Control Room Design Review

Program Plan

The South Texas Project

HOUSTON LIGHTING & POWER COMPANY

REV. 0
OCTOBER 11, 1982

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ACRONYMS AND ABBREVIATIONS

AO	Auxiliary Operator
ASSOC	Associated
ASST	Assistant
AUX	Auxiliary
CAT	Category
CLO	Checklist Observation
CONT	Control
CR	Control Room
CRDR	Control Room Design Review
CRT	Cathode Ray Tube
CVCS	Chemical Volume Control System
EES	Emergency Event Sequences
EOF	Emergency Operating Facility
EPRI	Electric Power Research Institute
ESF	Engineered Safety Feature(s)
EST	Estimate(d)
EXPER	Experience
FW	Feedwater
HE	Human Engineering
HED	Human Engineering Discrepancy
HL&P	Houston Lighting and Power Company
HPSI	High Pressure Safety Injection
I&C	Instruments and Controls
INPO	Institute of Nuclear Power Operators
INSTR	Instrument
LDR	Leader
LOCA	Loss of Coolant Accident
LPSI	Low Pressure Safety Injection
M/M	Man/Machine
MCP	Main Control Panel
MON	Monitor

ACRONYMS AND ABBREVIATIONS (Cont.)

MW(e)	Megawatts (electric)
NOS	Numbers
NRC	Nuclear Regulatory Commission
OERT	Operating Experience Review Task Group
OSC	Operational Support Center
PORV	Power Operated Relief Valve
PRT	Project Review Team
PSAR	Preliminary Safety Analysis Report
RAS	Recirculation Actuation Signal
PZR	Pressurizer
RCB	Reactor Containment Building
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RECIRC	Recirculating
REQ'D	Required
RO	Reactor Operator
RWST	Refueling Water Storage Tank
RX	Reactor
SBCS	Standby Cooling System
SG	Steam Generator
SIS	Safety Injection System
SOE	Selected Operational Event(s)
SPDS	Safety Parameter Display System
SRO	Senior Reactor Operator
SS	Subsystem
STAT	Systems Task Analysis Team
SUPVR	Supervisor
SW	Switch
SYS	System
TMI	Three-Mile Island
TSC	Technical Support Center

1.0 INTRODUCTION

1.1 GENERAL COMMENTS

This report describes the Houston Lighting & Power Company (HL&P) plan to perform a control room design review (CRDR) of its South Texas Project Nuclear Power Generation Station.

The purpose of this CRDR is to identify and implement control room design improvements that offer high probability for meeting plant safety and availability objectives.

This is part of an integrated plan covering TMI-related actions referenced in the TMI-2 Action Plan, NUREG-0660 and will consider the relationship of the CRDR with SECY 82-111 (Requirements for Emergency Response Capability), including:

- verification of the SPDS parameter selection, data display and function.
- Design control room modifications that correct conditions adverse to safety (reduce significant contributions to risk), and add instrumentation necessary to implement Regulatory Guide 1.97.
- The use of Westinghouse Owners group produced symptom-based emergency operating procedures.
- Training to enhance coping with emergencies.
- Design considerations for the Technical Support Center, Emergency Operations Facilities and Operations Support Center.

Figure 1-1 is a block diagram showing the relationship of the NUREG-0660 Task Action items HL&P will address.

The Houston Lighting and Power Company is committed to this program for identifying and implementing changes to the plant man/machine (M/M) interfaces that can reduce the probability of operator error thus resulting in an overall improvement in plant safety and reliability. To this end, HL&P has commited the necessary resources, including knowledgeable HL&P management and technical personnel, and technical specialists from Bechtel and its human factors consultant, Torrey Pines Technology, and Westinghouse, to effect the program defined herein.

1.2 OBJECTIVES

The Houston Lighting & Power Company intends to complete this review in a timely and cost-effective manner to:

- o Determine whether the control room provides the system status information, control capabilities, feedback, and analytical aids necessary for control room operators to accomplish their functions effectively.
- o Identify characteristics of the existing control room instrumentation, controls, other equipment, and physical arrangements that may impact optimum operator performance.
- o Analyze and evaluate potential problems that could arise from this review.
- o Define and put into effect a plan of action that applies additional human factors principles to enhance operator effectiveness. Particular emphasis will be placed on improvements affecting control room design and operator performance under abnormal or emergency conditions.
- o Integrate the CRDR review with other areas of human factors inquiries identified in the NRC Task Action Plan.

1.3 PLANT DESCRIPTION

The South Texas Project (STP) is currently under construction in south-central Matagorda County on a site 89 miles southwest of Houston (see Fig 1-2). Bechtel is the architect/engineer and Ebasco is the constructor. The station will consist of two 1250 - MW(e) (nominal) units. Each unit is powered by a Westinghouse Electric Corporation nuclear steam supply system consisting of a four-loop, pressurized water reactor and supporting auxiliary systems. The basic power conversion unit is also furnished by Westinghouse. Each turbine generator is an 1800 rpm - tandem compound unit and is furnished with electrohydraulic controls. Commercial operation for Units 1 and 2 is scheduled for June, 1987 and June, 1989, respectively.

1.4 DEFINITION OF CONTROL ROOM

The STP Control Room is defined as area panels CP-001 through CP-010 in the central control room including the SPDS displays and the remote shutdown facilities. The CRDR will extend to other M/M interfaces identified as a result of the analysis of selected events during the Systems Function and Task Analysis activity. Figure 1-3 illustrates the layout in the central control room. The Unit 1 and 2 control rooms are essentially identical.

1.5 CONTROL ROOM STATUS AND MILESTONES

Control panel sections CP-001 through CP-005 are complete through metal fabrication only. Panel sections CP-006 through CP-010 have been completed and were ready to ship when the entire order was placed on hold for implementation of post-TMI modifications. The auxiliary shutdown panel design was complete with no fabrication activities prior to the order being placed on hold.

All control panels are scheduled to recommence fabrication in March 1983 to support Unit 1 installation beginning the first quarter 1984.

