GEORGIA POWER COMPANY

PLANT EDWIN I. HATCH
UNITS 1 & 2

DETAILED CONTROL ROOM DESIGN REVIEW
PROGRAM PLAN

OCTOBER, 1984

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SECTION 1. INTRODUCTION

1.1 Background

Following the incident which resulted in fuel damage at the Three Mile Island nuclear power plant, the NRC expressed concern that the man-machine interface in the control room may have been a contributing factor. Numerous recommendations and suggested ways to improve this interface in the form of NUREG and REGULATORY GUIDES were issued for review and comment. In addition, numerous papers addressing the problem were issued by industry groups.

NUREG-0737, Supplement 1, addressed several items of concern which are directly or indirectly related to control room review. This program plan describes the method by which the Georgia Power Company (GPC) proposes to conduct a Detailed Control Room Design Review (DCRDR) at Plant Edwin I. Hatch Units 1 and 2.

Georgia Power Company participated in the Boiling Water Reactor Owners' Group (BWROG) Control Room Improvements Program. A human factors design review of the Hatch Units 1 and 2 control rooms was completed in 1981. The survey team was comprised of engineering and operations personnel from four utilities with the assistance of consultants from General Electric Company and the Massachusettes Institute of Technology. The review consisted of four phases: 1) an analysis of plant Licensee Event Reports (LERs) and scram reports to identify possible design-related operator errors, 2) interviews with approximately one-third of plant operators 3) a checklist survey of control room panels, 4) limited task analysis and walkthroughs of selected emergency operating procedures (EOPs).

This Program Plan describes a method for completing the DCRDR to meet the obligations of Generic Letter 82-33. It incorporates reviews previously completed for Plant Hatch. A glossary of terms used in this Program Plan is provided in Appendix A.

1.2 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.

1.3 Scope

The scope of the DCRDR shall consist of the following activities:

- Preparing a Program Plan to meet the guidelines of NUREG-0700 and conducting a human factors workshop to orient DCRDR members to pertinent background information and methods for performing the control room review.

- Performing a review of all modifications to the control room subsequent to the BWROG survey, including a survey of remote shutdown panels. Updating the original survey to include guidelines provided in the BWROG supplemental survey.

- Reviewing related LERs and Deficiency Reports of Plant Hatch Units 1 and 2 from 1981 to the present.

- Updating the operating experience review by obtaining additional input from operators recently licensed.

- Performing a task analysis of operator actions which are required to bring the plant to safe shutdown during emergency operating conditions.

- Verifying that Plant Hatch control room instrumentation and controls (I&C) and other equipment meet the specific requirements of the operator tasks which are required to bring the plant to safe shutdown during emergency operating conditions.

- Validating that the control room and remote shutdown areas support those operator functions which are required to bring the plant to safe shutdown during emergency operating conditions.

- Assessing Human Engineering Deficiencies (HEDs) uncovered in any of the review steps.

- Developing a schedule for HED resolution.

- Developing a final report addressing the activities in the DCRDR and integration with other Supplement 1 to NUREG-0737 requirements.

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.

1.4 Schedule

A schedule depicting the time lines of major tasks in the DCRDR process is shown in Figure 1-2. The major review activity will occur in 1985.

The final summary report of the Plant Hatch DCRDR will be submitted to the NRC in June 1986.

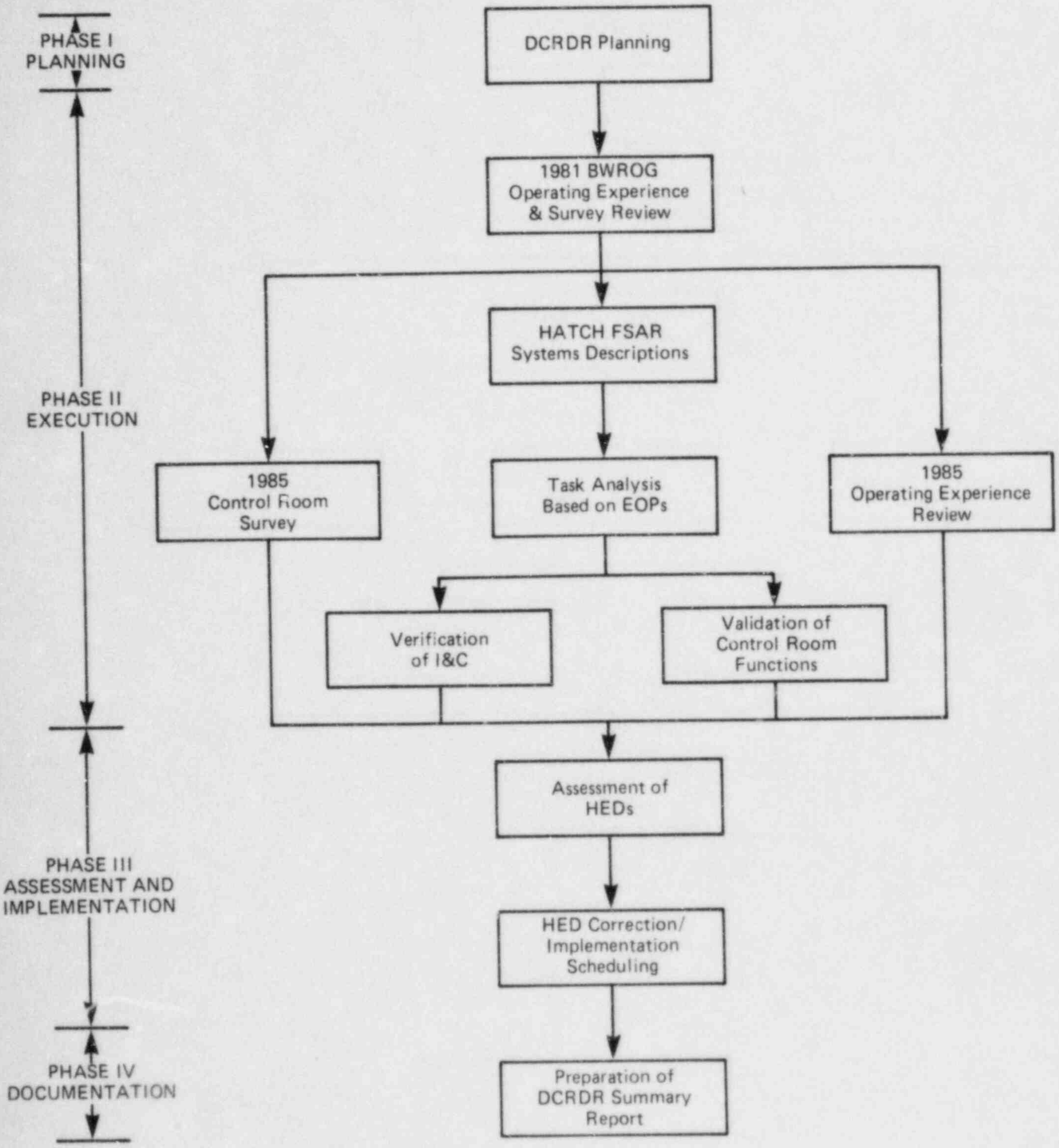

Figure 1-1. Flowchart of DCRDR Activities

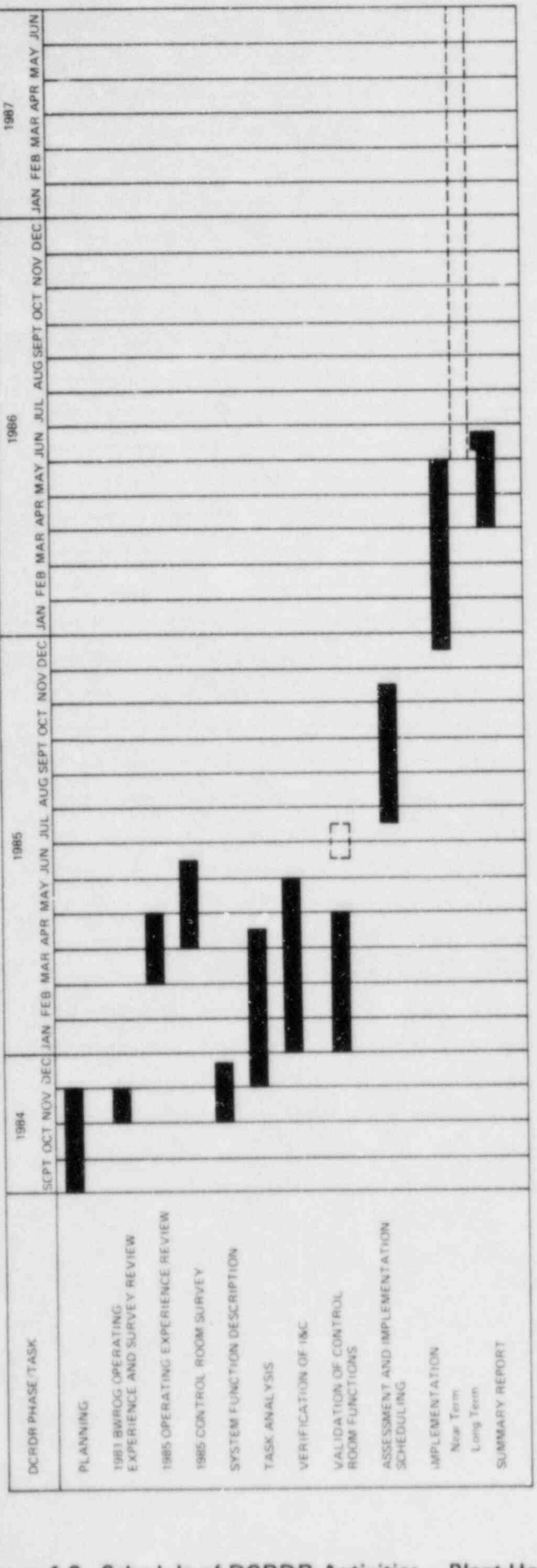

Figure 1-2. Schedule of DCRDR Activities – Plant Hatch

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 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

The ultimate responsibility for the Plant Hatch DCRDR will reside with the plant General Manager. The day-to-day conduct of the review will be the responsibility of the DCRDR review team. The original main control room survey was led by the BWROG Control Room Survey Team Leader. Remaining DCRDR activities will be managed by the Review Team Leader. The Review Team Leader will report progress on the DCRDR to the plant General Manager on a monthly basis. This will provide the necessary management attention to ensure that the DCRDR objectives are met and that the efforts are integrated with overall emergency response improvements. The DCRDR team will require interaction with other organizations within GPC and its supporting engineering organizations. The Review Team Leader will have the authority to assure freedom of the DCRDR team operation. Areas which will be included are:

- Access to information (records, documents, plans, procedures, drawings, etc.).
- Access to all required facilities.
- Access to any personnel with useful or necessary information.
- Access to support services.
- Freedom to document dissenting opinions.

