Detailed Control Room Design Review
Program Plan

New York Power Authority
Indian Point 3 Nuclear Power Plant
Docket No. 50-286

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SECTION 1. INTRODUCTION

The Detailed Control Room Design Review (DCRDR) is part of a broad effort within the industry and the NRC to upgrade control rooms, emergency response facilities and procedures. On December 17, 1982, the Nuclear Regulatory Commission (NRC) issued Generic Letter No. 82-33, entitled "Supplement 1 to NUREG-0737 - Requirements for Emergency Response Capability." This NRC letter provides additional clarification of the fundamental requirements for Safety Parameter Display Systems, Detailed Control Room Design Reviews, Regulatory Guide 1.97 (Revision 2), Upgrade of Emergency Operating Procedures, Emergency Response Facilities and Meteorological Data. Section 5 of the letter provides the requisite ingredients for performing a Detailed Control Room Design Review (DCRDR) to "improve the ability of nuclear power plant control room operators to prevent or cope with accidents". Following the guidance found in the NRC letter and other industry guidance documents, this Program Plan has been developed to describe the manner in which the New York Power Authority (NYPA) intends to conduct the DCRDR for the Indian Point 3 Nuclear Power Plant. Although the DCRDR is directed at the existing control room design, it is recognized that other emergency response activities need to be coordinated with the DCRDR effort. Therefore, this program plan will also address the integration and coordination of the other NUREG-0737 Supplement 1 activities as they relate to the DCRDR effort.

The scope and schedule of the DCRDR are described in Section 1. The plan for managing and staffing the DCRDR is described in Section 2. The anticipated input and output documentation and the procedures for controlling both are contained in Section 3. The specific methodology for performing the DCRDR is described in Section 4. A systematic approach for assessing human engineering discrepancies (HEDs) that are identified as a result of the review procedures are described in Section 5. The final summary report and ongoing human factors procedures are detailed in Section 6.

The Program Plan, by definition, is flexible and subject to revision as the stages of the DCRDR progress. Since the Program Plan serves as input documentation to the review process, the original document and subsequent

revisions will be controlled in accordance with the procedures described in Section 3.

1.1 Purpose

The purpose of the Program Plan is to ensure that the DCRDR satisfies government and industry requirements, the results are understandable and usable, and the benefits of human factors engineering are reflected in the control room design. Since the DCRDR process is rather involved and at times complex, the Program Plan also documents the review process, providing traceability of both the methodologies and the results of the DCRDR.

1.2 Scope

The scope of the DCRDR shall consist of:

- Review of input documentation, including any applicable operating experience data, plant design information, and applicable standards and regulations.

- A survey of the control room to compare the control room design with accepted human engineering guidelines as contained in INPO 83-042 (NUTAC), "Control Room Design Review Survey Development Guideline." The IP-3 Control Room Layout and Panels are illustrated and described in Appendix D.

- A task analysis of selected IP-3 Specific Emergency Operating Procedures (EOPs). The upgraded EOPs will be based on the Westinghouse Owners Group Emergency Response Guidelines. However, since the final version of the EOPs will not be available for the DCRDR task analysis, the first draft version of the EOPs will be utilized. The plant specific task analysis will include the identification and analysis of the requirements of operator tasks in terms of information, decision points and controls/actions for the selected procedures. The plant-specific task analysis will also serve as input into the final version of the EOPs.

- Verification that IP3 instrumentation, controls, and other equipment meet the specific requirements of the tasks to be performed by the operators in carrying out the EOPs.

- Validate that the operators can perform their tasks in the control room to meet emergency response guidelines.

- Assessment of HEDs uncovered in any of the review steps.

- Development of a schedule for HED resolution.

- Development of a final report addressing the integrated activities in the DCRDR.

- Development of a procedure to evaluate the effectiveness of proposed modifications and enhancements which are intended to resolve HEDs.

- Development of a procedure to ensure adequate human factors considerations for all future control room changes.

These items are described in greater detail in Sections 4 and 5. A flow chart depicting the interaction between the various review phases is shown in Figure 1-1. Any terms used in this document are explicitly defined in Appendix A, Glossary of Terms.

1.3 Schedule

A schedule of the major tasks in the DCRDR process is shown in Figure 1-2.

The final summary report of the IP3 DCRDR will be available within six (6) months of completion of the Assessment and Implementation phase.

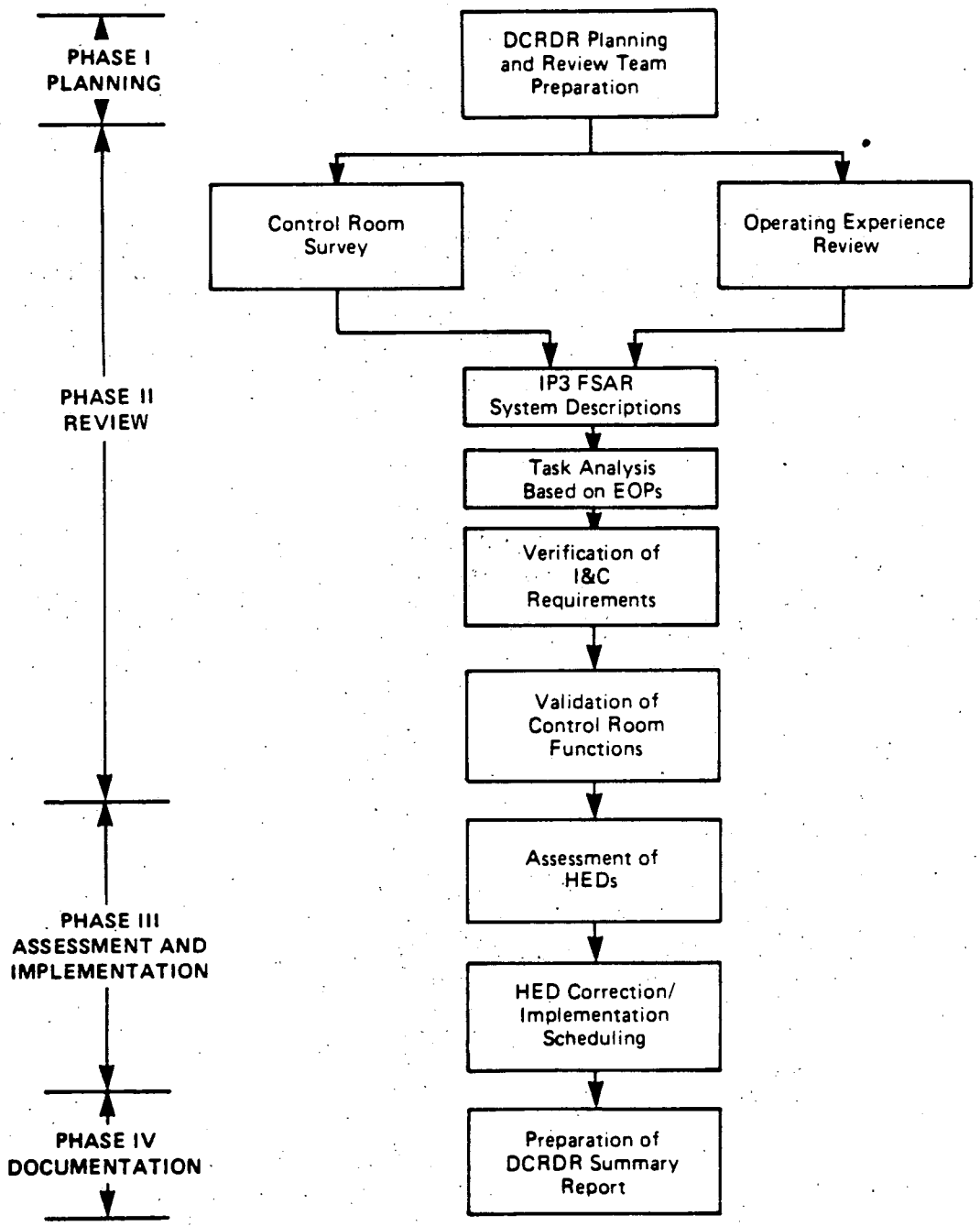

Figure 1-1. Flowchart of DCRDR Activities

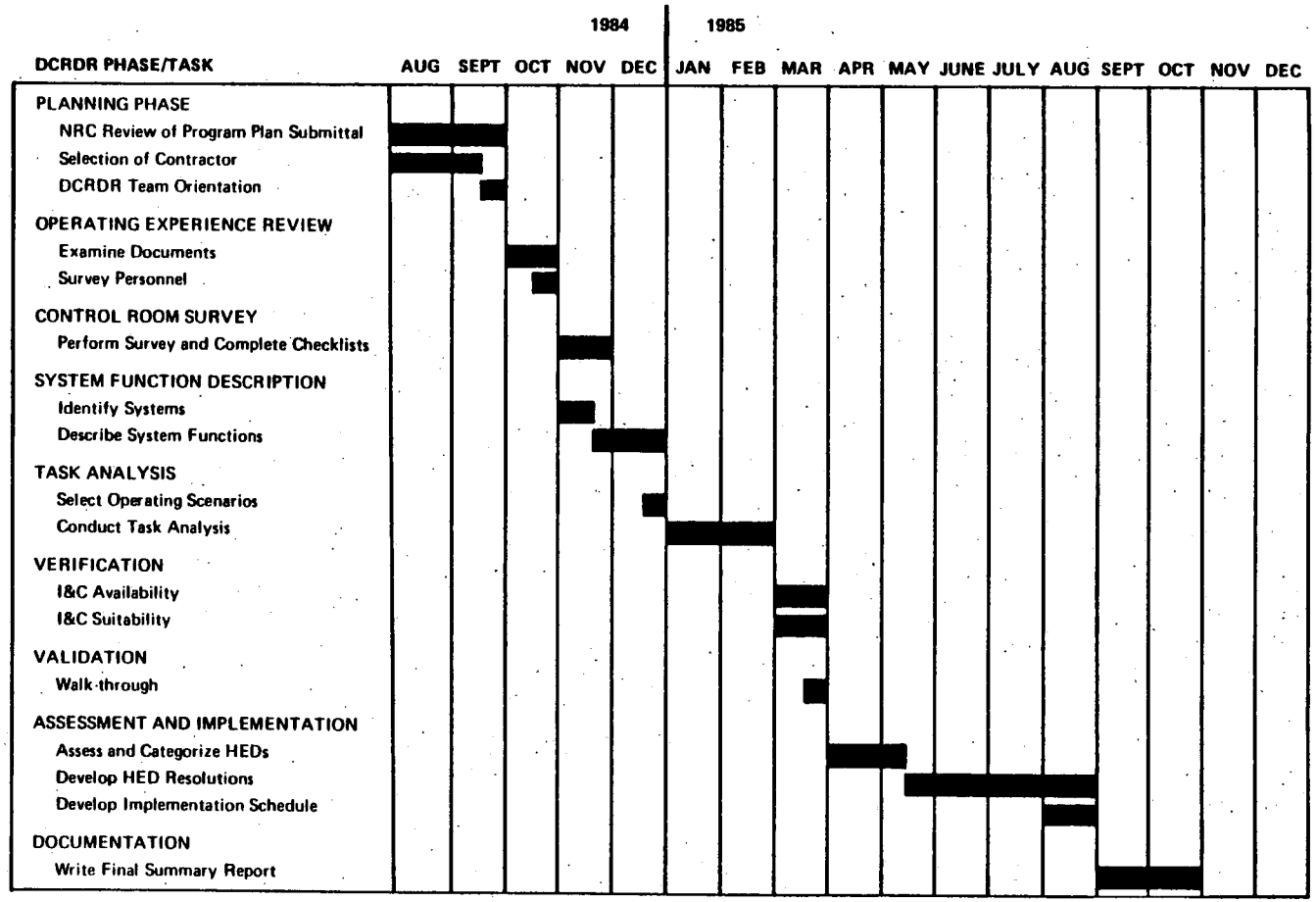

Figure 1-2. Schedule of DCRDR Activities

SECTION 2. MANAGEMENT AND STAFFING

This section of the DCRDR Program Plan addresses the management and staffing aspects of the review. Section 2.1 describes how the review process will be managed. Section 2.2 describes the structure of the review team. Section 2.3 describes the qualifications of the review team. A discussion of how the DCRDR interfaces with and is integrated into the other emergency response activities is contained in Section 2.4.

2.1 Sequence of the Review Process

An overview of the sequence of events that comprise the DCRDR is contained in this section. The events described include data gathering, analysis and documentation of results. The overview is presented in a sequential manner, although individual events may at times occur concurrently. Detailed methodology for conducting each phase/event of the review process is contained in Section 4, Review Procedures.

