts, e.g., mechanical or electrical engineers may be required to assist in selected activities. The qualifications of personnel will comply with those qualifications specified in NUREG-0801.

5.2 Review Team Structure

The structure of the review team will vary for different DCRDR activities described in Section 2.0 due to different demands of the technical tasks and the resources needed by the team.

5.3 Review Team Responsibilities

The DCRDR Project Manager is responsible for reporting the results of the review to upper management.

All review team staff members will report directly to the Project Manager during review activities. Each team member is free to document dissenting opinions when review team consensus cannot be achieved during any activity. Review team members will assist with assigned activities at the direction of the team leader.

SECTION 6.0 INFORMATION MANAGEMENT

A method for controlling document input and output will be implemented. The information handling system will take the following into account:

- Document Requirements
- Document Control
- Record Requirements
- Record Control

Document requirements and document control refer respectively to the necessary, FPC-supplied information and the procedures for handling this information transfer. Record requirements and record control refer to the actual data collected during the conduct of the DCRDR tasks; that is, the data to be collected and the method for handling this data.

6.1 Document Requirements

A large amount of documentation will be required to conduct a DCRDR. A structured method, therefore, is needed to control this information. The documentation integral to the DCRDR process consists of a compendium of input documents as well as subsequent output documents.

6.1.1 Input Documents

In order to initiate and conduct a DCRDR, the following documentation may be necessary during the course of a review:

- LERs
- UOERs, TAPs
- Outage Analysis Reports
- Systems Description
- Piping and Instrumentation Drawings
- Control Room Floor Plan
- Panel Layout Drawings

- Main Control Board Bill of Materials and Equipment List
- Panel Photographs
- A List of Acronyms and Abbreviations Used in the Control Room
- Description of Coding Conventions Used in the Control Room
- Software Descriptions; i.e., CRT Formats and Content
- Computer Print-Out Samples
- Procedures
- Operator Training Materials
- Any Previous Human Factors Control Room Assessment
- Guidelines for Procedure Writing
- Anticipated Transient Operating Guidelines
- I&C Lists for the Control Room, Back Panels, and Remote Shutdown
- Annunciator and Label Engraving Lists
- Communications Procedures & Manuals
- SPDS Design Basis

6.1.2 Output Documents

Throughout the review process, a number of documents will be produced during different DCRDR phases including:

- Program Plan
- Operator Questionnaire and Interview Format
- Historical Documentation Forms
- Task Analysis Data
- Completed Checklists
- List of HEDs
- Final Report

6.1.3 Document Control

A procedure for transferring the input and output documentation discussed in the preceding sections is needed. The following procedures will be implemented by General Physics consultants:

- Log-in Procedure Designation:
  - document title
  - document revision
  - date received
  - distribution list

- Internal Routing Procedures with Memorandum Providing:
  - document date
  - document title
  - document revision
  - distribution list for signature and return

- Log-Out Procedure Designating:
  - document title
  - document revision
  - date sent
  - distribution

A document receipt/distribution log is shown in Figure 6-1.

6.2 Database Management System

A computerized database/management (DBMS) for the CR3 DCRDR review will be used to track HEO/HED data on a PRIME computer. The DBMS software is based on the INFORMATION software provided by PRIME and on the SEEK software developed by General Physics for utility clients.

The software allows input, editing and retrieval of HEO/HED data. The database allows smooth management and tracking of the DCRDR review findings and results. The HED file provides the ouptut form that will be used in the final DCRDR report documentation.

DOCUMENT RECEIPT/DISTRIBUTION LOG

Document Category: **Project:**

Date Received	Document Identification	Revision	Description/Remarks	Distribution		Recall — Dates	
				To:	Date	Notice	Received

Figure 6-1 Document Receipt/Distribution Log

APPENDIX A

OPERATOR QUESTIONNAIRE

#_____

Operator Questionnaire

As part of the human factors control room design review, you are asked to complete this questionnaire. The information provided by operations personnel is an important contribution to the design review. Your responses will be given serious consideration. Please answer each question as completely as possible.

To aid us in our record-keeping and analysis, please fill in the following information.

Date: _____

Number of years or months (specify which) you have been a licensed operator: _____

Number of years or months (specify which) you have been a trainee: _____

Present job title: _____

Name: _____

We will need your name to follow up on your comments if we need more specific information.

WORKSPACE LAYOUT AND ENVIRONMENT

1. What aspects of the control room workspace, furniture and equipment make your job hard to do?

   What are your suggestions for improving each of those?

