CONTROL ROOM DESIGN REVIEW PLAN

PRAIRIE ISLAND NUCLEAR
GENERATING PLANT

NORTHERN STATES POWER COMPANY

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CONTENTS

INTRODUCTION

This document describes the Control Room Design Review program (CRDR) which will be undertaken at the Northern States Power Company Prairie Island Nuclear Generating Plant (PINGP). It is submitted to the Nuclear Regulatory Commission in accordance with Generic Letter 82-33.

This document consists of five sections. Section 1 contains an overview of the review plan, focusing on issues of policy and purpose. Section 2 describes how the review program will be supported within the management structure of Prairie Island Nuclear Generating Plant and the staffing plan. Section 3 details the methods and procedures to be used during the control room review program. Section 4 describes the procedures for documenting the control room review. Section 5 describes the integration of the NUREG 0737 Emergency Response Capability Elements in the Control Room Design Review Program.

SECTION 1
REVIEW PLAN OVERVIEW

1.1 Objectives

Northern States Power Company (NSP) has, for the last several years, been engaged in a number of human factors activities designed to enhance the operability of the Prairie Island Nuclear Generating Plant (PINGP). The control room design review program (CRDR) presented in this document will continue this work. The primary objective of the control room review is the improvement of the man-machine interface in the control room. As a corollary objective, the review program has been structured so that its results will be recorded in a form suitable for guiding future control room modifications.

The Prairie Island's control room review plan was developed in recognition of Nuclear Regulatory Commission (NRC) activities concerning control room review, especially NUREG 0700, NUREG 0801, and Generic Letter 82-33.

1.2 Perspective and Scope

The control room design review is part of a larger set of activities with human factors components being undertaken at Prairie Island. Prominent among these activities are the establishment of emergency facilities, an up-grading of emergency operating procedures, development of a safety parameter display system (SPDS), and the design and acquisition of new process computer capabilities. A full scale control room mockup of Unit 1 has also been assembled to assist in enhancement studies prior to implementation of changes on the main control board.

For the purpose of definition, it should be understood that the scope of the control review described here is limited by the need for control room operator interface and the physical boundaries of the unit 1/unit 2 control room at Prairie Island. All control panels, display components, auxiliary and back-panel control and display components, workspace, and environmental issues within this area will be reviewed.

1.3 Approach

PINGP's approach to performing a control room review is characterized by five major features.

First, during the period of August 1980 to December 1981, PINGP participated in the Electrical Power Research Institute (EPRI) research program RP501-4, Human Factors Review of Enhancement Approaches for Nuclear Control Room. During this study, the unit 1/unit 2 control room and the auxiliary hot shut-down panel at PINGP were subjected to close human factors review and evaluation, which included identification and evaluation of HED's, and generation and assessment of enhancement options. Methodologies, data, and documents which were developed during this study are available to the control room design review team and the methodology of the review takes advantage of this existing work wherever possible.

Second, PINGP has joined with other utilities to form a Westinghouse Pressurized Water Reactor (PWR) owner's group procedures subcommittee to address the accident and transient procedures requirements of NUREG 0737. As a complement to this work, the subcommittee has performed Generic System Review and Task Analysis (SRTA) designed to support human factors control room reviews. The task

analyses, modified to accommodate plant specific Emergency Operating Procedures at Prairie Island will be integrated into the other control room review activities.

Third, PINGP wishes to insure that the control room design review will be of lasting benefit, and that its findings are available in a form which can influence future control room modifications. To accomplish this goal, a set of human factor design specifications will be developed in parallel with other review activities. These specifications will document the human factors design principles used for control room enhancement, and the coding, labeling, and control/display conventions practiced.

Fourth, to minimize the potentially disruptive effect of personnel orientation, operator training, and the control room design review on operations, PINGP has constructed a full scale, color, photorelief mockup of the unit 1 main control board. This mockup is available to the review team and will serve as a test-bed for the evaluation of enhancement options. It also serves as the platform for walk-through/talk through analyses of selected procedures.

Fifth, to ensure that all the elements of the Emergency Response Capabilities described in G.L. 82-33 are coordinated, the control room design review will be the focal point for verifying final designs and implementation of changes to the control room.

SECTION 2
MANAGEMENT PLAN

2.1 Objectives

The objective of the control room design review management plan and team selection is to assure that a qualified multidisciplinary team is selected to coordinate the review and that the team is chartered to identify, qualify, and recommend to plant management corrections to identified discrepancies.

2.2 Team Selection

A number of technical specialists and managers have been selected to coordinate the control room design review. The skills represented by this team include:

- Human Factors
- Systems Engineering, including protection and control
- Operations
- Training

Evaluation members from the plant operations staff, general office technical services support, and training department have been selected for their decision making and judgemental skills as well as their technical knowledge and management status. All utility members hold or have held a Senior Reactor Operators License at the Prairie Island Nuclear Plant. The review team has also contracted with Honeywell Technology Strategy Center to supply the human factor expertise to the review project.

The review team members are:

1. Prairie Island Superintendent of Technical Engineering
2. Prairie Island Superintendent of Operations
3. Prairie Island Plant Superintendent of Operations and Maintenance
4. Prairie Island Superintendent of Nuclear Technical Services
5. Prairie Island Nuclear Technical Services Senior Operations Specialists
6. Prairie Island Training Department Instructor Supervisor
7. Honeywell Human Factors Project Leader

When certain expertise is needed, the review team members also have the authority to draw from experienced personnel from both Northern States Power and from Honeywell Technology Strategy Center.

2.3 Review Team Authority

The review team will present to the Plant Operations Committee all recommended changes to the control room. Decisions to recommend control room modifications will be by simple majority vote of the review team. In addition, any team member has the option of bringing any items to the Operations Committee.

2.4 Modifications

All modifications to the control room will be performed in accordance with plant approved administrative directives and Northern States Power Operational Quality Assurance Program.

SECTION 3
CONTROL ROOM REVIEW PROCEDURES

The various components of the human factors control room review of PINGP, and the inter-relationships between components are presented in the program summary in Figure 3-1.

The principal tasks in the review and assessment phases of the project are described in this section. They are:

- Operating experience review,
- System review and task analysis (SRTA),
- Control room inventory,
- Control room and conventions survey,
- Verification of task performance capability,
- Validation of control room functions,
- Compilation of HEDs,
- Assessment of HEDs,
- Implementation of improvements.

3.1 Operating Experience Review

Operating experience at PINGP will be analyzed to identify control room circumstances which may contribute to human performance problems. This anlysis will take two forms. First, archival records of operational experience will be examined. Second, structured interviews of a sample of operators will be performed. Human engineering discrepancies will be written from both analysis.

As part of EPRI study RP501-4, substantial portions of these activities were completed. Reactor trip reports for the period 1976 to October, 1981 were fully analyzed. To complete the analysis of archival documents, the following additional documents will be examined:

- Significant Operating Event reports,
- Licensee event reports.

The survey of control room operating personnel will be documented by structured interviews and critical incident recording forms. Extensive structured interviews with 6 operators were conducted as part of EPRI RP501-4. A profile of the operators who were interviewed is presented in Table 3-1. Six new interviews will also be conducted.

To assure that the information collected during the interviews is offered freely and without bias, interviews will be conducted by PINGP's human factors consultant. The structured interview form development during the EPRI study will be used for the additional interviews.

3.2 System Review and Task Analysis (SRTA)

The objective of the system review and task analysis is to compile and organize the monitoring, decision-making, and action requirements for the Emergency Operating Procedures. This analyses will identify control room crew tasks required for emergency conditions and the interaction of inputs (instruments and indicators), throughputs (knowledge and decision capability), and outputs (controls) that are required to perform these tasks.

A top down approach to system function review and task analysis has been developed to ensure a comprehensive and systematic treatment of operator tasks, plant systems, events sequences, and higher-level system functions.

The analyses is being conducted by the Westinghouse Owner's Group Procedures subcommittee and will be modified to reflect plant specific Emergency Operating Procedures. Appendix A contains a description of the program. Results of the system function and task analyses are intended to reveal the way control room components are used by the operators. Components will be examined to determine if, from a human factors point of view, individual components are designed to adequately support their intended function. Information concerning human factors suitability will be guided by NUREG CR/0700 and references documents for equipment designers, e.g., Woodson (1982), McCormick (1982), and MIL-STD-1472C.

