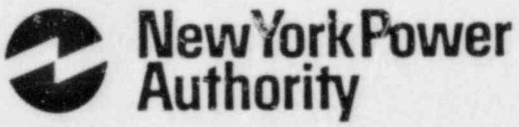
DETAILED CONTROL ROOM DESIGN REVIEW

PROGRAM PLAN
FOR THE
JAMES A. FITZPATRICK NUCLEAR POWER PLANT



October 19, 1983

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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. The Nuclear Regulatory Commission's (NRC) December 17, 1982, Generic Letter No. 82-33, on "Requirements for Emergency Response Capability" Section 5 is the basis for the requirement to perform a Detailed Control Room Design Review (DCRDR) at the James A. FitzPatrick (JAF) Nuclear Power Plant. In addition, the Generic Letter 82-18, "NRC Staff Review of the BWROG Control Room Survey Program" will be used as a supplemental basis for the JAF DCRDR. Although the DCRDR is directed toward the existing control room, it is recognized that other areas of concern, such as the Safety Parameter Display System (SPDS), among others, will be coordinated with the DCRDR.

The DCRDR Program Plan describes the manner in which the New York Power Authority (NYPA) intends to complete a review of the James A. FitzPatrick (JAF) Nuclear Power Plant. 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 methodology for performing the DCRDR is described in Section 4. Finally, 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 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, that 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 process, providing traceability of both the process 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.

- Performance of a control room survey which compares the control room design with accepted human engineering guidelines contained in BWROG Survey Program (reference NRC Generic Letter 83-18).

- A task analysis of the FitzPatrick specific Emergency Operating Procedures (EOPs). The FitzPatrick EOPs will be based on the BWR Owners Group Emergency Procedure Guidelines. Plant-specific task analysis data also will be used during the EOP upgrade to identify operator tasks and I&C needs.

- Identification of the requirements of operator tasks in terms of information, decision points and actions for the operating procedures looked at during the walkthroughs.

- Verification that FitzPatrick 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.

- Assess HEDs uncovered in any of the review steps.

- Develop a schedule for HED resolution.

- Develop a final report addressing the integrated activities in the DCRDR.

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. Any terms used in this document are explicitly defined in Appendix A, Glossary of Terms.

1.3 Schedule

A schedule depicting the time lines of major tasks in the DCRDR process is shown in Figure 2.

The start of the Task Analysis activity will be contingent on the availability of the JAF upgraded EOPs. These new symptom-oriented EOPs are not expected to be ready until December 1984.