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. This core group may be supplemented by personnel from other disciplines such as nuclear, mechanical, electrical, and civil engineering if required.

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 GPC personnel and those members who are consultant personnel.

The key positions of the review team are shown on Figure 2-1 and the role descriptions are as follows:

- GPC DCRDR Review Team Leader
  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 Review Team Leader. Because of his detailed knowledge of GPC systems and methods and the other NUREG-0737 Supplement 1 activities, this individual will provide a cohesive force for the different GPC department individuals and outside engineering organizations involved with this project.

- GP Project Manager/Human Factors Specialist
  As part of a NUREG-0737 Supplement 1 integration contract, General Physics Corporation (GP) will provide to Georgia Power Company (GPC) a Human Factors Specialist who will function as GP Project Manager for this project. The Human Factors Specialist will provide the team with human factors technical leadership throughout each phase of the DCRDR. Under the direction of the GP Project Director, the GP Project Manager/Human Factors Specialist will coordinate all activities from a human factors perspective and verify that task performance quality is maintained at a level necessary for a valid and comprehensive review.

- Operations Specialist
  The Plant Hatch Operations Department will provide an experienced, licensed senior reactor operator (SRO). The Operations Specialist will insure that operator tasks and needs are properly identified and documented. He will assist in the assessment of HEDs and the selection of resolutions.

In addition to the key personnel described above, the following support personnel shall be utilized as necessary:

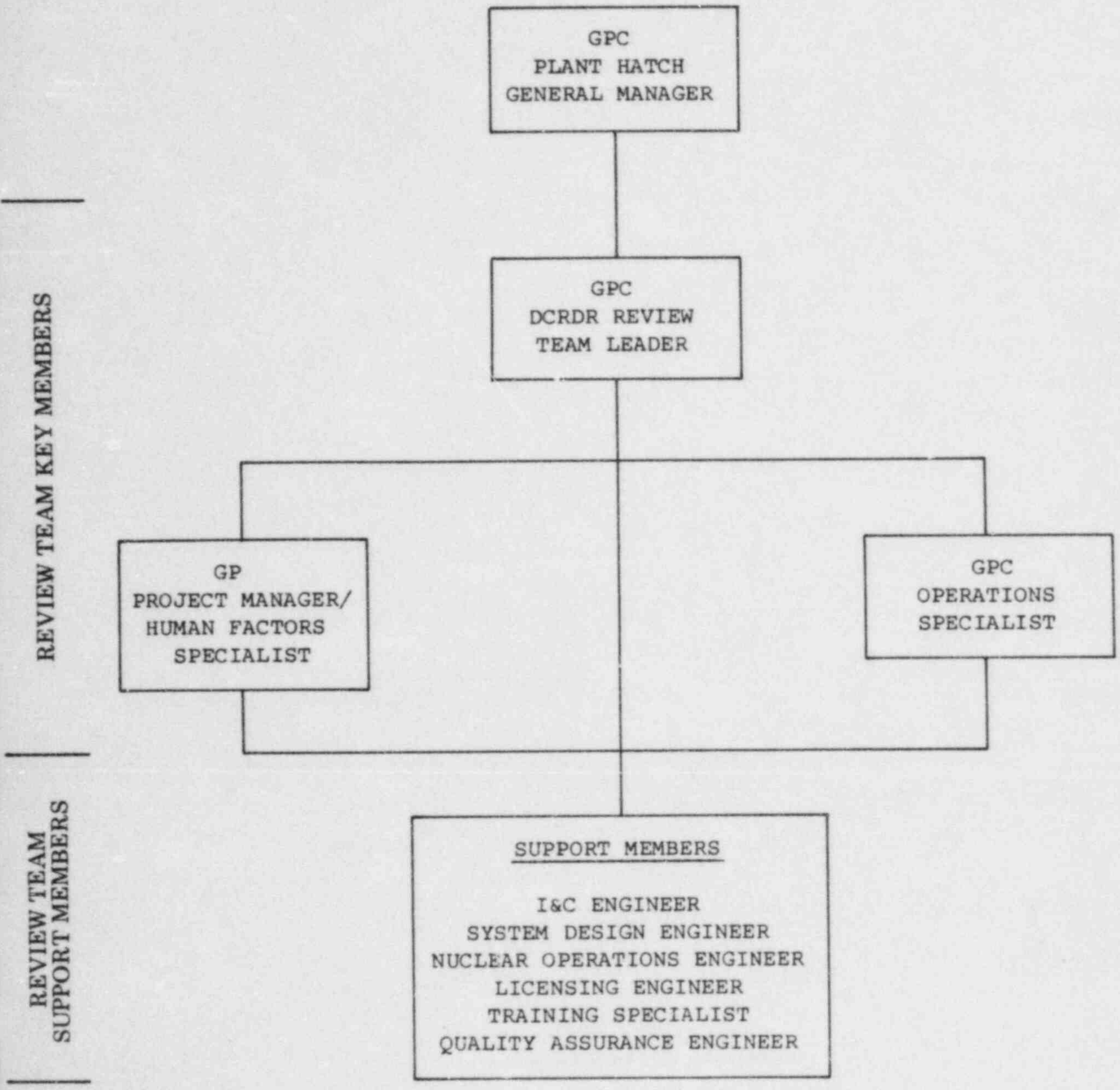

Figure 2-1. Functional DCRDR Team Organization

- Instrument and Controls Engineer: To provide advice on I&C issues, particularly during the survey, HED assessment and HED resolution selection activities.

- System Design Engineer: To provide advice on safety system issues, particularly during the survey, HED assessment and HED resolution selection activities.

- Nuclear Operations Engineer: To provide nuclear operations and associated task analysis expertise, particularly in validation of control room functions.

- Licensing Engineer: GPC Corporate Nuclear/Engineering Department individual to provide interpretation of requirements and interface between GPC and the Nuclear Regulatory Commission for this project.

- Training Specialist: To support review team in identification of simulator/main control differences, the performance of simulator-aided validation, and the evaluation of potential training revisions.

- Quality Assurance Engineer: GP Quality Control Department individual to insure that project documentation and test instrumentation procedures are properly used.

2.3 Qualifications of the Key Review Team Members

- GPC DCRDR Review Team Leader: An engineering degree (mechanical or electrical) with at least two years experience in nuclear instrumentation and control projects. Knowledge of NUREG-0737 Supplement 1 activities. Knowledge of Plant Hatch field and engineering administrative systems and methods.

- Human Factors Specialist: A degree or equivalent experience in human factors engineering. Experience in the application of human factors principles to design and/or evaluation of systems and equipment in the power industry with specific emphasis on workspace layout, panel and instrumentation design (controls and displays) environmental conditions (e.g., lighting and acoustics), and procedures and training. Experience in systems analysis and task analysis.

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

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

2.4.1 Safety Parameter Display System Integration

In May, 1981, GPC awarded contracts to Bechtel Power Corporation and the Georgia Tech Research Institute (GTRI) to develop an SPDS for Plant Hatch. Design criteria for the system were based primarily on NUREG-0696 and the BWR Owners Group SPDS Functional Specification published in April, 1981.

The system hardware consists of three 19" colorgraphic CRTs interfaced with two Rolm MSE/14 minicomputers. Disc storage is used to retain the previous four hours of data with a once per second time resolution. Tape recording is available if required for long-term data storage. A screen copier is provided to copy any display frame requested by the system operator. The color monitors and all other hardware requried for the SPDS function will have seismic qualification per IEEE 323-1974.

The software operating system is the Advanced Realtime System 1.12 supplied by Rolm Corporation. Software instructions are programmed in Fortran V. Data is updated once per second; display frame changes are accomplished in three seconds.

The SPDS will provide approximately 80 information display frames. Displays were designed by GTRI with assistance from the Plant Hatch Operations Department. Seven of the displays are based on the BWROG

Emergency Procedure Guidelines (EPGs) parameter plots designed by the BWROG and General Electric Company (GE). The EPG based displays will be used to monitor limits in the Hatch-specific EOPs. The primary SPDS displays are designed to provide the operator with a high-level overview of plant safety. They are not intended to provide all of the detailed information necessary to execute the EOPs.

Independent verification and validation (IV&V) of the SPDS hardware and software is being done by the Bechtel Power Corporation with assistance from the GPC engineering department.

The SPDS hardware is scheduled to be installed in the Plant Hatch simulator first. Operator familiarization and training will be conducted in preparation for SPDS installation in the control room in 1985. The SPDS is expected to be installed on both units by June 1985, but some additional outage related work may be required in the 1986 outages. June 1986 is expected as the completion date for implementation of the SPDS including training.

Recognizing the long lead times for equipment procurement and software development, the SPDS design was started prior to significant progress with the Detailed Control Room Design Review. Information provided by SPDS will be considered when the DCRDR assessment, implementation and reporting phases are performed. Parameters required for Regulatory Guide 1.97 implementation were considered during development of the signal list for the SPDS.

