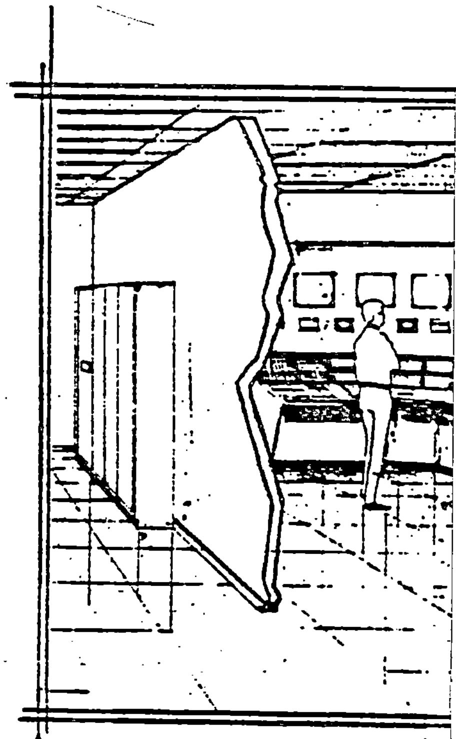
NOVEMBER 1982

SALEM GENERATING STATION
UNITS 1 AND 2

CONTROL ROOM DESIGN REVIEW
PROGRAM PLAN



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CONTROL ROOM DESIGN REVIEW

PROGRAM PLAN

For

Salem Generating Station

November 1, 1982
(Revised)

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1. INTRODUCTION

The approach developed for conducting the Salem Units 1 and 2 Control Room Design Reviews is described in this Program Plan. Chapter 1 describes the purpose of the Program Plan as well its scope and schedule. Chapter 2 describes the plan for managing and staffing the Control Room Design Review. The anticipated input and output documentation and the procedures for controlling both are contained in Chapter 3. The methodology for performing the Control Room Design Review is described in Chapter 4. Finally, a systematic approach for assessing any human engineering discrepancies that are identified as a result of the Control Room Design Review is described in Chapter 5.

The Program Plan, by definition, is flexible and subject to revision as the stages of the design review progress. Since the Program Plan serves as input documentation to the design review process, the original document and subsequent revisions will be controlled in accordance with the procedures described in Chapter 3.

1.1 Purpose

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

1.2 Scope

The detailed control room design review will encompass the vertical panels and the console in the Salem Units 1 and 2 control rooms and their corresponding hot shutdown panels. General Physics Corporation will provide human factors consulting services.

The Scope of General Physics involvement in the Control Room Design Review is to:

- Review input documentation, including any applicable operating experience data, plant design information, and applicable standards and regulations.
- Survey operations personnel.
- Provide an inventory of the control room instrumentation to meet the guidelines in NUREG-0700.
- Perform a control room survey which compares the control room design with accepted human engineering guidelines.
- Determine the input and output requirements of control room operator tasks by preparing a list of systems and systems functions and analyzing specific control room operator tasks.
- Verify that the tasks analyzed can be performed in the existing control room.
- Validate that control room functions can be exercised.
- Assist in the assessment of any human engineering discrepancies uncovered in any of the review steps.

Each of these items is described in more detail in Chapter 4. A flow chart depicting the interaction between the various items is shown in Figure 1. The consultant will provide a monthly progress report indicating funding and scheduling status, a draft report describing the review and the results of the review, a final report based on Public Service Electric and Gas comments on the draft report, and support for PSE&G during the Nuclear Regulatory Commission's (NRC) Review.

1.3 Schedule

The Design Review is a complex process involving numerous elements. A schedule depicting the time-lines of major events is shown in Figure 2.

FLOW CHART OF DCRDR ACTIVITIES

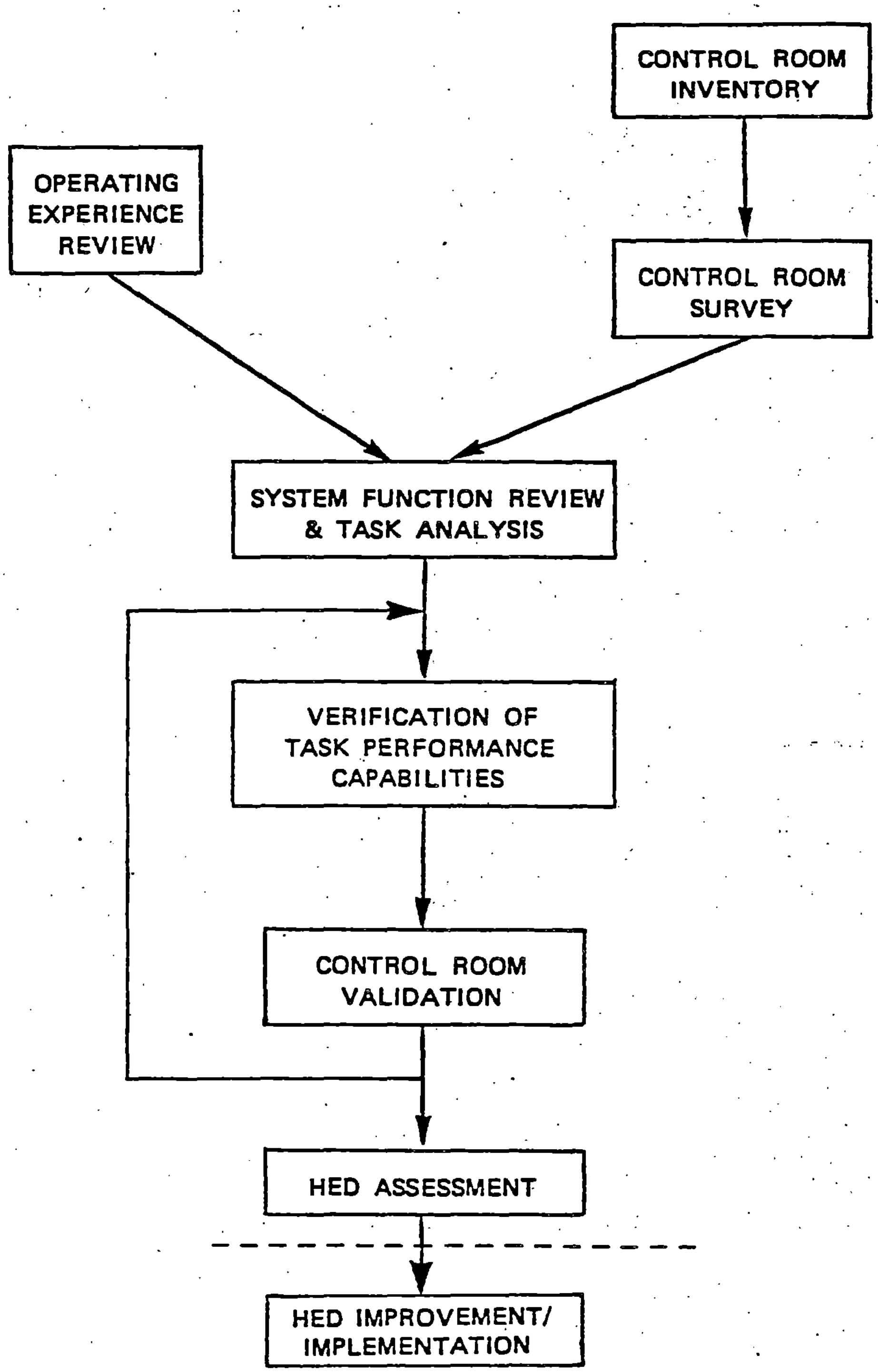


Figure 1

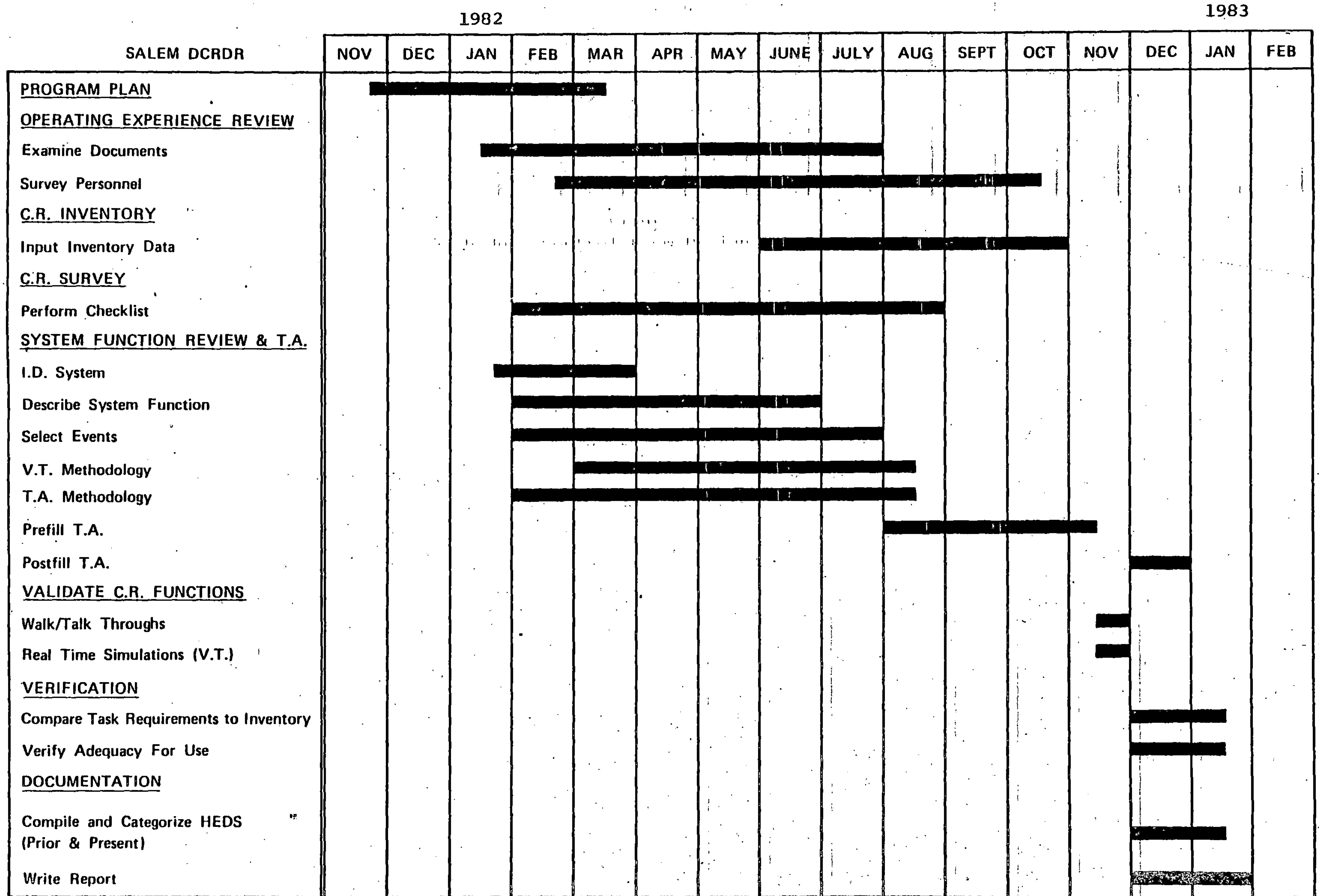


Figure 2
Schedule Control Room Design Review

2. MANAGEMENT AND STAFFING

Chapter 2 of the Control Room Design Review Program Plan addresses the management and staffing aspects of the review. Section 2.1 describes how the review process will be managed. Section 2.2 describes the structure and qualifications of the review team. A discussion of how the Control Room Design Review interfaces with and is integrated into the other human factors activities is contained in Section 2.3.