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

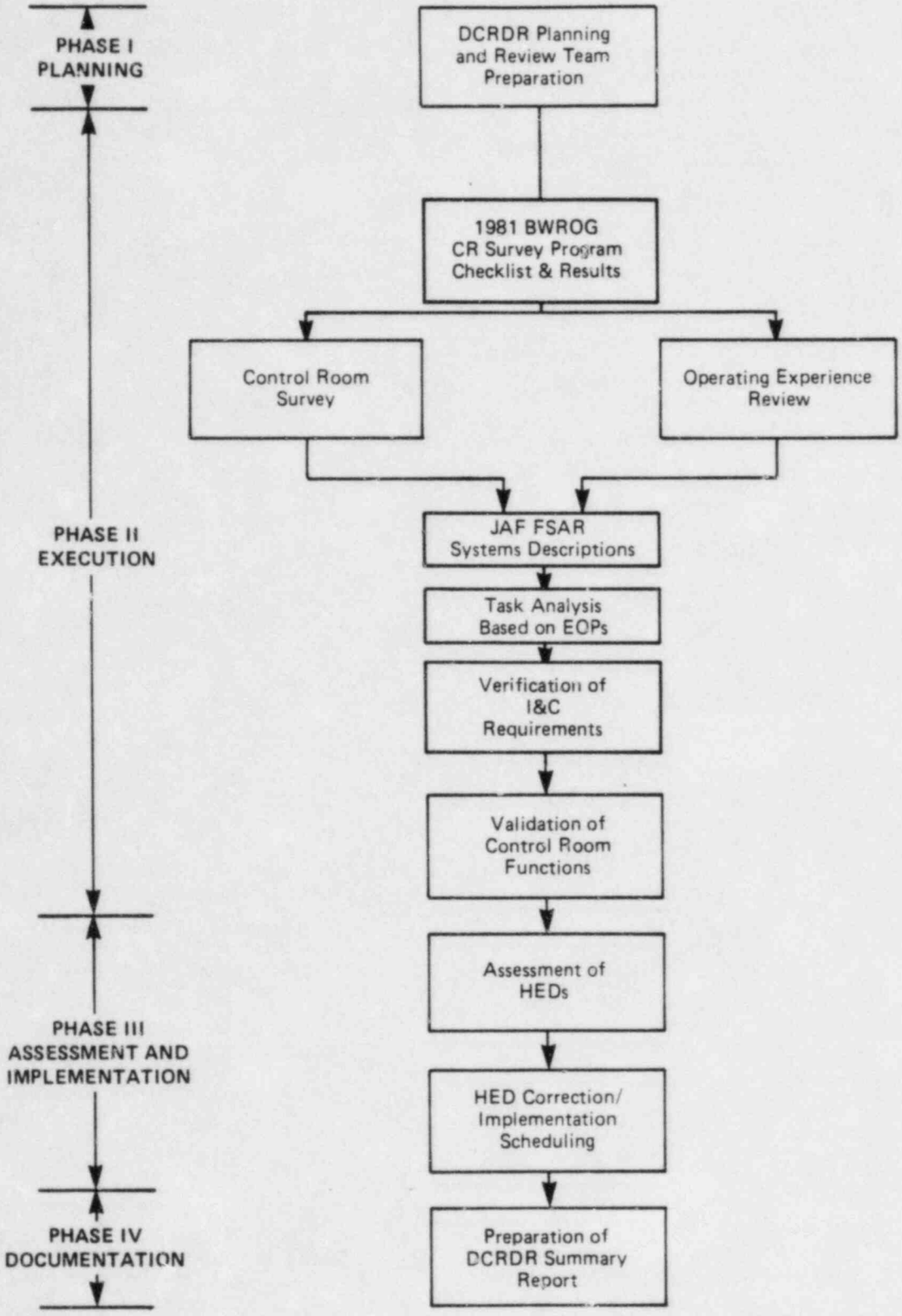
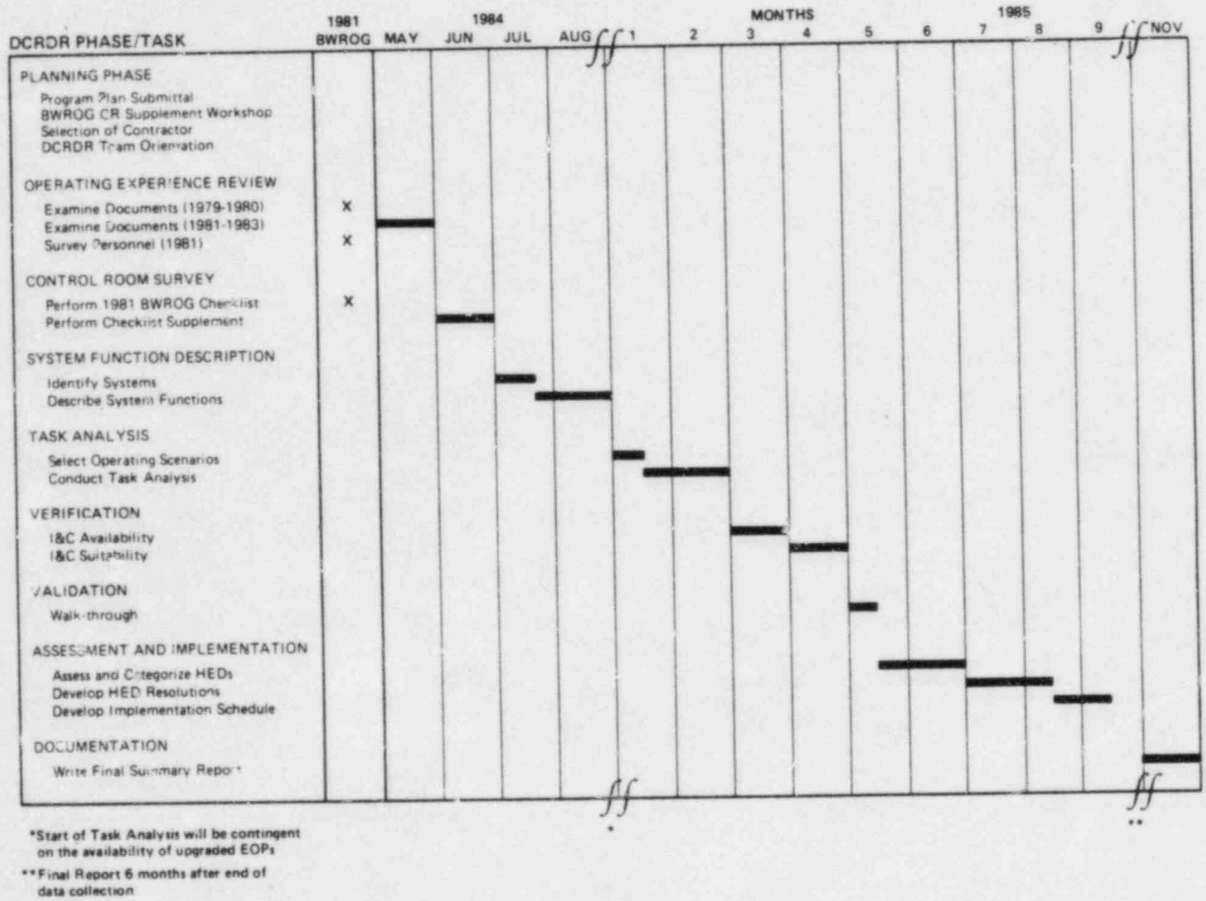


Figure 1. Flowchart of DCRDR Activities



*Start of Task Analysis will be contingent on the availability of upgraded EOPs

**Final Report 6 months after end of data collection

Figure 2. Schedule of DCRDR Activities

SECTION 2. MANAGEMENT AND STAFFING

Chapter 2 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 and qualifications 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 human factors activities is contained in Section 2.4.

2.1 Management 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.

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:

- Establish review team structure and contacts
- Review and finalize the project schedule
- Obtain existing, applicable documentation

Each of these objectives is discussed below:

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. Obtain existing, applicable documentation. The specific documentation is listed in Section 3.1.

C. Review Documentation

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

- Prepare for the Operating Experience Review
- Obtain information to be used in the EOP Task Analysis

D. Conduct Control Room Survey

The BWROG control room survey checklist supplement will be performed to update the survey conducted in April 1981. The supplemental checklist and survey approach has been reviewed by NRC in

Generic Letter 83-18 "NRC Staff Review of the BWR Owner's Group (BWROG) Control Room Survey Program" dated April 19, 1983.

The BWROG Checklist completed in April 1981 and the Checklist Supplement will be reviewed for potential Human Engineering Discrepancies (HEDs). These HEDs will then be examined in the DCRDR Assessment phase.

E. Describe Systems and Conduct Task Analysis

A functional description of each system is contained in the revised JAF Final Safety Analysis Report (FSAR). Operator tasks performed in the upgraded EOPs procedural steps will be documented on task analysis forms. Potential HEDs will be identified for assessment in the next DCRDR phase.

F. 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.

G. 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.

H. Documentation

The documentation used and data collected during the DCRDR will be maintained onsite by the DCRDR project manager. 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

The review team will have a core group of specialists in the fields of human factors engineering, plant operations (e.g., licensed operators), and instrumentation and controls engineering; the core group will also include personnel who are cognizant of the SPDS, EOPs and training issues. 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 will be staffed by a multidisciplined team of individuals with expertise in various areas. A range of experience and training is necessary to fulfill several kinds of review functions, which are:

- Technical task performance
- Project direction and management
- Administrative support
- Documentation support

Review team selection will result in a team with collective experience in the following areas:

- Human Factors Engineering
- Reactor Operations
- Instrumentation and Controls
- Engineering Disciplines as required
- Computer Operations
- Project Management
- Nuclear Licensing

- Safety Parameter Display System (SPDS)
- Emergency Operating Procedures (EOPs)
- Training

Due to the integrative nature of the DCRDR Project, the review team will have two distinct groups: those members who are the Authority personnel and those members who are consultant personnel.