2.4.2 Emergency Operating Procedures (EOPs) Upgrade Program Integration

GPC has supported the development of generic emergency procedure guidelines by the BWR Owners Group. An NRC Safety Evaluation Report dated November 23, 1983 for Rev. 3 (dated December 8, 1982) stated that the EPGs were acceptable for implementation. Revision 3 of the guidelines has incorporated the NRC comments and added guidelines for secondary containment control and radioactive release control. Revision 3 is the basis for symptom based EOPs at Plant Hatch. EOP implementation will be consistent with the requirements of NUREG-0737, Supplement 1.

Hatch specific technical guidelines have been developed from the owners group generic guidelines. A Hatch specific writer's guide has been prepared. The Plant Hatch EOPs are post-scram procedures consisting of two sets of five flow charts for each unit. One set includes actions to be taken in the control room and another set includes actions to be taken outside of the control room, when the control room becomes uninhabitable. Each flow chart has an end path procedure manual associated with it. Included in this manual are end path procedures, generic system recovery procedures, contingency procedures, containment control procedures and reactivity control procedures. The EOPs will be supplemented by abnormal operating procedures and annunciator response procedures for pre-scram conditions that could escalate into an emergency situation.

The EOPs address operator tasks which are required to bring the plant to a safe shutdown as well as many detailed tasks which are required to protect plant equipment during post-scram and emergency operating conditions and handle fire protection contingencies. Therefore, the Plant Hatch specific EOPs are significantly different in format and level of detail than many EOPs. Plant Hatch began the development and preliminary validation (including simulator exercises) work during mid 1983 with completion and initial verification of the control room EOPs planned for completion by December, 1984 after a major expenditure of technical manpower. The preliminary validation work alone involved over 1800 man-hours on the Hatch simulator by SRO individuals with another 100 man-hours instructor support.

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. Operator training on new EOPs is scheduled to start in early 1985. The EOP training program will include extensive classroom and simulator components. Simulator exercises developed in support of EOP training will be reviewed for their potential use in supplementing DCRDR and EOP validation efforts. Those operating scenarios that satisfy the objectives of the DCRDR and EOP validation program will be observed, videotaped and evaluated.

It should also be noted that the upgraded Hatch EOPs have been integrated with the SPDS by use of task footnotes that alert the operator to the related SPDS display.

2.4.3 Regulatory Guide 1.97 Integration

Provisions of Regulatory Guide 1.97 (Revision 2) were considered in the design of the Analog Trip Transmitter System (ATTS). Regulatory Guide 1.97 parameters were also considered during development of the signal list for the SPDS. In addition, Regulatory Guide 1.97 requirements will be considered for any systems which require upgrading as a result of the equipment qualification initiatives. A report which compares existing or planned Plant Hatch systems with Regulatory Guide 1.97 (Revision 2) was prepared and submitted to NRC on February 21, 1984. Detailed justification and/or planned enhancements were presented in that report for any deviations from the criteria of the Regulatory Guide.

The Plant Hatch systems review report identifies a number of instrumentation changes associated with Regulatory Guide 1.97 that are scheduled for the main control room (MCR) of Units 1 and 2 during outages planned for 1984 and 1985. Completed Regulatory Guide 1.97 modifications will be handled by DCRDR activities in the same manner as other MCR equipment. The portion of the DCRDR Execution Phase that will be integrated with ongoing Regulatory Guide 1.97 modifications is the Verification of I&C. The purpose of this verification of I&C phase is to verify that the required Instrumentation and Controls (determined during the Task Analysis portion) are:

- Present in the Control Room and
- Suitable to support correct emergency procedure performance

The DCRDR approach described in this Program Plan calls for a two-step process where first the "Information and Control Requirements" column of the Task Analysis Form is compared to the existing Control Room I&C to determine if each required item is present in the MCR. If a required Instrument or Control is not available to the operator, an HED is prepared to document the deficiency. At this point the list of outstanding Regulatory Guide 1.97 modifications will be reviewed to determine if any of the modifications will provide the required instrumentation documented on the HED. If so, the planned modification will be recorded on the HED to indicate an expected resolution for the HED and facilitate tracking.

The second part of the Verification of I&C phase involves a determination of the human engineering suitability of the required Instrumentation and Controls. In cases where a planned Regulatory Guide 1.97 modification was initially judged to be an acceptable resolution for an HED, an initial evaluation of the human engineering suitability of the planned instrumentation will be made and recorded on the HED. Verification of the completed modifications will be performed as described in Section 6.2

2.4.4 Emergency Response Facilities (ERFs) Integration

The Emergency Response Facilities (ERFs) activities are, for the most part, independent of the DCRDR. No involvement other than an evaluation of communications equipment with the ERFs is envisioned for the DCRDR effort. However, the ERFs and SPDS will come under human factors reviews that will be integrated into the DCRDR as appropriate.

2.4.5 Previous Plant Hatch Control Room Survey Integration

Georgia Power Company (GPC) is a participant in the BWR Owners Group (BWROG) Control Room Improvements Program. A part of the program is a control room survey intended to complete the planning and review phases of the DCRDR. A control room survey by a BWROG survey team was performed at Plant Hatch during the week of April 23, 1981. The survey consisted of four phases: (1) an analysis of plant Licensee Event Reports (LERs) and scram reports to identify possible design related operator errors, (2) interviews with approximately one-third of the plant operators, (3) comparison of control room panels with checklist standards derived from previous surveys and accepted human factors standards, and (4) task analysis and walkthroughs of selected emergency procedures. The survey team consisted of operations and engineering personnel from four utilities and consultants from General Electric Company and the Massachusettes Institute of Technology. A detailed discussion of the 1981 BWROG survey methodology is provided in Section 4.2 of this Program Plan.

Two particular problems of the control room, environment and annunciators, received corrective action. An industrial design company remodeled aspects of the control room environment in 1981. Overlays with improved labels and mimics were added to all control panels. Carpeting and ceiling and wall coverings were added or upgraded to improve esthetics and to bring lighting and ambient noise to acceptable levels. Further, an ongoing program to eliminate nuisance annunciators has corrected most of the problems with the annunciator system. However, all findings of the 1981 control room survey will be integrated into the current DCRDR and tracked.

2.4.6 INPO NUTAC Integration

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

These NUTAC guidelines will be used in the Plant Hatch DCRDR project and provide additional detail to procedures described in Section 4 of the Program Plan.

2.4.7 HED Resolution Integration

The HED resolution phase of the DCRDR will involve the integration of the EOP's, SPDS, Training, Regulatory Guide 1.97, previous work and other planned future control room changes. The resolution of HED's might necessitate revisions to the EOP's or to the SPDS displays. 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. HED resolutions will be factored into the appropriate training material as part of the integrated training program for NUREG-0737, Supplement 1 activities.

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 define human factors requirements and estimate the effects of control room changes proposed in the future.

Documentation collected during the DCRDR project will be maintained in files at General Physics Corporation. At the end of the project, all documentation will be turned over to the GPC Review Team Leader to maintain for future reference.

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 is preliminary:

- Licensee Event Reports
- Scram Reports
- Occurrence Reports
- Final Safety Analysis Reports (FSARs)
- Piping and instrumentation drawings
- Control room floor plan
- Panel layout drawings
- Panel photographs
- Hatch Specific Emergency Procedure Guidelines (EPGs)
- Hatch Plant-Specific Emergency Operating Procedures (EOPs)
- Results of the 1981 BWROG Survey
- List of panel changes since the 1981 BWROG Survey

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 used as primary input to the review or generated during the review will be subject to General Physics' Quality Assurance 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. Quality Assurance project procedures will be established for the control of DCRDR documentation.

All project documents will be maintained in a project file at General Physics' Columbia, Maryland office.

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 3-1). This information allows the engineer the opportunity to compare all of the deficiencies which apply to a given checklist item or panel and to track the HEDs efficiently through the course of the DCRDR project.

HEDs will be inputted into a computerized database management system. This system will allow for efficient and accurate updating, sorting, and tracking of these records by GPC management.

3.6 Quality Assurance Program

General Physics will maintain a corporate Quality Assurance Program developed to comply with the stringent standards of Title 10, Part 50, Appendix B of the Code of Federal Regulations, Energy. The GP Quality Assurance Program has been audited by utility industry clients and found to be satisfactory. The GP Quality Assurance Manual prescribes controls for project

HUMAN ENGINEERING DEFICIENCY RECORD
EDWIN I. HATCH NUCLEAR PLANT

DATE: HED NO. :

REVIEWER: TRACKING STATUS:

DATA SOURCE:

CHECKLIST NO. :

PANEL/WORKSTATION NO.
(1.) COMPONENT DESCRIPTION

DESCRIPTION OF DEFICIENCY:

RECOMMENDATIONS:

ACTION:

DCR# ISSUE DATE / /

IMPORTANCE RATING:

IMPLEMENTATION SCHEDULE:

Figure 3-1. HED Form

organization, control of documents, inspection, corrective action, quality assurance records, review of project work, and other applicable activities.

Project procedures will be prepared by the GP Project Manager in accordance with the DCRDR Program Plan. Quality Assurance project procedures will be prepared as necessary to control those tasks affecting project quality. The Project Quality Plan will then be submitted to our Chief Quality Engineer for review and approval. After the Plan and associated project procedures are reviewed, approved, and implemented, the project is audited by the GP Chief Quality Engineer, or his designee, for compliance. Once approved by the GP Project Director, project procedures will be treated as controlled documents.

Utilization of the project procedures on this project will ensure that appropriate project activities are controlled, evaluated and documented in accordance with the DCRDR Program Plan.

SECTION 4. REVIEW PROCEDURES

The 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 Plant Hatch 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 the interaction of craw members.

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.

4.1.2 Methodology

There are two major steps in the Operating Experience Review: the LER and Deficiency Report Review and the Operator Interviews. Both tasks were initially completed as part of the 1981 BWROG Control Room Survey Plan. The LER review and Operator Interviews 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 Update

Licensee Event Reports (LERs) for the Hatch plant were reviewed by the 1981 BWROG survey program which then identified plant specific design deficiencies known to have previously contributed to operator errors and then documented those items for inclusion in the upcoming HED activities.