2.1 Management of the Review Process

An overview of the sequence of events that comprise the Control Room Design Review is contained in this section. The events described include data gathering, analysis and documentation of results. The overview is presented in a sequential manner, although individual events may at times occur concurrently. The Schedule in Chapter 1 displays the relationship of the individual events in the overall time-frame of the review process.

A. Kick-Off Meeting

An initial meeting will be held between PSE&G and the human factors consultant, General Physics. The objectives of this meeting are to:

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

Each of these objectives is discussed below.

(1) Establish review team structure and contacts. During the kick-off meeting, individuals from both PSE&G and General Physics will be identified as members of the Control Room Design Review Team. Specific authority and responsibilities for each team

member will be identified and agreed upon. In addition, an individual from both organizations will be designated as the primary contact for that organization. Reference Section 2.2 for the proposed strucutre of the design review team.

(2) Review and finalize the project schedule. During the kick-off meeting members from both PSE&G and General Physics will review the project schedule (reference Section 1.3). Specific tasks will be scheduled to permit an uninterrupted work flow for the review team, at the same time minimizing interference with control room operations. The end result will be a schedule extending from the beginning of the review through preparation and issuance of the final report.

(3) Obtain existing, applicable documentation. The kick-off meeting will take place at the PSE&G office and the initial data-gathering activity will begin at this meeting. The specific documentation is listed in Section 3.1.

B. Review Documentation

The documentation that was obtained at the kick-off meeting is to be reviewed to:

- Prepare for the control room inventory and survey
- Identify factors that may impact operator performance
- Conduct an operating experience review

This review will be specifically geared toward obtaining information to be used in defining systems functions and analyzing operator tasks.

C. Conduct Phase I Site-Visits

Site visits will be conducted to:

- Inventory the control room.
- Survey the control room.
- Survey operating personnel.

At the conclusion of these site visits, General Physics will have a listing of the instrumentation in the control room, a listing of Human Engineering Discrepancies (HEDs) identified during the Survey and a listing of inputs to the review from the operating personnel. GPC will also conduct an exit meeting with the PSE&G review team at the completion of each site visit.

D. Define System Functions and Analyze Operator Tasks

Systems important to safety will be identified from a listing of plant systems supplied by PSE&G. Using the results from the control room inventory, those systems that are important to safety and are represented in the control room will be determined. A functional description of each of these systems that are important to safety and are located in the control room will be prepared. From this, operating events to be analyzed will be identified. These operating events will be chosen to ensure that all systems which are important to safety and are represented in the control room are exercised. The operator tasks which are involved in each of the operating events will then be analyzed. A special form for the Task Analysis will be "pre-filled" for each operating event to analyze operator tasks and operator/system interactions. The descriptions of systems and functions and the pre-filled task analysis forms will then be reviewed by PSE&G prior to the next step.

E. Conduct Phase II Site-Visits

Site-visits will be conducted to videotape the operating events that were analyzed in the previous step. Operators will walk and talk through these operating events in the control room or in the simulator, as available. The information in the pre-filled task analysis forms will be reviewed and perhaps revised during these walk-throughs.

F. Analyze the Videotapes to Identify HEDs

After the operating event has been videotaped, operators will be debriefed and the event will be analyzed using the pre-filled task analysis forms and the videotape. The result may be a second listing of HEDs that were not identified during the control room survey.

G. Assess HEDs

The HEDs that were identified during the control room survey and during the operating event walk-throughs will be assessed for their safety implications. HEDs identified as having safety implications or potential for safety implications will be categorized and a resolution implementation schedule will be recommended. These assessments and recommendations will be used as input to the Phase II final report.

H. Prepare Final Report

The methodology employed in the Control Room Design Review and the findings that resulted from the review will be documented in a draft report prepared by General Physics for PSE&G. The draft report will be finalized based on comments provided by PSE&G.

I. Participate in NRC Review Meeting

General Physics will support PSE&G utility at any NRC meeting concerning the Control Room Design Review.

J. Project Progress Reports and Memorandum Reports

To ensure that the activities described in these ten steps are performed in a timely and cost-effective manner, General Physics will prepare a monthly progress report throughout the project. The progress report (see sample in Appendix A) will indicate both funding and scheduling status. In addition, General Physics will issue memorandum reports to PSE&G throughout the Review to allow timely review of perceived problems.

2.2 Structure of the Review Team

Personnel from PSE&G and GPC will work directly on the Detailed Control Room Design Review. A description of each review team follows.

A. The PSE&G review team consists of the following four positions:

- Project Manager
- Engineering Coordinator
- Operations Coordinator
- Design Coordinator

The project manager is responsible for providing support to the coordinators in the area of decision making throughout the project to ensure satisfactory completion. The project manager also:

- Provides administrative support for the project
- Interfaces with the GPC review team when necessary

The individual assigned as project manager of the Control Room Design Review team is a member of PSE&G's Controls Division. This individual has the education and experience necessary to function as project manager and team leader.

The engineering coordinator is responsible for coordinating the entire Control Room Design Review. The engineering coordinator also:

- Maintains direct communication between PSE&G and the GPC review team.
- Works with operations and design coordinators to provide the necessary documentation for the design review.

The responsibility of the operations coordinator is to provide all operations support necessary for the review. The requirements of GPC along with the other members of the PSE&G review team will determine the type of support which will be provided by the operations coordinator. This individual is also required to interface with members of the GPC review team as it becomes necessary.

The responsibility of the design coordinator is to provide all design support necessary for the review. The requirements of GPC along with the other members of the PSE&G review team will determine the type of support which will be provided by the design coordinator. This individual is also required to interface with members of the GPC review team as it becomes necessary.

B. The General Physics review team consists of the following three positions:

- Project Manager
- Project Director
- Project Staff

The project manager is responsible to PSE&G for all project work and reports administratively to the project director. The project manager has the responsibility and authority to:

- Prepare the project quality plan
- Implement quality assurance procedures
- Maintain communication with PSE&G on quality affecting project activities

The individual assigned as project manager of a Control Room Design Review is a member of the General Physics Human Factors Engineering Group. This individual has the education and experience necessary to function as project manager and team leader of a Control Room Design Review.

The project director is responsible for ensuring that the project manager has the support of General Physics Corporate Resources, when necessary, to support the project. The project director reports through department and division management to the office of the president of General Physics. The project director has the responsibility and authority to:

- Assist the project manager in staffing the project
- Coordinate technical support for the project
- Provide administrative support for the project

The project staff members report to the project manager. The staff members participate in data collection, analysis, and report writing and at times may directly interface with PSE&G personnel. Depending upon the extent of utility expertise and participation in the review process, the staff may consist of personnel with the following expertise:

- Human factors engineering
- Power plant operations
- Training
- Systems analysis
- Design engineering
- Computer applications

Each staff member on the review team will be assigned specific responsibilities corresponding to his or her level of education and experience in the required area of expertise.

A diagram showing the design review team structure and the primary contacts between PSE&G and General Physics is shown in Figure 3. Individual role assignments are provided with the resumes in Appendix C.

2.3 Integration of Control Room Design Review with Other Human Factors Activities

The CRDR will be interfaced with other on-going human factors programs at the Salem Generating Station. Examples of other relevant work are shown in Figure 4.