RELATIONSHIP OF NUREG 0660 TASK ACTION ITEMS

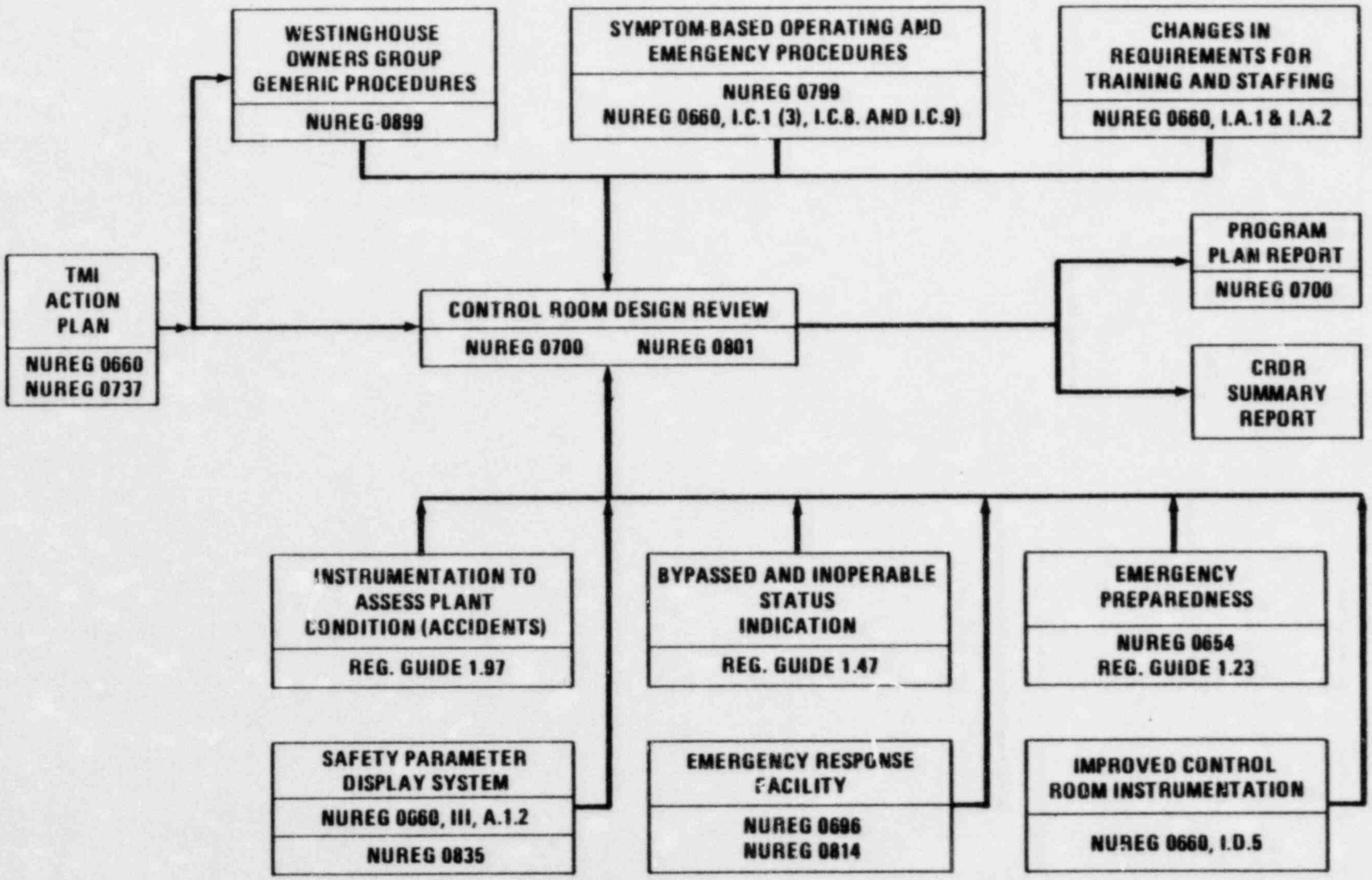
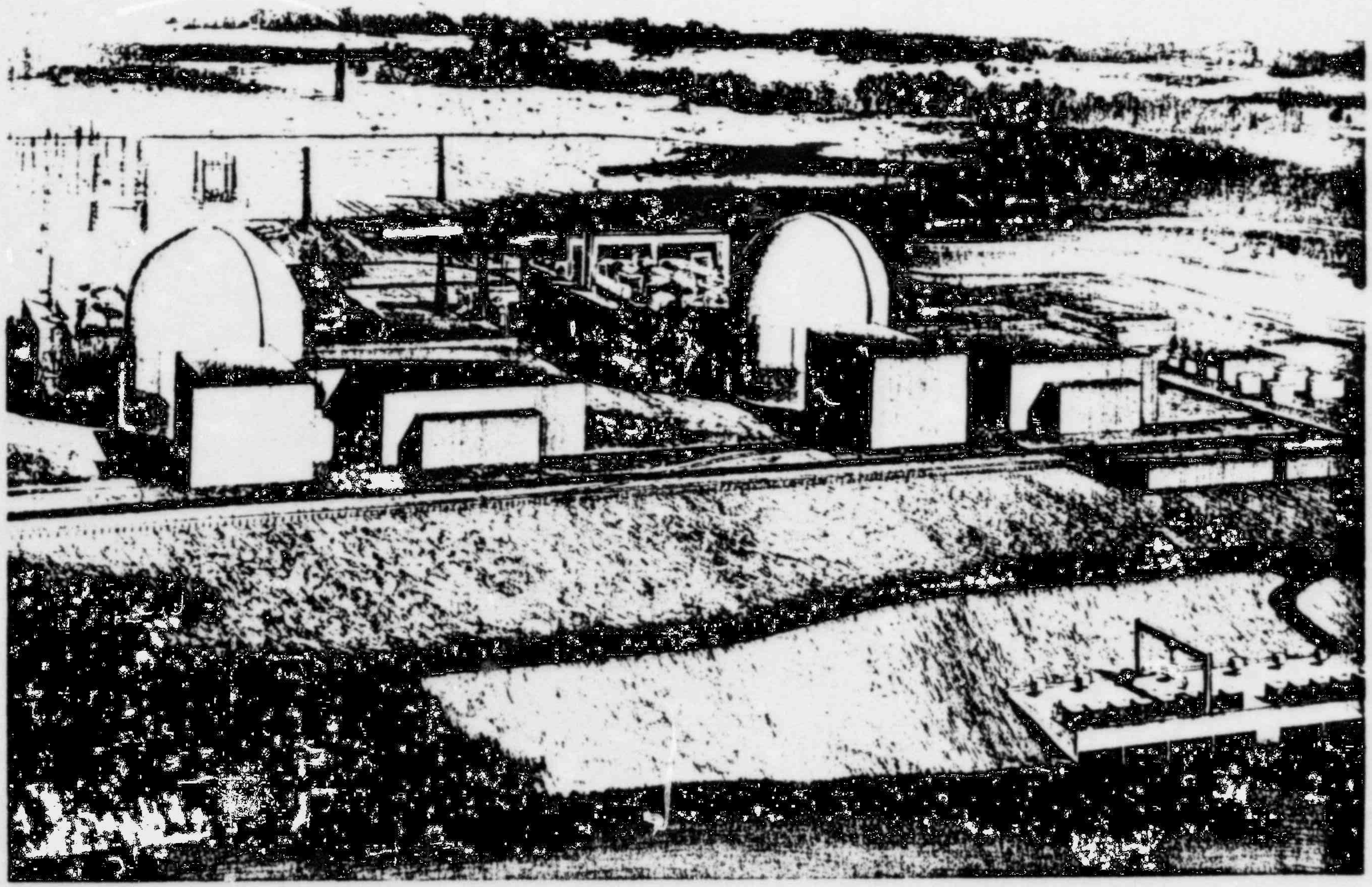
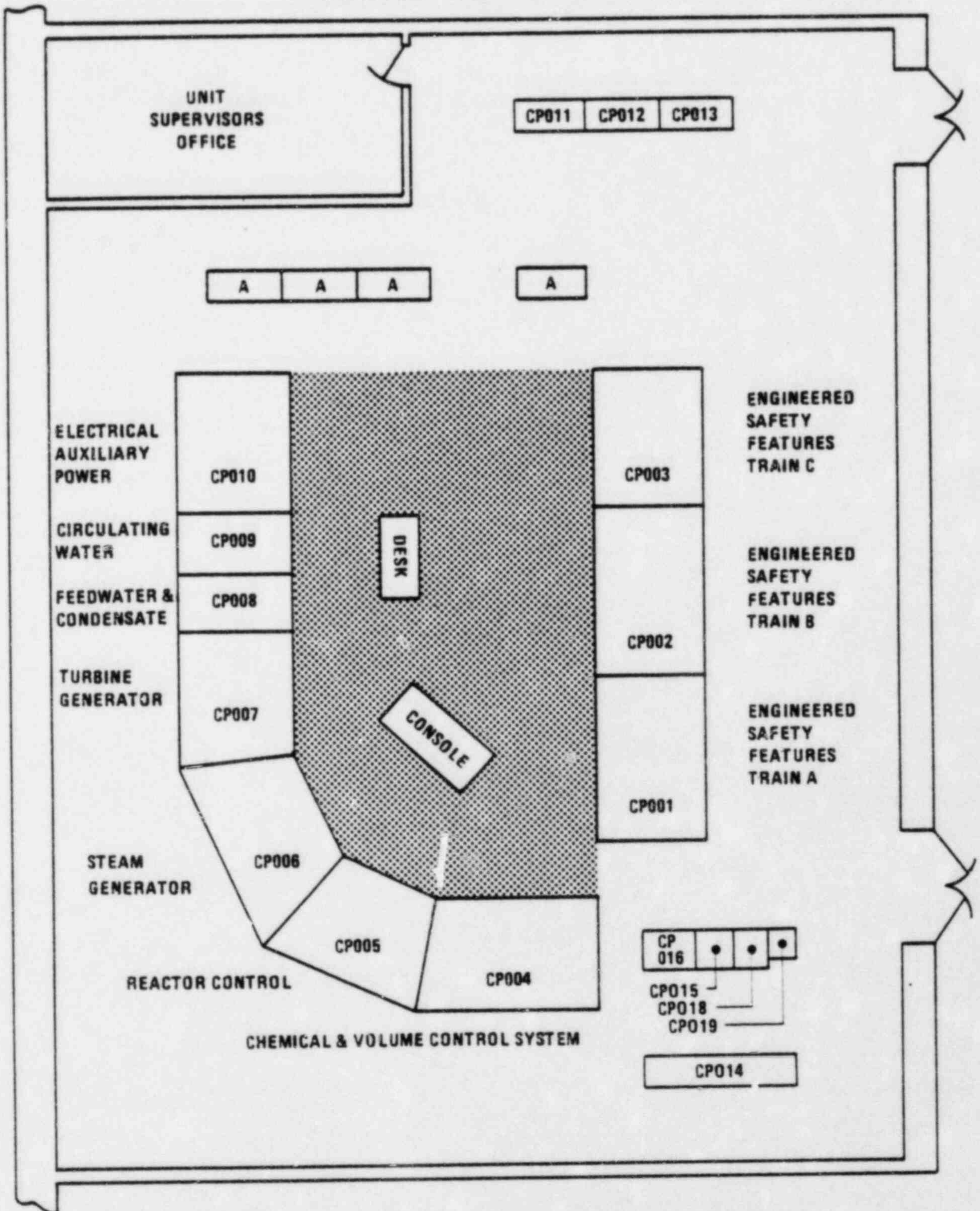