3.3 Control Room Inventory

PINGP currently maintains a complete list of all control room controls, indicators, displays, and other front panel instruments. This will be reviewed and adopted for the control room review. The inventory of control room components will include data about component location, instrument number, function, manufacturer, where appropriate, range, major/minor switch positions, and color codes. It will be organized by component type (switches, meters, controllers, etc.) and will be cross-referenced across unit 1/unit 2.

3.4 Control Room Survey and Conventions Specification

PINGP will undertake two distinct tasks as part of its human factors survey activity. First, under EPRI study RP501-4, a control room checklist was performed and human engineering discrepancies were written; these will be reviewed for accuracy and thoroughness. Second, the principles and practice which underlie the design of unit 1/unit 2 control room will be identified, documented, and coded into a conventions specifications list.

3.4.1 **Control Room Checklist** - Under EPRI contract, a human engineering review of the Prairie Island control room was conducted. This included a review of meters, lighting, noise levels, workspace/ environment, labels, controls, panel layout, annunciators, communications, protective gear, and the process computer. This review will be supplemented with the guidelines of NUREG 0700. Each of nine topic areas will be evaluated:

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

Discrepancies identified during this review will be documented in Human Engineering Discrepancy record forms which contain the following information:

- HED data source;
- Plant system, subsystem, and equipment component identification;
- HED record identification code and topic;
- Photograph identification code (as appropriate);
- HED description;
- Significance and safety consequences;
- Backfit requirements.

A sample HED record form is shown in Figure 3-2.

3.4.2 **Conventions Specification** - The purpose of the conventions specification will be to guide future control room modifications. It will be considered a human factors reference document which can insure the consistency of new control room enhancements with post operating practice. It will also help insure that future design changes are based on sound human engineering principles.

The conventions specification will be written from two sources. First, human factors design literature will be used to set the scope and general guidelines for the specifications list. Second, current PINGP design practice will be reviewed, made consistent, and extended for the conventions specification list.

Several design conventions in evidence in the control room of PINGP were reviewed and documented under the EPRI contract. Key elements included color coding, meter banding, indicator lights, and labels. Other design conventions will be examined and documented.

3.5 Verification of Task Performance Capability

In addition to determining if the available equipment is suitable for the operator's tasks, it is important to verify that all the hardware and software the operator needs to operate the plant during an emergency condition is present in the control room. This will be accomplished by comparing the results of the task analyses with the equipment inventory. HEDs will be written where discrepancies are in evidence.

3.6 Validation of Control Room Functions

A list of critical events will be selected, and operator actions during these events will be simulated in order to validate functions of the operator and the control system.

The events to be studied are those that provided focus for the system review and task analyses activities. The method of study will be walk-throughs and talk-throughs performed at the Prairie Island full-scale control room mock-up. HEDs will be written to document discrepancies identified by this analysis.

3.7 Compilation of Human Engineering Discrepancies

Human engineering discrepancies identified during the review phases described above will be reviewed, clarified, and compiled by system and by topics. Duplicate discrepancies will be eliminated and the remaining discrepancies will be compiled, documented, and summarized prior to assessment.

3.8 Assessment of HEDs

Human engineering discrepancies will be assessed for potential consequences on safety, plant integrity, and operator performance to determine which discrepancies require correction. The following factors will be considered in the assessment process:

A. Potential of HED to affect plant safety and availability.
B. Careful balance of human factors considerations and remediation impact.
C. Co-equal professional judgement of the Control Room Design Review Team.
D. Prior regulatory committments.
E. Electrical Separations and Seismic Design Requirements.

3.9 Implementation of Improvements

Several factors will affect scheduling of discrepancy improvements are:

- Severity of discrepancy,
- Schedule of plant shut-downs,
- Integration of the other elements of the Emergency Response Capabilities as described in Generic Letter 82-33,
- Engineering Requirements,
- Hardware delivery dates,
- Training requirements.

FIGURE 3-1

CONTROL ROOM DESIGN REVIEW PLAN

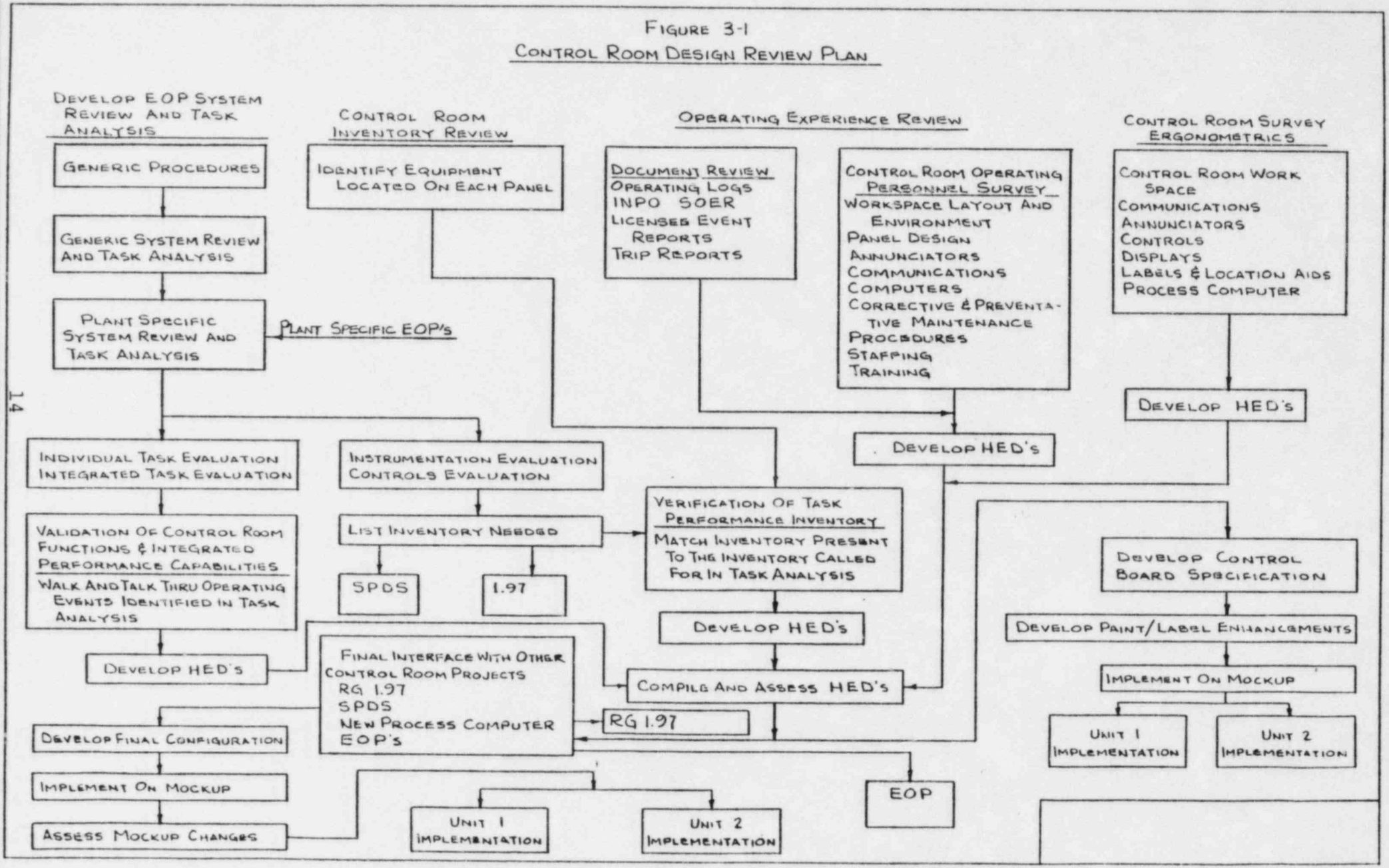

FIGURE 3-2

HUMAN ENGINEERING DISCREPANCY RECORD

HED DATA SOURCE

_____ OPER. EXP. REVIEW
_____ INTERVIEW
_____ CHECKLIST
_____ SURVEY
_____ VALIDATION

HED IDENTIFICATION

CODE NO. _____
PHOTO I.D. NO. _____
DATE _____
REVIEWER _____

TOPIC IDENTIFICATION

HED TOPIC ITEM _____
NUREG-0700 GUIDELINE REF _____

EQUIPMENT IDENTIFICATION

UNIT _____
PLANT SYSTEM/SUBSYSTEM _____
CONTROL BOARD PANEL _____
COMPONENT I.D. NO. _____
COMPONENT NAME _____

HED DESCRIPTION

DESCRIPTION:

RELATED EVENT/FUNCTION/TASK:

SAFETY CONSEQUENCES:

INTERACTION WITH OTHER HED'S, SYSTEMS, EVENTS, FUNCTIONS, TASKS:

POTENTIAL CORRECTIONS

ACTIONS TO CORRECT HED:

CORRECTION SCHEDULE:

COMMENTS

TABLE 3-1. PROFILE OF OPERATORS PREVIOUSLY INTERVIEWED AT PINGP

OPERATOR	JOB TITLE			LICENSE	YRS. EXPERIENCE			EDUCATION	AGE
	PERO	LPERO	SS		Navy	Fossil	Nuclear		
1	X			RO		.5	10	HS	46
2			X	SRO		12	18	HS	56
3	X			RO	7		6	3 Years College	31
4		X		RO		1.5	9	2 Years College	36
5			X	SRO		8	19	1 Year College	48
6			X	SRO	9		10	1 Year College	37

KEY: RO - Reactor Operator License
LPERO - Lead Plant Equipment and Reactor Operator
SS - Shift Supervisor
SRO - Senior Reactor Operator License
PERO - Plant Equipment and Reactor Operator

SECTION 4
DOCUMENTATION AND DOCUMENT CONTROL

A records and data management system will be used to:

A. Record results of analyses, inventories, and surveys;
B. Provide a support base to manage and execute the various steps and phases of the systems review;
C. Provide a design data base from which future control room modifications may be assessed.

Information in different formats and media contained in the data base will include equipment inventory listings, human engineering surveys and photographic documentation.

In addition, detailed technical interim reports will be issued as the CRDR progresses. A series of reports are anticipated, and will include:

Volume I:	Operating Experience Review
Volume II:	Control Room Inventory
Volume III:	Component Checklist
Volume IV:	Surveys: Noise, Lighting, Communications, Annunciators, Workspace, Panel Layout
Volume V:	Task Analysis
Volume VI:	Verification and Validation
Volume VII:	HED Compilation and Assessment
Volume VIII:	Implementation Schedule

4.1 Reference Documents

Basic reference documents used to support the control room design review will be listed. They include, but are not limited to, the following:

- Nuclear Regulations--e.g., NUREG 0578, 0585, 0600, 0696, 0700, 0737, 0801, CR-1250;
- Regulatory Guides--e.g., RG 1.47, 1.97;
- Control room design documentation--e.g., floor plans, panel layout drawings, panel photographs, system functional descriptions, and flow diagrams;
- Procedures--e.g., operating procedures, emergency procedure guidelines, guidelines for procedure development, fault analysis trees, operating training procedures;
- Human factors references tests--e.g., Woodson, 1982; Hutchingson, 1982; McCormick, 1982; Van Cott and Kinkade, 1972;
- Military standards--e.g., MIL-STD-1472C, Human engineering design criteria for military systems, equipment, and facilities; MIL-H-46866B, Human engineering requirements for military systems, equipment, and facilities;
- Control room design review technical reports--e.g., EPRI NP-309, Human factors review of nuclear power plant control room design; EPRI NP-1118, Human factors methods for nuclear control room design; EPRI NP-2411, Human engineering guide for enhancing nuclear control rooms; Aerospace Report No. ATR-77 (2315)-1, Human engineering of nuclear power plant control rooms and its effects on operator performance;
- Plant reports--e.g., Licensee Events Reports, Final Safety Analysis Reports, coding convention reports, Significant Event Reports, operating logs, Outage Analysis Reports.

4.2 Correspondence

Background correspondence from the NRC, the Westinghouse Owners Group, and the Human Factors Society, etc., as well as correspondence generated or received by the design review will be filed in the data base.

4.3 Data Collection Instruments

Information contained on various data collection forms will be cross-referenced. The following categories will be used in the data management system for efficient retrieval of information:

- Major plant operating systems,
- Major component subsystems,
- Panel/work station equipment components,
- Control room operator tasks,
- HED records,
- Photograph identification.

The types of data and documentation that will be collected during each of the planned design review tasks are summarized in Table 4-1.

TABLE 4-1. DOCUMENTATION FOR DESIGN REVIEW TASKS

TASK	DOCUMENTATION
Operating experience review	• Reference documentation • Plant reports--e.g., licensee event reports, outage analysis reports, INPO SOER • Structured interview forms and critical incident forms • HED record forms
System functions & task analysis	• Task element tables • Task analysis forms
Control room inventory	• Control room equipment components, labeling photographs
Control room checklist & conventions survey	• Equipment design checklists • Inventory of design conventions • HED record forms
Verification of task performance capability	• Task analysis forms • HED record forms
Validation of control room	• Walk-through talk-through records • HED record forms
Compilation and assessment of human engineering discrepancies	• HED summary listing by euqipment, task, and topic

SECTION 5
EMERGENCY RESPONSE CRITERIA ELEMENT INTEGRATION

Figure 5-1 details the other elements of the Emergency Response Capabilities that will be integrated into the control room review. The initial critiera from the Safety Parameter Display System project, Regulatory Guide 1-97 project, Emergency Operations Procedures rewrite project, Emergency Response Facilities project, and Control Room Design Review project will be reviewed in an integrated fashion. This review will ensure that all critieria are consistent with each other, all significant human engineering discrepancies are being resolved, and all necessary interfaces with the other elements have occurred. This review will identify all necessary changes to the respective initial criteria in order to finalize these other elements. This review may occur more than once as a result of problem areas identified during the integration reviews.