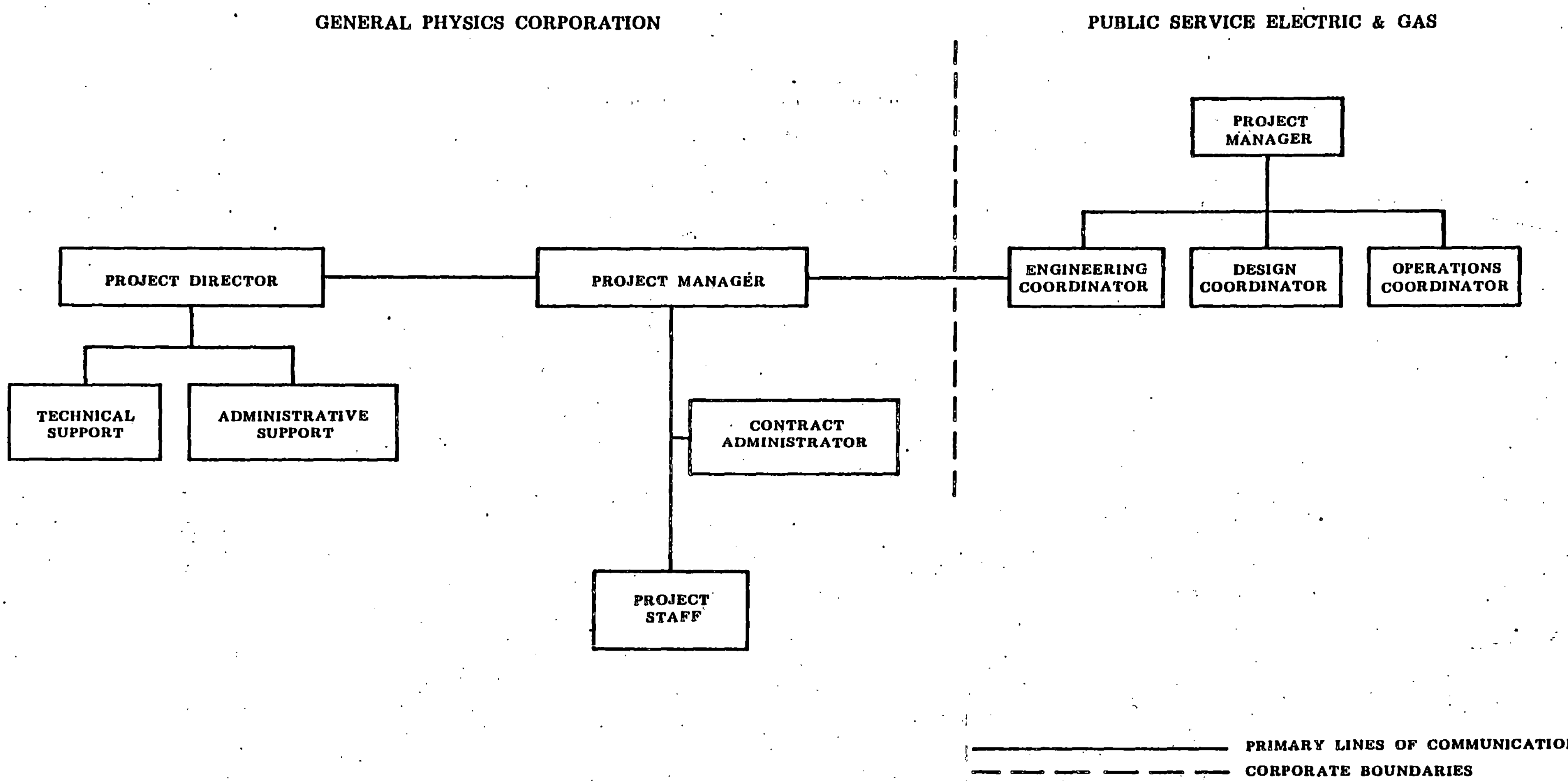


Figure 3

Design Review Team Structure

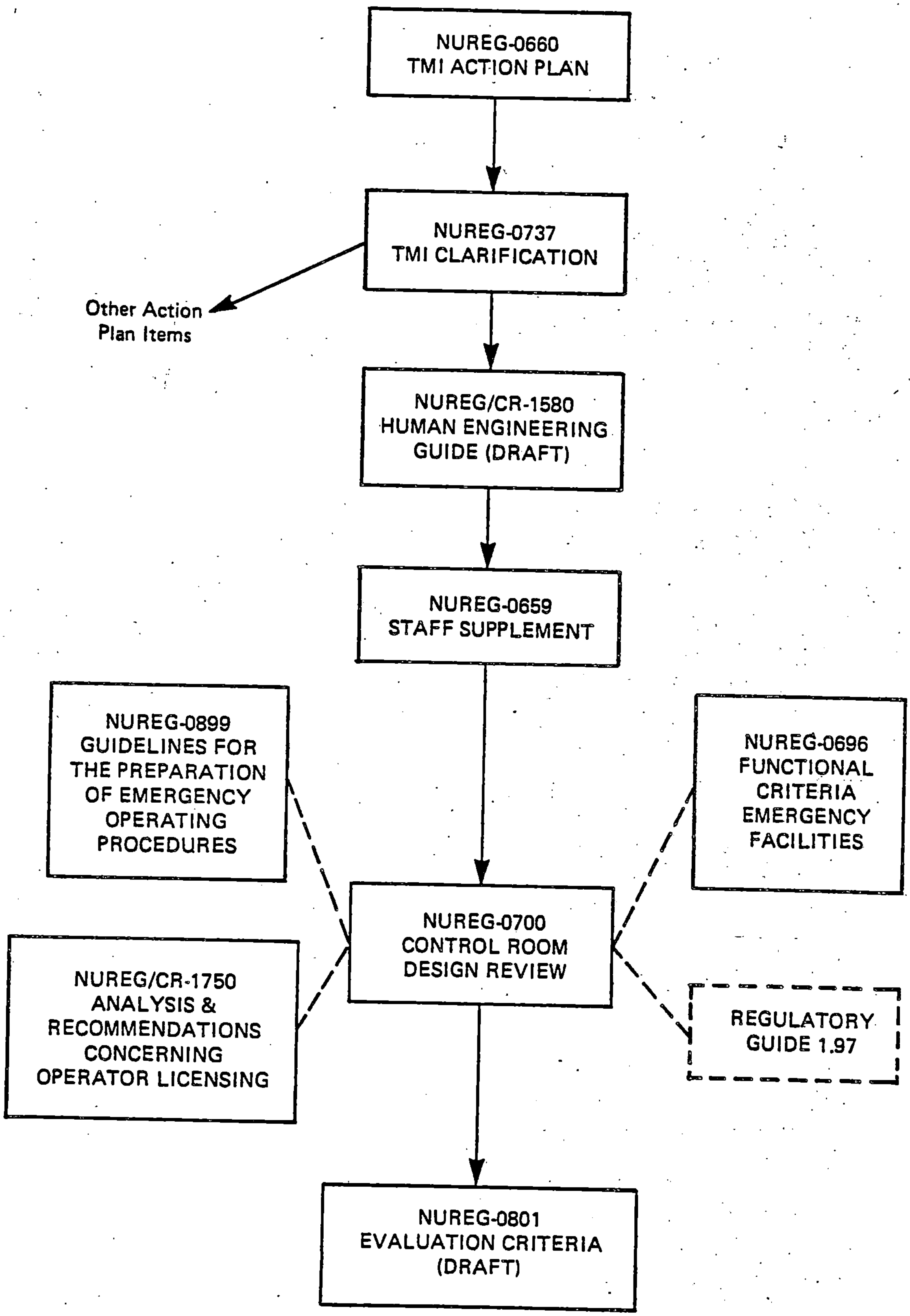


Figure 4

Relationship Between NUREG-0700 DCRDR
and Other NUREG Documents

3. DOCUMENTATION AND DOCUMENT CONTROL

A large number of documents will be referenced and produced during the Control Room Design Review. Therefore, a systematic method for controlling these documents is necessary. The input and output documentation that has been identified to date and the process by which these documents will be controlled is described in this chapter.

3.1 Input Documentation

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

- Licensee Event Reports
- Incident Reports
- Fault trees and failure mode and effects analyses
- Final Safety Analysis Report
- Systems descriptions
- Piping and instrumentation drawings
- Control room floor plan
- Panel layout drawings
- Panel photographs
- Lists of acronyms and abbreviations used in the control room
- Descriptions of coding conventions used in the control room
- Software descriptions, including CRT formats and content
- Samples of computer printouts
- Procedures currently in use (emergency, operating, etc.)
- Operator training materials
- Control Room Preliminary Assessment
- Guidelines for procedure development
- Instrumentation and controls list
- Annunciator and label engraving lists

3.2 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 3.3. The following list represents a preliminary estimate of the types of documents that will result from the review and be submitted by General Physics to PSE&G:

- Control Room Design Review Program Plan
- Project schedule
- List of control room instrumentation
- Control room survey checklists
- Operator questionnaire
- Human Engineering Discrepancy form
- Project memorandum reports
- List of plant systems
- List of systems represented in the control room
- Description of control room safety systems functions
- Description of operating events analyzed
- Task analysis form
- List of HEDs assessed according to their safety implications
- Summary Control Room Design Review Report

3.3 Documentation Control Procedures

The General Physics Project Manager will designate a review team member who will be responsible for documentation control. All documents received from PSE&G, used as primary input to the review, or generated during the review will be subject to the following control procedures.

A. Log-in Procedures

All documentation received and generated during the review will be logged into the GPC Document Receipt/Distribution Log. The log contains the document identifier, the revision level, the date received, and individual(s) to whom the document is distributed (see Appendix B).

B. Internal Routing

After documents have been logged, they are routed to review team members. If the document is too large to be routed, e.g., an FSAR, a memo giving the document date, title, and revision will be routed. After all team members have signed the routing sheet, the document will be returned to the document control person.

C. Log-Out Procedures

In a manner similar to the log-in procedures, all documents will be controlled through a log-out procedure. Once again, the document identifier, the revision level, the date sent, and to whom it is distributed will be logged. In the case of revisions, the superseded version can be recalled concurrently with issuance of the latter version using the Document Receipt/Distribution Log Form (see Appendix B).

D. Document Filing

All project documents will be maintained in a project file. The document control person will periodically insure that no material has been removed from the file that has not been properly logged-out.

3.4 Management of HED Records

All information pertaining to HEDs will be stored in the General Physics Corporation PRIME I-1000 computer via General Physics' HEDSMAN (Human Engineering Storage and MANipulation) System. The HEDSMAN software was written specifically for the collection, storage, manipulation and tracking of HED-associated data. The system will be used to provide assurance that all

HED data are accurately recorded, organized, and assessed. Cross-referencing among files will be provided. For example, all component information for an HED can be compared to the data collected during the Control Room Inventory. Furthermore, an inquiry to the HED data file can result in a listing of all HEDs affecting any system, subsystem, or component.

4. PROCEDURES FOR THE CONTROL ROOM DESIGN REVIEW

A description of how the control room design review process is to be accomplished is contained in this chapter. The review is divided into the following:

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

A procedure for each follows. However, at this stage the procedures are preliminary and may be revised as the review progresses.

4.1 Operating Experience Review

Two separate steps are involved in reviewing operating experience. The first is to review available and applicable documentation. The second is to survey operating personnel. Each is addressed separately.

A. Documentation Review

Operating experience documentation will be reviewed in an effort to identify problems that have occurred in the past which could impinge on control room operations. Therefore, the following items will be considered as possible review documents.

- Licensee Event Reports
- Final Safety Analysis Report
- Modifications to Technical Specifications
- Incident Reports

4.2 Control Room Inventory

An inventory of all instrumentation, controls, and equipment in the control room will be prepared. Instrumentation, controls, and all equipment used for remote shutdown will also be inventoried. The inventory will identify systems and subsystems; instrumentation and controls (components) related to each; emergency equipment, communication devices, procedures and any other items physically present in the control room. Selected features of instruments to be specified include parameter ranges and unit of measure.

Prior to actually performing the inventory, the following documents will be reviewed:

- Plant layout
- Control room layout
- A/E drawings
- Instrumentation and controls listing
- Annunciator and label engraving lists
- CRT formats and content in hardcopy
- Plant operating procedures
- Control room photographs

Photographs of the control room will be provided for use in the review. There are three objectives for obtaining control room photographs:

- To provide an "as built" documentation of the control board at the beginning of the review and to provide an overall reference for the control room for later identified HEDs.
- To document corrective measures taken in an effort to resolve the HED's and,
- To provide a necessary element of a control room review for submittal to the NRC.

Once the control room inventory is complete, all items physically located in the control room and remote shutdown area will have been identified. The results will be documented in a form suitable for use during the verification of task performance capabilities.

Also, any other documentation that could provide insight into control room operability will be reviewed. Industry-wide information on plants most similar to Salem will also be surveyed in an effort to identify useful documentation.

General Physics and PSE&G will agree upon the list of documents to be reviewed prior to this step of the review. Any problems that are identified as having potential impact on control room operations will be documented and examined later in the process.

B. Operating Personnel Survey

Operating personnel will be surveyed to elicit information regarding positive and negative aspects that have been noted during actual or simulated operation. A questionnaire will be used to sample operation opinion and elicit recommendations. Areas that will be addressed include:

- Controls
- Displays
- Annunciators and alarms
- Procedures
- Computer systems
- Workspace environment
- Control room workspace
- Panel layout

The information collected from the operations personnel will be documented for examination later in the review process. Follow-up interviews with respondents will be scheduled, as necessary, to clarify or elaborate on questionnaire results.

4.3 Control Room Survey

The purpose of the control room survey is to compare design features of the control room to the human engineering guidelines presented in NUREG-0700 and other relevant human factors standards. Checklists will be used to provide a thorough and efficient method by which direct observation and measurement of control room features may be undertaken. The checklists organize guideline items under the broad categories of instruments, equipment, layout, and ambient conditions. In the control room survey, checklists will be used to evaluate each system with the purpose of identifying control room characteristics that do not conform to accepted human engineering practices. Thus, the survey will be used to identify discrepancies which will later be evaluated as to their potential effects in the final systems context.

While most of the checklist items are applicable at the component level, some guidelines apply to specific task uses of instruments and equipment, task sequence requirements, communications requirements or other aspects of dynamic operation. These dynamically-oriented guidelines may be most appropriately addressed from the task or function perspective described in Section 4.4.

Specifically, checklist items will be hierarchically organized for reference ease and will provide space for an indication of compliance or noncompliance to each guideline. When lack of compliance is found, a specific reason or reasons will be clearly described in an adjacent space. Items which require further documentation of a human engineering discrepancy will be described in greater detail as a separate record cross-referenced to the checklist. Photographic evidence of at least one example of each type of HED will also be provided if feasible.