Figure 1-1



ARTIST'S RENDITION OF SOUTH TEXAS PROJECT PLANT
FIGURE 1-2

CONTROL ROOM LAYOUT



CP011 – NUCLEAR INSTR. PANEL
CP012 – FLUX MAPPING
CP013 – MOTION SEISMIC MONITORING
CP014 – VIBRATION MONITORING
CRDR EVALUATION AREA
CP015 – LOOSE PARTS MONITORING
CP016 – AUX. BOILER PANEL
CP018 – RECORDER PANEL
CP019 – FIRE PROTECTION PANEL
A – COMPUTER TYPERS

Figure 1 - 3

2.0 CONTROL ROOM DESIGN REVIEW PLAN

2.1 GENERAL COMMENTS

2.1.1 The CRDR will be conducted principally as recommended by NUREG-0700 and SECY-82-111 and will consider the integration of related project requirements that may affect control room human factors discrepancies. The following related activities and documents will be coordinated with the CRDR:

- Development of emergency operating procedures (reference Item I.C.1(3), I.C.8, and I.C.9 of NUREG-0660).
- Development of a safety parameter display system (SPDS), (reference Item I.D.2 of NUREG-0660; also NUREG-0696, Functional Criteria for Emergency Response Facilities).
- Upgrading of emergency support facilities (reference Item III.A.1.2 of NUREG-0660 and NUREG-0696, Functional Criteria for Emergency Response Facilities).
- Development of improved control room instrumentation (reference Item I.D.5 of NUREG-0660).
- Changes in requirements for training and staffing (reference Items I.A.1 and I.A.2 of NUREG-0660).
- Implementation of Regulatory Guide 1.97, Revision 2.
- Evaluation criteria for CRDRs (NUREG-0801).

- o Methodology for evaluation of emergency response facilities (NUREG-0814).

- o Human factors acceptance criteria for SPDS (NUREG-0835).

2.1.2 The overview of the CRDR processes is shown in Fig. 2-1 which is a copy of Exhibit 3-1 of NUREG-0700.

The program describes the following:

- o Planning (Section 2.2)

- o Review (Section 2.3)

- o Management and Staffing (Section 3.0)

- o Assessment and Implementation (Section 4.0)

- o Documentation and Document Control (Section 5.0)

2.2 PLANNING

The planning phase covers relevant actions completed to date or planned as noted herein.

Houston Lighting & Power organized a management team to guide, monitor and implement this program. Membership on this team is shown in Fig. 2-2 and qualification of the members is shown in Appendix A. The management team has made provisions for designated alternates to key positions. The functions of this team correspond to those recommended for Management in NUREG-0700. They are to:

- o Assure proper relationships and awareness between this project and other NUREG-0660 efforts.

- Assignment of key management and Project Review Team personnel (see Fig. 2-2).

- Approve detail program plan.

- Provide resources required to carry out the program plan.

- Identify and assure that plant operational constraints and project requirements are properly coordinated.

- Monitor CRDR progress.

- Review and approve control room improvement recommendations.

- Establish and initiate the control room improvement program.

The management team has analyzed NUREG-0700 in relation to this plant facility and resources and has defined the program described herein. The major activities are shown in Fig. 2-3. The planning activity includes, in addition to the above items, the following:

- Definition of all man/machine interfaces and related activities to be reviewed.

- Definition of objectives.

- Definition of management team role.

- Formulation of the task structure for the program and corresponding personnel assignment (see Fig. 2-3).

- Development of administrative procedures to govern this review.

The management team gave considerations to the advantages and disadvantages of performing the CRDR prior to completion of operating procedures, training, and construction of the control room complex. The decision to proceed with the review was based on the advantage of identifying major departures from HEDs, if any, of the control panel design prior to completion of manufacture. This will minimize negative transfer and retraining problems. To facilitate this review, project management authorized the construction of a full scale, realistic mock-up and provided facilities for an extensive review by human factors and systems specialists at the Bechtel-Houston engineering offices with the reviewers performing all phases of their tasks in the vicinity of the mockup.

Bechtel is charged with the responsibility of implementing the technical scope. With HL&P concurrence, they awarded the human factors consulting services contract to Torrey Pines Technology following its established competitive bidding procedures. They are currently performing their work scope, primarily at the Bechtel-Houston offices.

2.3 REVIEW

The review phase is basically the investigative phase. This effort is organized into specialty task groups per Fig. 2-3. Specialized personnel are selected as required for each task group from HL&P, Bechtel, Westinghouse, and Torrey Pines Technology. Approximately 25 engineers and key operations personnel will participate in the detailed reviews and evaluations of the task groups.

The following types of personnel are included:

- System designers and analysts
- Human factors consultants
- Control board designers

- Instrumentation and control engineers
- Computer and data management engineer
- Plant operators
- Licensing engineer

2.3.1 Methodology

2.3.1.1 Criteria

- The Design Review and Technical Task Team will prepare control room design and review criteria which will be included in the Criteria Report. This effort will stress the human factors considerations and requirements for the control room design. This document will describe the function of the control room and plant systems related to external communications. It will also address one of the major post-TMI concerns: the systems and human factors features for Annunciator/ Computer/safety Equipment interfaces relative to prioritization, consistency, and overall integration.

  The following topics will be included in this document.

  A. Introduction

  B. General

  C. Control Room Layout and Features

  D. Main Control Panels Layouts and Features

E. Human Engineering Guidelines (plant specific adaptations of NUREG-0700, Section 6, guidelines not covered in other major topics)

F. Communications

G. General Control Room Annunciation Features

H. Post-Accident Monitoring Features

I. Bypass and Inoperable Status Features

J. Safety Parameter Display

K. Auxiliary Shutdown Panel

L. References

2.3.1.1.1 Criteria will be developed considering:

- o Those human factors engineering practices that have general industry acceptance and have resulted in proven performance.
- o Pertinent NUREG documents and Regulatory Guides.
- o Established criteria from general industry, EPRI, INPO, government sources, HL&P, Westinghouse, and Bechtel standards and practices.
- o Current plant systems and operations requirements.
- o Firm human factors-related criteria stated by suppliers of major equipment and systems.