The Authority part of the review team has the DCRDR Project Manager as its key person. 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.

An Authority individual will provide the bridge between this project and other human factors activities at the utility. This is an important input to the review team since resolution of Human Engineering discrepancies identified must be integrated with other possible changes to the control room originating from changed requirements or design.

The Director of Licensing of the BWR Support Group will provide the interface between the Authority and the Nuclear Regulatory Commission. An individual within the licensing group will be identified as the liaison.

The review team will contract with a qualified human factors engineer who will be responsible for assigned project work and human factors technical issues and will report directly to the Authority DCRDR Project Manager.

A diagram showing the relationship between and among team members is shown in Figure 3.

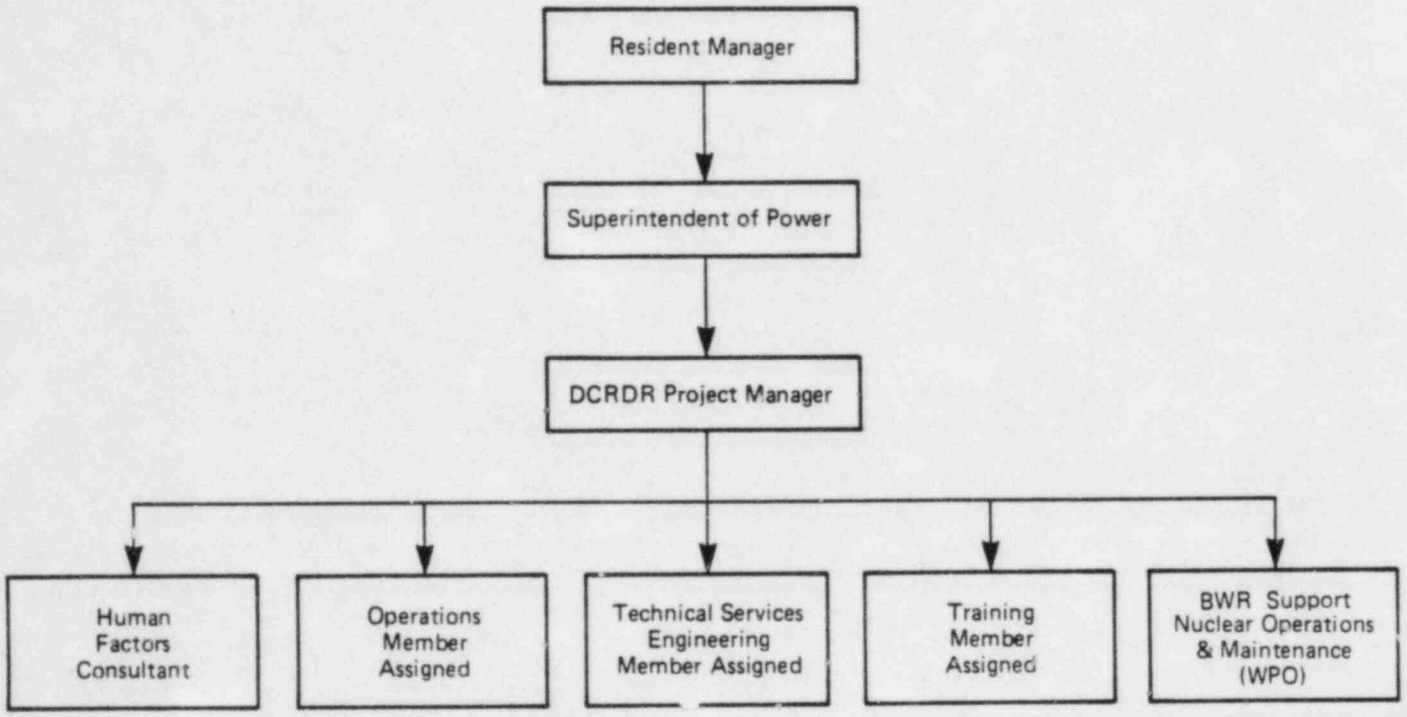


Figure 3. Functional DCRDR Team Organization

2.3 Qualifications of the Review Team

The qualifications of key review team members will be as follows:

- Human Factors Specialist: A degree, at the graduate level, in human factors engineering is recommended. The Authority will contract with a human factors specialist and will use some of the following criteria during the section process. Experience in the application of human factors principles to design and/or evaluation of systems and equipment in the power industry is preferred. Workspace layout, panel and instrumentation design (controls and displays) environmental conditions (e.g., lighting and acoustics), and procedures and training are areas of specific emphasis. 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 senior reactor operator with a minimum of two years' experience in the FitzPatrick control room being reviewed will be included on the Control Room Design Review team.

- Instrumentation and Control Engineer: The I&C Department superintendent or his staff will be available as required.

- 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 the Control Room Design Review With Other Human Factors Activities

The DCRDR Project will interface with and/or reference previous and ongoing human factors efforts at the FitzPatrick Nuclear Power Plant. A description of some of the work is provided below.

2.4.1 BWROG Control Room Survey Program

In April 1981, the BWR Owners' Group conducted a control room survey at the JAF nuclear power plant. A team comprised of operations and engineering personnel from four utilities performed the checklist survey with the assistance of consultants from General Electric Company and the Massachusetts Institute of Technology. The survey consisted of four phases: (1) an analysis of plant LER's and scram reports to identify possible design-related operator errors, (2) interviews with approximately one-third of the plant operators, (3) panel evaluations using checklists developed from previous surveys and accepted human factors standards, and (4) task analyses and walkthroughs of selected emergency procedures. The result of the survey was a summary report and a completed checklist.

The intent of the BWROG Control Room Survey report for FitzPatrick was to identify areas of control room design for which modifications should be considered. These were stated as general suggestions with the understanding that any corrective action should be considered on a control room wide basis.

The Authority is currently responding to the requirements set forth in Supplement 1 to NUREG-0737. This DCRDR Program Plan is the first step in responding to the DCRDR requirements (Section 5 of Generic Letter 82-33). The BWROG Program and INPO NUTAC on CRDR documents are the primary guidance documents on which this Program Plan, and the corresponding DCRDR project, will be based.