Some guidelines will be addressed primarily on a control-room wide basis such as those that fall in the categories of communications, process computer, control room layout, and environmental factors. Others will be approached on a control-room wide basis first, and then panel-by-panel, such as the annunciator system and layout. Still other guidelines will be evaluated element-by-element, and then for general control room consistency, such as controls, displays, labels, and location aids.

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

4.4 System Function Review and Task Analysis

The flow of activities which comprise the system function review and task analysis is represented in Figure 5. This step in the review process is performed to determine the input and output requirements of operator tasks involved in selected operating events. These requirements will be used later in the review to assess the adequacy of the control room design. For clarity, the procedure for determining these input and output requirements is divided into the following four parts:

- Identify systems
- Describe system functions
- Identify event sequences
- Identify and analyze operator tasks

Each is discussed separately below.

A. Identify Systems

From plant documentation, a list of plant systems will be prepared. From this list, those that are important to safety will be identified.

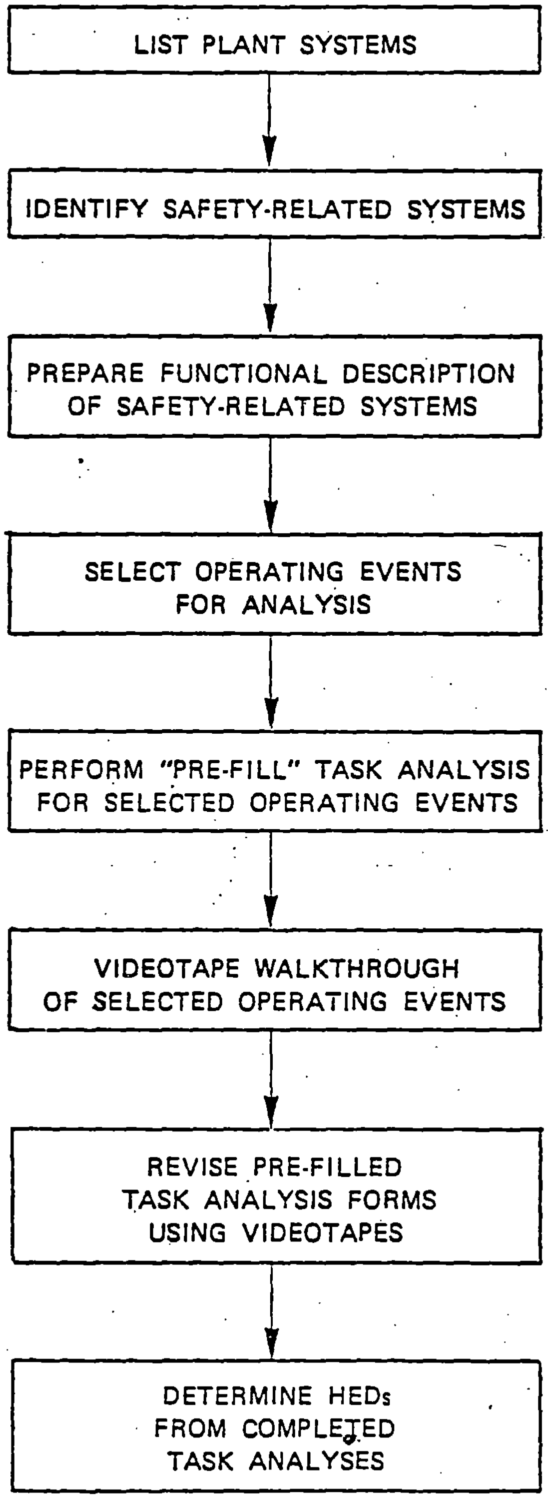


Figure 5
Systems Function Review and Task Analysis

C. Identify Event Sequences

Two sources of information will be used as the primary basis for identifying the event sequences to be analyzed. The first is the result of the operating experience review. If a particular event has been problematic in the Salem plant or in similar plants, it will be identified and analyzed. The second is the list of systems that were identified as being important to safety. The objective in identifying events to be analyzed is to choose events which will exercise all of the systems that are identified as being important to safety. Therefore, a matrix-type form will be developed to compare "safety important" systems and operating events. In this manner, operating events will be chosen to ensure that each major system that is important to safety is included in the task analysis. The types of operational events that will be considered for analysis are:

- Small break LOCA
- Start-up from hot standby to minimum load
- Anticipated transient without scram, following loss of main feedwater
- Inadequate core cooling
- Steam generator tube failure
- Shutdown for refueling
- Large break LOCA
- Control room evacuation

The list of events to be analyzed will be approved by PSE&G prior to the initiation of task analyses.

D. Identify and Analyze Operator Tasks

After the operational events have been identified, task anlaysis forms will be pre-filled for each event. The purpose of the pre-filled task analysis form is to document the operator tasks and task resource requirements necessary to perform the operator functions required in each operating event analyzed.

The primary criteria that will be used to determine the safety importance of systems is whether the system is designated as safety-related, e.g., Class 1E, in the plant documentation. In addition, the following three factors will be considered:

- Manual control systems needed by the operator for real-time support to prevent plant trips.
- Manual control systems needed by the operator for post-trip control of decay-heat transfer from the core to the various heat sinks in the plant.
- The degree of interconnection on non-class 1E systems. A system which is highly interconnected with other systems may be a source for causing many systems to fail as failure may propagate over the connections.

After the systems have been designated as being important to safety, those systems which are controlled or monitored in the control room will be identified.

B. Describe System Functions

Descriptions of the functions for each of the systems identified in the previous step will be prepared. The list is comprised of those systems that are important to safety and are controlled or monitored in the control room. These system descriptions will include:

- The function(s) of the system ("function" is defined as a mission or goal)
- Under what conditions the system is used
- A brief explanation of how the system operates

These descriptions will be used as input to the task analysis.

The task analysis forms will be pre-filled prior to on-site visits to minimize time on site and disruption to the plant control room. The system functional descriptions will be used as the starting point during these paper-and-pencil task analyses. Tasks explicit and implicit in procedures will also be identified and described. For each task, operator actions and information requirements will be drafted. The information contained on the task analysis form will include:

- Operator subtasks
- Description of operator behavior
- System/subsystem
- Input requirements
- Output requirements
- System/subsystem response
- Time sequence
- System performance criteria
- Consequences to plant of error/omission

Functional descriptions and procedures will not provide sufficient detail to allow the task analysts to fully determine sequential ordering of actions, control/display location, optional elements, minimum symptoms to diagnose a problem, and other information at the task element level. Some of this information will be provided by station personnel prior to the walk-throughs. The remainder will be collected during real-time performance of the events (reference Section 4.6).

4.5 Verification of Task Performance Capabilities

The objective of performing this step in the review process is to determine if the instrumentation and controls that the operators need to perform their tasks are available in the control room and, if they are, to determine if the design allows for effective human/machine interface. In order to ensure that this step has been adequately addressed, the procedure described below will be performed at least twice. The first time will be prior to the on-site visit when the talk-throughs of the operating events are conducted. The second time will be after the video-tapes of the walk-throughs have been analyzed.

Briefly, the procedure for determining if the necessary instrumentation and controls are available, and if there are any interface problems connected with the simulated operating event, is as follows:

- Information on input and output requirements from the task analysis forms will be compared with the control room inventory list.
- Any instrumentation or controls that are required but not present in the control room will be noted as possible HEDs.
- If the instrumentation parameters do not agree with the parameter information requirements it will be noted as a possible HED.
- If instrumentation or control features do not allow successful task completion, they will be noted as possible HEDs.
- The possible HEDs identified prior to the walk-throughs will be evaluated to ascertain if they constitute a discrepancy in the context of the control room.
- After the operating event walk-throughs have been analyzed, additional HEDs may be identified.

After the selected operating events have been analyzed, a check will be made to determine if the control room contains instrumentation or equipment that may not be necessary. If this condition exists, additional evaluations will be performed to ascertain if the instrumentation or equipment should be altered or removed.

The procedures identified in this section will result in a compilation of HEDs that have been identified throughout the Control Room Design Review process. If an item is identified as a possible HED, and is later found to not actually be a discrepancy, it will be eliminated from further analysis.

4.6 Validation of Control Room Functions

After the task analysis has been pre-filled and verified as described in Sections 4.4 and 4.5, a walk-through of the selected operating events will be conducted. At this time, any additional information will be recorded on the task analysis form. The operating event walk-through will be video-taped to provide a means for later analyses of the tasks and to minimize the time required on site. If the simulator is available, the walk-through will be video-taped in a real-time situation. If not, a simulated walk-through will be video-taped in the control room or in an authentic mock-up. As much information as possible will be collected during the walk-through. However, it is anticipated that the major portion of the task analysis information obtained from the walk throughs will be recorded and analyzed from the video-tapes at a later date.

The primary purpose of this step is to identify difficulties, based on the control room design, in accomplishing the necessary tasks involved in the operating event, to ascertain the validity of previously identified discrepancies, and to identify any discrepancies not previously recorded. Once the video tapes have been analyzed, the task analysis forms will have been completed. Then the procedure described in Section 4.5 will be repeated to finalize the list of HEDs identified throughout the review process.

5. HED ASSESSMENT AND RESOLUTION

The design review team, comprised of PSE&G personnel and General Physics personnel will assess identified discrepencies 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.

- HED categorization
- HED resolution
- Schedule for modification

A procedure for each follows. These procedures are tentative and subject to revision.

5.1 HED Categorization

The categorization process is designed to assess and prioritize HEDs. Review team members from both PSE&G and General Physics will participate in the categorization of HEDs. All identified HEDs will be categorized as follows:

- Category I - HEDs Associated with Documented Error
- Category II - HEDs Associated with Potential Errors
- Category III - HEDs Associated with Low Probability Errors of Serious Consequence
- Category IV - Non-significant HEDs

The categorization process is shown in Figure 6. Categorization will be determined by:

- Previously documented errors
- DCRDR team judgement of potential for error
- Cumulative or interactive effects
- Impact on plant operational safety