A. Select Contractor(s)

1. Prepare Bid Specification
2. Issue RFP
3. Evaluate Proposals
4. Award Contract

B. Initial Meeting

An initial meeting will be held between the Authority and the human factors consultant. The objectives of this meeting are to:

1. Establish review team structure and contacts. During the initial meeting, individuals from both the Authority and the human factors consultant will be identified as members of the DCRDR Team. Specific authority and responsibilities for each team member will be identified and agreed upon. In addition, an individual from both organizations will be designated as the

primary contact for that organization. Reference Section 2.2 for the proposed structure of the design review team.

2. Review and finalize the project schedule. During the initial meeting, members from both the Authority and the human factors consultant will review a proposed project schedule (reference Section 1.3). Specific tasks will be scheduled to permit an uninterrupted work flow for the review team, at the same time minimizing interference with control room operations. The end result will be a schedule extending from the beginning of the review through preparation and issuance of the final report. Time required for design, procurement, installation, and testing of modifications to current HEDs will not be identified until after completion of all survey activities.

3. Gather existing, applicable documentation. A preliminary list of the documentation is provided in Section 3.2.

C. Review Team Orientation

A Human Factors Engienering (HFE) orientation lecture will be presented by the HFE consultant to familiarize the review team members with HFE practices and their application to the DCRDR. Also, the DCRDR objectives and the methodologies to be employed to achieve these objectives will be reviewed.

D. Review Documentation

The documentation that was obtained at the initial meeting is to be reviewed to:

- Prepare for the Operating Experience Review
- Assemble drawings and I&C lists for Control Room Survey
- Obtain information to be used in the Systems Function Review and Task Analysis

E. Conduct Operating Experience Review

The operating experience review (OER) will include:

- Review of plant-specific LERs and selected PWR generic events (e.g., Salem ATWS, NUREG-1000)
- Operator Interviews

The OER will be conducted early in the DCRDR project to allow incorporation of findings in the control room survey and task analysis process. Potential HEDs will be compiled for later verification and assessment.

F. Conduct Control Room Survey

INPO Survey Guidelines will be used. HED's identified during the survey will be documented on HED forms in a computerized database.

G. Describe System Functions and Conduct Task Analysis

A functional description of each plant system is contained in the revised IP-3 Final Safety Analysis Report (FSAR). The FSAR system descriptions will serve as the primary information source for identifying plant systems and associated instrumentation and controls available to the operator for response to plant emergency conditions. The information in the FSAR will be supplemented, as necessary, with other existing plant documentation to ensure that the emergency functions and operations of the systems are adequately defined. These system function descriptions will be used to:

- Identify safety-related and safety important systems
- Summarize the safety-related functions
- Briefly describe how those functions are accomplished through system operation

The system functions reviewed above will serve as the basis for determining the information and control requirements for operator tasks in plant emergency operating conditions.

A task analysis of control room operator tasks will then be conducted for selected events which maximally exercise operator/machine interfaces and systems functions. It is anticipated that the following events will be included:

- Small Break Loss of Coolant Accident
- Inadequate Core Cooling
- ATWS, Following Loss of Offsite Power
- Steam Generator Table Rupture (SGTR)

Additional events or sequences needed to examine the balance of operator tasks for emergency operations will be specified, if needed, during this phase of the review. A complete description of the system function review and tasks analysis procedures is contained in Section 4, Review Procedures.

H. Verification and Validation

The Verification of Task Performance Capabilities will be conducted using the completed task analysis data that has been checked against walk-throughs in the control room. This process of the DCRDR will involve two steps:

- Verification of Availability
- Verification of Human Engineering Suitability

The detailed procedures for conducting the steps are described in Section 4, Review Procedures.

The Validation of Control Room Functions will involve walk-throughs of the selected event sequences identified above. These walk-throughs

will be conducted in the control room. Data collected in the walk-throughs will be added to the task analysis forms to provide a complete description of the operator tasks and information and control requirements needed for emergency operations.

I. Assess HEDs

The HEDs that were identified during the various review processes will be assessed for their safety implications. HEDs identified as having safety implications or potential for safety implications will be categorized, and a resolution and tentative implementation schedule will be recommended.

J. Prepare Final Summary Report

The methodology employed in the DCRDR and the findings that resulted from the review will be documented in a final summary report.

- Effectiveness of proposed control room changes resulting from HEDs - procedure will be developed to evaluate the effectiveness of all proposed control room modifications to resolve HEDs.
- Future control room changes - A procedure will be developed to ensure HFE considerations are incorporated into all future control room changes.

K. Documentation

The documentation used and data collected during the DCRDR will be maintained onsite. Only example data and data forms from the execution phase will be included in the final summary report where appropriate. A complete list of output documentation is described in Section 3.3.

2.2 Structure of the Review Team

Due to the integrative nature of the DCRDR project, the review team will have a core group of specialists in the fields of human factors engineering,

plant operations (e.g. licensed operators), nuclear engineering, instrumentation and controls engineering, licensing, training, Safety Parameter Display Systems and Emergency Operating Procedures. This core group may be supplemented by personnel from other disciplines such as nuclear, mechanical, electrical, and civil engineering if required.

The ultimate responsibility for the Control Room Design Review will reside with the Authority management personnel. The day-to-day conduct of the review, however, will be the responsibility of a review team established specifically for the DCRDR. The review team will provide the management oversight to ensure the integration of the project objectives and to meet the regulatory intent of the review. The review team is responsible for the planning, scheduling, coordinating, and integration of DCRDR activities.

The DCRDR Project Manager will be the key person on the review team. This individual provides the administrative and technical direction for the project. Access to information, facilities and those individuals providing useful or necessary input to the team will be coordinated by the Project Manager. Because of his detailed knowledge of the Authority systems and methods, this individual will provide the cohesive force for the different Authority department individuals and vendor organizations involved with this project.

The review team will include qualified human factors consultant personnel who will be responsible for assigned project work and human factors technical issues and will report directly to the Authority DCRDR Project Manager.

The Licensing engineer on the review team will be responsible for coordinating the DCRDR with the other NUREG-0737, Supplement 1 activities. The DCRDR project manager will be responsible for incorporating planned future control room changes, resulting from other NRC requirements and NYPA capital improvement projects, into the DCRDR. These two individuals will provide important input to the review team especially during the resolution phases of the DCRDR effort.

A diagram showing the DCRDR team organization is provided in Figure 2-1.

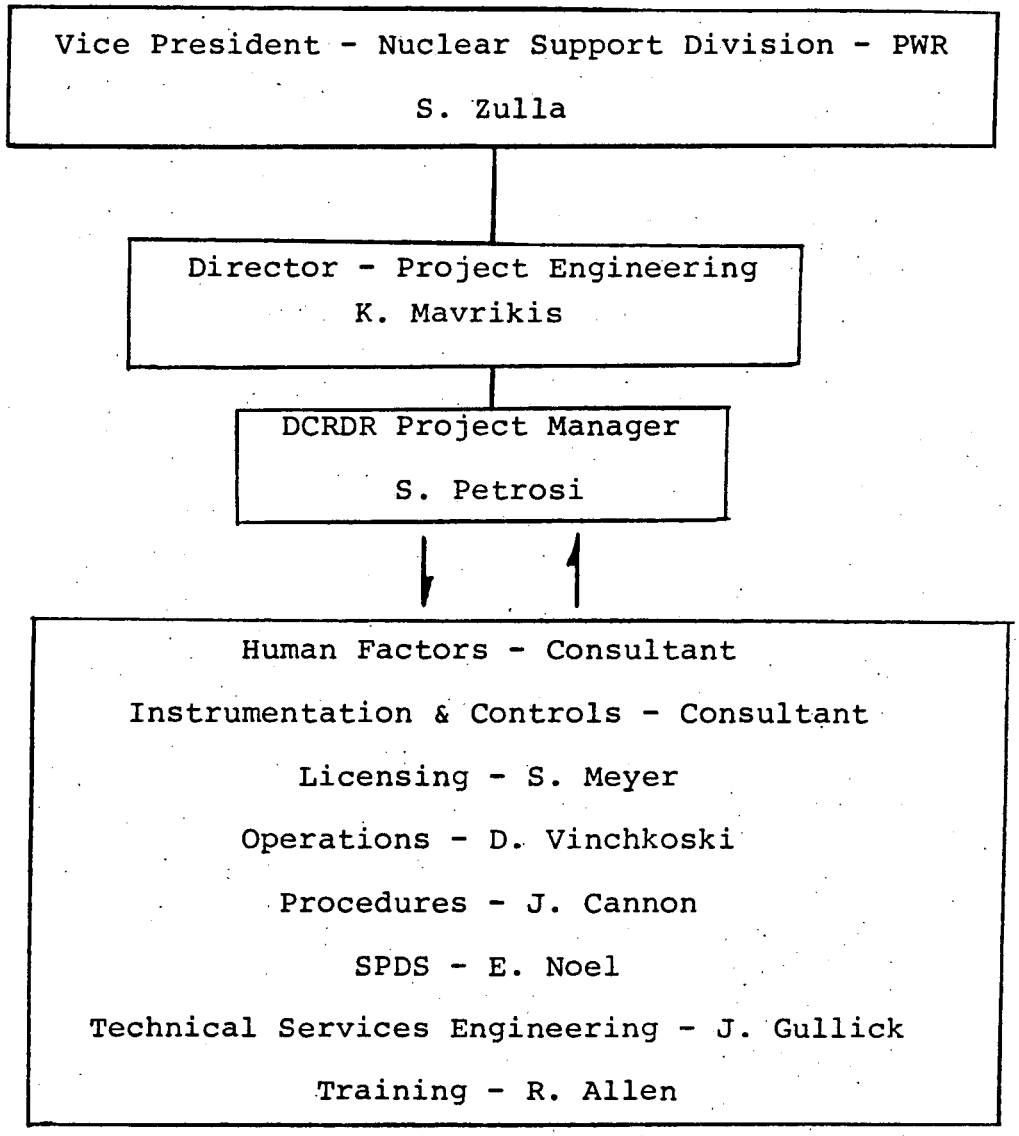

Figure 2-1. Functional DCRDR Team Organization

2.3 Qualifications of the Review Team

The resumes of authority personnel who will be review team members are included in Appendix B. The qualifications of human factors specialists, I&C engineers and supplemental reviewers will be as follows:

- Human Factors Specialist: A degree, at the graduate level, in the human factors engineering field. The Authority will contract with a human factors specialist and will use some of the following criteria during the selection process: (1) experience in the application of human factors principles to design and/or evaluation of systems and equipment in the power industry is preferred; (2) workspace layout, panel and instrumentation design (controls and displays) environmental conditions (e.g., lighting and acoustics), and procedures and training experience are areas of specific emphasis; and (3) experience in systems analysis and task analysis must be demonstrated within the complement of human factors professionals on the team.

- Reactor Operator: A currently licensed reactor operator with a minimum of two years experience in the IP3 control room.

- Instrumentation and Control Engineer: A bachelor's degree in electrical engineering with a minimum of five years experience in nuclear power plant I&C engineering.

- Other Disciplines: A bachelor's degree in the specific discipline will be provided as a minimum. A minimum of three years of applied design or operating technical experience is recommended. Professional licenses or certification and appropriate society memberships provide additional evidence of the experience level desired. Experience at nuclear plants or other process control applications is preferred. Alternatively, experience with other complex commercial, industrial, or military facilities and systems will be considered acceptable.

2.4 Integration of Supplement 1 to NUREG-0737 and Related Human Factors Programs

2.4.1 Safety Parameter Display System (SPDS)

In the second quater of 1981 the Authority contracted with Combustion Engineering for the development and implementation of the Emergency Response Facility Data Acquisition and Display System (ERFDADS). The ERFDADS is an integrated program involving replacement of the plant computer and installation of a Qualified SPDS (QSPDS) and a Critical Function Monitoring System (CFMS). The QSPDS has been designed as a seismic category I, electrical class IE, single failure-proof, display system. Input signals to the QSPDS include core exit thermocouples, hot and cold leg RTDs, pressurizer pressure and level and source, intermediate and power range neutron detectors. The QSPDS displays a relatively limited set of parameters and serves as a backup to the CFMS in the unlikely event of a seismic disturbance. The CFMS is a highly reliable system not designed to seismic category I and electrical class 1E criteria. The CFMS monitors a much larger set of parameters than the QSPDS, including the following cirtical safety functions and parameters:

- core reactivity control
- RCS pressure, inventory and heat removal
- core heat removal
- containment environment
- containment isolation status
- radiation emissions control

In addition, the CFMS will monitor the position of selected valves and indicate the status of actuation and initiation signals for reactor trip and engineered safety features, as well as providing historical data storage and retrieval capacity. The expanded input list and enhanced computer capability of the CFMS relative to the QSPDS logically leads to its designation as the principle SPDS "device" for purposes of compliance with the requirements of this Item of Supplement 1 to NUREG 0737. As further discussed below, credit will be taken for the seismic cate-

gory I, electrical class IE design of the QSPDS and the extensive capabilities of the CFMS when performing the Control Room Design Review and the review for compliance with Revision 2 to Regulatory Guide 1.97.