LERs for the Hatch plant from 1981 through 1983 and Deficiency Reports beginning January 1984 will be examined during the Operating Experience Review.

The LER and Deficiency Report update review will consist of the following steps:

1. Obtain the LERs from 1981 through 1983 and the Deficiency Reports from January 1984 to present.

2. Examine documentation and summarize the circumstances and events that are associated with the problem noted in the documentation. A form will be used to summarize and document the control room human factors problems identified in historical reports. The form will provide information concerning the event itself as well as an indication of what actions have been taken to resolve the problem and additional human factors recommendations.

3. The resulting summaries will be reviewed to determine whether the report does indeed describe a control room problem. A control room problem is defined as one in which:

   - the equipment referenced in the LER is located in the control room or remote shutdown panels;

   - the procedure referenced is used within the control room or remote shutdown panels; or

   - the personnel error occurred using control room or remote shutdown panel components.

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

4.1.2.2 Operator Interviews Update

The purpose of the 1981 BWROG 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 approximately one-third of the operators was selected covering a range of experience, education, ability, and physical size. Using the BWROG Survey program questionnaire, 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 verbal 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 verbal 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.

Human factors personnel assigned to the current DCRDR project will supplement the 1981 Operator Interviews by distributing questionnaires and conducting follow-up interviews with operating personnel at Plant Hatch Units 1 and 2. A concise questionnaire, based on the BWROG Questionnaire and Interview format, will be used as the first step in gathering operator input. Extra questions covering the impact of the upgraded EOPs on follow-up interviews will be conducted with approximately 50% of the operations personnel to elicit information regarding human engineering aspects of the control room from the user's standpoint.

The steps fcr updating operator input are:

1. Distribute questionnaires to as many operating personnel as practical.

2. Assimilate questionnaire responses and develop interview format based on responses.

3. Conduct follow-up interviews on sample of questionnaire respondents (approximately 50% of operating personnel). If possible, conduct interviews in the control room (or simulator) so that interviewees can refer to the control boards (or simulator) to explain in detail the types of problems they have encountered.

4. Review data to ascertain whether the problems identified by operators are Human Engineering Discrepancies (HEDs).

5. Document HEDs on HED form.

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.

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 indicated 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.

All items having an evaluation product of 4 or greater were evaluated for potential corrective actions. In the current DCRDR, all items greater than "1" on the degree of compliance scale will also be examined in the HED Assessment Phase.

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 was described in BWROG Control Room Improvements Committee summary report for Plant Hatch Units 1 and 2 control rooms dated March 1982. All findings from this review will be carried forward for consideration in the HED Assessment Phase of the current DCRDR.

4.2.3 1983 BWROG Survey Methodology

The 1981 BWROG control room survey areas described above will be updated for the Hatch 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 January 1, 1981. 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 for each control room panel covered by the 1981 survey and each remote shutdown panels during the planned DCRDR activities. Modifications made since 1981 to the control room panel will be evaluated against both the original BWROG Checklist and the Supplemental Checklist.

The major steps in the checklist effort are:

1. The DCRDR review team will participate in a two-day human factors orientation workshop prior to conducting the control room survey. The orientation will include an introduction to human factors methods and techniques as well as a discussion of the respective roles of the review team members in the DCRDR process.

2. Obtain one copy of the Supplemental Checklist per panel for each unit; obtain one copy of the Original and Supplemental Checklist per control room modification for each unit.

3. Compare, by direct observation and measurement, design features of Plant Hatch Units 1 and 2 control rooms with the guidelines contained in the checklists.

4. After all the checklist data have been collected, the data will be reviewed to extract HEDs. HEDs will be documented on an HED form and input into the computerized database system. HEDs from prior BWROG checklist findings will also be input to the database. These forms will be the input documentation for the DCRDR Assessment and Implementation phase.

4.3 Systems Function Review and Task Analysis

4.3.1 Purpose

The purpose of the Systems 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 tasks required to being the plant to safe shutdown during emergency operating conditions and to ensure that required systems can be efficiently and reliably operated under the conditions of emergency operation by available personnel. This will be accomplished by performing an analysis of tasks required to bring the plant to safe shutdown during emergency operating conditions as handled within the Plant Hatch Emergency Operating Procedures (EOPs).

The steps which comprise the System Function Review and Task Analysis are shown in Figure 4-1 and are described below.

4.3.2 Systems Functions Description

4.3.2.1 Identify Plant Safety-Related Systems and Functions

Plant systems and subsystems in the control room that the operator must access for safe shutdown of the plant during emergency operating conditions will be identified. Existing plant documentation (e.g., FSARs, training materials, procedures) relating to safety systems will serve as information sources.

Descriptions of the functions for each of the systems identified above will be prepared. These system descriptions will include:

- The function(s) of the system
- Under what conditions the system is used
- A brief explanation of how the system operates

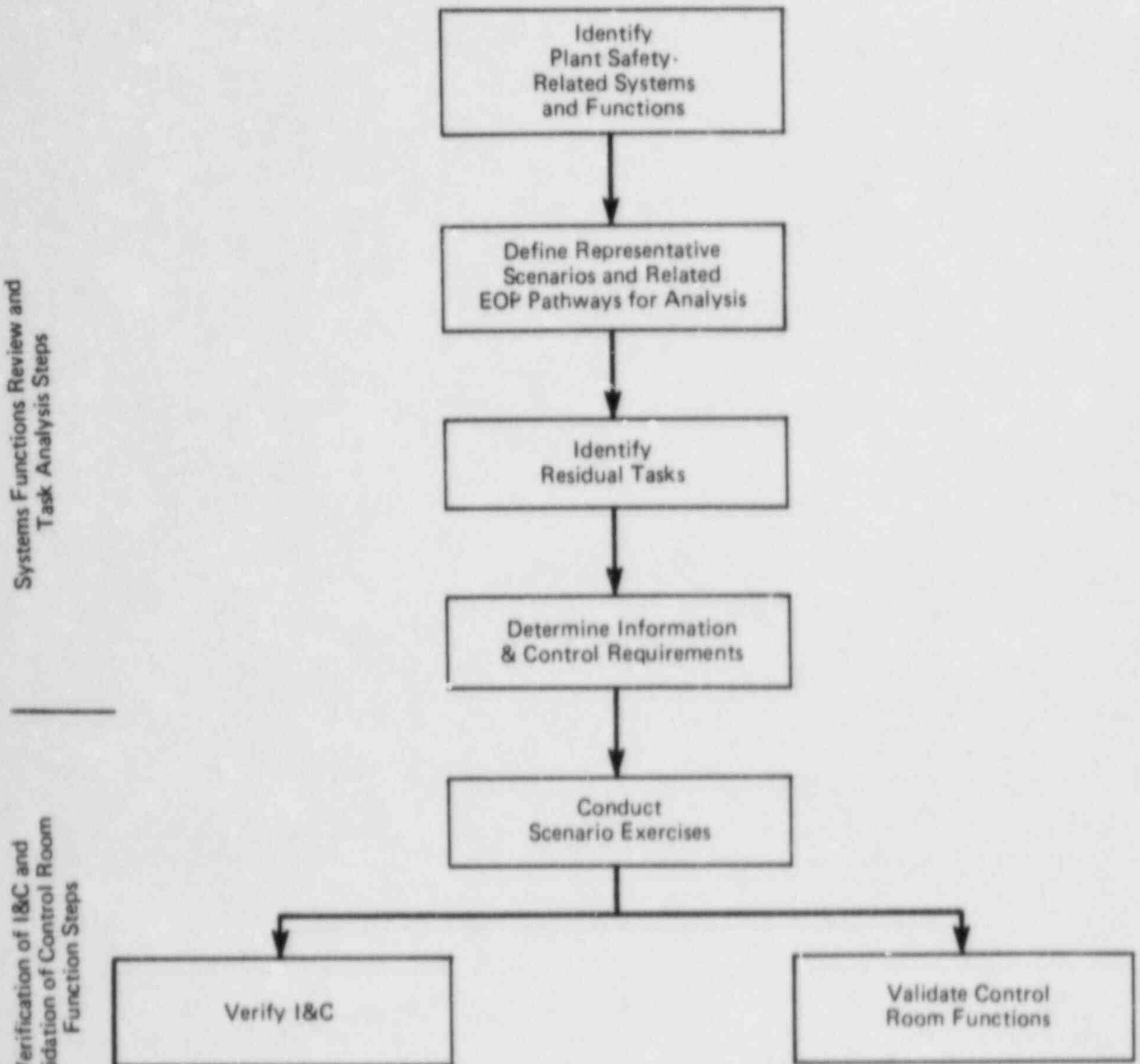

Figure 4-1. Flowchart of Systems Functions Review, Task Analysis, Verification of I&C and Validation of Control Room Function Activities

The description of systems functions in this manner will serve as a reference base for subsequent task analysis. In addition, the systems list will be used to assist in the selection of operating scenarios for each walk-through.

4.3.2.2 Define Representative Scenarios

The BWR Owners Group Emergency Procedure Guidelines and the list of Hatch safety-related systems will be used to define a set of scenarios which adequately sample various emergency conditions and the plant systems and system functions used in those conditions. The related Hatch plant-specific EOP pathway will be identified as well in this step.

In addition, a brief narrative description of each scenario will be prepared that establishes the symptoms and limits of the events to be analyzed. It will include:

- initial plant conditions
- sequence initiator symptoms
- progression of action
- final plant conditions
- major systems involved

4.3.2.3 Identify Residual Tasks

Residual unique operator tasks required for safe shutdown of the plant during emergency conditions and from the Hatch specific EOPs but not covered in the scenarios will be identified and later analyzed for associated information and control requirements. The analysis of residual tasks will be done to ensure that all operator interfaces required for safe shutdown during emergency conditions have been examined even if those interfaces are not exercised in the sample of emergency scenarios selected for validation of control room functions. Verification of I&C will be performed for these residual tasks as well as for tasks embedded in the emergency scenarios.