The strengths of the BWR Owners Group program as presented by the BWROG to the NRC on September 16, 1982 are:

> The program is generic in nature, a cooperative effort between BWR utilities, resulting in standardized review methodology.
>
> Extensive, multi-disciplinary design effort was involved in the development of the program. Reviews were performed by several independent agencies.
>
> Human factors specialists have been involved in each phase of the program.
>
> Impartial data gathering and standardized methodology were assured through use of inter-utility survey teams. Survey team members were trained in design review techniques during a 6-day workshop followed by on-site instruction.
>
> Operational experience was incorporated into both the development and review phases.
>
> Integration of the DCRDR with other control room enhancement programs was stressed from an early date.
>
> Task analyses, operator interviews, and operating experience reviews were included in the review methodology. Task analyses were based upon the new symptom based technical guidelines being developed by the BWROG. The checklist reviews and operator interviews are relatively comprehensive.
>
> A final general report will be prepared, summarizing results of all BWR DCRDR to promote the exchange of experience, technology, and ideas between utilities.
>
> The BWROG Survey program and Supplement efforts will be coupled with the INPO CRDR NUTAC guidelines and other human factors approaches in the conduct of the JAF DCRDR.

2.4.2 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 CRDR methodology and implementation guideline
- a guideline on the development of CRDR survey checklists
- a CRDR task analysis guideline
- a set of human engineering review principles

The NUTAC CRDR guidelines will be used as appropriate in the JAF DCRDR project.

2.4.3 Supplement 1 to NUREG-0737 Activities

Given the integrative nature of Generic Letter No. 82-33, the DCRDR process will be coordinated with other post-TMI activities that are addressed in the letter. The results of the DCRDR project can be utilized in specific applications as discussed below:

- EOPs - The Systems Function Description and Task Analysis portion of the review will use the FitzPatrick-specific EOPs as its basis. Thus, examination of the EOPs will inherently integrate their upgrading with the DCRDR.

- SPDS - One of the aspects of the DCRDR project is to identify and define operator requirements during conditions of emergency operation. These requirements may define some of the necessary plant inputs to the SPDS and the display formats for the graphic displays. In addition, the SPDS may provide operator information requirements that could preclude some control room modification (e.g. installation of additional displays or rearrangement of displays).

- Reg Guide 1.97 - The Verification of the Task Performance Capabilities portion of the DCRDR systematically verifies the presence or absence of information required by the operator during emergency operations. The results of this process will give insight into the monitoring instrumentation that is available to the operator and, conversely, if any type of indication is required but missing.

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 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 in a manner that allows future access to help determine the effects of control room changes proposed in the future.

Documentation collected during the DCRDR project will be maintained in files at the JAF 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
- Scram Reports
- Occurrence Reports
- Final Safety Analysis Report (FSAR)
- Systems descriptions

- Piping and instrumentation drawings
- Control room floor plan
- Panel layout drawings
- Panel photographs
- BWROG Generic Emergency Procedure Guidelines (EPGs)
- JAF 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
- Panel Checklists
- Task Analysis Worksheets
- List of HEDs assessed according to their safety implications
- Photographs of Control Board
- Summary DCRDR Report

3.4 Documentation Control Procedures

A review team member will be designated as responsible for documentation control. All documents received from the Authority used as primary input to the review, or generated during the review will be subject to the following document control procedures.

All documentation received and generated during the review will be logged. The log will contain the document name, the revision level, and the date received.

All project documents will be maintained in a project file onsite at JAF Nuclear Power Plant.

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 (see Figure 5). This information allows the engineer the opportunity to compare all of the discrepancies which apply to a given component.

HUMAN ENGINEERING DISCREPANCY RECORD # PLANT:

REVIEWER: ST DATE: 02/17/82 NO.: 100

PANEL NUMBER	COMPONENT IDENTIFIER
1C 651	RFPT FLOW CONTROL DISPLAYS

DESCRIPTION OF DISCREPANCY

THESE DISPLAYS ARE NEITHER LOCATED DIRECTLY ABOVE ASSOCIATED CONTROLS NOR ARE THE DISPLAY CONTROL PAIRS ARRANGED IN ROWS.

REVIEW SECTION CODE:
9. C/D INTEGRATION)

GUIDELINE NO.: 6.9.2.X a-1&2
CATEGORY: II. (RESOLVED)

COMMENTS

SURVEY

RECOMMENDATION

PROVIDE GLOBAL LABELING AND/OR DEMARCATION TO ENHANCE CONTROL/DISPLAY RELATIONSHIP.

IMPLEMENTATION

THIS HED HAS BEEN RESOLVED. DEMARCATION HAS BEEN IMPLEMENTED.

Figure 5. HED Form

SECTION 4. REVIEW PROCEDURES

The JAF DCRDR review procedures are primarily based on the BWR Owners Group (BWROG) Control Room Survey Program (reference Generic Letter 83-18). The BWROG survey program addresses the planning and review phases only of the DCRDR process. The assessment, implementation and reporting phases are described in this program plan specifically for the JAF DCRDR.

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 Description 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 and/or have previously caused human performance problems and could be alleviated by improved human engineering. This review will provide information on potential problem areas by studying documented occurences of human engineering related problems that have occurred in operating plants that are similar to FitzPatrick.

4.1.2 Methodology

There are two major steps in the Operating Experience Review: an LER Review and Operator Interviews. Both tasks were completed as part of the 1981 BWROG Control Room Survey Plan. The LER review will be updated when the BWROG CR Survey Supplement checklist is performed. The methodologies for both tasks are described below.

4.1.2.1 LER Review

Licensee Event Reports (LERs) for the JAF plant were reviewed to identify plant specific design deficiencies known to have previously contributed to operator errors and to document the need for further evaluation during the other Control Room Review phases.

The 1981 BWROG survey program documented JAF plant specific LERs and Scram reports from the preceding two years (1979-1980). LERs for the FitzPatrick plant from 1981 to 1983 will be examined during the conduct of the BWROG Survey Supplement. Any occurence for which operator error was identified as a contributing factor was listed on an LER form indicating the LER number and a description of the operator error.