2.4.2 Emergency Operating Procedure (EOP) Upgrade Program

The Authority intends to utilize the technical guidelines prepared by the Westinghouse Owners Group (WOG) as part of the WOG Emergency Response Guidelines (ERGs) program as the technical basis for emergency procedure upgrade for Indian Point 3. Specifically, the Authority intends to utilize Revision 1 to the WOG ERG set. Revision 1 reflects the numerous interactions and correspondence among the Owners Group, Westinghouse Electric Corporation and the NRC staff and should be best suited for use in the Indian Point 3 EOP Upgrade Program.

The Writer's Guide for the EOP Upgrade Program will incorporate appropriate recommendations and comments from various sources including NUREG-0899, ANSI/ANS 3.2-Draft 8, Institute of Nuclear Power Operations (INPO) document INPO-82-017 and the WOG guidelines.

The Authority will perform a comparative review of the WOG ERG set and the existing Plant Emergency Procedures (PEPs) and Off-Normal Operating Procedures (ONOPs). The PEPs and ONOPs will be revised as deemed necessary to reflect the WOG technical guidelines. The WOG Function Restoration Guidelines and ERG fold-out pages will be reviewed and incorporated into the PEPs and ONOPs during this review. All major differences between the revised PEPs and ONOPs and the ERG set will be documented and maintained on site.

The existing PEPs and ONOPs have been reviewed to verify that the instrumentation and indications called for in the PEPs and ONOPs are available in the control room. A similar comparison will be performed during the emergency operating procedure (EOP) upgrade program. In addition, a comparison will be made between the Critical Functions

Monitoring System/Qualified Safety Parameter Display System input lists and the instrumentaion and indication requirements of the upgraded EOPs.

2.4.3 Program for Implemetation of Regulatory Guide 1.97, Revision 2

The Authority is currently reviewing the requirements of Regulatory Guide 1.97, Revision 2, regarding variables associated with the monitoring of postulated accident/post-accident conditions. The first phase of this effort establishes the degree of compliance with the Guide.

The second phase of the program, if necessary, will involve the determination of specific justifications of exceptions to the Guide and the development of specific design modifications, if required. Since a large number of variables will be displayed in the Technical Support Center (TSC) and the Emergency Operations Facility (EOF), justifications and (or) corrective actions associated with implementaion of the Guide may also affect the TSC and EOF. The Authority intends to take credit for the seismic category I, electrical class 1E design of the QSPDS and the extensive capabilities of the CFMS to obviate the need for modifications to display systems, as appropriate.

2.4.4 Integration of Supplement 1 Activities with the DCRDR

The Authority's program for implementation of the CRDR, EOP Upgrade, and the CRDR initiatives is centered around the next (Cycle 4/5) refueling outage in early 1985. Prior to the startup from that outage, the Authority expects to complete the installation of the QSPDS, and CFMS implement the upgraded EOPs, and resolve on paper human engineering deficiencies identified during the CRDR task, to the extent possible. In addition, the necessary training programs will be completed prior to startup from the cycle 4/5 refueling outage and will encompass the SPDS, CRDR, and the EOP Upgrade initiatives.

The Systems Review and Task Analysis (SRTA) and Background Documents prepared by the Westinghouse Owners Group for development of the Emergency Response Guidelines will be used to develop the plant-specific SRTA. The plant-specific SRTA will be used for the EOP upgrade effort as well as the CRDR.

The Verification and Validation (V&V) phases of the DCRDR address some of the same concerns which must be addressed in the EOP upgrade V&V process described in NUREG-0899. Specifically, item 3.3.5.1d of NUREG-0899 states "that there is a correspondence between the procedures and the control room/plant hardware," and it is noted in NUREG-0899 that this item can only be adequately addressed using control room/plant walkthroughs. Therefore, the Verification and Validation phases of the DCRDR will be done in conjunction with the V&V for the EOP upgrade effort. Also, as part of the Verification phase, the necessary instrumentation and indications referenced in the upgraded EOP's will be compared to the parameters displayed on the SPDS.

The HED resolution phase of the DCRDR will involve the integration of the EOP's, SPDS, Training, Regulatory Guide 1.97 and other planned future control room changes. The resolution of HED's might necessitate additions to the EOP's or to the SPDS parameters displayed. For example, HED's that cannot be easily corrected due to conflicting requirements can be explicitly flagged in the upgraded EOP's. Missing or inappropriately located information that is identified during the DCRDR could be displayed on the SPDS. Missing instrumentation or inappropriate instrument ranges will be compared to Regulatory Guide 1.97. Significant control room modifications would involve training to familiarize the operating crew members with the modifications.

The Emergency Response Facilities (ERF's) activities are, for the most part, independent of the DCRDR. No involvement other than communications with the ERF's is envisioned for the DCRDR effort. However, the ERF's will be coordinated with the SPDS.

2.4.5 Summary of Previous Human Engineering Assessment of IP3

Between March 18, 1980, and June 6, 1980, Essex Corporation performed a human engineering assessment of the control room at Indian Point Unit 3 nuclear power plant. This evaluation employed state-of-the-art human engineering evaluation techniques and published criteria and guidelines similar to those used to evaluate TMI-2.

The human engineering methods and techniques employed in the preliminary review included:

- Human Factors Engineering Checklists
- Control room-wide surveys
- Operator interviews
- Procedure walk-through/talk-throughs

HFE Checklists - HFE checklists were comprised of statements of standard human engineering criteria, principles, data and standard practices. Those checklists employed at the Indian Point 3 control room were adapted from the criteria and guidelines found in the human engineering literature. Checklists were applied by two distinct procedures: at a panel (systems) level, and at a component level, thereby helping to ensure that all appropriate components were examined according to applicable guidelines. Each component/system in the control room was documented (on a documentation form), and checklists applied. Components and assemblies data regarding compliance or noncompliance with guidelines is therefore available.

Control Room Surveys - Control room surveys were conducted which examined areas such as: control room lighting, communications, temperature; ambient noise; protective equipment; fire fighting equipment; and security. Data were collected on survey forms and saved for review.

Operator Interviews - Several approaches to operator interviewing were taken. First, interviews were specifically intended to solicit comments regarding any HFE related problems encountered by Indian Point 3 operators and shift supervisor. Problem areas mentioned were noted. Second, informal interviews, in the form of specific questions dealing with specific components, were conducted to clarify any HFE discrepancies as noted via checklist application, procedure walk-through/talk-through, and/or control room survey. Finally, interviews were conducted to help identify potential operational effects of errors induced by design of controls and displays. Interviews were conducted throughout the course of data collection, were sequence independent, and conducted with operators were available and as HFE design data became available (post checklist applications, etc.).

Procedure Walk-Throughs/Talk-Throughs - Operators were videotaped and interviewed while performing emergency procedures using the IP-2 simulator; each emergency procedure being videotaped at least twice. Data collected includes: control and display layouts, sequencing of procedural steps and problems in locating infrequently used components.

Procedures were evaluated according to standard procedures writing guidelines. Basically, procedures were altered to: 1) increase accessibility; and 2) increase readability and usability, in terms of reading speed, accuracy and reduction of reading errors such as step interpretation, step omission, etc.

Results of the preliminary assessment evaluation were:

- Identification of control room design features that disagree with human engineering practices
- Preparation of revised emergency procedures for IP3 operations
- Suggestions for control room human engineering backfits
- Documentation of the evaluation process

Primary human engineering problem areas identified during this evaluation included:

- Priority 1 (on a 5-point scale)
  - accessibility of procedures
  - accessibility of personal protective equipment
  - demarcation of functionally related components
  - controls positioned to enhance probability of accidental operation
  - control use conventions
  - control feedback
  - control display associations
  - annunciation (audible) defeats
  - lamp test capability
  - annunciator locations
- Priority 2
  - implementation of rewritten-reformatted procedures
  - labeling
  - display failures
  - annunciator readability
  - audible alarms localization
- Priority 3
  - temporary labels
  - display glare
  - trend recorder readability

2.4.6 INPO NUTAC on CRDR

The Nuclear Utility Task Action Committee (NUTAC) on CRDR was established by a group of representative utilities in recognition of the need for guidance on performing a CRDR. The principal objectives were (a) to determine the boundaries of the CRDR, (b) to develop a methodology, (c) to define terms, (d) to integrate other initiatives with the CRDR (e.g., SPDS development, EOP development, staffing, and training), and (e) to provide practical implementation guidelines that included:

- a guideline on the development of CRDR survey checklists
- a set of human engineering review principles
- EOPIA V&V Guideline

These NUTAC guidelines will be used in the IP3 DCRDR project and provide additional detail to procedures described in Section 4 of the Program Plan. A copy of these documents are included with this document.

SECTION 3. DOCUMENTATION AND DOCUMENT CONTROL

A large number of documents will be referenced and produced during the DCRDR. Therefore, an efficient and systematic method for controlling these documents is necessary.

3.1 Documentation Requirements

The documentation methodology described in this section will be utilized to meet the following requirements:

- Provide a record of all documents used by the review team as input references during the various phases of the DCRDR.
- Provide a record of all documents produced by the review team as project output.
- Allow an audit path to be generated through the project documentation.
- Develop project files to support on-going assessments of the effects of control room changes proposed in the future.

Documentation collected during the DCRDR project will be maintained in files at the IP3 Nuclear Power Plant.

3.2 Input Documentation

The following documents have been identified as possible reference material to be used during the review process. As the review progresses it is anticipated that additional material will be identified and referenced. Therefore the following list of documents, if available, is preliminary.

- Licensee Event Reports (LERs)
- Final Safety Analysis Report (FSAR)
- Systems descriptions
- Piping and instrumentation drawings
- Control room floor plan
- Panel layout drawings

- INPO NUTAC Guidance Documents on DCRDR
- Westinghouse Generic Emergency Response Guidelines (ERGs)
- Westinghouse Generic Systems Review and Task Analysis (SRTA)
- IP3 Plant-Specific Emergency Operating Procedures (EOPs)

3.3 Output Documentation

Throughout the review process documents will be processed to record data, document analyses and record findings. Whenever possible, and appropriate, standard forms will be developed and utilized. All of the documentation produced during the course of the review will be controlled in accordance with the procedures described in Section 3.4. The following list represents a preliminary estimate of the types of documents that will result from the DCRDR project:

- Detailed Control Room Design Review Program Plan
- Project schedule
- Operator Questionnaire
- Operating Experience Review Report
- Control Panel Checklists
- Task Analysis Worksheets
- List of HEDs assessed according to their safety implications
- Photographs of Control Boards
- Summary DCRDR Report

3.4 Documentation Control Procedures

The DCRDR Project Manager will be responsible for documentation control. All documents used as primary input to the review, or generated during the review will be subject to the following document control procedures.

- All documentation used during the review will be logged. The log will contain the document name, the revision level, and the date.
- All project documents will be maintained in a project file onsite at IP3 Nuclear Power Plant.

- All correspondence between the DCRDR project manager and consultants will be filed in the project file.

The document controls above will ensure adequate tracking of input and output documentation used in the DCRDR project.

3.5 Management of HED Records

All information pertaining to HEDs shall be stored in a separate file. When an HED has been identified, the engineer records his/her observations on an HED form. This information allows the engineer to easily compare all of the discrepancies which apply to a given component.

A computerized database management system (DBMS) will be used for the IP3 DCRDR. The system will be used to input, store, retrieve and analyze significant data from the DCRDR project. The majority of data will be generated from the control room survey, task analysis and operating personnel interviews. The major sources of data input will be the following:

- HED Form Records
- Task Analysis Data
- Operating Personnel Interview Data
- System Nomenclature List
- I&C Inventory

Each of the data files allows smooth management and tracking of the DCRDR review findings and results. The HED file provides a look-alike output form (see Figure 3-1) that can be used in the final DCRDR report documentation.