HED CATEGORIZATION PROCESS

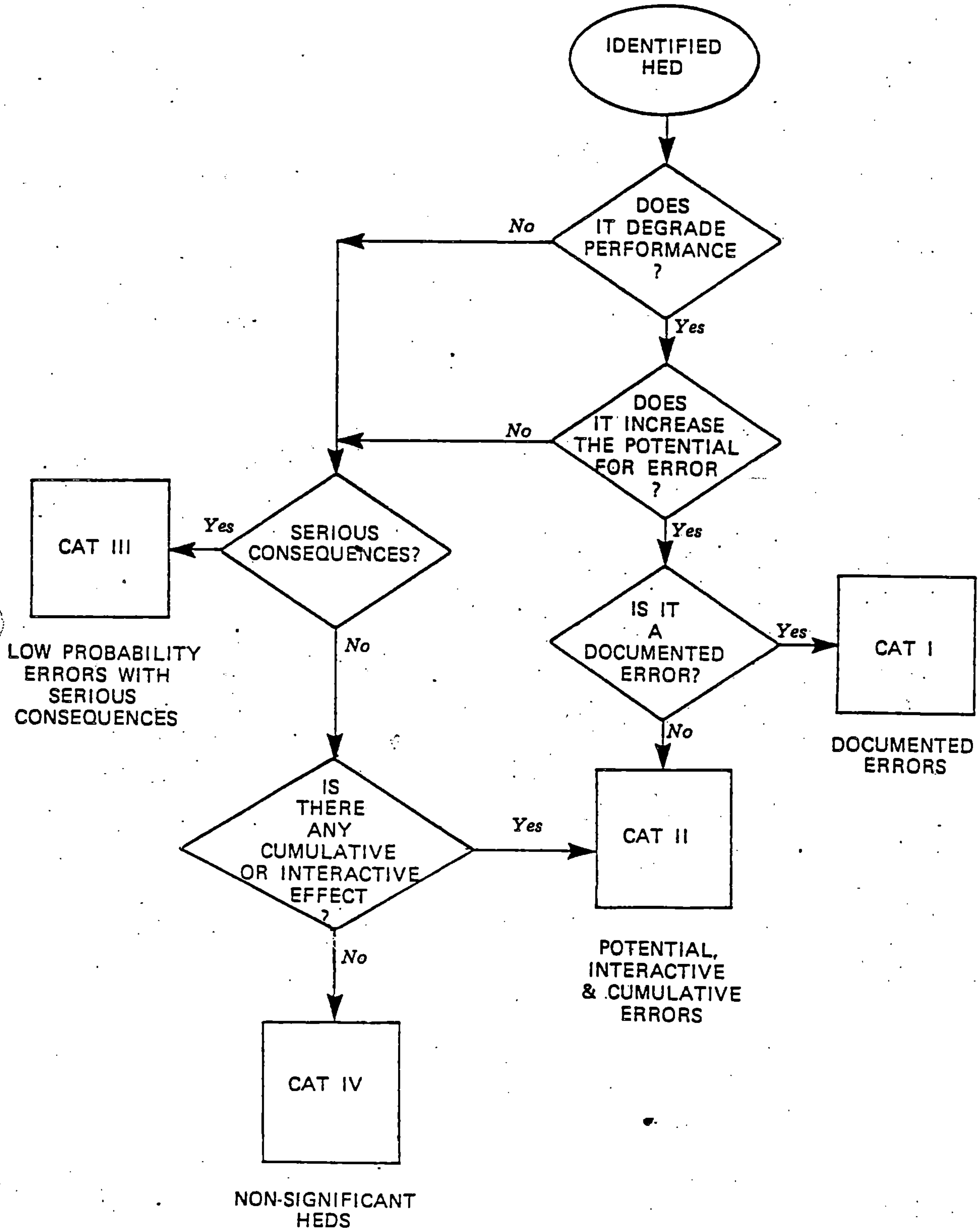


Figure 6
(adapted from NUREG-0801)

A. Category I - HEDs Associated with Documented Errors

All HEDs which have been previously documented (as determined by the operating experience review described in Section 4.1) as having contributed to an operating crew error will be determined to be significant and assigned to Category I.

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

HEDs placed in Category II may come from two sources:

- Those which degrade performance and increase the potential for error
- Those which have cumulative or interactive effects

Each of these two is discussed below:

(1) It is the responsibility of the review team to judge the significance of HEDs. In order to reduce the subjectivity of such a judgement, review team members will answer a series of structured questions, designed to indicate the effects of the HED on operating crew performance. If it is judged that the HED degrades performance and if the effects of the HED are judged to be serious enough to cause or contribute to increasing potential for operating crew error, the HED will be determined to be significant and assigned to Category II.

(2) Any HED which does not degrade performance, which does not increase the potential for operating crew error and does not have adverse safety consequences will be further analyzed to determine if it has any cumulative effects or any interactive effects with other HEDs. This determination will be based upon knowledge derived from the review of systems, subsystems, panels, components and functions/tasks, as well as from human performance references. If the HED is determined to have a cumulative or interactive effect it will be assigned to Category II.

C. Category III - HEDs Associated with Low Probability Errors of Serious Consequence

HEDs initially determined to have a low potential for error will be further analyzed by the review team, in terms of the effect of an error on plant operational safety. HEDs with a low probability for error, but which could result in adverse conditions if such an error did occur, will be determined to be significant and assigned to Category III.

D. Category IV - Non-significant HEDs

Any HED which has been analyzed and determined neither to increase the potential for causing or contributing to an operating crew error, nor to have adverse safety consequences, nor to have any cumulative or interactive effects will be assigned to Category IV.

Categories will be broken down into levels and each HED will be further analyzed for level determination. Levels will be determined by:

- System importance to safety
- Severity of consequences

5.2 HED Resolution

Recommendations for HED resolution will be proposed for all HEDs. Corrective actions will be developed using the resources contained in the DCRDR team and other specialists (e.g. Plant Engineering Department). The recommendations will take into account the impact of the correction on operating effectiveness, system safety, acceptability of design, consistency with control room characteristics and cost.

5.3 Schedule for Modification

The development of a schedule for modifications of HEDs is dependent on HED categorization and PSE&G decision.

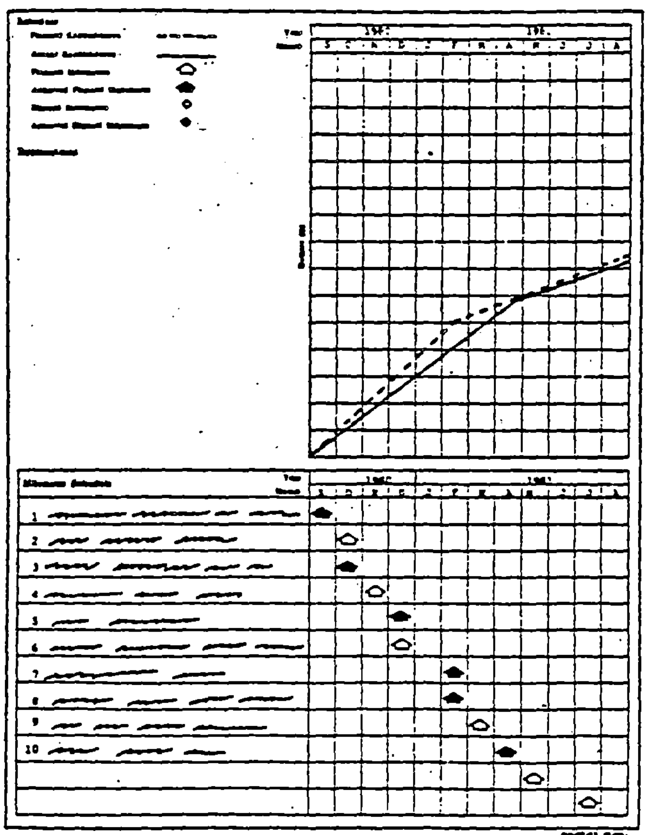
APPENDIX A

PROJECT PROGRESS REPORT

GENERAL PHYSICS CORPORATION
PROJECT PROGRESS REPORT

Utility Company/Government Agency

Engineering Services and Analysis Support



DOCUMENT RECEIPT/DISTRIBUTION LOG

Document Category: **Project:**

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

APPENDIX C

RESUMES

Role Assignments

Public Service Electric and Gas

Project Manager..Lawrence F. Leitz
Engineering Coordinator.......................................Milton H. Allicock
Operations Coordinator..James V. Bailey
Design Coordinator...James G. McFadden

General Physics Corporation

Project Manager..Peter A. Doyle
Project Director..Donald C. Burgy
Project Staff ....Claudia Lempges (Human Factors)
..............................Frank B. Rogalla (Human Factors)
..............................Richard Corfield (Operations)
..............................Patrick Casey (Operations)

LAWRENCE F. LEITZ

EDUCATION

1969	B.A. Mathematics, City University of New York, Queens College
1958	A.A.S. Electrical Technology, State University of New York at Farmingdale

EXPERIENCE

1970 - Present

Public Service Electric and Gas Company
Newark, New Jersey
Senior Engineer - Engineering & Construction Department

Job activities are related to the controls and instrumentation for both fossil and nuclear fuel generating stations. Prinicpal involvement has been associated with nuclear generation with an equal emphasis on both the primary and balance of plant systems.

Responsibilities include development of systems logic, preparation of system descriptions, detail equipment specifications, estimates for material, labor, and scheduling.

Other responsibilities include the organization, supervision and review of the duties of other technical personnel within the discipline and the analysis and resolution of Production Department operating problems encountered on a daily or emergency basis. In addition, the interfacing of project requirements with other in-house engineering disciplines, vendor representatives, as well as the solicitation of technical input from outside sources, i.e., professional societies, architect engineers, etc.

1965 - 1970

Allied Chemical Corporation - Morristown, New Jersey
Supervising Engineer - Instrumentation

Responsible for the supervision of the engineering as well as design for the instrumentation and control systems relative to various chemical processes, coke ovens, coal chemical recovery plants, and combustion systems.

Duties include the preparation of specifications, subcontracts, the layout of plot plans, schematics, elementary and wiring drawings, installation, details, and panel drawings. In addition, bid evaluation, project coordination, scheduling, estimating and field start-up supervision.

1958 - 1965 **Bailey Meter Company - Wickliffe, Ohio**
Sales Engineer

New York District sales representative for the chemical industry and industrial contractors. Products included industrial instrumentation, control systems, and special purpose computers.

1960 - 1963 Application Engineer

Involved with the layout of systems and instrumentation primarily for the power industry. Duties included acting as the engineering and commercial liason between the architect engineer and the Corporate Contract Engineering Department, plus technical back-up to the district Sales Department.

1959 - 1960 Service Engineer

Start-up and maintenance service for new and existing installations. Dealt primarily with combustion systems for the utility and marine industries.

1958 - 1959 Cadet Engineer

Participant in a nine (9) month formal training program for industrial instrumentation and systems. The program included classroom theory and instruction in the laboratory, shop and engineering department.

MILTON H. ALLICOCK

EDUCATION

1981	Westinghouse Pressurized Water Reactor Information Course. Public Service Electric and Gas Company
1980	Graduate course in Management Science. New Jersey Institute of Technology
	B.S., Electrical Engineering Technology New Jersey Institute of Technology
1976	A.A.S., Electronics Engineering Technology Essex County College
1965 - 1972	Boiler Operator's Certificate Boiler House Practice Certificate Turbine Plant Operator's Certificate. City and Guilds of London Institute, London, England

EXPERIENCE

1981 — Essex County College
Adjunct Instructor - Engineering Department

Instructed a course in DC Circuit Analysis.

1981 - Present — Public Service Electric and Gas Company
Engineer - Controls Division

Makes design changes to existing systems involving instrumentation and controls, to maintain reliability and the safe operation of a Nuclear Generating Station. Other duties include selecting and purchasing equipment for the design changes. I am presently involved in making design changes of Salem Units 1 & 2 Control Room to satisfy Human Factors Guidelines. I am the Sponsor Engineer responsible for the Salem Units #1 and 2 Control Room Design Review.

1980 - 1981 — Public Service Electric and Gas Company
Associate Engineer - Controls Division

Makes design changes to existing systems involving instrumentation controls, to maintain reliability and the safe operation of a Nuclear Generating Station. Other duties include selecting and purchasing equipment for the design changes. Established a computer based equipment list for Salem Nuclear Generating Station. Prepared a response to Regulatory Guide 1.97 for Salem Unit #2.