2.3.1.2 Operating Experience Review

2.3.1.2.1 The operating experience review task group (OERT) will review pertinent operating experience documents and conduct a survey of control room operations personnel. In addition to typical human factors operator concerns, the OERT will emphasize systems - operability using critical incident techniques. It is anticipated that valuable input will be developed for use by the other task group, particularly the Systems Task Analysis Team (STAT). Specific attention will be placed on those of normal plant procedures that experienced operators identify as having the greatest potential for human factors engineering enhancements. This information will be used in the selection process for those events to be analyzed by the STAT.

Consideration will be given to include in the operator experience review one or two operators from related Westinghouse PWRs. These operators will be used in the mock-up area for one to two weeks.

2.3.1.2.2 The OERT will perform the following.

A special meeting will be held to review the methodology used in the preparation of operating procedures. Sample procedures will be reviewed and comments submitted to the operations department.

A. Meet with key operations and training personnel to determine pertinent information on training, assigned duties, anticipated work scheduling, and the availability of the various classes of operations personnel.

B. Prepare questionnaires and interview forms. See Table 2-1.

C. Review by Project Review Team.

D. Completion of questionnaires by operations personnel.

E. Evaluate the data obtained.

F. Interview plant personnel.

G. Evaluate and summarize observations.

2.3.1.2.3 Interview sheets and questionnaires will be prepared considering the special knowledge the control room operating personnel have concerning potential control room problems and positive features as determined by their experience.

A. Interviews will identify those aspects of the control room equipment layout and general design which are considered by the operators to provide opportunities for improvement relative to their decision making processes.

B. Questions will be focused on those details of the control room environment which are projected to indicate notable success, failure, and near-miss situations based on past experiences.

C. Respondents will be advised that the information obtained will not be used for performance evaluation purposes.

D. The following NUREG-0700 will be included in this operator review:

1. Workspace layout and environment
2. Panel design

3. Annunciator warning system
4. Communications
5. Process computers
6. Corrective and preventive maintenance
7. Procedures
8. Staffing and job design
9. Training

E. The respondents will be encouraged to speak openly about problems from their past experience or perceived potential problems and suggested solutions.

F. Other kinds of human factors concerns such as those related to employee programs.

G. Other questionnaires developed by industry and research groups in previous projects.

H. The interviews will be structured to allow for additions of material developed during the interview.

I. Table 2-1 covers the general topics that will be considered in development of operating personnel questionneires.

2.3.1.2.4 Data evaluation will be done immediately following completion of the interview period to assure maximum benefit from the interview. The data evaluation results will be forwarded to the project review team for review. The results of this work will be evaluated and summarized.

2.3.1.2.5 A re-review of areas of significant changes may be required.

TABLE 2-1

QUESTIONNAIRE AND INTERVIEW SHEET REFERENCE TOPICS

The following will be covered in the interview sheets and questionnaires to determine positive and negative features and suggestions for improvements:

- The role of the operations personnel in emergency situations.
- The use of an SPDS and other facilities in emergency situations.
- Those normal functions and tasks that the respondents consider should be included in the systems function and task analysis.
- Major concerns and strengths of related plant operations.
- Techniques for maintenance of high vigilance. How boredom will be prevented. How proficiency will be maintained.
- Views of engineering and engineered product necessary for plant operation.
- Overall management policies - how perceived by interviewees.
- Views of projected job assignments (work loading - too much, too little?).
- Views of job satisfaction or dissatisfaction (long-range job objectives).

TABLE 2-1 (Cont.)

- o Views of personal training received to date - adequate? Suggestions for improvements.
- o Views of the control center complex - strengths and weaknesses.
- o Views of the control room complex in the general areas noted in NUREG-0700 Appendix C and Section 3.3.2.2 for normal and abnormal situations.
- o Discussion of emergencies.
- o Discussion to determine special techniques useful in plant control.
- o Views of the engineering of the products required for plant operations.
- o Views of external elements - NRC and press.
- o Views of projected shift staffing.
- o Relationship with fellow workers, maintenance, and other associates.
- o Discussion of main concerns, major strengths or weaknesses, and improvements that are most sought for.
- o View of projected workload and difficulties in performing assignments.
- o Views of projected relationship with other groups that effect overall plant operations.
- o Views of training.
- o Views of administrative procedures.

2.3.1.3 Systems Function and Task Analysis

2.3.1.3.1 The Systems Task Analysis Team (STAT) will perform a structural review and analysis of the control room complex to determine the adequacy of its design, and documentation to facilitate safe plant operations. This work will be done considering the following:

A. Attend a series of plant design and plant systems lectures conducted by Bechtel.

B. Review pertinent plant documents such as: configurations, PSAR, systems descriptions, operating procedures (Westinghouse Owners Group Emergency Response Guidelines)*.

C. Prepare system and subsystem diagrams, Figs. 2-4, 2-5 and 2-6 and Tabulation Fig. 2-7. Key systems identified in NUREG-0700 Section 3.4.2.1 will be included.

D. Prepare tabulation of all emergency event sequences, Fig. 2-8, and background system information, Fig. 2-9.

E. Review results of operating experience. Review task group to help identify those functions and tasks that are judged to be candidates for review.

F. Prepare selection criteria. Select events to be analyzed in a series of STAT meetings. Such events are defined as selected operational events (SOE).

* These generic procedures are considered to be an excellent source material to meet the objectives of the NUREG-0700 defined system function and task analysis.

G. Perform system function and task analysis for each SOE considering the following:

1. Prepare basic elements diagram, Fig. 2-10.

2. Modify Westinghouse Owners Group-produced ERG functional (decision-action) flow diagrams as necessary, Fig. 2-11.

3. Complete functional sequences tabulation, Fig. 2-12, in STAT meetings.

4. Continue the heirarchial review process of identifying tasks associated with each function, Fig. 2-13, including equipment required.

5. List details about input, action/decisions (throughputs and outputs). Task oriented decision-action diagrams that may be required for some tasks are shown in Fig. 2.4. The NUREG-0700 recommendation for paying particular attention to the decision making tasks is covered in Fig. 2-14 and 2-15. Figure 2-15 also covers recommendations for other needed task and subtask data such as: type of attention needed for control actions (discrete or continuous), expected results, performance criteria, consideration for errors, and the consequences thereof.

H. Prepare panel interface equipment tabulation with the full complement of data requirements suitable for use in the verification process, Fig. 2-16.

I. Prepare operational sequence diagrams, Fig. 2-17, and traffic link diagrams, Fig. 2-18.

J. Evaluate data and summarize observations.

2.3.1.4 Control Room Inventory

An inventory of controls, instrumentation, displays, and other equipment on the control room man/machine interfaces will be performed. This inventory will establish a reference data base for comparison with the requirements established by operator task analysis. The inventory will include component use and characteristics, and will serve as a support base for assessment of review observations. A plant specific computerized format similar to NUREG 0700, Exhibit 3-6, will be used.

2.3.1.5 Control Room Survey

2.3.1.5.1 A survey of the full scale mock-up located in the Bechtel-Houston engineering offices will be performed to document compliance with the human factors criteria document. The use of a realistic mock-up including sample control panel hardware will permit completion of the bulk of the checklist items developed. Those items that cannot be checked, such as voice-assisting communication devices, control room noise, illumination, use of protective clothing and other environmental considerations, will be deferred and completed using the simulator or control room in actual service conditions.

2.3.1.5.2 The Control Room Survey Task Group will perform the following tasks.

A. Prepare plant specific checklists for the following:

1. Control room workspace
2. Communications
3. Annunciator warning system
4. Controls
5. Visual displays
6. Labels and location aids
7. Process computers
8. Panel layouts
9. Control-display integration

B. Submit checklists for Project Review Team review.

C. Finalize checklists.

D. Perform control room survey.

E. Evaluate data, summarize observations.

F. Recheck any significant modifications resulting from above work, if necessary.

G. Prepare a special report on the results of this review which may be beneficial in operator training.

2.3.1.6 Verification of Control Room Function

The verification task group will verify the availability of instruments and equipment needed to implement each task. This verification will be made by comparing the requirements identified by the STAT to the Control Room Inventory list. An adequacy determination of operator-equipment interfaces for task accomplishment will be made and the observations will be recorded. Formatted information developed during the inventory and system function task analysis activities will be used.