HUMAN ENGINEERING DISCREPANCY RECORD

HED. NO. : 0039
PLANT:
DATE:

TRACKING STATUS: ASSESSMENT

REVIEWER: PRELIMINARY STUDY

DATA SOURCE: CONTROL ROOM SURVEY - GP

DOCUMENT NO. : 1.1.3.14a 0700 GUIDELINE NO. : 6.5.1.5

GUIDELINE AREA:
VISUAL DISPLAYS

PROBLEM CATEGORY:
SCALE MARKING

PANEL/WORKSTATION ID. :	COMPONENT NO. :	COMPONENT DESCRIPTION:
C-12	FR-154	RCP 3 AND 4 SEAL LKOFF LOW REC
C-12	FR-156	RCP 1 AND 2 SEAL LKOFF FLOW REC
C-12	FI	RCP SEAL WATER FLOW METER

DESCRIPTION OF DISCREPANCY:
RECORDERS FR 154 (RCP 3 & 4 SEAL LEAKOFF FLOW) AND FR 156 (RCP 1 & 2 SEAL LEAKOFF FLOW), ALONG WITH THE RCP SEAL WATER FLOW METER (FI-142A) HAVE SCALES WHICH ARE DIFFICULT TO READ TO THE .2 PRECISION LEVEL AS REQUIRED IN PROCEDURES.

RECOMMENDATION:
CHANGE
CORRECT SCALE DESIGN TO REFLECT REQUIRED ACCURACY. PERHAPS THE LOW RANGE COULD BE FROM ZERO TO ONE OR CHANGE SEAL LEAKOFF FLOW RECORDERS SO THAT EACH SHOWS HIGH AND LOW RANGES FOR ONE LOOP.

ACTION:
RDC#

CRITICALITY RATING:
IIB-POTENTIAL ERROR

IMPLEMENTATION SCHEDULE:

Figure 3-1. HED Form

SECTION 4. REVIEW PROCEDURES

The Indian Point 3 DCRDR review procedures are primarily based on guidance provided in NUREG-0700 "Guidelines for Control Room Design Reviews" and in NUREG-0801 (Draft) "Evaluation Criteria for Detailed Review." In addition, the Institute for Nuclear Power Operations (INPO) Nuclear Utility Task Action Committee (NUTAC) documents for CRDR will be used as appropriate to supplement the NUREG documents above.

The DCRDR addresses the following specific objectives:

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

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

The first objective is concerned with the completeness of the control room given control room operator functions and task responsibilities. The second objective is concerned with the suitability of the design in light of human and equipment performance capabilities, individual task responsibilities, and operational dynamics.

Five major processes are used to establish and apply benchmarks for identifying human engineering discrepancies of both completeness and human engineering suitability:

- Operating Experience Review
- Control Room Survey
- System Function Review and Task Analysis
- Verification of Task Performance Capabilities
- Validation of Control Room Functions

The procedures involved in each of the five processes are discussed below.

4.1 Operating Experience Review

4.1.1 Purpose

The purpose of the Operating Experience Review is to identify factors or conditions that could cause or have previously caused operations problems and could be alleviated by improved human engineering. This review will provide information on potential problem areas by studying documented occurrences of human engineering related problems and by surveying experienced operations personnel at IP3.

4.1.2 Methodology

4.1.2.1 Documented Incidents

The Authority will provide Licensee Event Reports, plant significant event reports or other sources that could be informative for the purpose of identifying problems relating to human engineering design. A human factors engineer and an individual with operations experience will jointly review the sources to determine if the incident described involved a control room problem with human engineering implications. A control room problem is defined as one in which the equipment referenced is located in the control room or remote shutdown area, the procedure (or steps therein) is utilized within the control room or remote shutdown area, or the personnel error occurred utilizing control room or remote shutdown components. In addition, determinations will be made if adding or deleting equipment to the control room (e.g. alarms) would help to avert other identified incidents.

The information obtained and the candidate problems identified in this effort will be documented in the Operating Experience Report will be integrated with data obtained during the control room

survey, task analysis and assessment and correction of human engineering discrepancies (HEDs).

4.1.2.2 Operations Personnel Survey

The purpose of the survey of IP3 operations personnel is to elicit information regarding positive and negative human engineering aspects of the control room and remote shutdown area that have been noted during operation. This step in the review process will provide insight on control room design from the user's standpoint.

A self-administered questionnaire will be used for obtaining operator input. A range of operations staff, with varying degrees of experience and training, will be asked to complete the questionnaire. Operations personnel will be insured anonymity for their responses. When all questionnaires have been returned to the human factors engineer and appropriately coded, they will be reviewed by DCRDR team personnel. Responses will be summarized and candidate HEDs will be identified. Candidate HEDs will be reviewed and investigated further in follow-up interviews. Features of the control room which are identified as favorable will also be noted.

Follow-up interviews will be conducted with approximately half of the questionnaire respondents. More respondents will be interviewed if all candidate HEDs cannot be fully described by those interviewed. Interviews will be conducted by human factors engineers who are experienced in interviewing techniques. The interviews will be structured to cover items of interest from the questionnaire, however, interviews will be open-ended to allow elaboration by the respondent.

The information collected during the Operating Personnel Survey portion of the review project will allow existing human engineering problems in the control room to be explained in detail for investigation later in the CRDR project. The areas that will

benefit from the data collected in the operating personnel survey will be the control room survey, task analysis, assessment of HEDs, and correction of discrepancies.

4.2 Control Room Survey

4.2.1 Purpose

The purpose of the Control Room Survey is to identify characteristics of instruments, equipment, layout and ambient conditions that do not conform to guidelines of good human engineering practice, regardless of the particular system or specific task requirements. This is accomplished by conducting a systematic comparison of existing control room design features with human engineering guidelines.

4.2.2 Methodology

Checklists will be used to compare control room design features with the guidelines contained in INPO 83-042 (NUTAC), "Control Room Design Review Survey Development Guideline". Prior survey work done by Essex Corporation in 1980 will not be used in the DCRDR survey given the incomplete backup documentation available and the number of changes made to the IP3 control room since that time.

Some checklist items will be addressed on a control-room wide basis such as items that fall into the categories of communications, process computer, control room layout, and environmental factors. Other items will be approached on a control-room wide basis first, and then panel by panel, such as the annunciator system and panel layout. Still other items will be evaluated component-by-component, and then for overall control room consistency, such as controls, displays, labels and location aids.

Finally, control and display functional grouping and integration will be examined panel-by-panel. Control room operators or supervisors will be especially helpful at this stage given their detailed knowledge of the panels and their operations experience.

The major environmental items on the checklist, lighting and sound, will require specialized equipment and methodologies beyond the checklist itself.

The performance of the light survey will consist of measurements of the lighting characteristics of the IP3 control room. These measures fall into two major categories: illuminance measurements, which measure the amount of light falling upon a surface or object, and luminance measurements, which measure the amount of light reflected from a surface or emitted from a source. Measurements will be taken per NUREG-0700 guidelines using calibrated instrumentation.

The performance of the sound survey will consist of taking measurements of the noise characteristics of the control room. Integrated "A" weighted dB(A) measurements will be taken, and 1/3-octave measurements will also be noted that include center frequencies from 250 Hz to 4000 Hz. Sound measurements will include ambient noise levels (where ambient noise is defined as background control room noise without the contribution of alarms, printers, or communications equipment), and annunciator alarm (or other warning device) levels.

Other aspects of the control room environment, temperature, humidity, and wind velocity will also be measured using specialized instrumentation. A torque wrench will be used to measure resistance from representative control switch types.

A team composed of human factors engineers and operations personnel will perform the control room survey in the IP3 control room. The checklists are designed to include principles or explanatory statements followed by specific categorical or numerical statements that require a

yes or no response. The procedure will be to observe or measure as required and check compliance with each categorical or numerical statement. If compliance with a guideline is observed, it will be noted by checking the "Yes" column of the guideline. An item that receives a "Yes" response indicates that control-room wide compliance has been observed. For example, the checklist item that states that all labels in the control room should be white with black lettering would be answered with a "Yes" if there were no other types of label coloring configurations used in the control room. If there is any instance of non-compliance, full or partial, the "No" box would be checked, and a reference notation made as to where non-compliance occurs. A specific reason or reasons for non-compliance will be described in an adjacent space. All non-compliances will be recorded on an HED form (see Figure 4-1) for later evaluation by the design review team.

As Figure 4-1 indicates, the HED form contains areas for various data that will facilitate HED identification, tracking, and resolution. A space is provided to identify, by component, where the HED occurs. An area for a detailed description of the discrepancy is provided, along with a space to indicate the Review Section Code (NUREG-0700 guideline section number) and the specific guideline or guidelines to which the discrepancy relates. A space for explanatory comments is provided, followed by a space for a description of the recommended correction. Finally, a space is provided in which implementation information (such as scheduling requirements or constraints) can be added. If other information is deemed useful or desirable, the form can be altered to fit IP3's particular needs.

The HED information will then be input into the CRDR Computer Database System. The system will be used to store HEDs in a manner that will allow for efficient HED data retrieval, sorting, and manipulation.

The results of the control room survey will be data in the form of HEDs. These HEDs will be examined during the assessment of HEDs and correction of discrepancies phases of the CRDR project.

HUMAN ENGINEERING DISCREPANCY RECORD

HED. NO.: 0039
PLANT:
DATE:

TRACKING STATUS: ASSESSMENT

REVIEWER: PRELIMINARY STUDY

DATA SOURCE: CONTROL ROOM SURVEY - GP

DOCUMENT NO.: 1.1.3.14a 0700 GUIDELINE NO.: 6.5.1.5

GUIDELINE AREA:
VISUAL DISPLAYS

PROBLEM CATEGORY:
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ACTION:
RDC#

CRITICALITY RATING:
IIB-POTENTIAL ERROR

IMPLEMENTATION SCHEDULE:

Figure 4-1. HED Form

4.3 Systems Function Review and Task Analysis

4.3.1 Purpose

The purpose of the system function review and task analysis portion of the 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. Westinghouse Owner's Group (WOG) System Review and Task Analysis documentation, that has been used as a basis for developing the Emergency Response Guidelines (ERGs), will serve as one of the inputs to the plant-specific CRDR along with the ERGs themselves. The ERG guidelines have been developed to verify automatic actuations following a reactor trip or safety injection condition (Guideline E-0), to diagnose the plant condition with respect to event sequence (Guideline E-0), to diagnose the plant safety state (Guideline F-0), to recover the plant from an event sequence (remaining E Series Guidelines), and to restore the plant safety state (remaining F Series Guidelines).

4.3.2 Methodology

The activities which comprise the system function review and task analysis for the CRDR are shown in Figure 4-2. For clarity, the procedure for determining these input and output requirements is divided into the following two areas:

- Identification of systems and systems functions
- Identification and analysis of operator tasks

The first step above corresponds to the first box in Figure 4-2. The second step comprises the remaining boxes. These two areas are now described in detail.

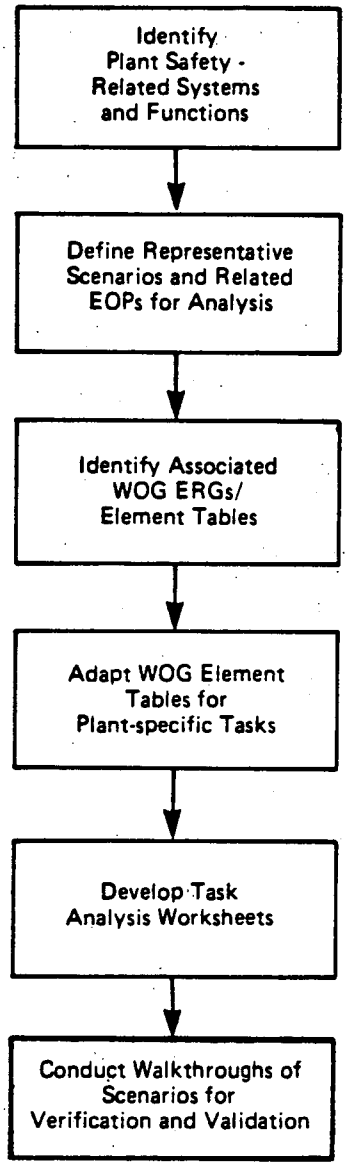


Figure 4-2. Systems Function Review and Task Analysis

4.3.2.1 Identification of Systems and Systems Functions

The set of guidelines that comprise the WOG Emergency Response Guidelines contain plant systems that the operator must access and utilize during emergency operations. They also identify operator functions and tasks required during emergencies. High level tasks are further broken down into subtasks which may include several inputs and outputs. The identification of event sequences (i.e. guidelines), systems, functions, tasks, and subtasks is organized in generic Task/System Sequence Matrices (TSMs), which have been prepared for each individual Emergency Response Guideline. The first step, therefore, in performing the plant specific systems review task analysis is to specify a set of comparable IP3 systems to those found in the WOG TSMs.