The survey team then analyzed each event to identify possible deficiencies in the human engineering design of the control room by cross referencing the corresponding criteria from the Control Room Review checklists. These items will be included in the detailed evaluation during the DCRDR assessment phase.

The results of the LER Review update will be potential HEDs documenting operating experience problems related to the JAF control room designs.

4.1.2.2 Operator Interviews

The purpose of the Operator Interviews was to obtain direct operator input to aid in identifying potential or actual deficiencies in the control room layout or design or in operating procedures that result in confusion (mental activities), difficulty (manual activities) or distraction (the environment).

For the interview, a representative group of one-third or more of the operators was selected covering a range of experience, education, ability, and physical size. A total of twelve operators was interviewed as part of the 1981 BWROG control room survey program. These included four shift supervisors, six licensed and two non-licensed operators. No additional interviews are planned as part of the BWROG supplement program.

Using the questionnaire in Appendix C, operators were asked to respond in writing based on their operational experience and knowledge of control rooms. Copies of the written responses were provided to the survey team for a preliminary review prior to actual interviews. Interviewees retained their copies and reviewed them with a survey team member during a later oral interview.

The interviews were conducted by utility personnel and survey team members with background or experience in operations and engineering or design under conditions conducive to a free flow of

information. The oral interview took one to two hours for each operator with the entire interview process taking about one day.

Following the interviews, the survey team consolidated the information obtained and analyzed it to help identify specific areas of concern for detailed analysis during the DCRDR assessment phase.

4.2 Control Room Survey

4.2.1 Purpose

The purpose of the Control Room Survey is to identify characteristics of instruments and controls, equipment, control room layout, and environmental conditions that do not conform to precepts 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. The ultimate objective is to identify potential modifications of the operator-control room interface which will reduce the potential for human error.

4.2.2 1981 BWROG Survey Methodology

The methodology followed in conducting the control room survey is described in the BWROG control room survey program (1981 and Supplement 1983).

Each Control Room Survey was conducted by the survey team using the BWROG checklists which are titled, in order, (A) Panel Layout and Design, (B) Instrumentation and Hardware, (C) Annunciators, (D) Computers, (E) Procedures, (F) Control Room Environment, (G) Maintenance and Surveillance, and (H) Training and Manning. Checklist (A), (B), and (C) were completed for each panel in the control room, including back panels, auxiliary panels and peripheral equipment that contain controls and displays normally operated by the control room operator. The

remaining checklists were completed only once since they were applicable to the entire control room.

In completing the checklists, particular attention was given to items identified as potential problem areas in the Operator Interview and in the LER Analysis to ensure complete coverage. These items were cross-referenced to the checklist items where applicable.

Supplemental information was provided in the BWROG workshop to give additional guidance to review team members in completing the checklists.

Each checklist item was presented in the form of a question for consideration by a survey team member. Following that question was a series of numbers in which the specific item being reviewed was evaluated. The first set of numbers (4 3 2 1 0) indicated the degree of compliance wherein 4 indicated no complicance, 3 indicated somewhat compliance, 2 indicated mostly compliance, 1 indicated full compliance, and 0 indicated the specific question being considered was not applicable or could not be considered at this time. As each specific question was evaluated, the team member(s) actually doing the evaluation of that question indicated the relative degree of compliance by circling the applicable number.

Following the number indicating the degree of compliance for each item being evaluated was a predetermined number ranging from one to three which indicated the relative importance of that item with respect to the potential for causing or contributing to operator error. A 3 indicated high potential for operator error, 2 indicate moderate potential, and 1 indicated low potential. In the final evaluation of each item considered, it was the product of the degree of compliance multiplied by the potential for operator error that determined if the consideration of corrective action is justified.

Following each checklist item was space for the person performing the evaluation to enter comments. For each specific checklist item,

these comments identified items or components of non-compliance, the scope of review, or any qualifying statement judged to be appropriate to the evaluation. If, for example, a large number of components are reviewed and only a few were non-compliance, these were specifically noted in the comment space and the general rating was "mostly compliance." To provide additional documentation, still photographs were taken of major items or components of non-compliance such as mimic layouts, control/display groupings, labeling systems or equipment locations. These photographs were cross referenced to the specific checklist item by a notation in the comment space. Due to the importance of comments in the evaluation, additional Comment Forms were attached for more detail when necessary.

The 1981 BWROG survey covered the following areas:

- Panel Layout and Design
- Instrumentation and Hardware
- Annunciators
- Computers
- Procedures
- Control Room Environment
- Maintenance and Surveillance Procedures
- Training and Manning

Each of these control room survey areas and general findings is described in the sections that follow.

4.2.2.1 Panel Layout and Design

Control panel layout and design were evaluated against checklist standards covering anthropometrics, panel arrangements, mimic and demarcation lines, control/display grouping, color codes, labels, temporary modifications, and traffic patterns. As a result

of this review, the following recommendations were offered as general areas in which modifications should be considered:

1) More extensive use could be made of demarcation lines, hierarchical labeling systems, and other methods of control and display grouping.

2) Color usage should be standardized.

3) The placement, size, and nomenclature of labels should be standardized.

4) A formal method of controlling and evaluating temporary panel labels is needed.

5) Potential obstructions in operator walking paths and visual spans should be minimized.

6) Relocation and rearrangement of certain indications within the control room should be considered.

4.2.2.2 Instrumentation and Hardware

Control room instrumentation and hardware were evaluated against checklist standards addressing controllers, indicators, recorders, indicating lights, and switches. Conclusions drawn in each of these areas are discussed below. The following recommendations were provided as general areas in which modifications should be considered:

(1) Control room indicators and recorders should be reviewed to determine which would benefit from the addition of markings or color coding to indicate normal and abnormal ranges.

(2) The use of non-standard indicator scales should be minimized.

(3) Multipoint recorders should be used only where such a format is applicable. Where used, readability should be enhanced and consideration given to incorporating fast speed and point select capabilities.

(4) Emergency switches should be clearly marked.

4.2.2.3 Annunciators

The annunciator system was evaluated against checklist criteria addressing window design and grouping, audible and visual alarms, annunciator procedures, maintenance, and the usefulness of alarms provided. Based on this review and inputs from operator interviews, the following general recommendations were provided as areas in which modifications should be considered:

(1) The readability of annunciator legends should be improved by standardizing type size and style, abbreviations, terminology, and syntax.