4.3.3 Task Analysis

4.3.3.1 Develop Task Analysis Worksheets

Task Analysis Worksheets (see Figures 4-2 and 4-3) will be developed which indicates the operational steps required in each scenario to reach safe shutdown of plant during emergency conditions along with the appropriate information and control requirements, means of operation, and I&C present on the control boards. The Task Analysis Worksheets will be prepared in the following manner:

1. Discrete steps in the Hatch EOPs will be identified in order of performance. These procedure/flowpath number and grid coordinates will be recorded in the first column of the Task Analysis Worksheet, and branching points noted depending on the plant transient being analyzed 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 in the column when no explicit procedure 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.

3. The correct scenario response for the task being analyzed in this scenario will be noted in the third column.

.ASK ANALYSIS WORKSHEET

SCENARIO_______
PAGE____of_____

Proced./Flowpath No. Grid Coordinates	Task/Subtask	Scen. Resp.	Crew Memb	Loc.	Decision and/or Contingent Action Requirements	Information & Control Req.	Means	I&C Ident.		Verification		Comments/ Candidate HEDs
								Panel	No.	Avail.	Suit.	

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Figure 4-2. Task Analysis Worksheet

1. **SCENARIO** - operating scenario name and identifier (ID).

2. **PROCEDURE/FLOWPATH NO./GRID COORDINATES** - procedure step identification for HATCH EOPs (Emergency Operating Procedures) steps.

3. **TASK/SUBTASK** - a description of the crew member task/subtask in the operating sequence.

4. **SCEN. RESP.** - a notation designating decision points or branching information needed for correct task execution for the operating scenario (as defined in the operating scenario description).

5. **CREW MEMBER** - the crew member who performs the task.

6. **LOC** - the location where the task is performed.

7. **DECISION AND/OR ACTION REQUIREMENTS** - any contingent decision and/or action requirements that are linked to task performance.

8. **INFORMATION AND CONTROL REQ.** - the information and control requirements for successful task performance (derived independently of the actual I&C in the control room). Noted in this column are (1) the system involved (2) the parameter, component in procedure needed and (3) the relevant characterstics of the parameter or component referenced for the operator to execute the task.

9. **MEANS** - the actual means (eg. switch, meter, etc.) used by operators to perform the task in the control room.

10. **I&C IDENT. (PANEL/NO.)** - the actual instrumentation and controls (I&C) identified from walkthroughs that the operators used to perform the task. The I&C is uniquely identified using a PANEL number and Equipment Number (NO.). SPDS display identifiers will be noted where appropriate.

11. **VERIFICATION (AVAIL./SUIT.)** - columns that indicate the availability and suitability of the instrumentation and controls (I&C) needed for task performance. These columns would contain a "yes" or "no" answer which is arrived at through a Verification Process Flowchart. Entries that are a "no" are detailed further on an HED Suitability Assessment Form.

12. **COMMENTS** - any comments related to scenario execution, task performance, or the accompanying task requirement columns (the balance of the task analysis worksheet). SPDS integration effects will be noted where appropriate.

Figure 4-3. Task Analysis Worksheet Fields (Columns) Definitions

4. The operator decisions and/or actions that are linked to task performance are then noted 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.

5. Input and Output requirements for successful task performance are noted in the "Information and Control Requirements" column on Figure 4-2. These would typically be parameters, components or procedural information that are necessary for operators to adequately assess plant conditions or system status (e.g., reactor vessel water level, suppression pool temperature, core flow, reactor pressure, etc.).

   Relevant characteristics for parameter readings or control selection will be noted in the "Information and Control Requirements Column" in Figure 4-2. Primary sources of information and control requirements for each task will be noted on the form in Figure 4-4. The interrelationship between Figure 4-2 Task Analysis Worksheet and Figure 4-4 Information and Control Requirement Sources is shown in Figure 4-6.

6. Once the Tasks, Decision Requirements, and Information and Control requirements have been specified, the specific instrumentation and controls (I&C) that the operator requires per procedural step will be documented. 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. The "Means" column refers to how the information and control requirements are presented on the 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.

For each I&C (equipment) identified in this column, the equipment characteristics (parameter, range, units, scale, and/or control states) are noted on the form in Figure 4-5. The interrelationship between Figure 4-2 Task Analysis Worksheet and Figure 4-5 Equipment Characteristics is shown in Figure 4-6. These characteristics are used in the Verification of I&C Availability and Suitability Phase of the DCRDR.

It is important to note that Steps 1 through 5 are completed on the Task Analysis Worksheet using independent sources of data (Figure 4-4) other than the actual I&C present in the control room. Step 6 essentially completes the first step in the Verification of I&C Process to identify whether or not the necessary I&C for task performance is available in the control room.

The remaining columns of the Task Analysis Worksheet will be utilized during the Verification of Task Performance Capabilities, which is described in Section 4.4. These columns are briefly described below:

7. Verification column (used during V&V phase)
   "Availability" of the necessary I&C for successful operator task performance is noted by a check in this column; "Suitability" of the I&C to meet the information and control requirements of operator task is noted by a check in this column.

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

   The Task Analysis Worksheet thus serves as the complete record of operator tasks, decisions, information and control requirements, and I&C availability and suitability verification during the selected emergency operating sequences. This record is developed through the series of steps described above.

INFORMATION AND CONTROL REQUIREMENT SOURCES

Completed by: ____________

Date: ____________

TAW REF.		SOURCE OF INFORMATION & CONTROL REQUIREMENT								
Scenario	Task I.D.	EPG	Hatch EOPs	EOP Basis	SPDS/AMI	FSAR/ Design Bases	Tech. Specs.	EPRI GDG	Other	Location of Source

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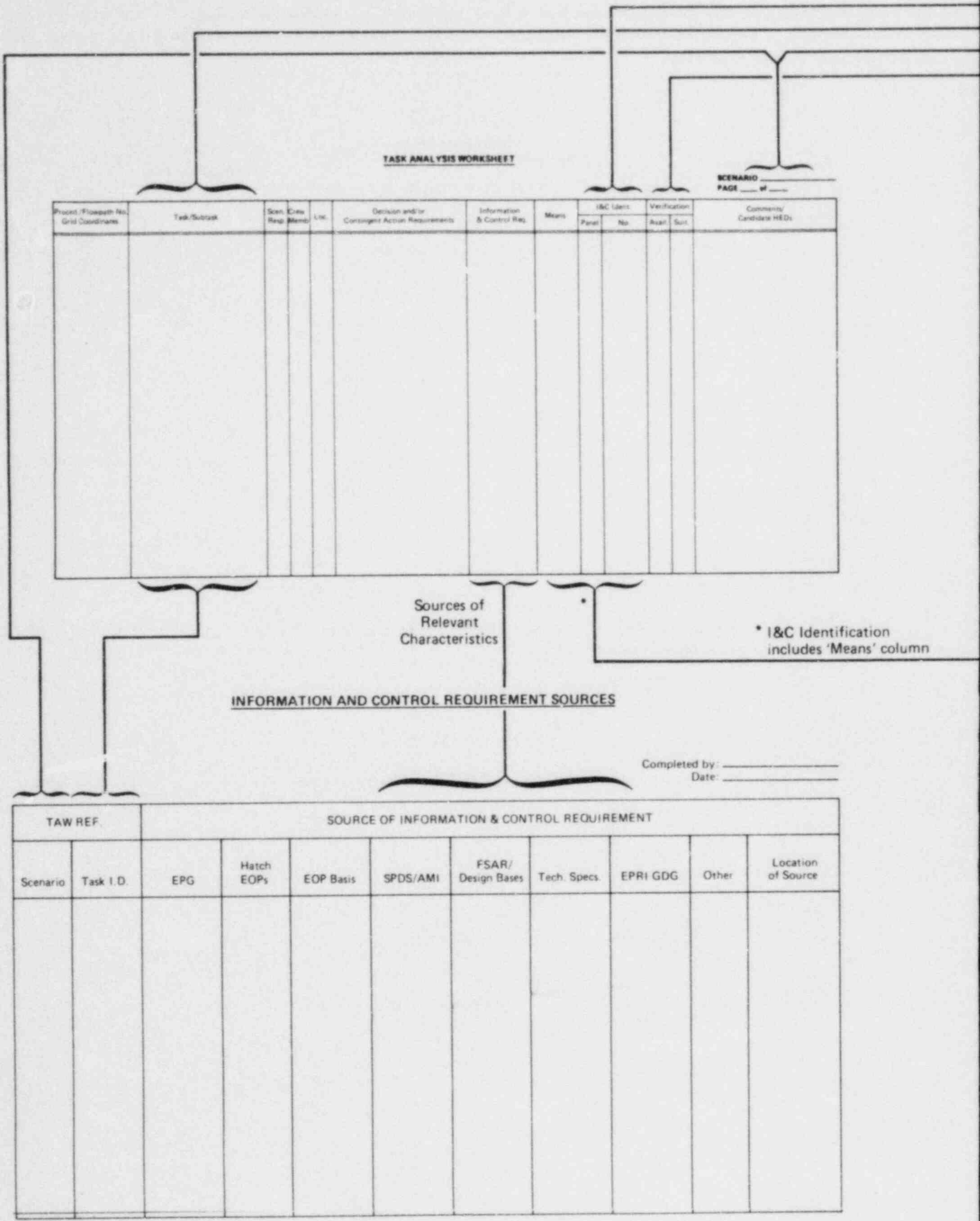
Figure 4-4. Sources of Information and Control Requirements Form

EQUIPMENT CHARACTERISTICS

I & C (Equipment) Identification	Display Characteristics				Control
	Parameter	Range	Units	Scale Units/Type	State(s)

Figure 4-5. I&C Equipment Characteristics



TASK ANALYSIS WORKSHEET
SCENARIO ______
PAGE ___ of ___
Procedure/Flowpath No. Grid Coordinates
Task/Subtask
Scen. Resp.
Crew Memb.
Loc.
Decision and/or Contingent Action Requirements
Information & Control Req.
Means
I&C Ident.
Panel
No.
Verification
Avail.
Suit.
Comments/ Candidate HEDs
Sources of Relevant Characteristics
* I&C Identification includes 'Means' column
INFORMATION AND CONTROL REQUIREMENT SOURCES
Completed by: ______
Date: ______
TAW REF.
Scenario
Task I.D.
SOURCE OF INFORMATION & CONTROL REQUIREMENT
EPG
Hatch EOPs
EOP Basis
SPDS/AMI
FSAR/ Design Bases
Tech. Specs.
EPRI GDG
Other
Location of Source

EQUIPMENT SUITABILITY HEDs**

TAW REF.		I&C Equipment Ident.	Info. not Appropriate	Direct Sys. Status Not Provided	Not Fully Useable	Comments
Scen.	Task I.D.					