The Indian Point 3 Final Safety Analysis Report (FSAR) contains System Design Descriptions for IP-3 NSSS and BOP systems. The FSAR will serve as the primary source of information to identify a set of IP-3 plant systems comparable to those found in the WOG TSMs. The FSAR will be supplemented, as necessary, with other existing plant information.

4.3.2.2 Identification and Analysis of Operator Tasks

There are several steps to this phase of the Task Analysis effort. These steps are outlined in Figure 4-2 beginning with the step of defining representative scenarios for analysis. The steps are discussed briefly below. Each step below will be appropriately documented during the actual conduct of the DCRDR.

Define Representative Scenarios. The Westinghouse Owners Group (WOG) Task Flow Charts (TFC) and the list of IP3 safety and safety-related systems will be used to define a set of scenarios which adequately samples various emergency conditions and the plant systems used in those conditions. The related IP3 plant-specific EOPs will be identified as well in this step.

The WOG Task Sequence Matrices (TSMs) associated with the scenarios selected will be revised to a plant-specific form to include those tasks applicable for the IP3 plant systems. Once TSMs are revised, a check will be performed to ensure that the desired systems and system functions are exercised in the scenarios chosen. Additional scenarios will be defined if necessary to ensure that all system functions have been exercised.

Residual operator tasks (unique tasks) from the plant-specific EOPs not covered in the scenarios will be analyzed independently for information and control requirements. The analysis of residual tasks will be done to ensure that all operator interfaces have been examined even if those interfaces are not exercised in the sample of emergency scenarios selected for validation. Note that verification of equipment availability and suitability will be performed for these residual tasks as well as for tasks embedded in the emergency scenarios.

Identify Associated Element Tables. When task sequences are defined, the WOG ERGS and element tables will be selected and arranged in proper task sequence for each scenario. Residual task element tables will be ordered according to the generic ERG numbering system.

Adapt Element Tables. The generic element tables (from the WOG SRTA) will then be adapted to plant-specific tables to define IP3-specific information and control requirements. The plant-specific element tables will be developed initially by engineering personnel and reviewed by operations personnel.

Develop Task Analysis Worksheet. The revised TSMs and revised element tables will be used to develop a task analysis worksheet (see Figure 4-3) which indicates the operational steps required in each scenario, along with the appropriate information and control requirements, means of operation, and I&C present on the control

TASK ANALYSIS WORKSHEET

SCENARIO _____
PAGE ____ of ____

Procedure No.		Task/Subtask	Scen. Resp.	Crew Memb.	Loc.	Decision and/or Contingent Action Requirements	Information & Control Req.	Means	I&C Ident.		Verification		SPDS		Comments/ Candidate HEDs
IP3	ERG								Panel	No.	Avail.	Suit.	Y	N	

Figure 4-3. Task Analysis Worksheet

boards. The operator tasks will be analyzed using the selected plant-specific EOPs as a starting basis and documented in the following manner:

1. The discrete steps in the plant-specific EOPs in order of performance and the corresponding ERG steps will be recorded in the "Procedure Step Number" column of the Task Analysis Worksheet and branching points, if any, will be recorded in the "Scenario Response" column. Note that there may be more tasks subsequently identified in Step 2 below than there are procedural steps. In this case, a dash will be entered when no explicit procedural step is present in the EOPs and/or EPGs.

2. A brief description of the operator's tasks (in order of procedural steps) will be recorded in the "Tasks/Subtasks" column of the Task Analysis Form. Note that there may be many more tasks described than are explicitly called out in the procedural step. All tasks, both explicit and implicit, will be documented by using operations, engineering, and human factors personnel.

3. The operator decisions and/or actions that are linked to task performance are then recorded in the "Decision and/or Contingent Action Requirements" column. System functional response is described when appropriate in this column. This set of data also includes branching points in the EOPs that determine the outcome of the operating sequence.

4. Input and Output requirements for successful task performance are recorded in the "Information and Control Requirements" column. These would typically be parameters, components or procedural information that is necessary for operators to adequately assess plant conditions or system status (e.g., reactor vessel water level, hot leg temperature, reactor coolant system flow, pressurizer pressure, etc.). Specific values for

parameter readings or control selection will be recorded based on EOPs and Technical Specifications.

It is important to note that Steps 1 through 4 are completed on the Task Analysis Worksheet using independent sources of data other than the actual I&C present in the control room.

The remaining columns of the Task Analysis Form will be utilized during the Verification and Validation phases which are described in Sections 4.4 and 4.5. These columns are described below:

5. Once the Tasks, Decision Requirements, and Information and Control requirements have been specified, the existing instrumentation and controls (I&C) that the operator uses for each procedural step will be documented based on the control room inventory. All I&C needed to either (1) initiate, maintain or remove a system from service, (2) confirm that an appropriate system response has or has not occurred, i.e., feedback, or (3) make a decision regarding plant or system status will be listed in the "Means" and "I&C Identification" columns. The "Means" column refers to how the information and control requirements are presented on the existing control boards (e.g., switch, meter, etc.). The "I&C Identification" column provides the specific panel number and identification number of the control or instrument.

6. Verification column (used during V&V phase)
   - "Availability" of the postulated I&C required for successful operator task performance is noted by a yes or no in this column.
   - "Suitability" of the existing I&C to meet the postulated information and control requirements for operator tasks is noted by a yes or no in this column.

7. SPDS (used during V&V phase)
   During the Verification and Validation phase of the DCRDR, an explicit comparison of information available on the SPDS and that on the control boards will be made. Presence or absence of information and control requirements on the SPDS will be noted by checking either the "yes" or "no" columns.

8. Comments/Candidate HEDs
   Comments or candidate HEDs can be noted in this column during any step of the Task Analysis or V&V phases. Data for HEDs will be entered on an HED form and into the computerized database.

9. During the validation phase, the identification of which member of the operating crew is performing each task will be recorded in the "Crew Member" column.

10. During the validation phase, the Location of the crew member when performing the task will be recorded in the "Location" column.

The Task Analysis Worksheet thus serves as the complete record of operator tasks, decisions, information and control requirements, I&C availability and suitability and SPDS usage during the selected emergency operating sequences. This record is developed through the series of steps described above. All task data will be entered into the DCRDR computerized database.

Conduct Walk-through of Scenarios. Using the appropriate Task Analysis Worksheets, Human factors and I&C engineers will perform a walkthrough of each scenario with IP3 control room operators. During this walk-through the tasks required will be analyzed in terms of the presence of necessary instruments and controls or other equipment or job aids (the Verification of Task Performance Capabilities specified in NUREG-0700) and the suitability of equipment, job aids and control room design for reliable execution of the required tasks (the Validation of Control Room Functions specified in NUREG-0700).

Walk-throughs will be videotaped to fully document the tasks involved for all crew members and the candidate human engineering discrepancies which may arise. A complete description of the walkthrough method is described in the validation process in Section 4.5. The task data is subsequently examined in both the verification and validation process described in the sections that follow.

An important element for the successful and accurate completion of the task analysis is the involvement of all disciplines (engineering, operations and human factors) in each of the steps above.

4.4 Verification of Task Performance Capabilities

4.4.1 Purpose

The purpose of the Verification of Task Performance Capabilities is to systematically verify that the Instrumentation and Controls that were identified in the Task Analysis as being required by the operator are:

- Present in the Control Room
- Effectively designed to support correct task performance

4.4.2 Methodology

The Verification of Task Performance Capabilities will utilize a two-phase approach to achieve the purpose stated above. In the first phase, the presence or absence of the Instrumentation and Controls that were postulated in the Task Analysis worksheets will be confirmed. This will be done by comparing the postulated requirements in the "Information and Control Requirements" column of the Task Analysis Form to the actual control room I&C listed in the "I&C Identification" and "Means" columns.

4.4.2.1 I&C Availability

The presence or absence of required Instrumentation and Controls will be noted by a "yes" or "no" in the "Availability" column of the Task Analysis form. If it is discovered that required Instrumentation and Controls are not available to the operator, any such occurrence will be identified as an HED and documented accordingly on an HED form.

A result of the verification of I&C availability will be a CR inventory listed in the task analysis worksheet column labeled "I&C Identification." The parameter, range, scaling units, and related information will be compiled on a separate inventory listing. A separate review of the I&C identified above will be done to ensure direct versus indirect indications of parameters.

In addition to verification of the required I&C on the control boards, an additional step will be conducted to verify critical safety parameters that are present on the Safety Parameter Display System (SPDS). The presence or absence of these indications on the SPDS will be noted in the "SPDS" column.

4.4.2.2 I&C Suitability

The second phase will determine the human engineering suitability of the required Instrumentation and Controls. For example, if a meter utilized in a particular procedure step exists in the control room, that particular meter will be examined to determine whether or not it has the appropriate range and scaling to support the operator in the corresponding procedural step. If the range and scaling are appropriate, it will be noted by checking the "yes" area in the "Suitability" column of the Task Analysis Form. Conversely, if the meter range or scaling is not appropriate for the parameter of interest to the operator, the "no" area in the "Suitability" column of the Task Analysis Form will be checked. This type of occurrence will be defined as an HED and documented accordingly on an HED form.

The suitability review of I&C will be performed by an operations expert and I&C engineer.

4.5 Validation of Control Room Functions

4.5.1 Purpose

The purpose of the Validation of Control Room Functions step in the DCRDR process is to determine whether the functions allocated to the control room operating crew can be accomplished effectively within (1) the structure of the IP3-specific EOPs and (2) the design of the control room as it exists.

Additionally, this step provides an opportunity to identify HEDs that may not have become evident in the static processes of the DCRDR, for example, in the control room survey.

4.5.2 Methodology

Utilizing the completed Task Analysis Worksheets, walk-throughs will be performed in the control room based on the symptom-oriented EOPs developed from the WOG ERGs. A normal complement of the IP3 operating crew will be performing the walk-throughs.

The purpose of the walk-through is to evaluate the operational aspects of control room design in terms of control/display relationships, display grouping, control feedback, visual and communication links, manning levels and traffic patterns.

The operating crew will be provided with copies of the new EOPs to follow as they are walking through the events. DCRDR team members will use the partially completed Task Analysis Worksheets to record observations and potential HEDs.

One event at a time will be walked-through. Operators will first be requested to perform the walk-through in slower than real time to

provide a relatively slow-paced rehearsal of the event. During the walk-throughs, the operators will be instructed to speak one at a time and describe their actions. Since this will force serial action, the operations will not be performed simultaneously. Specifically, the operators will verbalize:

- The component or parameter being controlled or monitored
- The purpose of the action
- The expected result of the action in terms of system response

As the operators walk-through the event, they will point to each control or display that they utilize, and indicate which annunciators are involved.

As the walk-throughs proceed, the operators will note any errors, such as improper step sequencing or branching, that may occur on the Task Analysis Worksheets. These errors will be traced back to the EOPs for investigation to ascertain whether the error occurred because of a procedural problem.

If a procedural problem is discovered, it will be documented. This documentation will be useful in responding to Item 7 of Supplement 1 to NUREG-0737, which involves the Upgrade of Emergency Operating Procedures. Procedure validation problems will be addressed as part of the task analysis and walk-throughs of the upgraded EOPs. This documentation will also be useful in any type of long-term training program which involves procedures upgrades.

After the slow-paced walk-throughs, the operating events will be run in real time on a plant-specific procedure. These real-time runs will be videotaped for later reference.

The operators who performed the event will review the Task Analysis Worksheets and Videotapes along with human factors specialists. The operators will be asked to note any errors or problems that were encountered in the real-time walk-throughs and to expound upon the

source of the errors or problems. These errors or problems will be documented for investigation as possible HEDs.

For each task, the following types of information will be recorded:

- An indication that the scenario response was accomplished will be noted in the "Scen. Resp." column.

- The identification of which member of the operating crew is performing the task. This will be noted in the "Crew Member"column on the Task Analysis Worksheet.

- The location of the crew member when performing the task in the "Loc." column.

- A verification of the specific decisions and contingent actions that are associated with each operator task. This will include communications between and among crew members.

- A verification of the Instrumentation and Controls required in the associated procedural step, for example, an indicating light on a controller energizing to red, or a pointer on a meter deflecting upward. This will be added to the "I&C Ident." column on the Task Analysis Worksheet.

- Comments related to verification or validation and potential HEDs.

Once the events have been analyzed to extract the information noted above, Link Analyses, which trace the movement patterns of the operating crew in the control room, will be prepared to assess whether the control room layout hinders operator movement while performing the events.

The final step in the validation process will be to have a reactor operator who did not walk or talk through the events review the analysis

in an attempt to uncover any operator task difficulties from an independent objective viewpoint.