2.3.1.7 Validation of Control Room Functions

The validation task group will determine whether the control room operating crew can perform allocated functions within defined procedures. The bulk of this effort will be performed on the mock-up using walk-through/ alk-through techniques. In this effort, identification will be made of the time-dependent SOE and plans will be made for their real time reviews on the plant simulator when this facility can be made available.

2.3.1.8 Annunciator Review

- The annunciator review task group will perform a design review of all alarms of the main plant annunciator, plant computer, and ESF bypass and inoperable status system.

- The task group will perform a functional integration of the identified annunciators.

- The task group will review the results of NRC and EPRI annunciator studies as available.

- The task group will develop review criteria, and recommend rearrangement of displays accordingly. They will also develop prioritization criteria and categorize annunciator displays accordingly.

- A review of window engravings, computer printouts, displays, and documents showing planned or actual signal inputs for each window, CRT display or printout will be performed, as will a review of abbreviations, colors, arrangements, and locations based on human factors principles. Finally, the task force will evaluate and summarize the observations of the review.

OVERVIEW OF CRDR PROCESSES

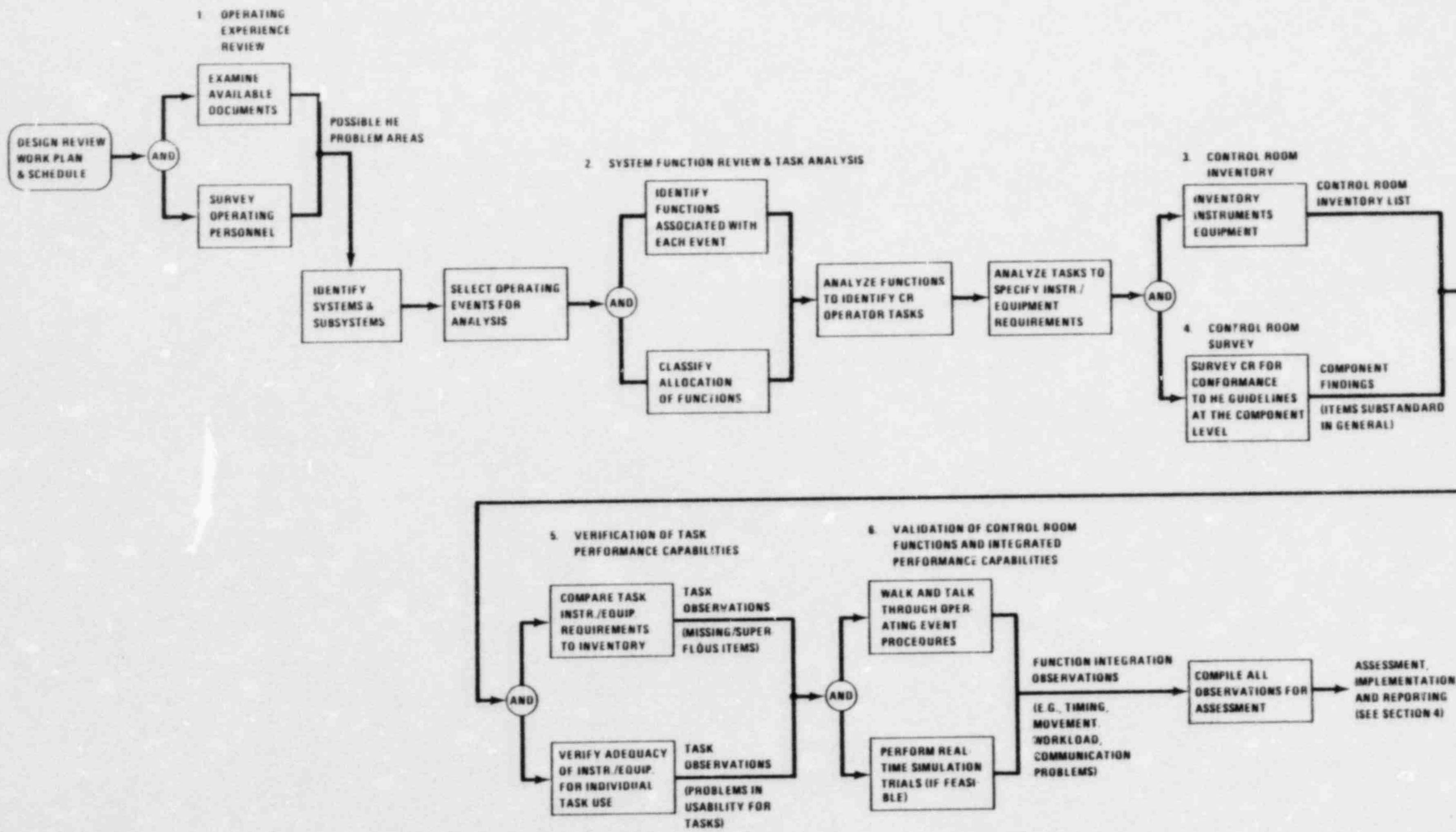


Figure 2-1