(2) The usability of the annunciator system should be improved by prioritizing alarms, segregating informational and advisory displays, clarifying ambiguous legends and providing a alpha-numeric code for window identification.

(3) Silence, reset, and first-out capabilities should be incorporated.

4.2.2.4 Computers

An evaluation of selected human factors aspects of computer design and operability was performed, covering the computer console, computer capabilities, CRT's, and typers. Since the

complete JAF plant computer system is scheduled to be replaced, general findings of the 1981 BWROG survey are not relevant to the DCRDR.

4.2.2.5 Procedures

Plant procedures were reviewed and evaluated in terms of availability, access, format, content, use of reference material, and methods of revision. The content of administrative procedures covering plant logkeeping practices and the availability of flow diagrams and schematics were also reviewed. No attempt was made to evaluate the technical content of procedures, only their effectiveness as operator aids. The suggestions made here were derived from a general examination of the procedure file with more detailed attention given to selected procedures. In addition, the procedures used in walkthrough evaluations were separately analyzed. . The following recommendations are offered as general areas in which modifications should be considered:

(1) Control room copies of flow diagrams and schematics should be reviewed and updated where necessary, ensuring all recent modifications are incorporated.

(2) More complete administrative procedures detailing procedure content and formats may be appropriate.

(3) The procedure revision process should involve operators to a greater degree.

4.2.2.6 Control Room Environment

The evaluation of control room environmental factors included a review of communications systems, audible alarms, lighting and noise levels, heating and air conditioning, emergency response capabilities, and housekeeping considerations. Based on this

review the following recommendations were offered as general areas in which modifications should be considered:

(1) Audible alarms should be prioritized, distinguishable for alarm location, and loud enough to be audible over background noises.

(2) Glare-free lighting of adequate brightness should be provided at panel surfaces.

4.2.2.7 Training and Manning

These areas received only limited attention in the 1981 BUROG survey program since other NUREG requirements call for separate, detailed evaluations of training methods and manning levels. However, operator interviews did identify the plant training program as a major complaint, indicating a desire of the operators for more detailed, plant specific information. Therefore, it was felt that the content of the training program should be reviewed separately from the control room design review program.

4.2.2.8 Maintenance and Surveillance Procedures

Maintenance and surveillance activities were reviewed only in areas that directly involved control room operating personnel. This included operator maintenance functions, jumper and lifted lead control, methods of control board modification, tagout procedures, spare part availability, and general maintenance procedures.

4.2.3 1983 BWROG Survey Methodology

The 1981 BWROG control room survey areas described above will be updated for the JAF control room during the DCRDR using the 1983 BWROG Supplement checklist (July 1983).

This Supplement is intended to augment Revision 1 of the BWR Owners Group Control Room Survey (CRS) Program dated 1/1/81. It is to be included as part of the Control Room Review Checklists (Section III of the CRS Program) to further document proposed control room enhancements. The additional items listed in the supplement have been drawn from human engineering guidelines recommended in NUREG-0700 and verified through considerable experience of BWR Owners Group Survey teams.

Major sections of the supplement checklists are identified by letters corresponding to section designations used in the original checklists. In order to differentiate between the two numbering systems, an "S" prefix has been assigned to each supplement item. The supplement checklist sections are:

SA. Panel Layout and Design
SB. Instrumentation and Hardware
SC. Annunciators
SD. Computers
SE. Procedures
SF. Control Room Environment
SG. Maintenance and Surveillance

This checklist supplement will be performed during the planned DCRDR activities. The results of BWROG 1981 checklist survey and the 1983 Supplement Survey will be compiled on HED forms described in Section 3 Documentation. These forms will be the input documentation for the DCRDR Assessment and Implementation phase.

4.3 System Function Description and Task Analysis

4.3.1 Purpose

The purpose of the Systems Function Description and Task Analysis portion of the DCRDR is to identify control room operator tasks and

corresponding instrumentation and control requirements during emergency operations. This will be accomplished by performing an analysis of events encompassed in the FitzPatrick-specific Emergency Operating Procedures (EOPs).

4.3.2 Methodology

This portion of the DCRDR entails two major, sequentially oriented tasks. Each of the two tasks is discussed separately below.

4.3.2.1 Systems Function Description

Plant systems and subsystems in the control room have been identified and listed in the JAF FSAR. Major systems include the reactor control and instrumentation systems, safety systems, feedwater systems, power generation systems, and power distribution systems. Subsystems are identified only if they are considered operationally separate from the major system of which they are a part.

The functions associated with each system and subsystem are described in the JAF FSAR. This information will serve as a reference base for the subsequent Task Analysis and Assessment phases. In addition, the systems list will be used in the selection of operating scenarios for each walk-through during the Task Analysis.

4.3.2.2 Task Analysis

Using the FitzPatrick-specific EOPs as a basis, the Task Analysis will identify and document the discrete tasks that the operators must perform during emergency operations. Correspondingly, the specific instrumentation, controls and equipment that are required to successfully perform the emergency operations will be identified and documented. Task analysis data

collected as part of the EOP upgrade effort will be used as a basis for the DCRDR task analysis effort.

The INPO NUTAC CRDR Task Analysis Guideline will be used as a reference for the task analysis to be conducted for the JAF DCRDR. The guideline provides a general description of the task analysis process to be followed. It provides sample forms for (1) control and display requirements, and (2) task analysis worksheet data to be collected.

A preliminary Task Analysis Form is shown in Figure 1. Operator tasks will be analyzed using the symptom-oriented EOPs and documented in the following manner:

1. The identification of discrete steps in the EOPs in order of performance. These steps will be recorded in the "Procedural Step" column of the Task Analysis form and branching points noted depending on the plant transient being analyzed.

2. A brief description of the operators' tasks per procedural step will be recorded in the "Operator Tasks" column of the Task Analysis form.

3. The identification of the instrumentation and/or controls that the operator requires per procedural step to either: (1) initiate, maintain or remove from service a system, (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. The required Instrumentation and Controls will be recorded in the "I&C Requirements" column of the Tasks Analysis form.