Any dynamic performance problems that were uncovered during this phase of the DCRDR process will be documented for review in the HED assessment phase of the DCRDR.

5. HED ASSESSMENT AND RESOLUTION

The review team will assess identified discrepancies and recommend corrective actions for their resolution in an iterative review process. Descriptions of procedures for assessing and categorizing HEDs and recommending corrective actions are contained in this chapter, specifically:

(1) HED Categorization
(2) HED Resolution
(3) Implementation Schedule

5.1 HED CATEGORIZATION

5.1.1 Determining the Importance of HEDs

The importance of an HED is assessed on the basis of the potential for operating crew error and its potential impact on safety. This is accomplished by analyzing and evaluating the problems that could arise from the identified HEDs.

Human factors specialsts will assist utility personnel in assessing the HEDs that were identified during the previous phases of the DCRDR in a manner similar to guidance given in draft NUREG-0801, "Evaluation Criteria for Detailed Control Room Design Review". The two primary criteria presented in NUREG-0801 are: (1) whether or not the HED has resulted in a documented error or provides the potential for operator error, and (2) what impact the HED has on plant safety. Each of the criteria is discussed separately below.

5.1.1.1 Operator Error

Information from the operating experience review will be used to help assess whether an HED resulted in an operator error or provides the potential for operator error. If an HED is a result of a documented error, for example in an LER or identified in an operator interview, then the HED is automatically assessed as having an effect on operator performance. HEDs not associated with documented errors must be

systematically assessed to determine their impact on operating crew performance. Information gathered during the survey of operating personnel will be considered regarding problems that resulted in, or provide the potential for, operator error.

HEDs that may affect operating crew performance are subjected to a series of statements or questions, as shown in Table 5-1. Other performance shaping factors such as training, operator experience, procedure adequacy and situational requirements will be considered. The responses to this line of questioning should aid the reviewers in identifying those HEDs which degrade operating crew performance enough to cause, or contribute to the potential for, operator error. This technique relies on the evaluators' judgment, however.

5.1.1.2 Plant Safety Impact

HEDs considered to have resulted in documented errors or contribute to the potential for error will be assessed according to impact on plant safety based on the following criteria:

(1) An unsafe condition may result.
(2) Violation of a Technical Specification may result.

HEDs are assessed as to their impact on safety by subjecting each to a series of statements or questions, as shown in Table 5-2. The responses to this series of questions will aid the reviewers in identifying those HEDs which impact plant safety. Also, task element tables from the plant-specific systems review and task analysis can be consulted as an aid in establishing consequences of error for HEDs found during verification and validation phases. As before, the technique does rely on the evaluators' judgment.

5.1.2 Categorizing HEDS into Levels of Significance

Categories in which HEDs are grouped are defined below. This categorization is an aid to the reviewer in further assessing the importance

of HEDs as well as providing a means of prioritizing HEDs for corrective action. The method allows for distinguishing between those discrepancies that are known to have contributed to operator error and those that have been evaluated to have potential for contributing to operator error.

The categories are:

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

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

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

(4) Category IV - HEDs not important to safety.

Table 5-3 provides a summary of the HED categories to assist in the categorization process.

The primary purpose in categorizing the HEDs is to assist in prioritizing HEDs for resolution. HEDs having the most significant impact on plant operations, i.e., Categories I and II, would need resolution first. The review team will assess and categorize HEDs in preparation for their resolution.

To reach a consensus concerning category assignment among DCRDR members, the following approach will be used. All HEDs will be categorized independently by DCRDR members The first round of categorization results will be summarized by the DCRDR Project Manager to determine the distribution of category assignments per HED. The predominant category will be indicated for each HED and results redistributed to the evaluators. Each evaluator will

have the opportunity, if desired, to defend his category choice if it deviates from the predominant category. If no comments are forthcoming, then the prdominant category becomes the consensus. For HEDs on which comments are received, a meeting will be held with all evaluators to determine which category should be assigned. The evaluator that had provided comments earlier will be allowed to defend his choice. A final choice will be made at that meeting by a vote of the attendees.

5.2 HED RESOLUTION

5.2.1 Recommendations for Resolution

The DCRDR team will provide recommendations to resolve each HED documented during the review. Resolution of Category IV HEDs are optional and will depend upon the nature and complexity of the discrepancy. Questions to be addressed in determining recommended actions are included in Table 5-4.

In selecting recommendations for HED resolution, considerations will be given to the effectiveness of the improvement and assurance that no new HEDs result from the improvement.

Information copies of the Category I, II, and III HEDs with the DCRDR team recommendations for resolution will be provided to NYPA Management. This will enhance management awareness of problems and potential solutions early in the resolution phase.

5.2.2 Evaluation of Recommendations

5.2.2.1 Engineering Feasibility and Scope Review

The listing of HEDs and associated recommendations for resolution, will be evaluated by NYPA engineering and operations personnel to decide how each HED may be resolved. Implementation of all recommendations provided by the review team is not likely. Alternate solutions are possible. Feasibility studies and scope reviews will be performed, as necessary, to evaluate the recommendations.

In evaluating the recommendations, a line of questioning similar to that used in Table 5-4 is appropriate. Additionally, other plant-specific questions must be addressed. These questions are listed in Table 5-5.

The results of the engineering and operations review will then be forwarded to all DCRDR team members. Team members must be certain that implementing proposed changes in the control room enhances, rather than degrades, reactor safety and normal plant operations.

5.2.2.2 DCRDR Team Review

To develop a final list of HEDs and planned corrective actions will require several iterations of review. The first phase is the distribution of HEDs and proposed solutions to members of the DCRDR team. Team members will obtain input from their respective departments. Subsequently, several meetings will be scheduled to obtain consensus on selecting the optimal solution for each HED. Attendees will have the opportunity to suggest alternative solutions and the basis for their choice.

From these meetings, a revised list of HEDs and proposed corrective actions will be tabulated and redistributed to the same DCRDR team members. If disagreements over particular items still exist, the DCRDR Project Manager will decide the final resolution.

5.2.2.3 Management Approval of HED Resolutions

When consensus is reached, the proposed corrective actions and cost estimates will be tabulated and forwarded to Utility Management for review and approval. Management authorization to proceed with implementation of the corrective actions is necessary before the Summary Report can be submitted to the NRC.

For those HEDs in Category I, II, or III in which a decision not to correct, or only partially correct, is made, justification is required. Management personnel, as well as evaluators, must assure that adequate justification exists for disallowing corrective action. Category I, II, or III HEDs not corrected, or only partially corrected, and the associated justification will be submitted to the NRC in the Summary Report, as required by NUREG-0737, Supplement 1.

5.3 IMPLEMENTATION SCHEDULE

The development of a schedule for modifications to correct HEDs is dependent on HED categorization, and complexity of the modifications and resource requirements, and engineering and equipment lead time requirements.

The Summary Report submitted to the NRC upon completion of the DCRDR will outline proposed control room changes with proposed schedules for implementation as required by NUREG-0737, Supplement 1.

TABLE 5-1

HED POTENTIAL FOR ERROR EVALUATION CRITERIA
(Modified From NUREG-0801)

To what extent do you agree with the following?

1. This discrepancy will cause undue operator fatigue.

2. This discrepancy will cause operator confusion.

3. This discrepancy will cause operator discomfort.

4. This discrepancy presents a risk of injury to control room personnel.

5. This discrepancy will increase the operator's mental workload (for example, by requiring interpolation of values, remembering inconsistent or unconventional control positions, etc.).

6. This discrepancy will distract control room personnel from their duties.

7. This discrepancy will affect the operator's ability to see or read accurately.

8. This discrepancy will affect the opeator's ability to hear correctly.

9. This discrepancy will degrade thstract control room personnel from their duties.

10. This discrepancy will degrade the operator's ability to manipulate controls correctly.

11. This discrepancy will cause a delay of necessary feedback to the operator.

12. Because of this discrepancy the operator will not be provided with positive feedback about control task(s).

13. This discrepancy violates control room conventions or practices.

14. This discrepancy violates nuclear industry conventions.

15. This discrepancy violates societal stereotypes.

16. Operators have attempted to correct this discrepancy themselves (by self-training, temporary labels, "cheaters," "helper" controls, compensatory body movements, etc.).

17. Tasks in which this discrepancy is involved will be highly stressful (i.e., highly time constrained, of serious consequence, etc.)

18. This discrepancy will lead to inadvertent activation or deactivation of controls.

19. If this discrepancy causes a specific error, it is probable that another error of equal or more serious consequences will be committed.

20. This discrepancy is involved in a task which is usually performed concurrently with another task (e.g., watching water level while manipulating a throttle valve control).

TABLE 5-2

HED PLANT IMPACT EVALUATION CRITERIA

To what extent do you agree with the following:

1. This discrepancy involves controls or displays that are used by operators while executing emergency procedures.

2. It is likely that the error caused by this HED would result in:

   a. A violation of a technical specification, safety limit, or a limiting condition for operation.

   b. The unavailability of a safety-related system needed to mitigate transients or system needed to safely shut down the plant.

3. This discrepancy involves controls or displays tha are part of an engineered safety function or are associated with a reactor trip function.

4. This discrepancy involves control or display problems that would not be readily identified or corrected by alarms, interlocks or other instruments.

5. This discrepancy could cause an event that readily develops into an ANS Condition II, III or IV event without other failures occurring.

TABLE 5-3

SUMMARY OF HED CATEGORIES

	Unsafe Condition or Tech Spec Violation	Not Important to Safety
Documented Error	I	IV
High Potential Errors	II	IV
Low Potential Errors	III	IV

TABLE 5-4

HED RESOLUTION CRITERIA

In evaluating how to resolve a given HED, the reviewer should ask the following questions:

1. Is the HED really a deficiency?

2. Due to its unique nature, does the HED require further study or assessment?

3. Can the HED be resolved with paint-tape-label enhancements?

4. Should the HED be resolved to maintain consistency with control room conventions or standards?

5. Is the HED part of a larger or generic HED?

6. Is the HED so minor that no physical change is needed and the only action required is to establish operator awareness in routine trainig?

TABLE 5-5

PLANT-SPECIFIC HED RESOLUTION CRITERIA

In addition to the questions in Table 5-4, a reviewer should consider the following questions when evaluating recommendations for HED resolution?

1. Does the recommended fix really address the issue of concern?

2. Is the operator's ability to respond to any Plant transient or accident degraded by implementing the recommended change?

3. Are there other, more cost-effective methods to resolve the HED?

4. Is the HED in the process of resolution with an existing design change?

5. Could this HED result in significant Plant downtime or personnel injuries?

6. Could resolution of this HED provide increased operator productivity and morale?

7. Is the recommendation consistent with present control room characteristics and practices?

8. Does the proposed change create any new HEDs?

SECTION 6. DCRDR FINAL REPORT AND FUTURE APPLICATIONS

6.1 Final Report

At the completion of the DCRDR project, a final report will be generated. This report will document, in summary form, the procedures utilized in the DCRDR. Any departures from the methodologies described in this Program Plan will be noted and justified.

The final report will summarize the results of the DCRDR review process. The HEDs that were identified during the Operating Experience Review, the Control Room Survey and the Task Analysis will be included along with the recommendations for correction and/or resolution for each HED. A schedule for contract award for design of modifications to correct HEDs will be included. An actual implementation schedule will not be provided until after completion of design, bid specification, and award of contract for installation of modifications.

6.2 Verification That Selected Design Improvements Do Not Introduce New HEDs

A procedure will be provided in the final report for evaluating the effectiveness of proposed modifications and enhancements intended to resolve HEDs. This procedure will reference standard plant engineering practice for handling design change requests.

In addition, a second procedure will be provided in the final report to ensure adequate human factors considerations in all future control room changes. This procedure will reference the survey criteria and checklists used in the DCRDR project.

6.3 Integration with Related Supplement 1 to NUREG-0737 Items

The final report will also address the integration of the DCRDR results with other areas of Supplement 1 to NUREG-0737, "Requirements for Emergency Response Capabilities."

The results of the DCRDR will be incorporated into IP3 training programs as applicable. This will ensure that any implemented changes involving physical modifications or procedural alterations will be brought to the operators' attention. The rationale for change will be included in the descriptions of the changes to operators.

SECTION 7. BIBLIOGRAPHY

Generic Letter 82-33, "Supplement 1 to NUREG-0737 - Requirements for Emergency Response Capability" (Section 5, pages 10-12), December 17, 1982.

Generic Letter 83-22, "Safety Evauation of Emergency Response Guidelines," June 3, 1983.

NUREG-0700 "Guidelines for Control Room Design Review," September 1981.

NUREG-0801 (Draft) "Evaluation Criteria for Detailed Control Room Design Review," October 1981.