OVERVIEW OF CONTROL ROOM DESIGN REVIEW ORGANIZATION

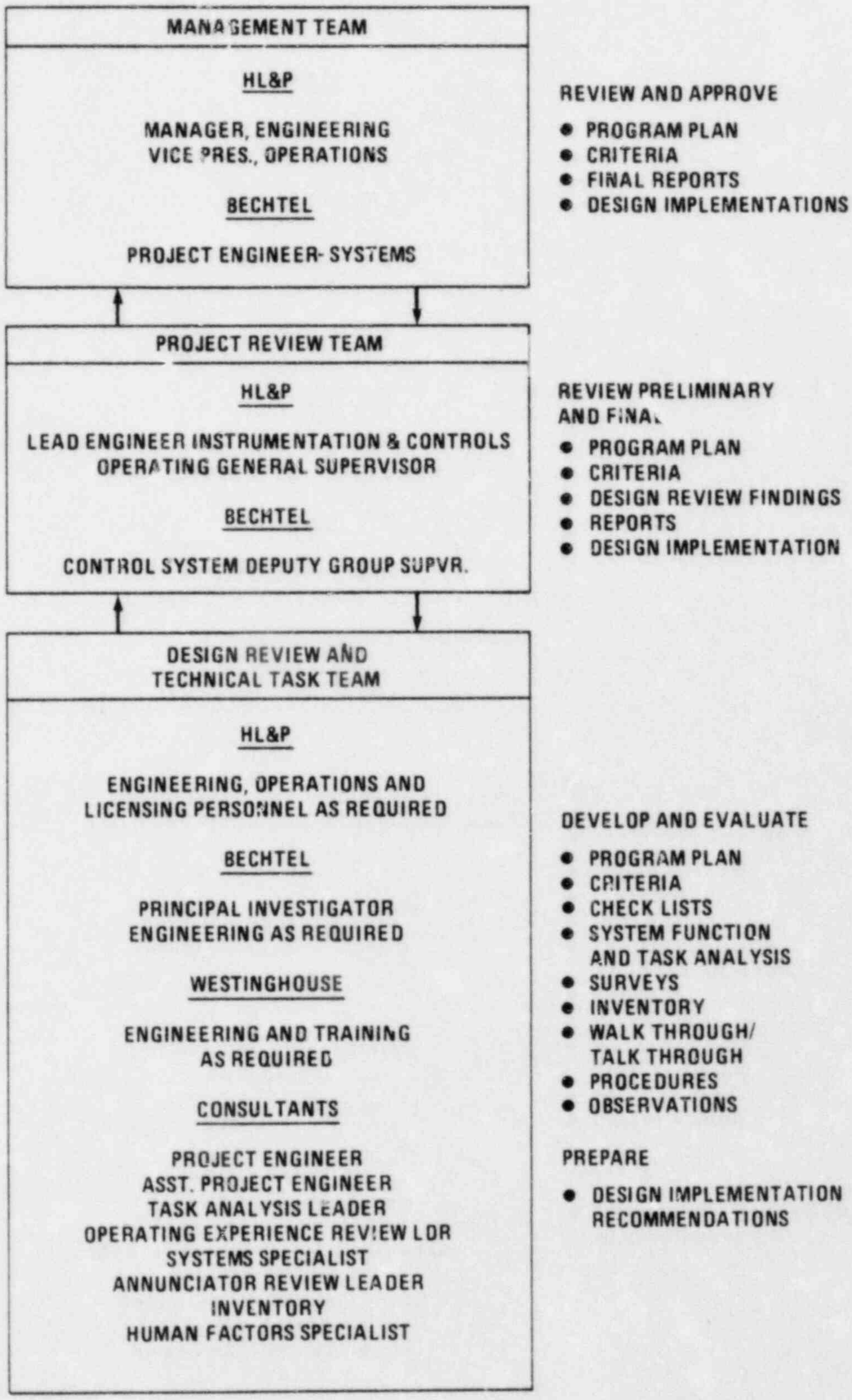


Figure 2 - 2

PROGRAM TASK ORGANIZATION

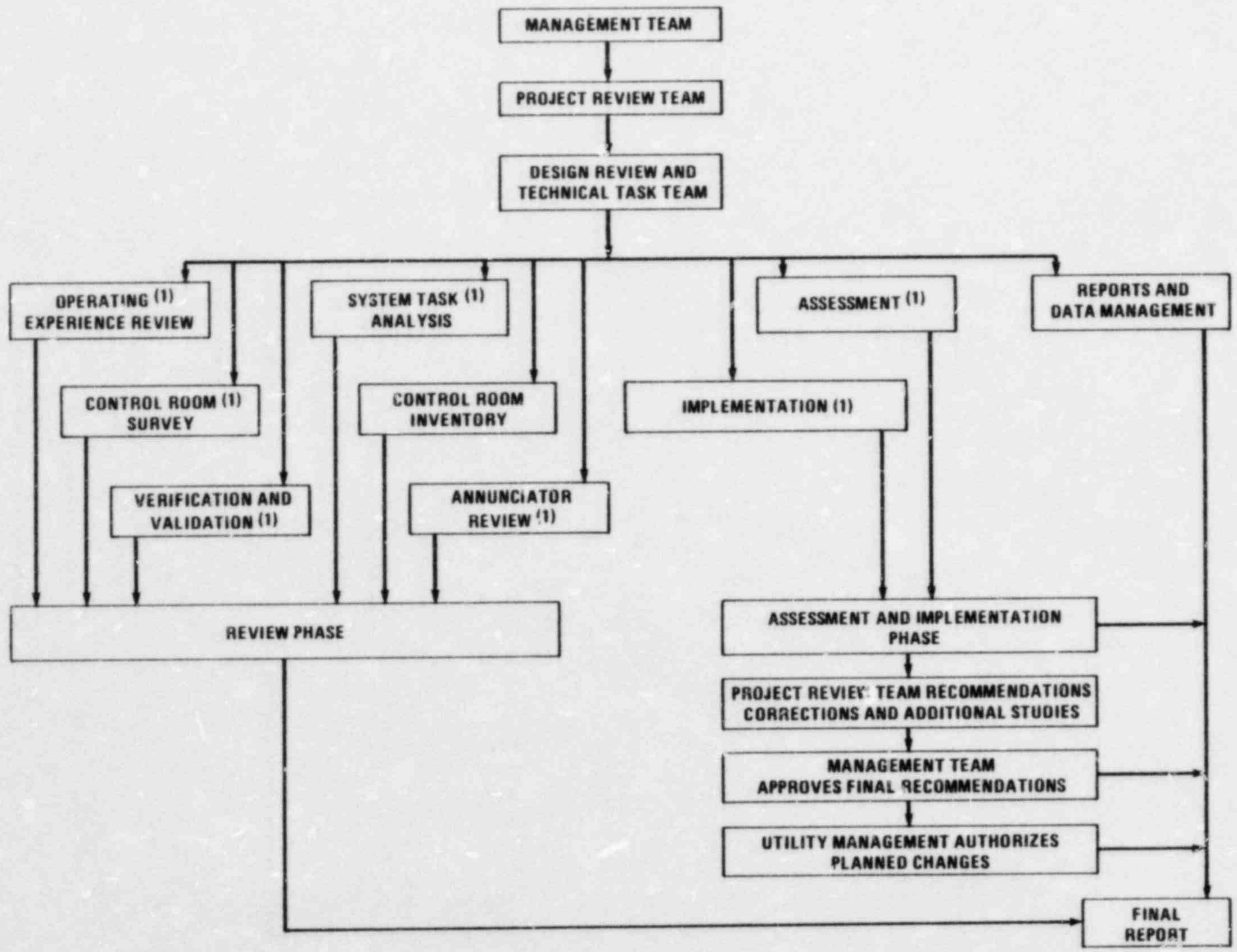


Figure 2-3

CONTROL PANEL FLOW DIAGRAM

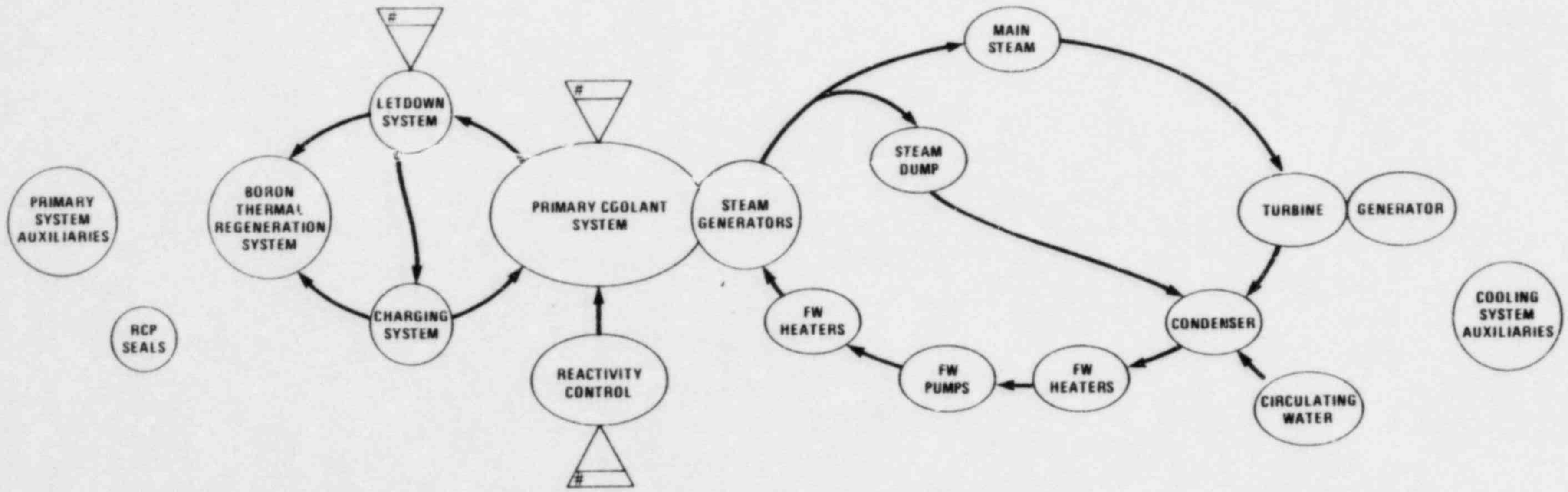


Figure 2-4

PRIMARY COOLANT SYSTEM
CONTROL PANEL FLOW DIAGRAM

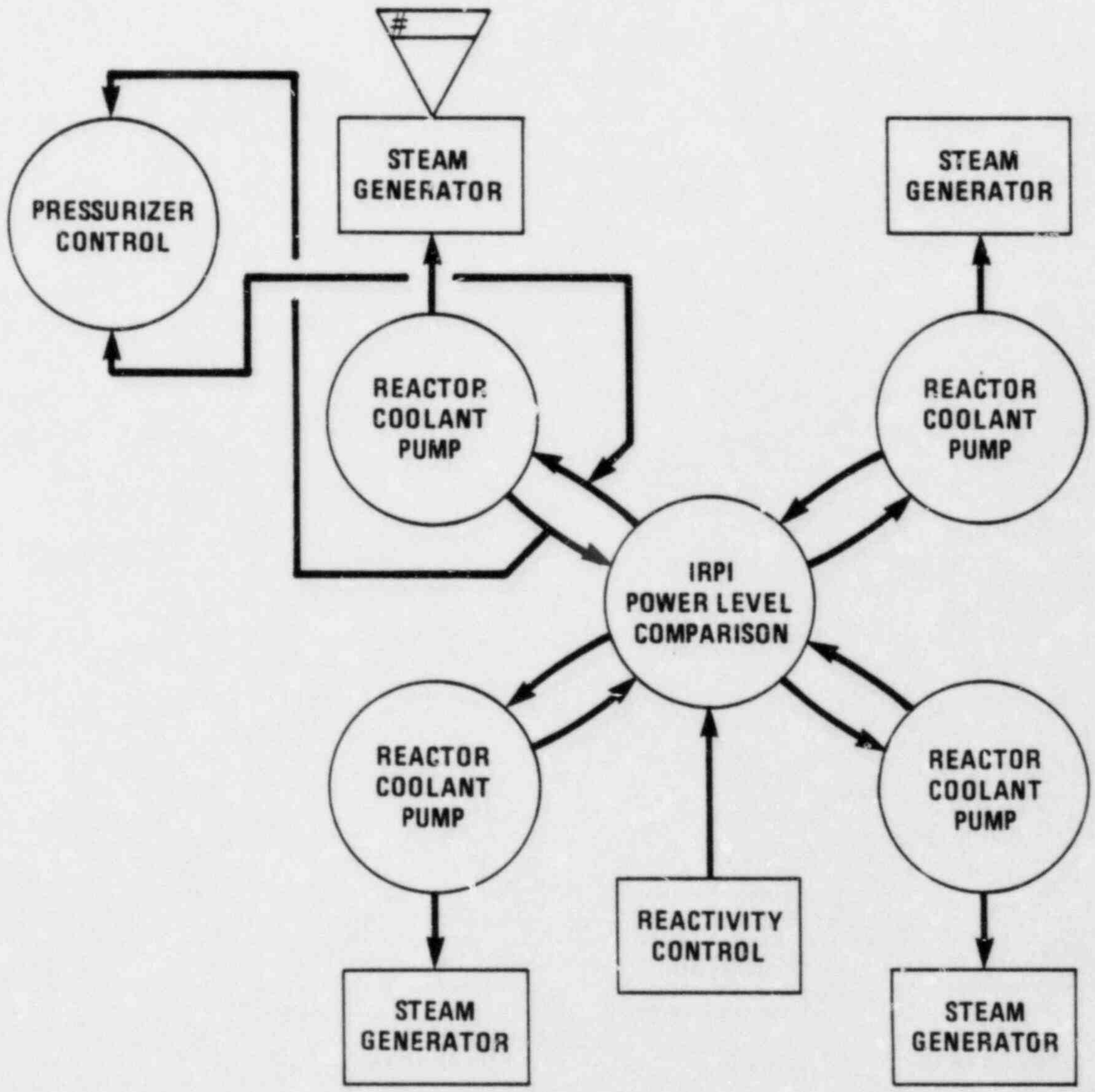


Figure 2-5

REACTOR COOLANT PUMP SYSTEM

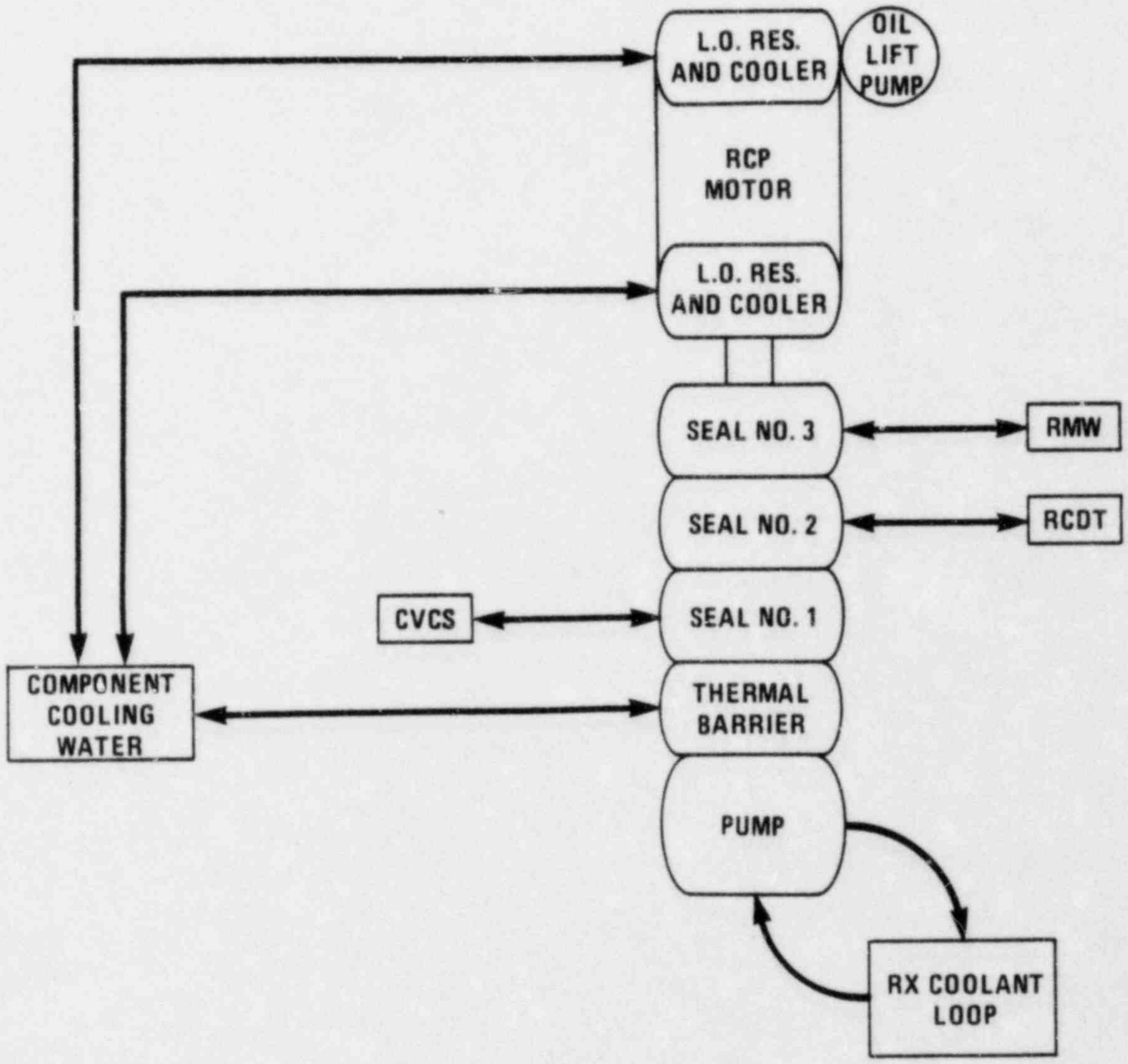


Figure 2-6

HOUSTON
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CONTROL ROOM DESIGN REVIEW
SYSTEM BREAKDOWN

EVALUATOR ____________
SIGNATURE ____________
DATE ____________
PAGE ________ OF ________
REF ____________

SYSTEM TITLE	SYSTEM DESIGNATOR	LOCATION PANEL NO.	SUBSYSTEM TITLE	SUBSYSTEM DESIGNATOR	LOCATION PANEL NO.