EMERGENCY RESPONSE CAPABILITY INTEGRATION PLAN

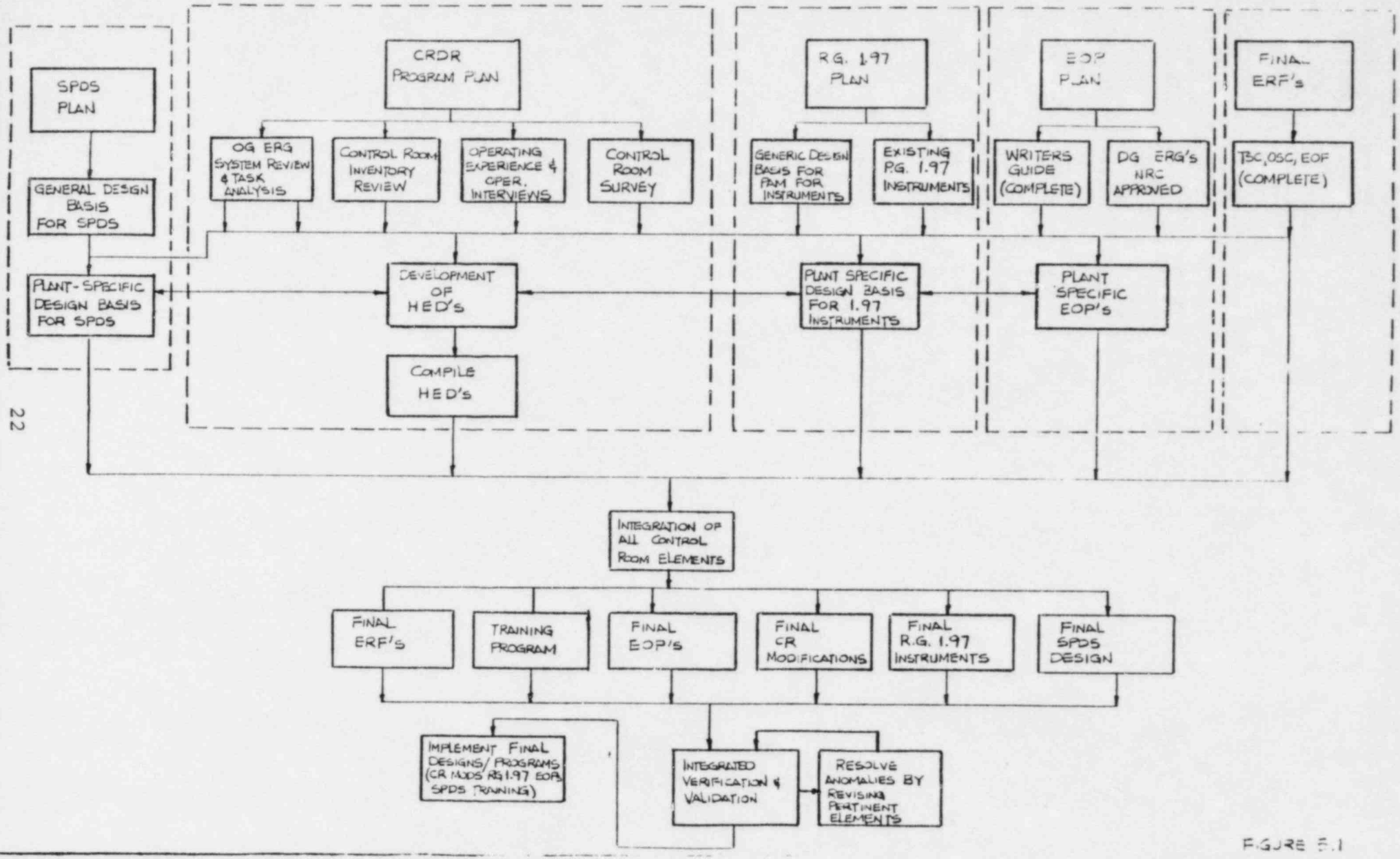

FIGURE 5.1

APPENDIX A

EMERGENCY RESPONSE GUIDELINE SYSTEM REVIEW AND TASK ANALYSIS PROGRAM DESCRIPTION

Revision: HP Basic

April 1, 1983

EMERGENCY RESPONSE GUIDELINE
SYSTEM REVIEW AND TASK ANALYSIS
PROGRAM DESCRIPTION

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1 INTRODUCTION

The Emergency Response Guideline (ERG) System Review and Task Analysis (SRTA) program is a generic product of the Westinghouse Owners Group (WOG). It was developed under the auspices of a special Task Analysis Working Group to the WOG Procedures Subcommittee to address, in part, the need for generic task analysis documentation for control room emergency operations.

1.1 WOG PROCEDURES PROGRAMS

The WOG Procedures Programs have been an effective part of the overall WOG effort since its formation in 1979. As the United States Nuclear Regulatory Commission (USNRC) post-Three Mile Island guidance on emergency procedures and other areas of emergency response capability has become more explicit, the role and scope of the WOG Procedures Programs have been modified and expanded to meet the needs of the WOG membership. This evolutionary development has culminated in the Emergency Response Guideline Programs which have the overall objective of providing support for control room emergency operations (i.e., operations in response to transients and accidents that cause plant parameters to exceed reactor protection limits).

The foundation of the Emergency Response Guideline Programs is a well-defined Framework for Emergency Operations. This framework considers the operators' role and special needs during emergency operations and provides a systematic approach to the diagnosis and restoration of plant safety state (through the Critical Safety Function Restoration concept) concurrent with the diagnosis and recovery from predefined event sequences (through the Optimal Recovery concept).

The Emergency Response Guideline Programs consist of the four major program areas outlined below:

- Emergency Response Guideline Development Program

  This program is the parent program. It consists of the Emergency Response Guidelines, including associated background information documents, which

provide technical guidance for control room emergency operations. The Emergency Response Guidelines include:

- Optimal Recovery Guidelines which provide technical guidance for diagnosis and recovery from predefined event sequences.

- Critical Safety Function Status Trees which provide technical guidance for diagnosis of the plant safety state.

- Function Restoration Guidelines which provide technical guidance for restoration of the plant safety state.

The Emergency Response Guidelines are presented in an example procedure format to aid in the development of plant-specific emergency operating procedures. The Emergency Response Guideline Development Program, including guidelines and background information documents, is described in References 1 and 2.

- Verification and Validation Program

This program is a daughter program to the Emergency Response Guideline Development Program. It evaluates the technical and human factors adequacy of the Emergency Response Guidelines through dynamic simulator application. A summary report of the Verification and Validation Program is provided in Reference 3.

- System Review and Task Analysis Program

This program is a daughter program to the Emergency Response Guideline Development Program. It provides a systematic compilation of the operator tasks, instrumentation and control requirements contained in the Emergency Response Guidelines. This program is described in this document.

- Training Programs

These programs are daughter programs to the Emergency Response Guideline Development Program. They provide expanded background and training

information that address select technical areas of the Emergency Response Guidelines.

The Emergency Response Guideline Programs provide support in four basic areas of control room emergency operations (i.e., Technical Guidance, Procedures Development, Training Support and Instrumentation and Control Requirements). The interrelationship between major programs and the area of control room emergency operations that they support are shown schematically in Figure 1-1. The content and interrelationship of the Emergency Response Guideline Programs are described more completely in Reference 4.