NUREG-1000 "Generic Implications of ATWS Events at the Salem Nuclear Power Plant," April 1983.

Control Room Design Review Task Analysis Guideline INPO NUTAC on CRDR (in press)

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

Control Room Design Review Survey Development Guideline INPO NUTAC on CRDR (INPO 83-042, November 1983)

Human Engineering Principles For Control Room Design Review INPO NUTAC on CRDR. (in press)

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY OF TERMS

Control Room Design Review (CRDR) - A post-TMI task listed in NUREG-0660, "Task Action Plan Developed as a Result of the TMI-2 Accident," and in NUREG-0737, "Staff Supplement to NUREG-0600," as Task I.D.1. Also referred to as Detailed Control Room Design Review (DCRDR).

Control Room Survey - One of the activities that constitutes a CRDR. The control room survey is a static verification of the control room performed by comparing the existing control room instrumentation and layout with selected human engineering design criteria, i.e., checking the control room match to the physical capabilities and limitations of the human operator.

Detailed Control Room Design Review (DCRDR) - see Control Room Design Review (CRDR) above.

Elements of a Utility CRDR Implementation Process - Necessary parts of a cohesive CRDR implementation process that a utility should consider in developing and reviewing its implementation plan and schedule.

Emergency Operating Procedures (EOPs) - Plant procedures directing the operator actions necessary to mitigate the consequences of transients and accidents that cause plant parameters to exceed reactor protection setpoints, engineered safety features setpoints, or other appropriate technical limits.

Emergency Response Guidelines (ERGs) - Guidelines, developed from system analysis of transients and accidents, that provide sound technical bases for plant-specific EOPs.

Human Engineering Discrepancy (HED) - A characteristic of the existing control room that does not comply with the human engineering criteria used in the control room design review.

Nuclear Utility Task Action Committee (NUTAC) for CRDR - Representatives from various nuclear utilities and INPO who are organized to define areas of CRDR implementation for which an overall industry effort can provide assistance to individual utilities in completing Task I.D.1, NUREG-0737.

Operational Experience Review - One of the activities that constitutes a CRDR. The operating experience review screens plant operating documents and operator experience to discover human engineering shortcomings that have caused, or could have caused, actual operating problems in the past.

Review Team - A group of individuals responsible for directing the CRDR of a specific control room. (See Survey Team.)

Safety Parameter Display Systems (SPDS) - An aid to the control room operating crew for use in monitoring the status of critical safety functions (CSFs) that consistute the basis for plant-specific, symptom-oriented EOPs.

Survey Team - A group of individuals responsible for conducting the control room survey. The survey team may or may not include individuals from the review team. (See Review Team.)

System Function Analysis - The determination of system functions required to meet system goals.

System Function Description - A brief description of the system function as determined by the design basis of the plant. The complete system description is contained in the Final Safety Analysis Report (FSAR).

SRTA - Systems Review and Task Analysis

Task Analysis - The systematic process of identifying and examining operator tasks in order to identify conditions, instrumentation, skill, and knowledge associated with the performance of a task. In the CRDR context, task analysis is used to determine the individual tasks that must be completed to allow successful emergency operation. In addition, this activity can verify and validate the match of information available in the control room to the information requirements of the emergency operating tasks.

Validation - The process of determining whether the control room operating crew can perform their tasks effectively given the control room instrumentation and controls, procedures, and training. In the CRDR context, validation implies a dynamic performance evaluation.

Verification - The process of determining whether instrumentation, controls, and other equipment exist to meet the specific requirements of the emergency tasks performed by operators. In the CRDR context, verification implies a static check of instrumentation against human engineering criteria.

WOG - Westinghouse Owners Group

APPENDIX B
RESUMES OF DCRDR TEAM MEMBERS

STEVEN MEYER

Associate Licensing Engineer

EDUCATION: Polytechnic Institute of New York
Candidate for M.S. of Mechanical Engineering
B.S. of Nuclear Engineering (1982)

EXPERIENCE: March, 1984 - Present - Associate Engineer
Nuclear Licensing Section
New York Power Authority

Additional duties include assisting in the development of NUREG-0737 Supplement 1 responses, assisting in ECCS and transient analyses review.

March, 1983 - March, 1984 - Assistant Engineer
New York Power Authority

Prepare correspondence to the NRC on the topics environmental qualification, control of heavy loads and containment purge and vent, coordinate the annual update to the FSAR and prepare applications for amendment of the facility operating license and plant technical specifications.

June, 1982 - March 1983 - Assistant Engineer
Nuclear Safety and Licensing Section,
American Electric Power Service Corp.

Responsible for safety and licensing aspects of unit refueling, coordinate the annual update to the FSAR, prepare requests for Technical Specifications changes, respond to NRC inspection reports, perform safety reviews of requests for changes, and model ECCS Analysis Codes.

June, 1981 - June, 1982 - Intern Engineer
Nuclear Safety and Licensing Section,
American Electric Power Service Corp.

Performed shielding calculations, prepared radiation data for Equipment Qualification, prepared correspondence with the Nuclear Regulatory Commission regarding safety matters.

Summer '80 - Technical Assistant
Advanced Projects Designs & Analysis Division, Princeton Univeristy's Plasma Physics Lab.

Modeled structures for computerized finite element stress analysis.

SAMUEL W. PETROSI
Project Support Engineer

EDUCATION: Received Bachelor of Science in Nuclear Engineering, Cum Laude, in 1976 from Rensselaer Polytechnic Institute.

EXPERIENCE: NEW YORK POWER AUTHORITY (MARCH 1982 - PRESENT)

Job Title: Project Support Engineer

Responsible for managing various primary side plant modifications at the Indian Point Nuclear Power Plant Unit No. 3. Duties include: (1) determination of required plant changes, (2) definition of scope of work involved to implement the changes, (3) obtaining cost estimates, (4) justification of changes to upper management for approval of funds, (5) preparation of bid documents and selection of contractors and vendors, (6) scheduling, (7) review of contractors' work to assure conformance with contracts and technical acceptability, (8) resolution of problems during the design and installation phases.

BURNS AND ROE, INC. (JUNE 1976 - FEBRUARY 1982)

Job Title: Nuclear Engineer

Responsible for the design of nuclear safety related cooling water systems and water storage systems for PWR's. Also responsible for the review and interface of Nuclear Steam Supply Systems (including radwaste systems) with Balance-of- Plant systems. Prepared process and instrumentation diagrams, general arrangement drawings, engineering system design descriptions, equipment technical specifications, portions of Safety Analysis Reports and engineering studies.

Performed and checked fluid flow, pressure drop, heat transfer and a variety of other calculations for sizing equipment and supporting systems design. Prepared bid evaluations and drafted recommendations for award on equipment. Reviewed drawings by NSSS suppliers for interface requirements and other vendors' drawings for conformance with BOP drawings and specifications. Provided technical direction to the design and drafting effort.

Participated in the Three Mile Island recovery effort. Member of team of engineers who designed an alternate system to control reactor coolant pressure and chemistry. Work involved a three month assignment in the field to design the system, expedite procurement and provide direction during construction.

SOCIETIES: Tau Beta Pi Nation Engineering Honor Society
Americal Society of Mechnaical Engineers

LICENSES: Licensed Professional Engineer in N.J. License #GE 27452

WILLIAM E. NOEL III, P.E.
Site Computer Engineer
Indian Point No. 3

EDUCATION:

University of Missouri, College of Engineering Columbia, MO.

B.S. Electrical Engineering - December 1974
Honors Scholar, Dean's List
M.S. Nuclear Engineering - September 1977
Atomic Energy Commission Research
Scholarship - 2 years
Thesis - Implementation of a Minicomputer
Sample Irradiation Monitoring System

QUALIFICATIONS:

Over seven years experience in computer system design, implementation and operation. Responsible for systems engineering and software implementation and maintenance at the New York Power Authority's Indian Point No.3 Nuclear Generating Station. Nearly five years experience as computer system project manager in support of nuclear safety experiments.

EXPERIENCE:

Over two years experience as the site computer engineer at Indian Point No.3. Responsibilities include systems engineering and software management of sites computer facilities in support of technical and administrative services. Lead engineer for design and implementation of site's Safety Parameter Display System (SPDS). Nearly five years experience as the computer systems project manager at the Department of Energy's Loss of Fluid Test Facility (LOFT). Responsibilities included design and management of computer facilities for date acquisition, processing and display during nuclear safety experiments. Chairman of Data Integrity Review Committee and member of Minicomputer Steering Committee and Software Review Committee.

WORK HISTORY:

New York Power Authority
Indian Point No.3
Buchanan, N.Y.
May 1983 - Present Site Computer Engineer.

EG&G, Idaho, Inc.
Idaho Falls, ID
September 1977 - May 1982 Minicomputer Project Management

University of Missouri Research Reactor
Columbia, MO
January 1977 - June 1977 Minicomputer System Design

PROFESSIONAL SOCIETIES :

National Society of Professional Engineers
Registered P.E. Electrical Engineering
Institute of Electrical and Electronics Engineers IEEE
Computer Society
American Nuclear Society
Eta Kappa Nu

ROBERT T. ALLEN
Training Superintendent at IP-3

AFFILIATIONS: Former Deputy Fire Commissioner, Village of Ardsley
Past Chief, Ardsley Fire Department
Assistant Chief, Ardsley Fire Department
Member New York State Association of Fire Chiefs

BACKGROUND: Nineteen years experience (14 years in the nuclear field) in power generation. During this time responsibilities included Shift Supervisor in a Nuclear Power Plant, and Training Superintendent of a Nuclear Power Plant.

EXPERIENCE:

April 1982 to Present — New York Power Authority, Indian Point Unit #3, Training Superintendent

Responsible for managing the site training functions. Directs training programs for approximately 430 permanent staff and 1,000 temporary personnel in 18 separate disciplines.

1977 to April 1982 — Power Authority of the State of New York Indian Point Unit #3, Shift Supervisor

The Shift Supervisor is in charge of the unit and operating personnel during his working hours. He is responsible for assuring all operations are conducted in accordance with approved procedures, rules and regulations, and limitations set forth in the unit's Technical Specifications. He is directly responsible for the safe operation of the facility, and is implementor of Emergency plans if required. He remains Emergency Director in an Emergency situation until properly reviewed by the appropriate personnel in the Emergency organization.

ROBERT T. ALLEN
(continued)

March 1974 to 1977	Consolidated Edison Company of New York, Inc. Senior Reactor Operator/Test Supervisor/Watch Foreman Indian Point Unit #3 Responsible for Shift Operations, supervision and support grouPs of a 1,000 megga-watt electric nuclear generating station. During construction phase responsible for acceptance testing associated with nuclear equipment and systems. Rewriting of startup procedures and initial writing of plant emergency procedures. Watch Foreman during initial core loading and physics testing on Indian Point #3. Obtained Senior Reactor Operator License on Indian Point Unit #3.
May 1972 to March 1974	Consolidated Edison Company of New York, Inc. Indian Point Station Formal Training for Senior Reactor Operators License. Became intimately familiar with all components of primary and secondary systems including design, purpose, limitations, and normal/emergency operating procedures. Participated in de-bugging and initial setup of the Indian Point real time nuclear Plant simulator. Obtained Senior Reactor Operator License (SOP 2095) on Indian Point Unit #2.
May 1971 to May 1972	Consolidated Edison Company of New York, Inc. Indian Point Unit #1 15' elevation and water factory operator
June 1970 to June 1971	Consolidated Edison Company of New York, Inc. Attended Con Edison Stationary Engineers School. October 1971 obtained New York City Stationary Engineers license.
August 1967 to May 1971	Consolidated Edison Company of New York, inc. Hell Gate Station Electrician Electrical trouble shooting and high and low voltage switching. Attended Con Edison electrical school October 1967 to Novemher 1967.
March 1965 to August 1967	Consolidated Edison Company of New York, Inc. Hell Gate Station Turbine Room and Pump Room Operator

JERRY GULLICK
Plant Engineer
Indian Point 3

EDUCATION:

Sept. 1969 - May 1974	BS Electrical Engineering, University of Missouri and one year graduate work in Nuclear Engineering
Jan. 1975	Nuclear Power Training in Math, Physics, Chemistry, Electrical Engineering, Plant Operations
Sept. 1983	Indian Point 3 Systems School
Sept. 1983	Improving Managerial Skills of the New or Prospective Manager

EXPERIENCE:

2/83 - Present:	Plant Engineer - Electrical, Indian Point 3 Projects include TSC computer installation, steam generator inspections and loose parts removal, metal impact monitoring, Reg. Guide 1.97 review, review, telephone installation review, corrections of plant electrical problems; involved and familar with wide range plant vent monitor, turbine first stage controls calculations, supervisory air for fire protection, CASP program, control room design review, battery test rig and spare battery charger tie-in, containment parameters monitoring and auxiliary boiler heat trace.
11/80-2/83	Analysis Support Officer Submarine Development Squadron Twelve Responsible for operations, maintenance and management of Burroughs Main-frome Computers supervisor of nine personnell responsible for the administrative support of tactical development departments member of tactics development groups stood duty as squadron duty officer for eight nuclear powered ships, responsible for the development of programs for a ship usage mini computer.
10/79-10/80	Division Officer, USS Nathaniel Greene Supervised watches of the reactor plant; supervised reactor plant maintenance; wrote, performed and inspected reactor plant testing which included steam plant testing, generator testing, rod testing, electrical plant testings; qualified as Engineer Officer on Navy Nuclear propulsion plant by Naval Reactors; selected as a candidate to work at naval reactors; stood watches over shift crew as Senior Supervisor Watch during reactor plant testing; assisted in training of nuclear personnel for reactor safeguards exam.