1978 - 1980	Public Service Electric and Gas Company Engineering Assistant - Controls Division Perform simpler duties pertaining to the redesign of existing systems in a Nuclear Generating Station to maintain reliability and safe operation.
1977 - 1978	Public Service Electric and Gas Company Technical Helper - Kearny Generating Station (Fossil) Perform simpler types of Station Performance Department duties associated with the repair and maintenance of instruments and Boiler feed water testing.
1976 - 1977	Public Service Electric and Gas Company Utility Man - Kearny Generating Station (Fossil) Helped in the repair and maintenance of power plant equipment.
1971 - 1974	Guyana Bauxite Company, Guyana, South America Shift Supervisor - Generating Station (Fossil) Was responsible for a shift consisting of ten men who were assigned to various manual operating positions within the plant. Other duties included control room operation.
1964 - 1971	Guyana Bauxite Company, Guyana, South America Power Plant Operator - Generating Station (Fossil) Operated steam generators, turbo-generators, power plant auxiliary equipment and water-treatment plant which treated water for the steam generators as well as for domestic purposes.
PROFESSIONAL AFFILIATION	Member, Institute of Electrical and Electronics Engineers

JAMES V. BAILEY

EDUCATION

1976 - Present	Training for Senior Reactor Operator License for Salem Generating Station.
1972	Training for Reactor Operator License for Surry Generating Station.
1965 - 1971	Various schools associated with the U.S. Navy Nuclear Power Program.
1965	Franklin Senior High School, Reisterstown, Maryland.

EXPERIENCE

1980 - Present

Public Service Electric and Gas Company
Lead Engineer on the Operations Staff.
Primary Area of Responsibility

Review and upgrading of station Emergency and Normal Operating Instructions.

Review of station desgin changes.

Company represenative to Westinghouse Owners Group, Procedures Subcommittee. This committee is responsible for the development and review of the Westinghouse Emergency Response Guidelines developed in response to NUREG-0737 Item I.C.1.

Representing the Westinghouse Owners Group and the Company on the combined owners group task force with INPO to develop a generic implementation plan for the industry to use in implementing the approved emergency response guidelines.

Station representative for the development and review of the Salem simulator.

Assisted the Engineering and Construction Department in the development of procedures to deal with the concerns raised by 10CFR50 Appendix R for safe shutdown of the station with a fire in the Relay Room.

1979 - 1980

Temporarily assigned from the Training Department to work for the Chief Engineer. Primary Areas of Responsibility:

Investigate and resolve post TMI licensing issues. Resolve various other licensing issues for Unit 2 operating license.

1977 - 1979	Nuclear Training Specialist Primary Responsibilities: Develop and implement a training program for NRC license candidates. Develop and implement a requalification training program for licensed operators. Develop training system descriptions.
1975 - 1977	Staff Assistant - Operating Department Trained for and obtained a Senior Reactor's Licnese (No. 2731) on Salem Generating Station. Filled a licensed operator position from July 1976 until April 1977 when the first class of reactor operators obtained licenses. Prepared station procedures.
1973 - 1975	<u>LPL Technical Services, Inc.</u> Engineer Worked as a Startup and Test Engineer during phase 1 and 2 startup testing on Salem Unit 1.
1971 - 1973	<u>Virginia Electric and Power Company</u> Worked as an operator assigned to the Startup and Test Group during the phase 1, 2 and 3 startup testing for Surry Unit 1 & 2. Trained for and received a Reactor Operator License for Surry Unit 1 & 2 (No. 3196).
1965 - 1971	<u>U.S. Navy</u>

JAMES G. MCFADDEN

EDUCATION

1956	Attended Brooklyn Polytechnic Institute - Chemical Engineering - 1 year
1954	Accredited Evening High School Repeated all high school math to satisfy New York State Board of Regents & Brooklyn Polytechnic Institute
1952	International Correspondence School - Mechanical Engineering - 1952/1954
1949	High School Graduate

COMPANY TRAINING COURSES

Fundamentals of the Critical Path Method of Planning and Scheduling
Supervisory Skills Program - Management Personnel
Quality Assurance Orientation for Engineers
General Employee Training - Nuclear Plants
Radiation Worker Training - Salem
BWR Technology - NUS Training Corporation

EXPERIENCE

1971 - Present — Public Service Electric & Gas Company

Assistant Chief Designer - Controls 11/80 to Present
Senior Mechanical Designer 7/73 to 11/80
Squad Leader - Controls Mechanical 7/72 to 7/73
Designer - Controls Mechanical 9/71 to 7/72

Assistant Chief Designer Controls

Assigned to control review team for preliminary review of Salem Unit 1 and 2 Control Rooms prior to NRC and Essex Corporation review. Accumulated and assembled all data, correspondence and drawings pertaining to design of Salem consoles and recorder panels. Interviewed operators to accumulate their experience of working in this Control Room. Assisted in preparation of report to document our findings based on this review.

Assigned to assist Essex Corporation and NRC perform their Control Room review of Salem Generating Station. Prepared the paperwork to implement fixes to Category 1 discrepancies found during this review.

Assigned to review team to examine and approve all ongoing changes and or corrections to Salem Control Rooms.

Assigned to provide design review and coordination between Salem 1 and 2 Control Rooms and simulator. Review and approve all functional specifications submitted by E.A.I. for simulator.

Assigned to Technical Support Center as Controls Design Representative during emergency response drills and/or accident. Prepared all technical artwork for system overviews at Cherc, EOF and TSC. Solicited bids, evaluated quotations, placed orders and installed charts at each facility. Provide ongoing support to maintain charts in updated status.

Assigned to Hope Creek to audit Bechtel's San Francisco home office productivity as it effects controls drawings and the instrument index.

Assigned to PSE&G Co. Computer Graphics Group as Supervisor. Responsible for manpower, productivity, training, budgeting, purchasing, and development of new software and programs.

Assigned to Salem as DCR (Design Change Request) Coordinator. Responsible for scheduling, manpower and productivity.

As Assistant Chief Designer Controls, I am the functional head, in the absence of the Chief Designer, of the Controls Group of the Engineering and Construction Department. The group consists of 58 men (4 Senior Designers, 4 Lead Designers, 33 Designers, Drafters and Detailers and 14 contract personnel). We provide the engineering design and drafting of all controls documents from schematics to installation details for all control devices, pneumatic or electronic, for nuclear, fossil and gas plants; new construction or "revamp" work. I am responsible for interviewing, hiring and evaluating personnel. I prepare all scheduling, logic input and manpower durations for our assigned work. Consult, advise and comment on controls portions of contractor supplier systems or packages.

1970 - 1971 Power Flow, Inc. (Contractor to PSE&G Co.)
Instrumentation Designer

As Instrumentation Designer, was assigned to new construction project for Linden 4 (fossil) Generating Station. I was responsible for the engineering, design and drafting of all controls documents from schematics to installation details. Provided assistance to sub-contractor for installation and calibration of instruments. Assigned to "revamp" construction project for Bergen (fossil) Generating Station; converting from coal fired to gas. Responsible for the engineering, field locations, design and drafting of all controls documents from schematics thru installation details.

1969 - 1970

The M. W. Kellogg Company, Houston, Texas
Design Engineer

As Design Engineer, was assigned to Construction Department, Shell Chemical, Deer Park, Texas, for all phases of controls. This included instrument engineering, design, calibration, testing, startup, inspection and purchasing of pneumatic and electronic instruments, control panels, control valves and piping wiring materials. Was involved in planning and new design of additions to plant.

1963 - 1969

The M. W. Kellogg Company, New York, New York
Design Engineer

As Design Engineer, was responsible for all design, planning, studies, specifications, bid analysis, vendor selection, purchasing, supervision of drafting, both piping and wiring, review and approval of vendor's drawing, inspection, functional testing and bid requotes of all control panels. Author of the Design Manual, Section 6, entitled "Standard Instrument Control Panel Design Philosophy." Design Engineer for the control panel at Shell Chemical Deer Park Plant. This panel was subject to I.S.A paper given at 1969 Houston Symposium. Joined ISA Committee SP60 "Control Center Standards" in 1969 and still participate as a committee member.

1956 - 1963

Customline Control Panels, Inc., Linden, New Jersey
Designer

As Designer, was responsible for all design, fabrication, specifications, bid analysis, quote preparation, inspection of steel, drafting, supervision of drafting, both piping and wiring, graphic presentations, nameplates, supervision and assistance to pipe fitters and electricians, inspection and functional testing, shipping and photographing of all control panels. Provided startup and istallation assistance for panels at client's job sites. Responsible for trade show exhibiting. I became a senior member of I.S.A. April, 1963. Served on host committees and program committees for N.J. Section of I.S.A.

1954 - 1956 The M. W. Kellogg Company, New York, New York
Designer

As Designer, was involved in the following phases of controls responsibility:

Wiring - All the documents from schematics to purchasing of instruments and wiring material for electronic instruments, including temperature measurement, annuciator and alarms and power wiring.

Piping - All the documents from process control diagrams, to installation details, to purchasing of instruments and piping materials, for pneumatic instruments and pressure gages, and steam tracing for freeze protection.

Control Panels - All the documents from panel fabrication drawing to nameplate lists to purchasing of control panel.

Instrumentation Engineer - All the data sheets and purchase orders for instruments.

1952 - 1954 U.S. Air Force, Selma, Alabama
Senior Draftsman

As Senior Draftsman, Airman 2nd Class, was assigned to Training Materials Unit, Air Training Command at Craig A.F.B., Selma, Alabama. Responsibilities consisted of design of training aids for pilot schools throughout the U.S. We produced classroom trainers that exactly simulated flight conditions including built-in malfunctions.

1950 - 1952 The M. W. Kellogg Company, New York, New York
Draftsman

As Draftsman, I did the drafting of process control diagrams for chemical and petroleum plants, instrument piping arrangements, tubing tray routing, wiring schematics, wiring diagrams, conduit and cable arrangements, control panel arrangements, installation details of instrument hook ups, heat tracing details, control air piping arrangements, instrument lists, material take-off of piping and wiring from drawings.

Joined Instrument Society of America

1949 - 1950 L. O. Koven, Jersey City, New Jersey

Responsible for filing of tracings and drawings. Operated blue print machine. Distributed prints in office and shop. Did drafting of original drawings from marked up prints and sketches of tanks, vessels, heaters and sheet metal sinks.

PROFESSIONAL AFFILIATIONS

Professional Engineer - State of California Control Systems No. CS003436

Senior Member - Instrument Society of America

Member - SP60 Control Centers Committee Instrument Society of America

PUBLICATIONS

Alworth, A., McFadden, J.G. "A Different Control Panel." Paper presented at the 1969 ISA Annual Conference and Exhibit, October 27-30, 1969.

Section 6 "Standard Instrument Control Panel Design Philosophy" of M. W. Kellogg Company Instrument Design Manual.

PETER A. DOYLE

EDUCATION

1978 - Present	Ph.D. Candidate, Applied Experimental Psychology, The Catholic University of America, Washington, D.C.
1977	M.A., Clinical Psychology, Loyola College
1974	B.A., Psychology, Towson State University

EXPERIENCE

1980 - Present

General Physics Corporation
Staff Scientist, Human Factors Engineering

Mr. Doyle works in the Human Factors Engineering Group at General Physics. His areas of expertise include man-machine systems, simulation, human performance and stress measurement, experimental methodology and statistical analysis on computers. Mr. Doyle has assisted in an EPRI Technical Planning Study of communications problems in nuclear power plants and has participated in control room reviews at the LaSalle, Zion, Surry, and Zimmer and Clinton Nuclear Power Plants. He has also assisted in the development of a Containment Isolation Mimic for the Wm. H. Zimmer Nuclear Power Plant and is presently the project manager for on-going control room reviews at the Trojan and Salem Nuclear Power Plants. He is also providing human factors support in the development of Salem's Emergency Response Facilities. Mr. Doyle's training responsibilities have included teaching the subjects of stress and human performance as well as systems analysis techniques, including task analysis. He has also participated in Shift Technical Advisor training, teaching a Behavioral Sciences course to STA candidates.