WESTINGHOUSE OWNERS GROUP EMERGENCY RESPONSE GUIDELINE PROGRAMS

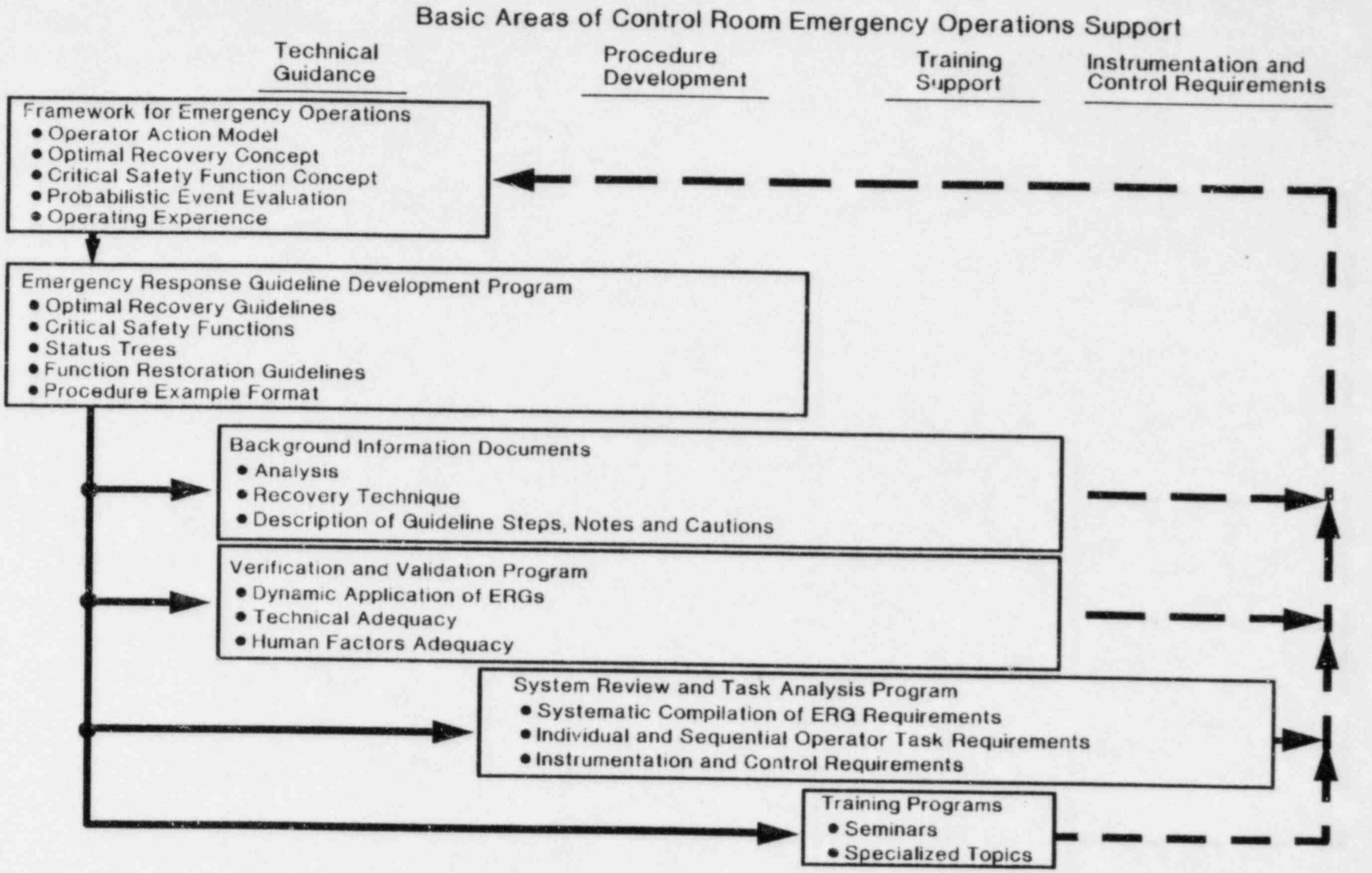

FIGURE 1-1 WESTINGHOUSE OWNERS GROUP
EMERGENCY RESPONSE GUIDELINE PROGRAMS

1.2 ERG SRTA PROGRAM

The ERG SRTA program was conceived in late 1981 to address the recommendation in Section 3.4 of NUREG-0700, Guidelines for Control Room Design Review, that generic system function review and task analysis documentation be utilized as one of the inputs to the plant-specific control room design review process. The program was discussed at the December 1981 WOG meeting and endorsed for further scoping. In early 1982, a special Task Analysis Working Group to the WOG Procedures Subcommittee was formed to work with Westinghouse in structuring and reviewing the ERG SRTA program. During these formative stages, the program was scoped to provide generic task analysis documentation for emergency operations as reflected in the Emergency Response Guidelines. The resultant documentation was envisioned to be of value to WOG utilities that intend to utilize the Emergency Response Guidelines as a basis for upgrading plant-specific emergency operating procedures and as an input to the control room design review and related areas of emergency response capability.

The ERG SRTA program was authorized at the March 1982 WOG meeting. Throughout the remaining months of 1982 and early 1983, Westinghouse and the Task Analysis Working Group met as necessary to review the status of USNRC basic requirements for emergency response capability and related industry activity in the control room design review area and to structure the ERG SRTA documentation end products. These meetings resulted in general concurrence that the ERG SRTA documentation will be of value to WOG utilities in performing the plant-specific task analysis of emergency operations as required by the USNRC. These working group meetings also resulted in significant improvements to the conceptual ERG SRTA documentation end products to facilitate their utilization.

Objectives

The primary objective of the ERG SRTA program is to provide generic task analysis requirements for emergency operations based on the Emergency Response Guidelines and to compile and organize these generic requirements in a manner that supports WOG utility effort in the area of control room design review.

The task analysis documentation should permit utility personnel in the control room design review area to systematically identify generic operator task requirements and associated instrumentation and control requirements.

The secondary objective of the ERG SRTA program is to complement the Emergency Response Guideline Development Program by developing documentation that supports the plant-specific Procedures Development, Training Support and Instrumentation and Control areas of control room emergency operations. This should permit utility personnel in the plant-specific emergency operating procedure development area, training area and related instrumentation and control areas to utilize and benefit from the ERG SRTA program documentation.

The above objectives ensure that the ERG SRTA program is compatible with other Emergency Response Guideline Programs and can be utilized singularly or in combination with other program documentation in addressing an individual area of emergency response capability or the integration of several areas of emergency response capability. This compatibility also permits the ERG SRTA documentation to be immediately integratable with plant-specific documentation developed from other Emergency Response Guideline Program documentation.

Scope

The ERG SRTA program provides generic system review and task analysis documentation for all guidelines that comprise the HP Basic issue of the Emergency Response Guidelines. The guidelines are itemized in Table 1-1.

The ERG SRTA documentation provides detail consistent with the detail in the Emergency Response Guidelines and the reference plant configuration upon which the guidelines are based. The reference plant is described in Reference 1. The documentation is generic and therefore independent of plant-specific control room configuration.

TABLE 1-1 (Sheet 1 of 2)
EMERGENCY RESPONSE GUIDELINES

GUIDELINE NUMBER	GUIDELINE TITLE
Optimal Recovery Guidelines (1)	
E -0	Reactor Trip or Safety Injection
ES-0.1	Reactor Trip Recovery
ES-0.2	Natural Circulation Cooldown
ES-0.3	SI Termination Following Spurious SI
E -1	Loss of Reactor Coolant
ES-1.1	SI Termination Following Loss of Reactor Coolant
ES-1.2	Post-LOCA Cooldown and Depressurization
ES-1.3	Transfer to Cold Leg Recirculation Following Loss of Reactor Coolant
ES-1.4	Transfer to Hot Leg Recirculation
E -2	Loss of Secondary Coolant
ES-2.1	SI Termination Following Loss of Secondary Coolant
ES-2.2	Transfer to Cold Leg Recirculation Following Loss of Secondary Coolant
E -3	Steam Generator Tube Rupture
ES-3.1	SI Termination Following Steam Generator Tube Rupture
ES-3.2A	SGTR Alternate Cooldown by Backfilling RCS
ES-3.2B	SGTR Alternate Cooldown Using Steam Generator Blowdown
ES-3.3	SGTR With Secondary Depressurization
ECA-1	Anticipated Transient Without Scram
ECA-2	Loss of All AC Power
ECA-2.1	Loss of All AC Power Recovery Without SI Required
ECA-2.2	Loss of All AC Power Recovery With SI Required
ECA-3	SGTR Contingencies

(1) Revision/date of Optimal Recovery Guidelines - Basic/September 1, 1981

TABLE 1-1 (Sheet 2 of 2)
EMERGENCY RESPONSE GUIDELINES

GUIDELINE NUMBER	GUIDELINE TITLE
Critical Safety Function Status Trees (2)	
F -0.1	Subcriticality Status Tree
F -0.2	Core Cooling Status Tree
F -0.3	Integrity Status Tree
F -0.4	Heat Sink Status Tree
F -0.5	Containment Status Tree
F -0.6	Inventory Status Tree
Function Restoration Guidelines (2)	
FR-S.1	Response to Nuclear Power Generation
FR-S.2	Response to Loss of Core Shutdown
FR-C.1	Response to Inadequate Core Cooling
FR-C.2	Response to Degraded Core Cooling
FR-C.3	Response to Potential Loss of Core Cooling
FR-C.4	Response to Saturated Core Cooling Conditions
FR-P.1	Response to Imminent Pressurized Thermal Shock (3)
FR-P.2	Response to Anticipated Pressurized Thermal Shock (3)
FR-H.1	Response to Loss of Secondary Heat Sink
FR-H.2	Response to Steam Generator Overpressure
FR-H.3	Response to Steam Generator High Level
FR-H.4	Response to Steam Generator Low Level
FR-H.5	Response to Loss of Steam Generator PORVs and Condenser Dump Valves
FR-Z.1	Response to High Containment Pressure
FR-Z.2	Response to High Containment Sump Level
FR-Z.3	Response to High Containment Radiation Level
FR-I.1	Response to Pressurizer Flooding
FR-I.2	Response to Low System Inventory
FR-I.3	Response to Void in Reactor Vessel

(2) Revision/date of Critical Safety Function Status Trees and Function Restoration Guidelines - HP Basic/September 1, 1982

(3) Revision/date of FR-P.1 and FR-P.2 Function Restoration Guidelines - HP Basic/December 1, 1982

2 OPERATOR TASK ANALYSIS DEVELOPMENT APPROACH

2.1 GENERAL APPROACH

The Emergency Response Guidelines have been developed utilizing a top-down approach that provides comprehensive technical guidance for emergency operations. The foundation of the Emergency Response Guidelines is a well-defined Framework for Emergency Operations that provides the operator with a systematic approach for responding to emergency conditions. The approach employs the emergency operations concepts of Optimal Recovery and Critical Safety Function Restoration. The Optimal Recovery concept provides guidance for diagnosis and recovery from a broad spectrum of predefined event sequences analyzed to be the significant contributors to plant risk. The Critical Safety Function Restoration concept provides guidance for diagnosis and restoration of the plant safety state independent of event sequence. These concepts are developed and coordinated within the Framework for Emergency Operations to provide comprehensive technical guidance for event diagnosis and recovery while at the same time facilitating diagnosis and restoration of the plant safety state.

Based on the Emergency Response Guidelines, ERG SRTA task analysis documentation is developed utilizing a top-down approach that identifies the guidelines (i.e., event sequences), the plant systems utilized in responding to event sequences, the operator functions and operator tasks performed in responding to event sequences, and the detailed elements that comprise the operator tasks. This top-down development approach ensures systematic and complete identification of operator tasks and task elements. In addition, the approach permits the task elements, such as instrumentation and control requirements, to be associated with higher level operator tasks, operator functions, systems and event sequences. The approach utilized to develop task analysis requirements based on the Emergency Response Guidelines is depicted schematically in Figure 2-1.