** Discussion of this form is included in verification section of program plan.

EQUIPMENT CHARACTERISTICS

I & C (Equipment) Identification	Display Characteristics				Control
	Parameter	Range	Units	Scale Units/Type	State(s)

Figure 4-6. Interrelationship of Task Analysis Data Forms (as represented in DCRDR Database)

4.3.3.2 Task Analysis Database

All task analysis data will be entered into the Hatch DCRDR computerized database. The forms that are used in collecting the data are:

- Task Analysis Worksheet
- Information and Control Requirement Sources
- I&C Equipment Characteristics

These forms collectively make up the complete database fields that are defined for the Task Analysis, Verification of I&C and Validation of Control Room Functions during the DCRDR.

The interrelationships between the discrete columns in the forms (database fields) are shown in Figure 4-6. The Task Analysis Worksheet is the master record of task data and the verification phase decisions made about the task data and associated I&C Equipment Characteristics.

In the computerized database, each data field (column) is represented only once with all data being keyed to one or more fields of the Task Analysis Worksheet. The other two forms are linked by either the Task Analysis Worksheet (TAW) Scenario and Task I.D. (see Information and Control Requirements Form) or by the I&C Equipment Identification columns (see I&C Equipment Characteristics form). The DCRDR team member can enter the database by referencing either the Scenario-Task ID or the I&C Identification (Panel-No.) keys. In this way, the database allows flexibility to search both operator task data and equipment data.

4.3.3.3 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 safe shutdown of the plant under emergency conditions actually exist. 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 Task Performance Capabilities. Equipment characteristics associated with the I&C (Equipment) identified in the task analysis worksheet will be noted using the form in Figure 4-5.

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

4.4 Verification of Instrumentation and Controls (I&C)

4.4.1 Purpose

The purpose of the Verification of I&C 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 I&C 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 (Figure 4-2) column labeled "I&C Identification." The parameter, range, scaling units, and related information will be compiled on a separate inventory listing (see Figure 4-5). A separate review of the I&C identified above will be done to ensure direct versus indirect indications of parameters.

4.4.2.2 I&C Suitability

The second phase of Verification of I&C 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 a human factors engineer, 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 required for safe shutdown of the plant during emergency operating conditions can be accomplished effectively within (1) the structure of the Hatch-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

The Validation of Control Room Functions will be performed in conjunction with the validation of Plant Hatch Emergency Operating Procedures required by NUREG-0737, Supplement 1. Scenario exercises (walk-throughs or simulator exercises) will be performed using the symptom-oriented EOPs developed from the BWROG EPGs.

The purpose of the scenario exercises 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 exercises. Operating crews will be briefed regarding the objectives of the validation effort and their respective roles in it. The participants will not, however, be briefed on the actual scenarios to be run.

The primary scenario exercise technique will be real time operating events run on the Hatch 2-specific simulator performed in conjunction with EOP training and validation. Exercises relevant to the DCRDR will be videotaped for the following uses:

- Validation of control room functions
- Verification of I&C
- Future reference

DCRDR team members will use the partially completed Task Analysis Worksheets to record their observations.

Walk-throughs will be performed on those scenarios that cannot be performed on the simulator (e.g., remote shutdown procedures).

The operators will be asked to note any errors or problems that were encountered in the real-time scenario exercises and to expound upon the source of the errors or problems. These errors or problems will be documented for investigation as possible HEDs which may then lead to revisions to the control room, EOPs, training, SPDS, ERFs or Regulatory Guide 1.97 items.

Following the above activities, the following types of information will be extracted from the video tapes:

- 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.

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.

Any dynamic performance problems that were uncovered following the tape review phase of the DCRDR process will be documented for review in the HED assessment phase of the DCRDR which may then lead to recommendations for revisions to the control room, EOP, training, SPDS or Regulatory Guide 1.97 items.

5. HED ASSESSMENT AND RESOLUTION

The review team will assess identified deficiencies 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 specialists 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 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 upon whether an unsafe condition 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 2. The responses to this series of questions will aid the reviewers in identifying those HEDs which impact plant safety. As before, the technique does rely on the evaluators' judgment.

TABLE 1

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

To what extent do you agree with the following?

1. This deficiency will cause undue operator fatigue.

2. This deficiency will cause operator confusion.

3. This deficiency will cause operator discomfort.

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

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

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

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

8. This deficiency will affect the operator's ability to hear correctly.

9. This deficiency will degrade distract control room personnel from their duties.

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

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

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

13. This deficiency violates Plant Hatch control room conventions or practices.

14. This deficiency violates nuclear industry conventions.

15. This deficiency violates societal stereotypes.

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

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

Table 1, cont'd

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

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

20. This deficiency 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 2

HED PLANT IMPACT EVALUATION CRITERIA

To what extent do you agree with the following:

1. This deficiency 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 safety limit, a limiting condition for operation or a technical specification.

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

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

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

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

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.

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

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

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

Table 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.

TABLE 3

SUMMARY OF HED CATEGORIES

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

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 predominant 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 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 GPC Management. This will enhance management awareness of problems and potential solutions early in the resolution phase.

TABLE 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 training?

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 GPC 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 4 is appropriate. Additionally, other plant-specific questions must be addressed. These questions are listed in Table 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

Developing 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.

TABLE 5

PLANT-SPECIFIC HED RESOLUTION CRITERIA

In addition to the questions in Table 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?

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 GPC Management for review and approval. Management authorization to proceed with implementation of the corrective actions is necessary before the Final 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 Final 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 DCRDR Summary Report will be submitted to the NRC to outline proposed control room changes with proposed schedules for implementation as required by NUREG-0737, Supplement 1. Improvements that can be accomplished with an enhancement program (paint-tape-label) will be initiated promptly in a near term program. More complicated design changes, if required, will be handled in a long term program.

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. 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 plan will be provided in the final report for evaluating the effectiveness of proposed modifications and enhancements intended to resolve HEDs.

In addition, a second plan will be provided in the final report to ensure adequate human factors considerations in all future control room changes.

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 Plant Hatch 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

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

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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)

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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 DCRDR. 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.

Emergency - Any plant condition causing an automatic or required manual scram.

Emergency Operating Procedures (EOPs) - Post scram 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 Procedure Guidelines (EPGs) - Guidelines, developed by Boiling Water Reactor Owners' Group (BWROG) from system analysis of transients and accidents, that provide sound technical bases for plant-specific EOPs.

Human Engineering Deficiency (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 DCRDR 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 DCRDR. 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 DCRDR 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 DCRDR 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 of Control Room Functions - 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 DCRDR context, validation implies a dynamic performance evaluation.

Verification of I&C - 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 DCRDR context, verification implies a static check of instrumentation against human engineering criteria.

APPENDIX B

RESUMES

GP

PHILLIP R. BENNETT
Director, Chattanooga BWR Training Services

EDUCATION

U.S. Navy Nuclear Power Training Program

General Electric Boiling Water Reactor Training Program

LICENSES AND CERTIFICATIONS

Licensed Senior Reactor Operator: Dresden Nuclear Power Station, Units 2 and 3

Licensed Senior Reactor Operator: Southwest Experimental Fast Oxide Reactor

Certified Senior Reactor Operator: Peach Bottom Atomic Power Station, Units 2 and 3

Certified Nuclear Power Plant Senior Reactor Operator Simulator Instructor, Boiling Water Reactor

EXPERIENCE
1974 - Present

General Physics Corporation
Mr. Bennett is responsible for marketing and managing training program development, simulator training and procurement, and on-site training. Representative projects include:

- Training Management
  Managed the Tennessee Valley Authority's Browns Ferry Nuclear Power Plant and Georgia Power Company's Plant Hatch simulator training staffs including marketing and coordinating with the owner organizations; prepared simulator instructors manuals and guides for these facilities; developed the training records for Niagara Mohawk Power Corporation's Nine Mile Point Nuclear Station.

- Pre-License Audit and Simulator Certification Examinations
  Prepared and conducted Nuclear Regulatory Commission-type pre-license examinations, simulator cold and hot license certification examinations, and observation training examinations for several utilities or the Tennessee Valley Authority's Browns Ferry Nuclear Power Plant simulator, Philadelphia Electric Company's Limerick Generating Station simulator, and Georgia Power Company's Plant Hatch simulator.

- Training Materials Development
  Developed classroom and simulator instructional materials for the Tennessee Valley Authority's Browns Ferry simulator, Georgia Power Company's Plant Hatch simulator, and Detroit Edison Company's Enrico Fermi Atomic Power Plant simulator; participated in the development of an automated simulator performance measurement system for the Electric Power Research Institute (EPRI); assisted in development of job performance aids for control room operations in conjunction with EPRI.