The remaining columns of the Task Analysis Form will be utilized during the Verification of Task Performance Capabilities, which is described in the next section.

4.3.2.3 Control Room Inventory

The function intended for a control room inventory in the DCRDR is to determine whether the instrumentation and controls needed to support operation under emergency conditions actually exist. (See INPO NUTAC Implementation Guideline.) This function will be accomplished as part of the task analysis effort and the related verification and validation efforts. The determination of I&C availability is described in Section 4.4, Verification of I&C requirements.

In addition, a complete set of control board photographs will be taken to provide an as-built inventory of the JAF instrumentation and controls during the DCRDR.

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 procedure 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 noted in the Task Analysis will be confirmed. This will be done by comparing the requirements in the "I&C Requirements" column of the Task Analysis Form to the actual control room.

TASK ANALYSIS FORM

Event _____
Unit _____
Page _____ of _____

Procedural Step	Operator Tasks	Instrumentation and Controls Required	Availability		Suitability	
			Yes	No	Yes	No

Figure 1 . Task Analysis Form

4.4.2.1 I&C Availability

The presence or absence of required Instrumentation and Controls will be noted in the "yes" or "no" areas, respectively, 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.

The result of the verification of I&C availability will be a CR inventory in the task analysis form column labelled I&C Requirements of instrumentation and controls needed to support operation under emergency conditions.

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 "I&C 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 "I&C 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.

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 FitzPatrick-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 Forms, from the Systems Functions Description and Task Analysis DCRDR phase walk-throughs will be performed in the control room based on the symptom-oriented EOPs developed from the BWROG EPGs. A normal complement of the 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 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 Forms. 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 walkthroughs of the upgraded EOPs. This documentation will also be useful in any type of long-term training program which involves procedures upgrades.

The operators who performed the event will review the Task Analysis Worksheets along with human factors specialists. The operators will be asked to note any errors or problems that were encountered in the 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 procedural step, the following types of information will be recorded:

- The identification of which member of the operating crew is performing the task. This will be added to the "Operator Tasks" column on the Task Analysis Form.

- A description of the specific behavioral action that is associated with each operator task. This will include communications between and among crew members. This will be added to the "Operator Tasks" column on the Task Analysis Form.

- A description of the system response as a function 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 "Instrumentation and Controls Required" column on the Task Analysis Form.

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.

SECTION 5. HED ASSESSMENT AND RESOLUTION

5.1 HED Assessment

All HEDs that are identified as a result of the DCRDR process will be assessed and categorized. Additionally, recommendations for the correction or resolution of HEDs will be generated, and a schedule for their implementation will be developed.

5.1.1 Purpose

The purpose of the HED Assessment phase of the DCRDR project is to examine the HEDs that have been identified and place them into categories in terms of their potential to increase operator error during operations. This is accomplished by analyzing and evaluating the problems that could arise from the identified HEDs.

5.1.2 Methodology

The DCRDR review team will evaluate HEDs for their potential to increase operator error during operations. As each HED is assessed, they will be categorized as follows:

1. Category I - HEDs Associated with Documented Errors

   HEDs which have been previously documented (as determined in the Operating Experience Review) as having contributed to a significant operating crew error will be assigned to Category I.

2. Category II - HEDs Associated with Potential or Interactive Errors

   HEDs placed in Category II come from two sources:

a. If it is judged that the HED degrades performance and if the effects of the HED are judged to be serious enough to cause or contribute to increasing the potential for operator error, the HED will be assigned to Category II.

b. If it is judged that the HED has any cumulative or interactive effects with other HEDs, it will be assigned to Category II. Cumulative HEDs would be those that are placed in this category by their number of occurrences, such as improper labeling characteristics throughout the entire control room. Interactive HEDs would be those HEDs that excaberate each other such as improper scaling on a meter combined with the absence of a parameter designation.

3. Category III - HEDs Associated with Low Probability Errors of Serious Consequences

All HEDs that are judged by the DCRDR review team to have a low potential for error but could result in serious consequences if the error did occur would be placed in Category III.

4. Category IV - Non-Significant HEDs

All HEDs that are judged by the DCRDR review team to neither increase the potential for causing or contributing to an operating crew error, nor to have adverse safety consequences, nor to have any cumulative or interactive effects will be assigned to Category IV.

5.2 HED Corrections

5.2.1 Purpose

Recommendations for HED resolution or correction will be made for each identified HED. This will be done in an attempt to alleviate the

human engineering problems that are associated with the HEDs. Recommendations will be based upon three criteria:

1. The recommended improvement adheres to accepted human factors engineering principles.

2. The recommended improvement is cost-effective and feasible from an implementation perspective.

3. The recommended improvement will be acceptable to both the Authority and the NRC.

5.2.2 Methodology

The following techniques are among the methods that may be utilized for the corrections of discrepancies.

- Correction by enhancement: Enhancement techniques include changing control and/or display labels and annunciator title legends, or adding demarcation lines or mimic lines to existing arrays of controls and displays. These techniques will be mocked up via drawings. The review team will then judge their effectiveness in resolving the HED. If the enhancement correction is judged to be effective, it will be considered to be the appropriate resolution.

- Correction by design change: HEDs that cannot be effectively corrected by enhancement may require a design effort, either in terms of component reconfiguration or rearrangement. These design changes will be verified by having operations personnel assess their effectiveness. This will be acheived by having operators walk through the portion of an EOP that involves the utilization of the component(s) that were reconfigured or rearranged to see if the design correction in fact did provide an enhancement.

- Correction by SPDS, training, or procedural modifications: Some HEDs can be resolved through methods that do not require physical modifications to instrumentation and controls. The lack of a required indication could be resolved by supplying this indication on the SPDS. Training programs could be initiated or supplemented to alert operators to particular control arrangements that not optimal but cannot be reconfigured due to space constraints or separation criteria, and Procedures could be modified to compensate for irreconcilable instrument and control layout or location.

5.3 Implementation Schedule

A schedule for implementation of HEDs will be developed based on the category assigned, additional engineering study requirements, implementation complexity, and plant scheduling constraints.

SECTION 6. DCRDR FINAL REPORT AND FUTURE APPLICATIONS

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.