SYSTEM REVIEW AND TASK ANALYSIS DEVELOPMENT APPROACH

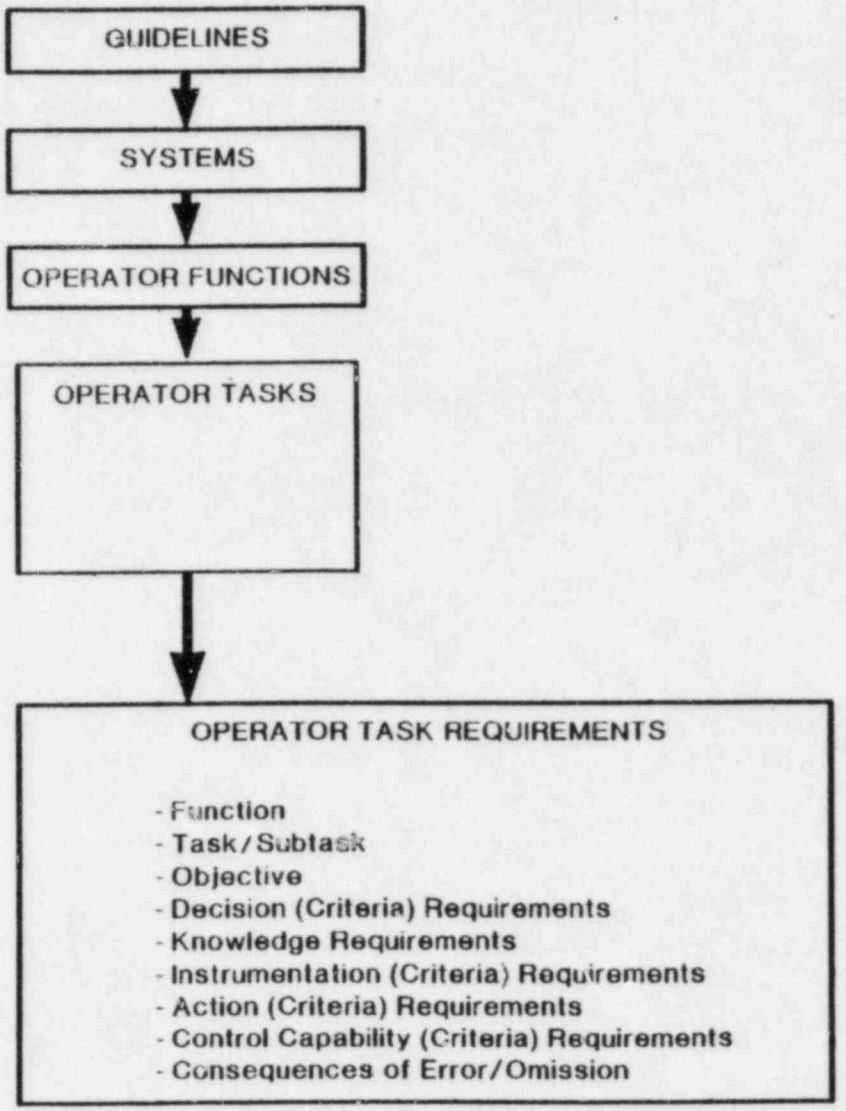

FIGURE 2-1 TASK ANALYSIS DEVELOPMENT APPROACH

2.2 IDENTIFICATION OF EVENT SEQUENCES

ERG SRTA documentation is developed for all quidelines that comprise the HP Basic issue of the Emergency Response Guidelines. The resulting documentation provides a comprehensive data base of operator task requirements that reflects the transient and accident event sequences upon which the Emergency Response Guidelines are developed. These event sequences are in compliance with NUREG 0737 Item I.C.1, Guidance for the Evaluation and Development of Procedures for Transients and Accidents, and include a spectrum of predefined and undefined event sequences.

The predefined event sequences are identified utilizing a probabilistic evaluation of accident initiators (i.e., loss of reactor coolant, loss of secondary coolant and steam generator tube rupture) and functional system failures to determine the sequences that constitute the significant contributors to the risk inherent in nuclear power plant operation. The resultant event sequences include a spectrum of multiple events and multiple failures. Technical guidance for diagnosis and recovery from these predefined event sequences is contained in the Optimal Recovery Guidelines. The probabilistic evaluation process and the predefined event sequences are described in Reference 1.

Technical guidance for undefined event sequences is contained in the Critical Safety Function Status Trees and Function Restoration Guidelines. This guidance permits the operator to diagnose the plant safety state independent of event sequence through monitoring a limited set of Critical Safety Function Status Trees. The status trees identify predefined and prioritized levels of challenge to critical safety functions and direct the operator to the appropriate Function Restoration Guideline to respond to an identified challenge. The Function Restoration Guidelines provide technical guidance to respond to a critical safety function challenge and restore the plant safety state independent of event sequence.

The Optimal Recovery Guidelines, Critical Safety Function Status Trees and Function Restoration Guidelines are developed and coordinated to permit the

operator to respond to the symptoms of a developing event sequence (i.e., identified or unidentified) in a systematic manner.

2.3 IDENTIFICATION OF PLANT SYSTEMS

The Emergency Response Guidelines were reviewed to identify the plant systems that the operator must access and utilize during emergency operations. The identified systems form a generic set which has general applicability to a broad spectrum of plants. The systems in the generic set are identified in Table 4-1 of the ERG SRTA Users Guide.

2.4 IDENTIFICATION OF OPERATOR FUNCTIONS

The Emergency Response Guidelines were reviewed to identify the operator functions required during emergency operations. Upon entering the Emergency Response Guidelines, the first operator function is to verify automatic actuation of plant safety systems and components. Following verification of automatic actuations, the operator has parallel functions of diagnosing the plant condition with respect to the event sequence and diagnosing the plant safety state independent of event sequence. Associated with each of these parallel diagnosis functions, the operator has parallel sets of control functions that control plant systems and components to optimally recover the plant or to restore plant critical safety functions. If an event sequence is diagnosed, the operator control functions are to monitor and regulate plant process parameters (i.e., RCS boron concentration, RCS pressure, RCS temperature, RCS inventory, secondary pressure, secondary inventory and containment environment) to optimally recover the plant from the identified event sequence. If the plant safety state is diagnosed to be under a severe challenge irrespective of the event sequence, the operator control functions are to monitor and restore plant critical safety functions (i.e., Subcriticality, Core Cooling, Integrity, Heat Sink, Containment and Inventory). The operator functions are identified schematically in Figure 2-2.