- On-Site Instruction
  Conducted hot and cold license, requalification, shift technical advisor and various management simulator programs for U.S. and foreign utilities. Conducted on-site hot license and requalification programs for Georgia Power Company's Plant Hatch, Power Authority of New York's James A. FitzPatrick Nuclear Power Plant, Niagara Mohawk Power Corporation's Nine Mile Point Nuclear Station, and Vermont Yankee Nuclear Power Corporation's Vermont Yankee Generating Station.

- Procedure Development
  Revised and standardized Commonwealth Edison Company's station procedures to comply with regulatory requirements.

1969 - 1974 **General Electric Company**

As a startup, test, and operations engineer at Philadelphia Electric Company's Peach Bottom Atomic Power Station, Mr. Bennett wrote and performed pre-operational tests and was a GE Shift Engineer during the power ascension and test program.

As a Shift Supervisor at Southwest Experimental Fast Oxide Reactor (a sodium-cooled fast breeder) he supervised zero power, power oscillating, and excursion experiments including work in sodium-argon atmospheres.

1960 - 1967 **United States Navy**

As Leading Reactor Control Division Petty Officer on a fleet ballistic missile submarine, Mr. Bennett was responsible for maintenance and operation of the S5W plant instrumentation and control equipment. He also served on diesel submarines.

DONALD C. BURGY
Director, Human Factors Engineering
(Hatch DCRDR GP Project Director)

EDUCATION

Ph.D. Candidate, Applied-Experimental Psychology, The Catholic University of America

M.A., Applied-Experimental Psychology, The Catholic University of America

B.A., Psychology, Swarthmore College

EXPERIENCE
1979 - Present

General Physics Corporation
Mr. Burgy directs all human factors engineering and man-machine systems design and evaluation work in the Company. His human factors expertise includes system analysis, information processing, man-computer interactions, performance evaluation, training systems, and speech/non-speech communications. Representative projects include:

- Control Room Design Reviews
  Directed or participated in nuclear power plant control room design reviews at twelve nuclear power plants: River Bend Station, Plant Hatch, North Anna, Surry Power Stations, Zion, LaSalle, and Dresden Stations, William H. Zimmer Nuclear Power Station, Susquehanna Steam Electric Station, Clinton Nuclear Power Plant, Salem Nuclear Generating Station, and Trojan Nuclear Plant. Managed DCRDR program plan development for thirteen plants, both BWR and PWRs to meet NRC licensing requirements.

- Task Analysis of Nuclear Power Plant Control Room Crews, U.S. Nuclear Regulatory Commission (NRC)
  Managed a major 18-month NRC research program in which a crew task analysis data collection methodology and approach were developed and used to collect data at eight power plants by teams of human factors and operations personnel. Directed the compilation of the results of the data collection effort in a computerized task data base.

- Guidelines for Internal Plant Communications, Electric Power Research Institute (EPRI)
  Participated in a study of communications problems in nuclear power plants and then managed project to

develop Guidelines for Internal Plant Communications based on these problems. Developed methodology for collection and analysis of real-time communications data in operating power plants.

- Prototype Large Breeder Reactor (PLBR) Operability Study, EPRI
  Participated in an operability study of the two major PLBR designs--pool and loop types; coauthored a PLBR design familiarization course text; and conducted task analysis for initial design evaluations of PLBR control console layout and instrumentation and control needs.

- Submarine Design Human Factors, U.S. Navy
  Developed task analysis format and collection methodology to promote team performance improvement and training enhancement in the Navy Submarine Advanced Combat Systems (SUBACS) program.

1976 - 1978 **The Catholic University of America Human Performance Laboratory**
Mr. Burgy conducted applied and basic research experiments on auditory signal classification of complex underwater sounds in research sponsored by the Human Factors Engineering branch of the Office of Naval Research.

PROFESSIONAL AFFILIATIONS

Member, Acoustical Society of America
Member, American Psychological Association
Member, Human Factors Society

PUBLICATIONS

Applied Human Factors in Power Plant Design and Operation, General Physics Corporation, 1980. Coauthor with P. A. Doyle, H. F. Barsam, and R. J. Liddle.

"Survey and Analysis of Communications Problems in Nuclear Power Plants," EPRI Report NP-2035, September 1981. Coauthor with D. A. Topmiller, D. R. Roth, P. A. Doyle, and J. J. Espey.

"Task Analysis of Nuclear Power Plant Control Room Crews," NUREG/CR-3371, 1983. Coauthor with C. Lempges, A. Miller, L. Schroeder, H. VanCott, and B. Paramore.

"Nuclear Power Plant Control Room Crew Task Analysis Database: SEEK System Users Manual," NUREG/CR-3606, 1984. Coauthor with L. Schroeder.

RICHARD S. GROSECLOSE
Chief Quality Engineer

EDUCATION

B.S., Liberal Studies (concentration in Industrial Engineering), The University of the State of New York

EXPERIENCE
1977 - Present

General Physics Corporation

Mr. Groseclose provides technical assistance to power utilities and government clients in the areas of quality assurance, training, maintenance programs, inservice inspection programs, and engineering services. Representative projects include:

- Quality Assurance Manager, Inservice Inspection Programs
  Developed and implemented Quality Assurance Programs during the Inservice Inspection projects for Oyster Creek Nuclear Power Plant, Jersey Central Power and Light Company and Midland Nuclear Power Plant, Units 1 and 2, Consumers Power Company.

- Quality Assurance Records Validation, Mississippi Power and Light Company
  Managed Quality Assurance Program for records validation at Grand Gulf Nuclear Station, Unit 1.

- Pressure Vessel and System Recertification, National Aeronautics and Space Adminstration
  Assisted in the conducting of an integrated recertification program of all pressure vessels and piping systems at the Goddard Space Flight Center and the Jet Propulsion Laboratory.

- Nondestructive Examination, Inservice Inspection Seminars
  Teaches inservice inspection-related nondestructive examination methods at seminars conducted by General Physics.

- Nondestructive Examination Qualification Program Development and Revision, Tennessee Valley Authority
  Revised personnel qualification program and prepared general, specific, and practical examinations for inspection Levels I, II, and III for all methods.

1975 - 1977	**Nuclear Installation Services Company** Mr. Groseclose was a Field Quality Assurance/Quality Control (QA/QC) Manager. He developed construction plans and quality assurance procedures for Cleveland Electric Illuminating Company and managed the QA/QC programs at Salem Nuclear Generating Station, Unit 1, Public Service Electric and Gas Company, and during steam generator modification work at Donald C. Cook Plant, Indiana and Michigan Electric Company.
1974 - 1975	**Control Flow Systems, Incorporated** Mr. Groseclose was the Manager of Manufacturing. He supervised fabrication, material planning and control, purchasing, scheduling, and quality assurance for this engineering/manufacturing company.
1973 - 1974	**Florida Power and Light Company** Mr. Groseclose was a Quality Supervisor in the Plant Construction Department. He implemented on-site quality control for fossil plant construction and provided quality control liaison on all nuclear projects.
1970 - 1973	**Burns and Roe, Incorporated** Mr. Groseclose was Lead Quality Assurance Engineer. He managed the Burns and Roe Quality Assurance Program at the Three Mile Island Nuclear Power Station Unit 2, General Public Utilities, during construction.
1968 - 1970	**United Nuclear Corporation** Mr. Groseclose was a Senior Industrial Engineer. He developed methods, standards, and procedures for nuclear fuel fabrication and nondestructive testing.
1966 - 1968	**Maryland Shipbuilding and Drydock Company** Mr. Groseclose was the Quality Control Superintendent responsible for directing nondestructive testing, mechanical and optical inspections, and certification of welders, welding procedures, and lifting equipment.
1962 - 1966	**T.D. Associates, Incorporated** Mr. Groseclose was responsible for product design and engineering, and management of quality assurance, including the training and supervision of inspection personnel and performance of nondestructive testing.

LOTHAR R. SCHROEDER
Senior Scientist
(Hatch DCRDR GP Project Manager)

EDUCATION

Ph.D., Experimental/Applied Psychology, Lehigh University

M.S., Engineering Psychology, Lehigh University

B.S., General Engineering, University of Illinois

B.A., Psychology, University of Illinois

EXPERIENCE

1982 - Present

General Physics Corporation

Dr. Schroeder's areas of expertise include task and error analysis, procedures validation equipment design studies, operations research, and organizational design and management. He is currently managing the control room design review at the Trojan Nuclear Power Plant and NUREG-0737 integration services for Plant Hatch. He has also assisted in developing a task analysis methodology for River Bend. Other representative projects include: supporting NRC research in the application of control room crew task analysis data for human engineering design and staffing areas, evaluating SPDS placement, reviewing emergency operating procedures, assessing the human factors aspects of EOP Flowcharts, and reviewing equipment tagging procedures in nuclear plants. Dr. Schroeder has also developed and given numerous supervisory skills workshops for ROs and STAs.

He is currently providing human factors integration services to Georgia Power Company to meet Supplement 1 to NUREG-0737 requirements.

1981 - 1982

U.N.C. Nuclear Industries

Dr. Schroeder worked as a human factors specialist, interfacing with engineers and other staff in identifying and solving problems relating to equipment design, the use of procedures, and training efforts at Hanford's N-Reactor. He also performed a human factors review of the 105-N control room in support of an ongoing control room upgrade program.

1974 - 1980 — **Department of Psychology, Moravian College**
Dr. Schroeder's responsibilities as Assistant Professor and Department Chairperson included planning and coordinating a day and evening program in psychology involving over 100 majors, serving on several college committees, supervising individual field study, independent study, and honors projects, and serving as academic advisor to day and evening session students having an interest in applied psychology.

1973 — **Wigdahl Electric Company**
Dr. Schroeder worked as a consultant, identifying potential organization problems and conducting problem solving sessions.

1972 — **Jewish Employment and Vocational Services**
As an industrial psychologist, Dr. Schroeder consulted with several industries and governmental agencies in order to develop, validate and administer "job-related" personnel selection tests under a Department of Labor contract.