2. What problems are there in the control room with color coding or labeling? Please be as specific as you can.

3. What areas of the control room have inadequate lighting?

4. Have you ever seen the use of the emergency lighting? (circle one) Yes No ?
If yes, what aspects of it were inadequate?

5. Is heating/ventilation adequate? Yes No
If no, please explain.

6. What would you change in your work environment to reduce stress, fatigue, or boredom? Be specific if you can:

Which of these recommended changes are significant enough, in your opinion, to reduce the likelihood of operator error?

7. Which (if any) noise levels are particularly high? Is communication between operators made difficult as a result of high noise levels?

8. Are there any special problems in operating panels/systems that make your job difficult (for example, layout, location, etc.)? Please explain and indicate panel or system to which you are referring.

What would you change about this to make your job easier or more effective?

9. What unsolved or repeated problems have you had with the maintenance or repair of panels? Please be specific.

10. On what systems or panels would more practice or training be useful, and why?

Additional Comments and Recommendations:

CONTROLS

11. Which controls do you think are difficult to find or access? Please be very specific.

12. Which controls are poorly designed or built for handling or operating, and why?

13. Which controls are most likely to be operated in error, and why (for example, due to location or label, etc.)?

14. Which controls, not currently in the control room, are needed to respond to normal or emergency situations?

15. Are there any controls on back panels that should be on front panels or vice-versa? Please be specific.

Additional Comments and Recommendations:

DISPLAYS (Excluding CRT Displays, Including Meters, Recorders, Indicator Lights)

16. Which displays are hard to locate or access? Please explain.

17. Which displays are difficult to read, and why?

18. Which important indicators are difficult to see during normal or emergency operation, and why?

19. Which control room displays are unnecessary?

20. What displays, not now in the control room, are needed to respond to normal or emergency situations?

Additional Comments and Recommendations:

ANNUNCIATORS

21. How can the annunciators be improved (e.g. content of legend, hardware, etc.)?

22. On what panel(s) does the placement of individual annunciators not follow a logical pattern?

23. Identify annunciators that are difficult to interprete or do not help diagnose a problem.

24. Identify annunciators that alarm too late to allow operator action.

25. Identify nuisance alarms.

Additional Comments and Recommendations:

COMMUNICATIONS SYSTEM

26. Is more or better communication equipment needed in the control room?
Yes No If yes, please explain.

27. Are verbal messages in the control room ever unclear? Yes No
If yes, please explain.

COMPUTER SYSTEM

28. Is the computer useful in providing you accurate, timely and easily usable data regardng important system parameters under normal, abnormal, and emergency conditions? Yes No If no, please explain.

29. Is the computer difficult to use in retrieving important system data? Yes No If yes, please explain.

Additional Comments and Recommendations:

CRT DISPLAYS

30. Are there problems with any of the following characteristics of the CRT displays?

a. visibility (glare or location)	yes	no
b. image quality	yes	no
c. coding (for example, color, symbol)	yes	no
d. organization of call-up displays	yes	no
e. format of displays	yes	no
f. response time	yes	no
g. keyboard (or other entry techniques)	yes	no

If you answered "yes" to any of the above, please explain as specifically as possible.

Additional Comments and Recommendations:

CORRECTIVE AND PREVENTIVE MAINTENANCE

31. Is the control room preventive maintenance program effective? Yes No
Are the maintenance procedures effective? Yes No
If no to either of the above, please explain.

Additional Comments and Recommendations:

PROCEDURES

32. Can you find the procedure binder you need when you need it? Yes No
Can you easily find the specific procedure or procedural step you need? Yes No
If no to either of the above, please explain.

33. Which specific procedures are so unclear that portions of them should be rewritten, and why?

Additional Comments and Recommendations:

STAFFING AND JOB DESIGN

34. What problems of control room shift staffing interfere with smooth, continuous system operation?

35. Under what circumstances are individual responsibilities and chain-of-command not clearly understood, and how could this be improved?

36. What duties are you required to perform that you consider unreasonable or distracting in your primary responsibility as SRO or RO?

37. What administrative procedures do you think could be implemented more efficiently (e.g. shift change, control room access)?

38. In off-normal situations, describe any workload problems you have encountered:

TRAINING

39. What items of real importance should you have known that you did not when you began working as an operator?

40. What could have been done to make your training more effective?

41. In what areas would refresher training be helpful for more effective operation?

42. In what technical or skill areas would additional training be helpful?

Additional Comments and Recommendations:

GENERAL

43. If you have any additional comments that have not been covered elsewhere, please note them in the space below.