ERG OPERATOR FUNCTIONS

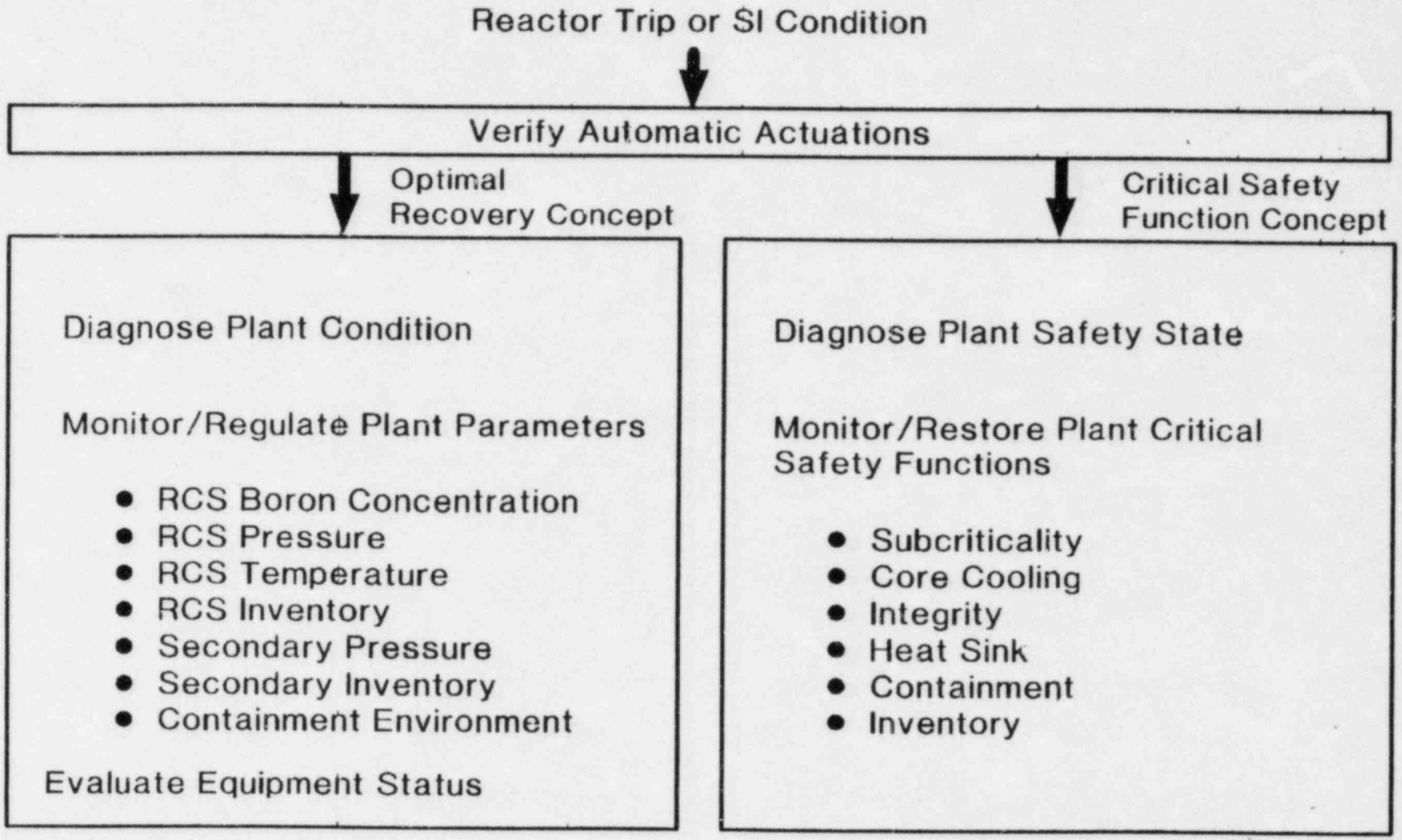

FIGURE 2-2 EMERGENCY RESPONSE GUIDELINE
OPERATOR FUNCTIONS

The operator functions of verification of automatic actuations, diagnosis of plant condition and regulation of process parameters are contained in the Optimal Recovery Guidelines. The operator functions of diagnosis of plant safety state and restoration of critical safety functions are contained in the Critical Safety Function Status Trees and Function Restoration Guidelines.

The operator verification and diagnosis functions include information gathering and decision-making actions that are not intended to control plant systems and components. Should an automatic system or component fail to automatically actuate, the verification function may include operator control actions to manually actuate the subject system or component. The diagnosis functions do not include operator control actions. The operator control functions include information gathering, decision-making and control actions necessary to control plant systems and components in response to the emergency condition.

2.5 IDENTIFICATION OF OPERATOR TASKS

Following identification of plant systems and operator functions, the Emergency Response Guidelines were reviewed in detail to identify the operator tasks. Since operator task is a somewhat relative term that has different connotations in different applications, it was first necessary to establish its meaning with respect to the ERG SRTA program. This definition was established to ensure ERG SRTA program compatibility with the Emergency Response Guideline Development Program objectives and documentation.

As generic technical guidelines, the primary objective of the Emergency Response Guidelines is to provide predefined strategies, utilizing extensive analytical and experiential bases, for responding to emergency conditions and to identify and coordinate the significant operator decisions and control actions necessary to implement the predefined emergency response strategies. The Emergency Response Guidelines are structured to provide technical guidance at two levels of detail: (1) via high level action steps that identify the significant operator decision requirements or control activities and (2) via detailed level action steps that identify the input (instruments) and/or

output (controls) requirements necessary to perform the significant decision requirements or control activities. In general, each high level action step contains a single significant operator decision requirement or control activity. Associated with each high level action step may be one or more detailed level action steps that identify the input and/or output requirements that support the high level action step. In some cases, the high level action steps contain more than one significant decision or control activity in order to establish the proper coordination between several decisions or control activities.

In order for the ERG SRTA program to be compatible with the objectives of the Emergency Response Guidelines, it was necessary that the ERG SRTA program focus on identification of the significant decisions and control activities contained in the Emergency Response Guidelines. To ensure that the ERG SRTA documentation is compatible with the Emergency Response Guideline documentation, it was necessary to structure the ERG SRTA documentation to directly correlate at some level with the Emergency Response Guidelines. This program and documentation compatibility is established at the task level through defining task as the specific actions (instrumentation observation, decision-making and/or control manipulations) that correspond to the guidance provided in a high level action step of the Emergency Response Guidelines. This definition establishes a one-to-one correlation between ERG SRTA tasks and Emergency Response Guideline high level action steps and provides a means to directly correlate the ERG SRTA documentation with the Emergency Response Guidelines. The definition also focuses the ERG SRTA program on identification of the significant decision requirements and control activities that guide operator response strategies.

The Emergency Response Guideline high level action steps that contain a single significant decision or control activity are addressed at the task level. Each task may contain several input and/or output requirements. For those Emergency Response Guideline high level action steps that contain more than one significant decision or control activity, each significant decision or control activity is defined as a subtask. For these cases, the task may

contain two or more subtasks. Each subtask may contain several input and/or output requirements. Through coordinated application of the task and subtask definitions, each significant decision or control activity can be identified for subsequent evaluation of constituent elements.

Having established the task and subtask definitions, each guideline that comprises the Emergency Response Guidelines was reviewed to identify associated tasks and subtasks.

2.6 IDENTIFICATION OF OPERATOR TASK ELEMENTS

Following identification of tasks and subtasks, the individual tasks and subtasks were analyzed to identify their constituent elements, (i.e., the detailed requirements underlying task performance). The elements were selected to establish the relationship between operator decision and action requirements, and the input, processing and output requirements necessary for task performance. Also included as elements are the objective and consequences underlying task performance.

The following listing summarizes the basic elements for which each task and subtask was analyzed:

- Objective
- Decision Requirements
- Knowledge Requirements
- Instrumentation Requirements
- Action Requirements
- Control Capability Requirements
- Consequence of Error/Omission

3 DOCUMENTATION DEVELOPMENT APPROACH

3.1 GENERAL APPROACH

The documents that comprise the ERG SRTA program were developed to both document the top-down development approach to task analysis and to subsequently compile information in an optimal manner to facilitate its utilization in reviewing operator task requirements. In addition to the need to document the top-down development approach, the following four user requirements were considered in establishing the number and types of documents that comprise the ERG SRTA program.

- The ERG SRTA shall systematically identify individual operator task requirements.
- The ERG SRTA shall systematically identify sequential operator task requirements.
- The ERG SRTA shall systematically identify individual instrumentation requirements.
- The ERG SRTA shall systematically identify individual control requirements.

The following briefly describes the documentation development process. The documentation development process is depicted schematically in Figure 3-1. The ERG SRTA documents are shown as bullet items on this figure. The user is referred to the ERG SRTA Users Guide for detailed descriptions and examples of the ERG SRTA documents.

3.2 DOCUMENTATION OF OPERATOR TASK ANALYSIS DEVELOPMENT APPROACH AND IDENTIFICATION OF INDIVIDUAL OPERATOR TASK REQUIREMENTS

Two documents were developed to document the top-down development approach to task analysis described in Section 2. Since this approach systematically identified all tasks and subtasks contained in the Emergency Response Guidelines, these documents were also structured as user documents for identifying individual task requirements.