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 FitzPatrick training programs as applicable. This will ensure that any implemented changes will be brought to operators' attention with regard to physical modifications or procedural alterations.

SECTION 7. BIBLIOGRAPHY

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

Generic Letter 82-18 "NRC Staff Review of the BWR Owners' Group (BWROG) Control Room Survey Program"

BWR Owners Group Control Room Improvements Committee, Human Factors Design Review of the FitzPatrick Control Room Summary Report (September, 1981)

BWR Owners' Group Human Factors Engineering Control Room Survey Supplement Annotated Checklist

Human Factors Evaluation Control Room Operator's Evaluations and Comments

BWR Owners' Group Control Room Survey Workshop Supplement

BWR Owners' Group Control Room Improvements Committee

BWROG Control Room Design Review Committee Meeting

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 (in press)

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

Sheridan, T. B. Memorandum entitled "Review of FitzPatrick Plant" April 16-17, 1981

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY OF TERMS

BWR Owners Group (BWROG) - A consortium of Boiling Water Reactor (BWR) utilities formed to address concerns and design issues common to BWR plants.

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 Procedures Guidelines (EPGs) - 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).

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.

APPENDIX B

RESUMES OF DCRDR TEAM MEMBERS

(TO BE PROVIDED LATER)

APPENDIX C

DATA COLLECTION FORMS

BWR OWNERS GROUP

CONTROL ROOM SURVEY

PLANT/UNIT: _____

DATE PERFORMED: PHASE I _____ II _____

III _____ IV _____

SURVEY TEAM MEMBERS: _____ Team Leader

_____

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OTHER PARTICIPANTS (HFE CONSULTANT, GE A-E, etc.): _____

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NOTE: CHECKLIST ITEMS FOR WHICH ADVANCE RESEARCH IS NECESSARY HAVE BEEN IDENTIFIED WITH AN ASTERISK IN FRONT OF THE ITEM NUMBER.

I OPERATOR INTERVIEW

INTRODUCTION TO QUESTIONAIRE

Job Position _____

Years Experience _____ Commercial Nuclear _____ Fossil

_____ Navy Nuclear

Date of first License _____ RO _____ SRO

Education/Degrees _____

Age _____ Sex _____ Height _____ Weight _____

In response to a post-TMI NRC requirement, your utility, along with other BWR owners, is conducting a control room review to identify and correct design deficiencies in the operator-control room interface to minimize the potential for human error. This review is performed by a survey team composed of representatives of several utilities using checklists prepared by the Control Room Improvements Subgroup of the BWR Owners Group.

You are asked to complete the attached questionaire basing your responses on your operational experience and knowledge of your control room and interfacing systems. You may complete this questionaire in the control room if you desire but please do so without discussing your detailed responses with other operators completing this survey. If additional space is needed, the attached Comment Form is to be used.

Following completion, a survey team representative will review your responses with you. Upon completion of all interviews, the survey team will consolidate the information obtained and apply it in their evaluation of your control room for compliance with human factor engineering principles.

The biographical information requested above will be used in compiling statistics on operating personnel physical characteristics. Current recommendations for panel design are based largely on data obtained from measurements of military personnel; there are few statistics presently available on, for example, the average height and weight of operators.

This survey provides you with a valuable opportunity for applying your knowledge and experience toward improving operating conditions in both your control room and future control room designs. Your honest and forthright opinions are not only welcomed, but needed.

I OPERATOR INTERVIEW

QUESTIONAIRE

A Would you recommend any changes in the following areas:

A1 shift coverage

A2 shift turnover

A3 training

A4 color coding

A5 control room access

A6 control panel layout or access

A7 communication systems

A8 heating or ventilation

I OPERATOR INTERVIEW

COMMENT FORM

This form is for use by the operator or interviewer for expanded responses to the Operator Interview questions. When used, each response will be identified by item number on this form and also so noted in the space following the applicable question to assure proper cross-referencing.

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II LICENSEE EVENT REPORT ANALYSIS

LICENSEE EVENT REPORTS (LERs)

*LER NUMBER	*OPERATOR ERROR	CHECKLIST ITEM

III CONTROL ROOM REVIEW

Panel _____

A PANEL LAYOUT and DESIGN

A1 For control panels:

A1.1	does the design generally meet measurement standards per the attached anthropometric diagrams (complete and attach)	4 3 2 1 0 x 2 = ____
A1.2	are they of the same layout and design on multi-unit plants (not mirror image)	4 3 2 1 0 x 2 = ____
A1.3	when panel components are permanently removed, are spaces covered to prevent debris or dust from entering panel internals and repainted to avoid visual distinctiveness	4 3 2 1 0 x 2 = ____
A1.4	have sharp corners and edges been eliminated?	4 3 2 1 0 x 1 = ____

A2 Are lines of demarcation, mimics or other graphic displays:

A2.1	used to distinguish between commonly shared systems or components in multiple unit control rooms	4 3 2 1 0 x 2 = ____
A2.2	used to enclose related displays	4 3 2 1 0 x 3 = ____

III CONTROL ROOM REVIEW

COMMENT FORM

This form is to be used during the performance of the Control Room Review to identify, for each specific checklist item as necessary, the scope of review, items or components of non-compliance, or any qualifying statements appropriate to the evaluation of that checklist item. When this form is used, the checklist item number is to be entered here, and a note is to be made in the space following the checklist item to identify the use of this comment form, assuring proper cross-referencing. This form is to be placed in the survey package directly following the page on which the checklist item appears.

Item	Comment
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IV EMERGENCY PROCEDURE WALKTHROUGH

TRANSIENT SCENARIO

Procedure Selected _____ SRO Review _____

Include entry conditions, symptoms, transient trends, equipment failures and end points.

IV EMERGENCY PROCEDURE WALKTHRU

CHECKLIST

Procedure Selected: _____

A Does the emergency procedure selected meet checklist standards for procedure:

A1 standardization and format (see III.E3) 4 3 2 1 0 x 2 = ____

A2 operator action (see III.E4) 4 3 2 1 0 x 3 = ____

A3 use of reference material (see III.E5)? 4 3 2 1 0 x 2 = ____

B. Summary:

Area of Concern	Checklist Item(s)