JERRY GULLICK

EXPERIENCE: (cont'd)

3/76-10/79 Division Officer, USS State
Responsible for radiological controls and chemistry of reactor and steam plant; qualified for operation and maintenance of a nuclear power plant; stood watches which controlled reactor plant refueling; stood watches which controlled reactor and steam plant testing; supervised the maintenance and overhaul of ships electrical equipment; supervised the activities of twenty electrical group personnel; supervised crew training for a reactor plant safeguards exam given by naval reactors; served as Assistant Engineer for last three months of overhaul.

JAMES M. CANNON IV

Shift Technical Advisor

EDUCATION:

1977 B.A. Bachelor of Arts, Physics, minors in Chemistry and Mathematics, Western Washington University, Bellingham, Washington.

1981 M.S. Master of Science, Nuclear Engineering, University of Washington, Seattle, Washington.

MILITARY EXPERIENCE:

U.S. Navy Commissioned May 1983 as an Ensign - Engineering Duty Officer assigned to AS-31 Hunley, submarine tender. Six years commitment as a reserve officer. Responsible for approximately fifty repair department enlisted personnel. Arrange drill weekend on board ships at Brooklyn Navy Yard by meeting with ship's chief engineer and duty engineer prior to arrival of reserve unit. Also, responsible for security clearances of all personnel.

EXPERIENCE:

Shift Technical Advisor (STA) - New York Power Authority, Indian Point No. 3 Nuclear Power Plant, Buchanan, New York
June 1980 - February 1981, November 1981 - Present

As engineer with the test group during the 1982 outage, responsible for reviewing and/or rewriting procedures such as blackout test with safety injection, integrated leak rate test, and B & C testing. Supervisor of 8-15 Nuclear Plant Operators (NPO's) in absence of test group Shift Supervisor. As Assistant to the Operations Superintendent, responsible for procedure reviews such as COL's update and incorporating mods in SOP's and PEP's. Reviewed engineering mods, NRC bulletins and site responses. Served as Operations Department alternate at PORC and outage meetings. Site contact for WOG Procedures Subcommittee Meetings and responsible for comparison of generic guidelines with site procedures. Responsible for supervising linewallks by NPO's and updating valve lists. Worked on plant modification packages for upgrading existing systems such as instrument air and cooling water to circulating water pump bearings. Maintained STA qualification through retraining and examination.

Graduate Student - University of Washington, Seattle, Washington
March 1981 - October 1981, September 1979 - May 1980

Studied two phase flow research for master of science thesis and degree.

Graduate Student = Western Washington University, Bellingham, Washington January 1979 - August 1979

Studied nuclear physics and mathematics in preparation for Master of Science Degree.

Junior Engineer - Art Anderson Associates, Inc., Bremerton, Washington
January 1978 - December 1978

Emphasis on technical updating and rewriting of manuals and schedules for U.S. Navy submarines and destroyers. Worked on energy conservation study of ventilation and air conditioning energy requirements for approximately sixty buildings. Made field reports and recommendations for energy conservation.

Engineering Aide - NUS Corporation, Maryland,
October 1977 - December 1977

Emphasis on energy conservation analysis of Fairchild space and electronics facilities. Analysis required use of Fortran computer program. Performed quality assurance tests on fuel storage metals. Experience in coal production, nuclear fuel management and nuclear fuel storage computer programs.

DONALD L. VINCHKOSKI

Assistant Shift Supervisor at IP-3

EDUCATION:

1968-1970	UNIVERSITY OF RHODE ISLAND, Biology Major Representative courses include: Gen. Chemistry, Zoology, Botany, Biology
1976-1979	MANHATTAN COLLEGE Graduate, Riverdale, N.Y. Bachelor of Mechanical Engineering, Cum Laude. Representative Engineering Courses include; Nuclear Engineering, Heating Ventilating and Air Conditioning, Convective Heat Transfer and Heat Exchangers, Computer Numerical Solutions to Mechanical Engineering Problems, Mechanics of Solids, Mechanics of Fluids, Analysis and Design of Mechanisms, Computer Science and Programming, Thermodynamics, Dynamics, and Engineering Economy.
1983-Present	MANHATTAN COLLEGE GRADUATE DIVISION Completed 70% of requirements towards a masters degree in mechanical engineering.

TECHNICAL TRAINING:

1983	New York Power Authority Senior Reactor Operating Licensing Training Nine months training in nuclear reactor theory, plant systems, accident and transient analysis, and related plant operations, in preparation for an NRC license exam.
1980	New York Power Authority Shift Technical Advisor Training Four months training session in nuclear reactor safety, nuclear theory, plant systems, and accident/transient analysis.
1979	General Electric Company Field Engineering Development Center Twelve weeks training in the following areas: steam turbine technology, power plant support systems, power plant operations, manpower planning and supervision, and turbine controls and supervisory equipment.

EXPERIENCE:

1983-present	New YorkPower Authority Assistant Shift Supervisor
1982-1983	New YorkPower Authority Attending Senior Reactor Operator Licensing School
1981-1982	New YorkPower Authority Assistant to the Operation Superintendent
1980-1981	New YorkPower Authority Shift Technical Advisor

EXPERIENCE cont'd:

1979-1980 General Electric Company
Nuclear and Steam Turbine Division
Installation and Service Engineering Division Field/Service Engineer

HONORS and
PROFESSIONAL SOCIETIES:

Deans Honor List
Member PI TAU SIGMA Mechanical Engineering Honor Society
Member American Society of Mechanical Engineers
Member American Nuclear Society

LICENSES:

Senior Reactor Operator License
Intern Professional Engineer, State of New York

APPENDIX C
OPERATOR QUESTIONNAIRE

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.

When you are finished, please mail the completed questionnaire to _____ _____ using the attached self-addressed, stamped envelope. Please complete and return the questionnaire within the next two weeks.

You may be interviewed to elaborate on your responses.

NOTE

To ensure anonymity, the following steps will be taken:

1. Upon receipt of your questionnaire a code number will be assigned to your questionnaire.

2. This sheet, with your name on it, will be removed from the questionnaire packet and placed in a file at _____.

3. The cover sheet, which contains only the code number, will become the only cover sheet in the questionnaire package, your name will not appear anywhere in the package. Your name will not be linked to your response when the results are presented to NU management.

4. The inside cover sheet containing your name will be used only to identify you if an interview is requested by _____.

Thank you for your time and consideration.

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 these?

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?

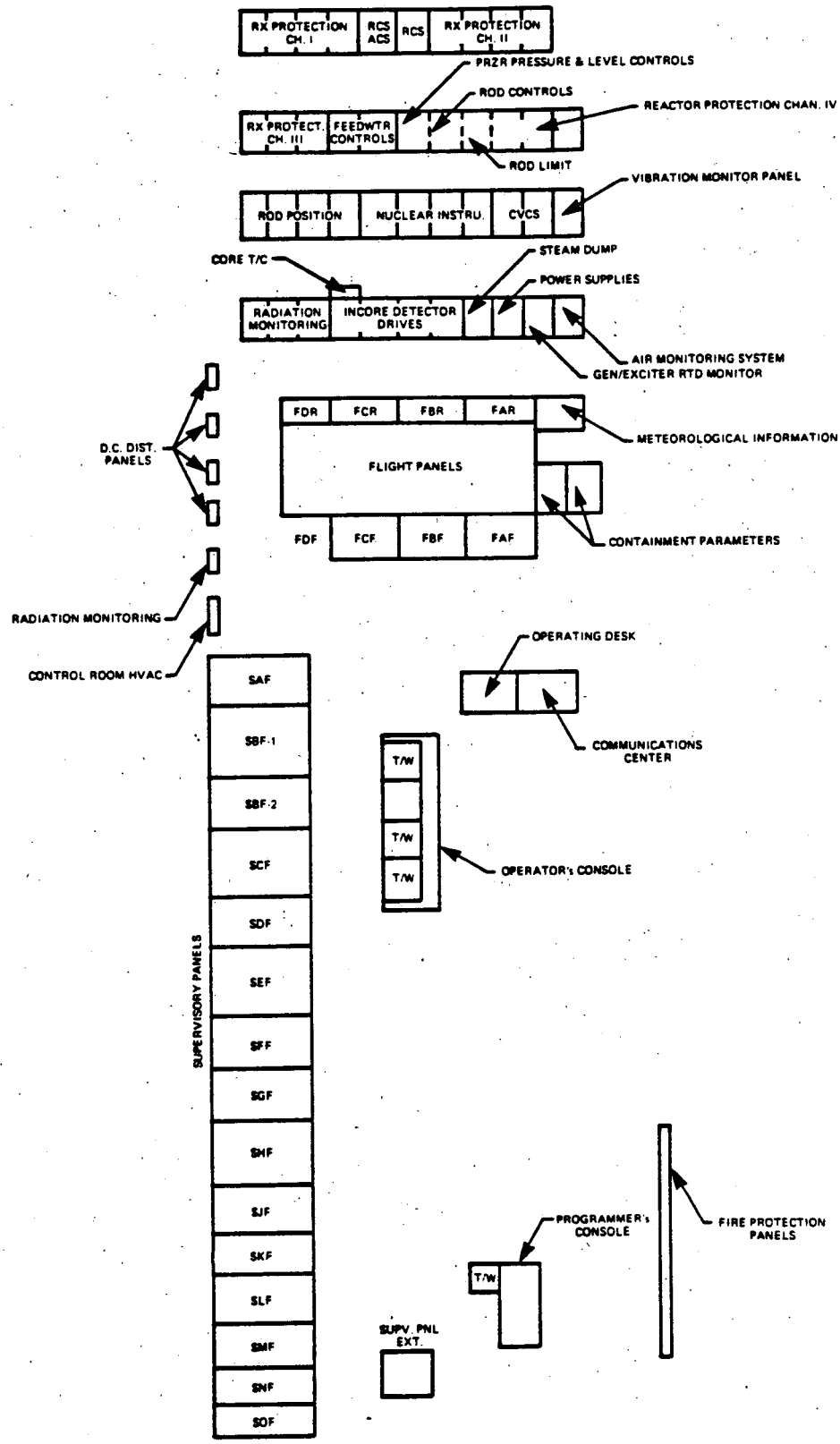
Additional Comments and Recommendations:

GENERAL

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

APPENDIX D

IP3 CONTROL ROOM LAYOUT AND PANEL NOMENCLATURE



IP-3 Control Room

FLIGHT PANELS

FAF - MAIN STEAM

FBF - MAIN FEEDWATER AND GENERATOR

FCF - ROD CONTROLS

FDF - NUCLEAR POWER

FAR - STATION ELECTRICAL

FBR - STATION ELECTRICAL

FCR - STATION ELECTRICAL

FDR - STATION ELECTRICAL

SUPERVISORY PANELS

SAF - REACTOR COOLANT SYSTEM

SBF-1 - SAFEGUARDS

SBF-2 - SAFEGUARDS

SCF - FEEDWATER AND CONDENSATE

SDF - TURBINE RECORDERS

SEF - TURBINE START-UP

SFF - CHEMICAL AND VOLUME CONTROL SYSTEM

SGF - AUXILIARY COOLING SYSTEMS

SHF - ELECTRICAL

SJF - COOLING WATER

SKF - BEARING MONITOR

SLF - CONTAINMENT BUILDING PRESSURIZATION SYSTEM

SMF - SAFETY INJECTION SYSTEM

SNF - CONTAINMENT ISOLATION

SOF - FAN COOLER CONDENSATE

EXT. PNL - CONTAINMENT ISOLATION

Indian Point Unit No. 3 Control Panels Reviewed