SYSTEM REVIEW AND TASK ANALYSIS DOCUMENTATION DEVELOPMENT APPROACH

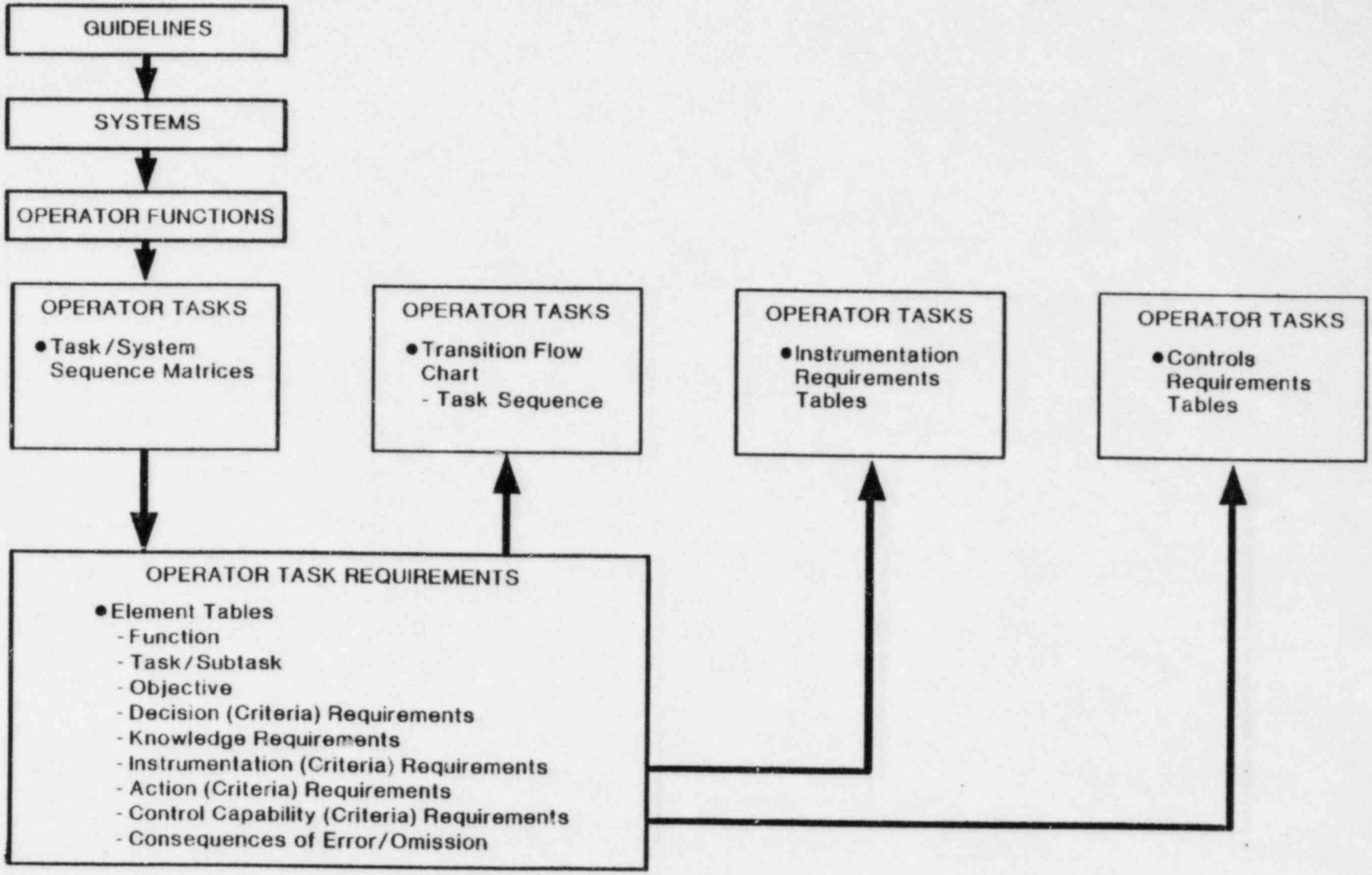

FIGURE 3-1 SYSTEM REVIEW AND TASK ANALYSIS DOCUMENTATION DEVELOPMENT APPROACH

Following identification of the guidelines (i.e., event sequences), systems, operator functions and operator tasks and subtasks, this information was organized in Task/System Sequence Matrices which were prepared for each specific Emergency Response Guideline. This document was developed to (1) identify all tasks and subtasks associated with a specific guideline, (2) identify the sequence in which the tasks or subtasks are performed in a specific guideline, (3) associate the tasks and subtasks with the plant systems that provide input and/or output for task performance and (4) identify the sequence in which plant systems are utilized in a specific guideline.

As the individual tasks and subtasks were analyzed to identify the constituent elements, this detailed information was organized in Element Tables which were prepared for each individual task and subtask. This document was developed to identify the detailed requirements (e.g., instrumentation and control requirements) that comprise each individual task and subtask and that must be addressed by the user in evaluating task performance.

The Task/System Sequence Matrices were structured to identify all individual tasks and subtasks and direct the user to the associated Element Table for detailed requirements. The Element Tables were structured to identify the detailed requirements that the user must address in evaluating task performance. In addition, these documents permit the detailed requirements to be associated with higher level operator tasks, operator functions, plant systems and guidelines (i.e., event sequences).

3.3 IDENTIFICATION OF SEQUENTIAL OPERATOR TASK REQUIREMENTS

In addition to documenting the top-down development approach and identifying individual tasks and subtasks, The Task/System Sequence Matrices identify the sequential requirements between tasks in individual Emergency Response Guidelines. To complement the Task/System Sequence Matrices in identifying the sequential requirements between tasks, the Transition Flow Chart was developed. This document compiles the sequential requirements between tasks in individual guidelines and between tasks in different guidelines. This

document directs the user to the associated Element Table for detailed sequential task requirements. The sequential requirements are compiled at the task level.

The Transition Flow Chart was developed by reviewing the Action Requirements element of all Element Tables and compiling the sequential task requirements in flow chart form.

3.4 IDENTIFICATION OF INSTRUMENTATION REQUIREMENTS

Instrumentation Requirements Tables were developed to satisfy the user requirement to systematically identify individual instrumentation requirements. This document compiles the instrumentation requirements on an individual instrument basis. The document directs the user to the associated Element Tables for detailed task requirements.

The Instrumentation Requirements Tables were developed by reviewing the Instrumentation Requirements element of all Element Tables and compiling the instrumentation requirements on an individual instrument basis. The resultant data base of Instrumentation Requirements Tables are organized on a plant system basis.

3.5 IDENTIFICATION OF CONTROL REQUIREMENTS

Controls Requirements Tables were developed to satisfy the user requirement to systematically identify individual control requirements. This document compiles the control requirements on an individual control basis. The document directs the user to the associated Element Tables for detailed task requirements.

The Control Requirements Tables were developed by reviewing the Control Capability Requirements element of all Element Tables and compiling the controls requirements on an individual control basis. The resultant data base of Controls Requirements Tables are organized on a plant system basis.

4 PERSONNEL

The ERG SRTA program was performed under the auspices of the Task Analysis Working Group to the WOG Procedures Subcommittee. The Westinghouse personnel that participated in the ERG SRTA program were members of the same multi-disciplinary technical staff responsible for development, verification and validation of the Emergency Response Guidelines. The technical staff that contributed directly to the ERG SRTA program were selected to ensure accurate and complete generic system review and task analyses documentation based on the Emergency Response Guidelines. Included in this staff are personnel with experience in reactor protection and control system functional design and analysis, fluid systems design and analysis, reactor core design and analysis, control room operations, and human factors.

The ERG SRTA program also reflects the contribution of utility personnel that have participated on the WOG Procedures Subcommittee and the Task Analysis Working Group. These individuals have contributed operations and training expertise to the Emergency Response Guideline development effort and control room human factors expertise to the ERG SRTA effort, respectively.

The combined efforts of the Westinghouse and WOG utility personnel that have contributed to development of the Emergency Response Guidelines and the ERG SRTA program ensure a truly multidisciplined foundation and approach to development of generic task analysis documentation.

5 REFERENCES

1. Westinghouse Owners Group ERG Seminar III Material, WOG-81-235, December 2, 1981.

2. Westinghouse Owners Group ERG Seminar IV Material, WOG-83-100, January 4, 1983.

3. WCAP-10204, Emergency Response Guideline Validation Program Summary Report, WOG-83-101, January 5, 1983.

4. Summary of Owners Group Procedure Programs, WOG-82-253, September 29, 1982.

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May 27, 1983

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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket No. 50-282 License No. DPR-42
Docket No. 50-306 License No. DPR-60

Supplement 1 to NUREG-0737 April 15, 1983
Response to Generic Letter 82-33 Control
Room Design Review Program Plan Submittal

Attached is the plan to complete the Control Room Design Review as identified in Generic Letter No. 82-33 dated December 17, 1982 and our response dated April 15, 1983.

David Musolf
Manager-Nuclear Support Services

cc: Regional Administrator-III, NRC
NRR Project Manager, NRC
NRC Resident Inspector
G. Charnoff

Attachment

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