PROFESSIONAL AFFILIATIONS

Member, Human Factors Society

Member, American Nuclear Society

PUBLICATIONS

"Human Factors Review of N-Reactor Control Room," U.N.C. Nuclear Industries Report UN1-2097, June 1982.

"A Human Factors Guided Survey for Systems Development," American Nuclear Society Winter Meeting, December 1981, coauthor with D.R. Fowler.

"Control Room Human Factors in Context," American Nuclear Society Winter Meeting, November, 1982, coauthor with D. R. Fowler & D. E. Friar.

"Learning Style Data Applied to Nuclear Power Plant Training Programs." American Nuclear Society Annual Meeting, June 1983.

"Task Analysis of Nuclear Power Plant Control Room Crews, Vol. I & II", NUREG/CR-3371, U.S. Nuclear Regulatory Commission, June 1983. Authored with D. Burgy, C. Lempges, A. Miller, H. Van Cott, and B. Paramore.

RICHARD I. STAMM
Senior Engineer

EDUCATION

M.S., Nuclear Engineering, Ohio State University

B.S., Chemistry, State University of New York College at Potsdam

LICENSES AND CERTIFICATIONS

Senior Reactor Operator, Boiling Water Reactor/6

EXPERIENCE

1983 - Present

General Physics Corporation
Mr. Stamm is a senior engineer in the Engineering Services Department where he provides technical assistance to power utilities in areas of operator and plant systems procedure development and preparation; reactor physics and operations; surveillance procedure development; and systems descriptions preparation and review. Representative project:

- Southern California Edison's San Onofre Nuclear Generating Station, Unit 2
  Mr. Stamm is assigned to a Configuration Management Analysis project where his responsibilities include review and evaluation of all design changes and proposed facility changes to SONGS Unit 2 to determine the impact on simulator software, hardware, and training.

1981 - 1982

General Electric Company, Startup Test Operations Unit
Mr. Stamm was a nuclear startup engineer, certified SRO on BWR/6, and worked at the Grand Gulf Nuclear Station. His responsibilities included revising plant systems descriptions; reviewing operating procedures; developing and instructing reactor physics and applied engineering courses, and instructing operators in BWR systems and operations.

1979 - 1981

General Electric Company, Radiological Testing and Instrumentation Unit
Mr. Stamm was an associate engineer assigned to the Vallecitos Nuclear Center. His activities included design of fuel rod scanner detector housing and shield; development of procedures for monitoring U-235

	inventory in waste incinerator; analysis of radioisotope transport in radwaste volume reduction process, and performance of fuel and piping gamma scans and dose rate measurements at reactor sites.
1977 - 1979	**Ohio State University, Department of Nuclear Engineering** Mr. Stamm was a graduate research associate. He participated in the development of gamma ray cameras for medical use; and in the design, fabrication and evaluation of germanium strip detectors.

(1/84)

RESUME

NAME: Johnnie C. Lewis, Jr.

TITLE: Operations Supervisor - Nuclear Operations Department (Hatch DCRDR Operations Specialist)

EDUCATION: Georgia Institute of Technology, two years, Chemistry, 1964 - 1966

LICENSE: Senior Reactor Operator, Plant Hatch, May, 1974

SPECIAL TRAINING:
- BWR Licensing (GE/Hatch) - four weeks
- Balance of Plant School (GE/Hatch) - six weeks
- BWR Observation Training (Dresden) - four weeks
- BWR Simulator Classes (GE) - twelve weeks
- BWR Technology (GE) - six weeks
- Basic Nuclear Fundamentals - eight weeks
- U.S. Navy Nuclear Power School & Simulator Training at S3G
- U.S. Navy Electronics Technician "A" School

WORK EXPERIENCE:

May 1981 to Present

Georgia Power Company, Plant Hatch - Operations Supervisor
Responsible for all on-shift Operations Supervisors in their day-to-day operation activities on Units 1 & 2 at Plant Hatch. Assisted in review of upgraded EOPs in 1984. Directed control room labeling enhancement work in 1981 and 1982.

February 1973 - May 1981

Shift Supervisor - Plant Hatch

February 1972 - February 1973

Assistant Operator - Plant Hatch

November 1971 - February 1972

Lab Technician - Plant McDonough (fossil)

September 1968 - October 1971

Reactor Operator, ET-1 (SS), U.S. Navy

<u>RESUME</u>

NAME: Charles C. Matson

TITLE: Project Coordinating Engineer - Georgia Power Company
Power Supply Engineering & Services Department

EDUCATION: Georgia Institute of Technology, BEB - 1970 (Co-Op)
Georgia College at Milledgeville, MBA Studies 1970 & 1971
Georgia State University, MBS Studies 1972

SPECIAL TRAINING: General Physics Corporation - Human Factors Workshop - 16 hours - 1984
General Electric Company - BWROG Control Room Survey Workshop - 20 hours, 1983
Georgia Power Company (Hatch) - Reactor & BOP System Classes - 80 hours, 1983
Georgia Power Company - Five Managment Classes - 172 hours, 1973 - 1982.
EPRI - Acoustical Engineering Seminar - 26 hours, 1978
Georgia Power Company (NUS) - Nuclear Power Fundamentals - 150 hours, 1975
GE - Digital Micro Processor System School - 160 hours, 1972

WORK EXPERIENCE:

<u>July 1983 to Present</u>

Georgia Power Company, Atlanta, Georgia - Project Coordinating Engineer, PSE&S
Responsible for the integration of five TMI projects for Plant Hatch Emergency response capability, with emphasis on emergency operating procedures and control room design review. Served as a committee member of BWROG Emergency Procedure Committee during 1984. Member of Control Room Survey Team for River Bend Station in February, 1984.

<u>February 1983 to July 1983</u>

Cable Tray Restoration Project, Assistant Project Manager at Plant Hatch
Responsible for all activities for crash $4,000,000 program with personal responsibility for material procurement, cost tracking and scheduling.

<u>June 1981 to February 1983</u>

Responsible for coordination of design groups and construction forces on various retrofit projects for Plant Hatch (BWR-nuclear); primary project - $24,000,000 simulator training and administration facilities addition with personal responsibility for schedule and budget.

1979 to 1981

Responsible for coordination of design groups and construction forces for Plants Mitchell and Hammond (both fossil); primary project - $7,100,000 balanced draft conversion of 160 MW Unit 3, with personal responsibility for handling of labor contracts and design versus operation conflicts.

1978 - 1979

Assistant Equipment Engineer, PSE&S
Responsible for the supervision of engineering personnel within the Equipment Section of the Mechanical Engineering branch of PSE&S. Also responsible for equipment bidders list administration. Member of special task force on Shenandoah Solar Energy Cost and Scheduling Study. Member of three equipment damage investigation teams.

1973 - 1978

Design & Sr. Design Engineer, PSE&S (formerly Civil and Mechanical Engineering)
Responsible for mechanical equipment selection for small retrofit modifications. Special areas of expertise: hoists, cranes, fans, noise control, elevators, chimney hoists, cooling towers, precipitators, ash handling systems, and scrubbers.

1972 - 1973

Results Engineer, Power Generation Smyrna
Responsible for the supervision of plant engineers, instrument technicians, plant chemists and engineering co-op students at Plant McDonough. Prepared the monthly and yearly reports on availability and heat rate for ten units (two coal and four gas boilers, and four combustion turbines).

1970 - 1972

Junior and Test Engineer, Power Generation Smyrna and Milledgeville
Responsible for instrument and controls maintenance at Plant McDonough. Special assignment as Construction Start-up Engineer for digital load control load system addition on first GPC units. Performed routine maintenance and troubleshooting on instruments and control systems at Plants McDonough and Branch. Performed various plant test activities.

MILITARY SERVICE:
1971

Three months of Signal Corps Officer training with staff assignment as technical advisor of electrical safety training film production at Fort Gordon, Georgia. Honorably discharged for Army Reserves in 1978 with the rank of captain.

ENGINEERING Co-Op:

1967 to 1969 — IBM, General Services Dept. RTP, N.C.
Cape Kennedy Space Center

Responsible for fabrication and worst case teting of new digital circuitry. Performed inspections and tests on ground electrical equipment on Saturn V project.

1965 to 1966 — DuPont, Experimental Station
Wilmington, Delaware

Performed drafting and assembly work on instrumentation for chemical research projects.

MEMBER: Full member of American Society of Mechanical Engineers
Atlanta Chapter member of the American Nuclear Society

RESUME

NAME: David W. Midlik

TITLE: Engineer II
(Hatch DCRDR Review Team Leader)

DEGREE: Bachelor of Mechanical Engineering, Auburn University, 1981

DATE EMPLOYED: September 14, 1981

WORK EXPERIENCE:

July 1984 to Present

Hatch Support Department Mechanical Section
Responsibilities include design change analysis for various safety-related systems such as Plant Service Water and RHR Service Water Systems. Analysis includes review of system instrumentation and seismic analyses for pumps and supports installation.

July 1983 to July 1984

Hatch Jobsite, Assistant to Project Manager for the Safety Parameter Display System (SPDS)
Responsibilities included supervision of all on-site engineering activities for the installation, functional testing and start-up of the activities for the installation, functional testing and start-up of the SPDS, Technical Support Center (TSC) modifications, Emergency Operations Facilities (EOF) modifications, and Emergency Response Facilities (ERF) integration. Work scope included supervising installation and check-out of the plant SPDS, installation of the Control Room Simulator SPDS, troubleshooting new and existing signal transmission and display to the MCR, TSC and EOF. Work also included review of SPDS Functional Specifications and functional tests of tie-ins to existing plant safety-related systems.

October 1982 to July 1983

Hatch Jobsite
Responsibilities for various safety-related and non-safety-related design change analysis and implementation such as NUREG 0737 required Health Physics habitability modifications.

September 1981 to October 1982

Hatch Support Department, I&C Section
Responsibilities included various design change analysis to both Main Control Room and remote instrumentation and controls modifications. Work scope included instrumentation application and layout and system logic changes.