1979-1981

United States Army Research Institute
Research Psychologist

Mr. Doyle assisted in development of battle simulation and combat gaming techniques for use in training Army strategic commanders and their support groups. He also did research pertaining to human performance capabilities in continuous combat using a computer simulation model.

1980

The Catholic University of America
Teaching Assistant

Mr. Doyle worked as a teaching assistant for the Department of Psychology, teaching experimental theory, methodology and report writing to a graduate class in experimental methodology.

1979 Biometric Research Institute
Consultant

Mr. Doyle helped to select drug clinics for research with the narcotic antagonist naltrexone.

1979 Science Applications, Inc.
Research Assistant

Mr. Doyle's duties included helping formulate objectives for modularized maintenance training courses for the Federal Aviation Administration. He also participated in design and construction of job expert review tests to validate selected training objectives and helped with statistical analysis of the results.

1978 The Catholic University of America
Research and Teaching Assistant

Mr. Doyle worked in the Human Performance Laboratory on research concerning auditory pattern recognition. His duties included subject recruitment and data collection, using a computer. He also worked as a psychology department teaching assistant, teaching experimental theory, methods and report writing to an undergraduate class in sensation and perception.

1974 - 1978 Friends Medical Science Research Center, Inc.
Research Assistant and Counselor

Mr. Doyle worked in the Narcotic Clinic, recruiting and interviewing subjects and collecting data on the narcotic antagonist naltrexone. He also counseled parolees with histories of narcotic addiction.

1977 - 1978 Baltimore County Board of Education
School Psychology Intern

As a part-time intern, Mr. Doyle worked on diagnostic evaluations of learning disabilities and emotional disorders of elementary and secondary school pupils.

1973 Spring Grove Hospital Center
Psychology Intern

Mr. Doyle participated in the summer training program. He tested patients and worked with them using behavior modification techniques.

PUBLICATIONS

Curran, S. F., Doyle, P.A., and Savage, C. "Maximizing Narcotic Antagonist (Naltrexone) Treatment Through the Use of Behavioral Reinforcement." Paper presented at the National Drug Abuse Conference, San Francisco, California, 1977.

Doyle, P.A. and Curran, S.F. "Delivery of Drug Abuse Treatment Services to Addicts in Community Corrections and Through Parole: A Status Report." Paper presented at the National Drug Abuse Conference, Seattle, Washington, April, 1978.

Savage, C., Curran, S.F., and Doyle, P. A. "A Naltrexone/Placebo Comparison Investigation." A Multicultural View of Drug Abuse; the Proceedings of the National Drug Abuse Conference of 1977. Edited by D. E. Smith, S. M. Anderson, M. Buxton, N. Gottlieb, W. Harvey and T. Chuny. Schenkman Publishing Co., Cambridge, Massachusetts, 1978.

Burgy, D. C., Doyle, P. A., Barsam, H. F., and Liddle, R. J. Applied Human Factors in Power Plant Design and Operation. Columbia, MD; General Physics Corporation, 1980.

Gaddy, C. D., Turney, J. R., Cohen, S. L., and Doyle, P. A. Behavorial Science and Human Factors in Power Plant Applications. Columbia, MD; General Physics Corporation, 1980.

Topmiller, D. A., Burgy, D. C., Roth, D. R., Doyle, P. A. and Espey, J. J. Survey and Analysis of Communications Problems in Nuclear Power Plants (EPRI NP-2035) 501-5). Electric Power Research Institute: Palo Alto, CA: EPRI, September, 1981.

REPORTS

"Preliminary Human Factors Engineering Recommendations for Near-Term Improvements of the Surry Nuclear Station Control Room" (Virginia Electric & Power Company, GP-R-705). Columbia, MD, General Physics Corporation, June 1980.

"Preliminary Human Factors Engineering Recommendations for Near-Term Improvements of the Zion Power Station Control Room" (Commonwealth Edison Company, GP-R-708). Columbia, MD, General Physics Corporation, June 1980.

"Summary of the LaSalle County Nuclear Generating Station Noise Report" (Commonwealth Edison Company, GP-R-13010). General Physics Corporation, Columbia, MD, August 1980.

"Summary of the LaSalle County Nuclear Generating Station Lighting Survey" (Commonwealth Edison, GP-R-13011). General Physics Corporation, Columbia, MD, August 1980.

"Preliminary Assessment Human Factors Review of the William H. Zimmer Nuclear Power Station Control Room" (Cincinnati Gas & Electric Company, GP-R-13046). General Physics Corporation, Columbia, MD, January 1981.

"Preliminary Human Factors Engineering Recommendations for Trojan Nuclear Power Plant" (Portland General Electric, GP-R-13106). General Physics Corporation, Columbia, MD, September, 1981.

UNPUBLISHED PAPERS

Doyle, P.A. "The Vicarious Emotional Responses of Idiopathic and Neurotic Sociopaths." Master's Thesis, Loyola College, Baltimore, MD, 1977.

Doyle, P.A. "Performance Effectiveness of Combat Troops: An Overview of the PERFECT Computer Model." U.S. Army Research Institute, Alexandria, VA, 1981.

DONALD C. BURGY

EDUCATION

1978 - Present	Ph.D. Candidate, Applied-Experimental Psychology, Catholic University of America
1978	M.A., Applied-Experimental Psychology, Catholic University of America
1976	B.A., Psychology, Swarthmore College

EXPERIENCE

1979 - Present

General Physics Corporation
Manager, Human Factors Engineering

Human Factors Engineering and Man-Machine Systems Design and Evaluation. Areas of human factors expertise include systems analysis, information processing, man-computer interactions, performance evaluation, training systems, and speech/non-speech communications. Applied research background includes an emphasis in experimental design and methods, multivariate statistical analysis, mini/micro computer applications and software psychology.

Experience in nuclear power plant control room reviews includes on-site field evaluations at North Anna, Surry, Zion, LaSalle, Susquehanna (Advanced Control Room Design), Zimmer, Shoreham and Trojan Stations. Evaluations have included the application of current NRC Human Factors guidelines and existing military standards to control room designs as well as field and laboratory experimentation to validate criteria used in design tradeoff analyses.

Experience in utility research and development efforts has included two EPRI studies entitled (1) a Survey and Analysis of Communication Problems in Nuclear Power Plants and (2) an Operability Design Review of Prototype Large Breeder Reactors. Methodology for collection and analysis of real-time field data in power plant control rooms was developed as part of the communications study. Functions/Task analyses and operational sequence diagrams were generated as part of the operability design review that involved the evaluation of six breeder reactor designs.

Additional task analytic experience has been largely for the Navy SUBACS (Submarine Advanced Combat Systems) program. The human engineering aspects of the program involved the development of task analysis formats and collection methodology for the Acoustic Subsystem. Team performance improvement and training enhancement were primary goals of the systems development effort.

1978 - 1979   Consultant

Private consulting in statistical design and analysis, computer programming and applications, microcomputer systems and software psychology.

1976 - 1978   Catholic University, Human Performance Laboratory
Research Assistant

Applied and basic research experiments conducted on auditory signal classification of complex underwater sounds. Research sponsored by the Human Factors Engineering branch of the Office of Naval Research. Additional research and related areas included auditory and visual pattern recognition, performance measurement and evaluation, multidimensional scaling, and computer-based systems for acoustic and experimental data analysis. Computer experience involved programming experimental events and subsequent data analysis on Digital Equipment Corporation PDP-8/e, PDP-11/34 and DECSystem-10 Computers.

1975 - 1976   Eagleville Hospital & Rehabilitation Center
Research Assistant and Interviewer

Interviewed study participants and assisted in data processing for an Alcohol Abuse Research Grant and coordinated all programming and clerical needs for a sub-study on Life Stress Events. Skills in programming included JCL, SPSS, PL/1, and FORTRAN on IBM 370/168 system.

PROFESSIONAL ORGANIZATIONS

Acoustical Society of America
American Psychological Association
Human Factors Society
National Conference on the Use of On-Line Computers in Psychology
Psychometric Society
Psychonomic Society
Software Psychology Society
Sigma XI

AWARDS

1978   Grant-in-Aid of Research, National Sigma Xi

1978 — Grant-in-Aid of Research, The Catholic University of America Chapter of Sigma XI

PUBLICATIONS AND PAPERS

Burgy, D.C. "Hemispheric Asymmetries in the Perception of Non-speech Sound Characteristics." Unpublished master's thesis, The Catholic University of America, May 1978.

Howard, J.H. Jr., and Burgy, D.C. "Structure Preserving Transformations in the Comparison of Complex Steady-State Sounds" (Technical Report ONR-78-6). Washington, D.C., The Catholic University of America Human Performance Laboratory, December 1978.

Howard, J.H., Jr., and Burgy, D.C. "Selective and Non-selective Preparation Enhancement Effects of an Accessory Visual Stimulus on Auditory Reaction Time." Unpublished manuscript, The Catholic University of America, 1977.

Howard, J.H., Jr., Burgy, D.C., and Ballas, J.A. "A Deglitching Circuit for the AA50 D/A Converter." Behavior Research Methods and Instrumentation, 1978, 10 (6), 858-860.

Howard, J.H., Jr., Ballas, J.A., and Burgy, D.C. "Feature Extraction and Decision Processes in the Classification of Amplitude Modulated Noise Patterns" (Technical Report ONR-78-4). Washington, D.C., The Catholic University of American Human Performance Laboratory, July, 1978.

Topmiller, D. A., Burgy, D. C., Roth, D. R., Doyle, P. A., and Espey, J. J. Survey and Analysis of Communications Problems in Nuclear Power Plants (EPRI NP 2035). Electric Power Research Institute; Palo Alto, CA: EPRI, September, 1981.

Burgy, D. C., Doyle, P. A., Barsam, H. F., and Liddle, R. J. Applied Human Factors in Power Plant Design and Operation. Columbia, MD; General Physics Corporation, 1980.

REPORTS

"Preliminary Human Factors Engineering Recommendations for Near-Term Improvements of the Surry Nuclear Station Control Room" (Virginia Electric & Power Company, GP-R-705). Columbia, MD, General Physics Corporation, June, 1980.

"Preliminary Human Factors Engineering Recommendations for Near-Term Improvements of the Zion Power Station Control Room" (Commonwealth Edison Company, GP-R-708). Columbia, MD, General Physics Corporation, June, 1980

"Human Factors Engineering Recommendations for Near-Term Improvements of the Zimmer Nuclear Power Station Control Room" (Cincinnati Gas and Electric Company), GP-R-13002). General Physics Corporation; Columbia, MD, December, 1980.

"Summary of the LaSalle County Nuclear Generating Station Noise Report" (Commonwealth Edison Company GP-R-13010). General Physics Corporation, Columbia, MD, August, 1980.

"Summary of the LaSalle County Nuclear Generation Station Lighting Survey" (Commonwealth Edison GP-R-13011). General Physics Corporation, Columbia, MD, August, 1980.

"Human Factors Engineering Considerations for Implementing a 'Green Board' at Zion Nuclear Generating Station" (Commonwealth Edison GP-R-31008). Columbia, MD, August, 1980.

"Program Plan: Task Analysis of Nuclear Power Plant Control Room Crews" (USNRC Office of Nuclear Regulatory Research). Columbia, MD: General Physics Corporation, March, 1982.

"Human Factors Engineering Meter Banding Study" (Commonwealth Edison Company GP-R-13016). General Physics Corporation; Columbia, MD, September, 1980.

CLAUDIA LEMPGES

EDUCATION

1977 M.S., Education, State University College of New York at Buffalo

1975 B.S., Communication Disorders, State University College of New York at Geneseo

EXPERIENCE

1981-Present **General Physics Corporation**
Staff Scientist

Ms. Lempges is a member of the Human Factors Group. She is responsible for specifying education and training requirements and program development in this area. She is currently working on a task analysis project of control room operating crews. On this project, she has been responsible for development of task analysis and data collection methodology. She will also be responsible for data collection. As part of the development phase of this project, Ms. Lempges spent time at the Institute of Nuclear Power Operations. She observed all phases of their Job and Task Analysis of Control Board Operators project, worked as a member of their quality control review team, and participated in their development of a methodology for writing terminal learning objectives and job performance measures.

Ms. Lempges has been on the review team for a detailed control room design review. For this project, she developed an operating event selection methodology, as required by NUREG-0700. She has also reviewed instrumentation in a control room for human engineering discrepancies and developed system functional descriptions for use in operator/system interface task analysis.

Ms. Lempges participated in the development of Instrumentation and Control Technician Certification program, based upon a job analysis, in conjunction with Limerick Training Center I&C instructors.

1980-1981 **Buffalo Public Schools**
Teacher

Ms. Lempges taught learning disabled students. She was responsible for evaluation, writing and implementation of specific behavioral objectives and classroom planning.

1977-1980 Erie County Association for Retarded Children
Speech Pathologist

Ms. Lempges was responsible for evaluation, writing and implementation of specific behavioral objectives for communication programs for severely retarded students. She was also responsible for inservice planning for staff and parents.

1977 Childrens Hospital Behavioral Sciences Dept. (Buffalo, NY)
Graduate Intern

Ms. Lempges was responsible for data collection; planning and implementation of communication program for autistic children.

PUBLICATIONS

Boland, L., DeWaters, J. and Lempges, C. Heritage School Communication Program: A Comprehensive Overview. Buffalo, NY; Erie County Association for Retarded Children, 1979.

Christmam, M and Lemges, C. Integrated Speech and Gross Motor Program for Severely Retarded Students. Buffalo, NY; Erie County Association for Retarded Children, 1980.

FRANK B. ROGALLA

EDUCATION

1980 - Present	M.S. Program, Human Factors Engineering Program, University of Michigan
1973	B.A., Psychology, University of Connecticut, Storrs, Connecticut. Areas of specialization: Industrial and Experimental Psychology.
1972	B.S., Electrical Engineering, University of Connecticut. Areas of specialization: Biomedical Instrumentation and Computer Science.

EXPERIENCE

1982 - Present

General Physics Corporation
Senior Engineer, Human Factors Engineering

Mr. Rogalla is assisting in an EPRI-sponsored project investigating Internal Plant Operational Communications. He is also assisting in the Salem Nuclear Generating Station Units 1 and 2 Detailed Control Room Design Review.

1980 - 1982

Combustion Engineering Corporation (C-E)
Senior Nuclear Engineer
Instrumentation and Controls Engineering Section

Human Factors Engineering duties included developing the informational man-machine interface using computer-based cathode ray tube (CRT) display systems. The systems involved were Accident Monitoring System, Critical Functions Monitoring System, Safety Parameter Display System (SPDS), Qualified Safety Parameter Display System (QSPDS) and the Advanced Control Room Design, Nuplex 80. The tasks involved designing the display set organization by developing a hierarchy and then structuring each display page to supply the required system information using accepted human factors engineering principles and practices.

A good example of this effort was the production of the Plant Monitoring System Supplementary Hierarchy for TVA. The Supplementary Hierarchy added many innovations to existing CE display technology. Some examples are: a hierarchical structure of safety systems and operational systems, new symbols, symbol types, symbol behaviors, new display types and new ways of coding. Other tasks involved the hardware design for computer-man interaction, A simulator instructor station control board and the design and review of controls and panels.

In order to effectively accomplish these tasks it was necessary to take CE's Nuclear Power Plant Operators short Course with actual power plant simulator training and have extensive discussions with system designers and operational personnel.

Mr. Rogalla Participated in CE's advanced accident monitoring and display systems design program that included workshops by noted authors, for example Rasmussen & Goodstein.

Mr. Rogallas' efforts that were incorporated by the company as policy are: 1) Human Factors Engineering input to the Accident Monitoring System. ISD-82-103. 2) Design of the page control module. ISD-80-1179. 3) Human factors considerations for I&CE products. ISD-81-661. 4) Standard List of engineering unit abbreviations for NUPLEX 80. ISD-80-1169. 5) Standardization of data status messages ISD-80-1168.

1976 - 1980 Hartford Techology Consultants & State Reception Systems
Owner, Operator

Mr. Rogalla provided electronic engineering services on a consultant basis. He operated an electronic signal systems business, designing, installing, and repairing intercom, sound systems, closed circuit television systems, and antenna systems for the private and public sector.

1973 - 1976 University of Conecticut Health Center
Assistant Director of Physical Plant

Mr. Rogalla provided human engineering expertise to accomplish the installation of viable electrical communications systems for the new Hospital - Dental/Medical and Research Facility. The systems included radio paging, nurse call, intercom-sound systems computer and closed circuit television systems. The task involved system conceptualization, specification writing and supervision of installation. The task also involved providing training courses for the operation and maintenance of the systems.

1973 Dynamic Controls Corporation
Test Engineer

Mr. Rogalla provided the liaison between the Engineering Department and the Electronic Production Department. Duties included assisting in the final stages of design/development and production of the U.S. Air Forces F-15 Eagle's armament system. The task involved the design of tests, testing and incorporation of changes. The task required the ability to determine a problem area, have tests taken, determine a fix action with the engineering department, and then have the fix incorporated and then retest.

1970 - 1973 **University of Connecticut at Storrs**
Special Research Assistant

Mr. Rogalla assisted in the design and development of biomedical instrumentation and instrumentation systems. Solid state electronics were used for the measurement and monitoring of brain waves (EEG's) and muscle signals (EMG's) and (EKG's).

RICHARD A. CORFIELD

EDUCATION

1981	B.S., Physics, University of the State of New York
1964 - 1967	Undergraduate Studies, Physics, Pennsylvania State University
1963 - 1964	Naval Nuclear Power School and Prototype Training

EXPERIENCE

1981 - Present

General Physics Corporation
Director, Columbia Power Services

Mr. Corfield heads the Columbia Power Services department. He directs and coordinates the activities of the department including personnel recruiting and selecting, sales and client contacts, program development, planning and cost control. His department provides on-site training and training materials development programs and other operations support services to nuclear utility clients.

1978 - 1981

General Physics Corporation
Manager, PWR Programs

Mr. Corfield managed Pressurized Water Reactor training. He was in charge of systems training projects and programs, as well as specialized training projects dealing with PWR power stations. He was responsible for the coordination, scheduling and cost control of training material preparation, on-site licensed and non-licensed training and training program development. He developed and presented courses in thermodynamics, heat transfer and fluid flow.

1977 - 1978

General Physics Corporation
Supervisor, Training Projects

Mr. Corfield was responsible for supervising the writing and editing of Systems Training Manuals detailing the purpose, description, operation and design bases of the systems associated with PWR power stations. He also conducted academic and technology training and requalification training programs for various utilities.

1975 - 1977

Public Service Electric and Gas Company of New Jersey
Nuclear Staff Assistant, Salem Generating Station

Mr. Corfield was a training instructor at Salem. He helped to develop training programs and materials, he trained reactor operator and senior reactor operator candidates during both the initial NRC licensing and the requalification programs. He held a Senior Reactor Operator's License on the Salem Unit.

1971 - 1975	<u>U.S. Naval Nuclear Power School</u> Classroom Instructor, Bainbridge, Maryland Mr. Corfield was an instructor for prospective operators of Naval Nuclear Power Plants in the subjects of Reactor Plant Technology, Reactor Plant Operations, and Electrical Theory; college level courses concerning the design, construction, operation and operational characteristics of reactor plant systems for energy transfer and reactor monitoring and control.
1967 - 1971	<u>U.S. Navy</u> Reactor Control Division Supervisor, Nuclear Submarine Program Mr. Corfield was in charge of preventive and corrective maintenance for Instrumentation and Control equipment for the nuclear plant. He supervised and trained personnel in the operation of all power plant equipment, watch standing practices, and techniques for containing and controlling ship's casualties and radiological hazards.
1960 - 1967	<u>U.S. Navy</u> Reactor Operator/Technician Mr. Corfield attended various schools and training programs and served in the electrical division aboard ship during his first several years in the Navy.

<u>CERTIFICATIONS/ASSOCIATIONS</u>

1977	Senior Reactor Operator License NO. SOP-2975 Salem Nuclear Generating Station Member, American Nuclear Society

PATRICK W. CASEY

EDUCATION

1970 - 1974 U.S. Naval Nuclear Power Training Program

1978 Commercial Nuclear Power Plant Operator's License Class, Virginia Electric and Power Company

EXPERIENCE

1981 - Present General Physics Corporation
Manager, PWR Services

Mr. Casey manages Pressurized Water Reactor Services. He is in charge of operator training programs as well as specialized training projects dealing with PWR power stations. He is responsible for the coordination, scheduling and cost control of training material preparation, on-site licensed and non-licensed training and training program development. He is certified by General Physics as a Senior Reactor Operator Instructor.

1980 - 1981 General Physics Corporation
Senior Specialist

At General Physics, Mr. Casey has participated as the senior instructor in several Reactor Operator/Senior Reactor Operator license courses and STA programs. He has also served as the on-site project supervisor for an accelerated Senior Reactor Operator's license course.

1979 - 1980 General Physics Corporation
Staff Training Specialist

Mr. Casey prepared training materials for nuclear power plant operator license candidates and technicians. Those materials included systems descriptions and training aids. He also prepared course materials and instructed in on-site training programs.

1975 - 1979 Virginia Electric and Power Company
License Reactor Operator, North Anna Power Station

Mr. Casey participated as a control panel operator in the initial startup, testing, and day-to-day operation of North Anna Unit 1. He also wrote plant operating, abnormal and emergency procedures for the North Anna Station. Mr. Casey earned his Reactor Operator's License on North Anna Unit 1.

1970 - 1974

U.S. Navy

Nuclear Submarine Propulsion Plant Operator - Electrical Operator

Mr. Casey was responsible for operating and maintaining the shipboard electrical equipment aboard an SSBN type nuclear submarine. He also participated in the refueling, testing and startup of the new reactor core during overhaul.