FIGURE 2-7

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
EMERGENCY EVENT SEQUENCES

EVALUATOR ____________
SIGNATURE ____________
DATE ____________
PAGE ________ OF ________
REF ____________

NO.	TITLE	CHECK SYSTEM DESIGNATOR INVOLVED								EST. TIME INVOLVED
		#	#	#	#	#	#	#	#	

FIGURE 2-8

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
BACKGROUND SYSTEM INFORMATION

EVALUATOR ______
SIGNATURE ______
DATE ______
PAGE ______ OF ______
REF ______

SYSTEM TITLE ______ SYSTEM DES. ______

1.0 THIS SYSTEM IS USED TO PERFORM THE FOLLOWING FUNCTIONS:

1.1 ______

FIGURE 2-9.1

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
BACKGROUND SYSTEM INFORMATION

EVALUATOR ______________________

SIGNATURE ______________________

DATE ______________________

PAGE ____________ OF ____________

SYSTEM TITLE ______________________ SYSTEM DES. ____________ REF ______________________

2.0 BRIEF DESCRIPTION OF ROLE AND IMPORTANCE OF SYSTEM TO PLANT SAFETY. INCLUDE MANUAL CONTROLS NEEDED TO PREVENT PLANT TRIPS AND FOR POST TRIPS FOR CORE COOLING.

2.1 ____

FIGURE 2-9.2

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
BACKGROUND SYSTEM INFORMATION

EVALUATOR ____________
SIGNATURE ____________
DATE ____________
PAGE ________ OF ________
REF ____________

SYSTEM TITLE ____________ SYSTEM DES. ____________

3.0 LIST OF CREDIBLE FAILURES WHICH MAY CAUSE SYSTEM FAILURE:

3.1 ____________

FIGURE 2-9.3

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
BACKGROUND SYSTEM INFORMATION

EVALUATOR ____________
SIGNATURE ____________
DATE ____________
PAGE ______ OF ______

SYSTEM TITLE ____________ SYSTEM DES. ____________ REF ____________

4.0 LIST OF PERTINENT PLANT SYSTEM FAILURE INCIDENCES AND COMPONENTS INVOLVED. INCLUDE DATA AND DURATION OF SYSTEM UNAVAILABILITY BASED ON DEFINED CRITERIA.

4.1 ____________

FIGURE 2-9.4

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
BACKGROUND SYSTEM INFORMATION

EVALUATOR ____________
SIGNATURE ____________
DATE ____________
PAGE ________ OF ________
REF ____________

SYSTEM TITLE ____________ SYSTEM DES. ____________

5.0 LIST SYSTEM FUNCTION VS. TYPICAL DURATION OF INVOLVEMENT TO COMPLETE FUNCTION FOR EACH OPERATING PERSONNEL INVOLVED. THIS IS TO APPRAISE "THE DEMANDS THE SYSTEMS PLACE ON OPERATOR LOAD."

5.1 FUNCTION 1.1: ____________

FIGURE 2-9.5

HOUSTON LIGHTING & POWER CO.

CONTROL ROOM DESIGN REVIEW
BACKGROUND SYSTEM INFORMATION

EVALUATOR ____________

SIGNATURE ____________

DATE ____________

PAGE ________ OF ________

SYSTEM TITLE ____________ SYSTEM DES. ____________ REF ____________

6.0 NOTE DEGREE OF INTERCONNECTION OF EACH SYSTEM TO NON-CLASS 1E SYSTEMS:

FIGURE 2-9.6

BASIC ELEMENTS INVOLVED IN REVIEW OF A SELECTED OPERATIONAL EVENT

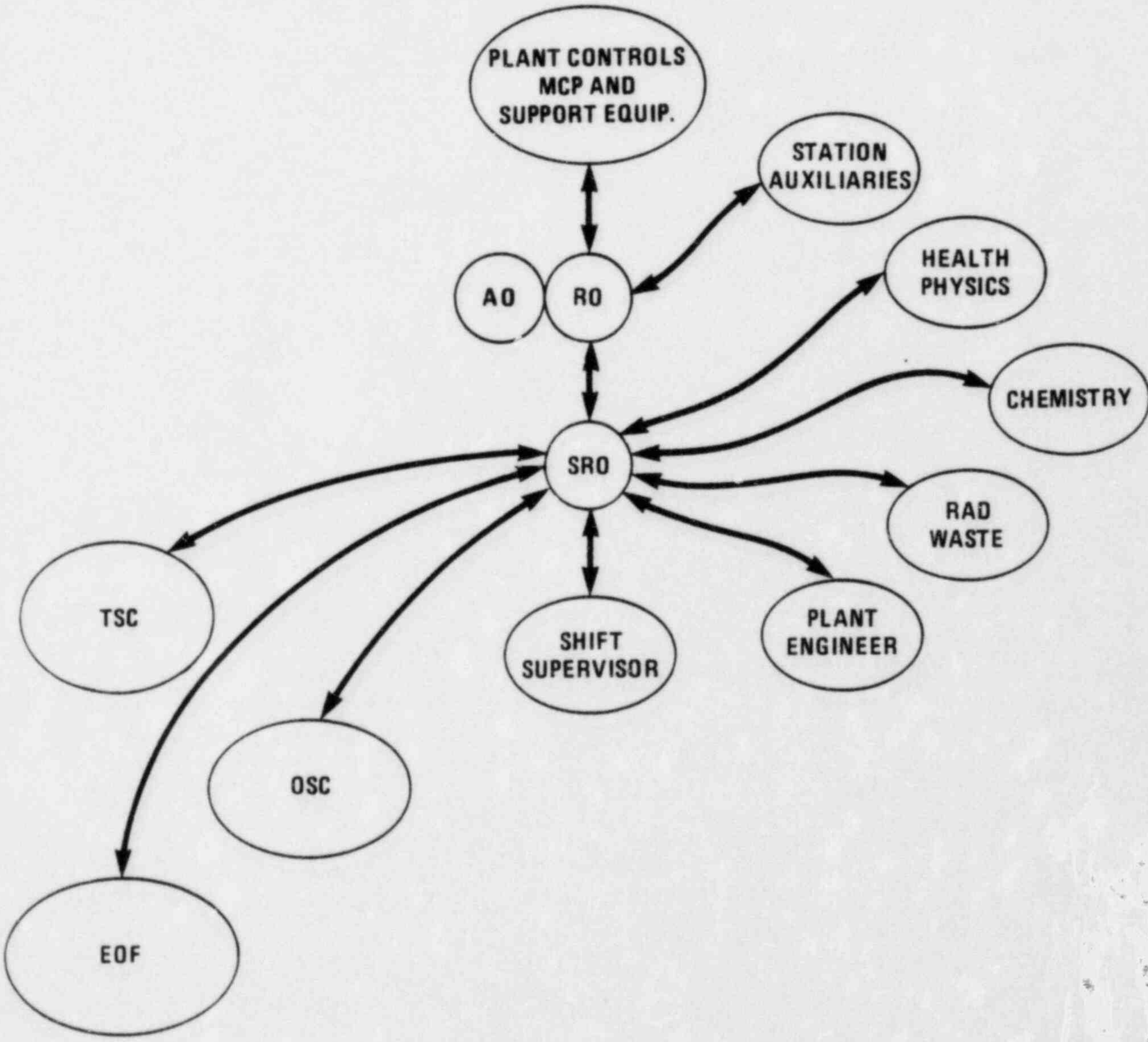


Figure 2-10

FUNCTIONAL (DECISION-ACTION) FLOW DIAGRAM

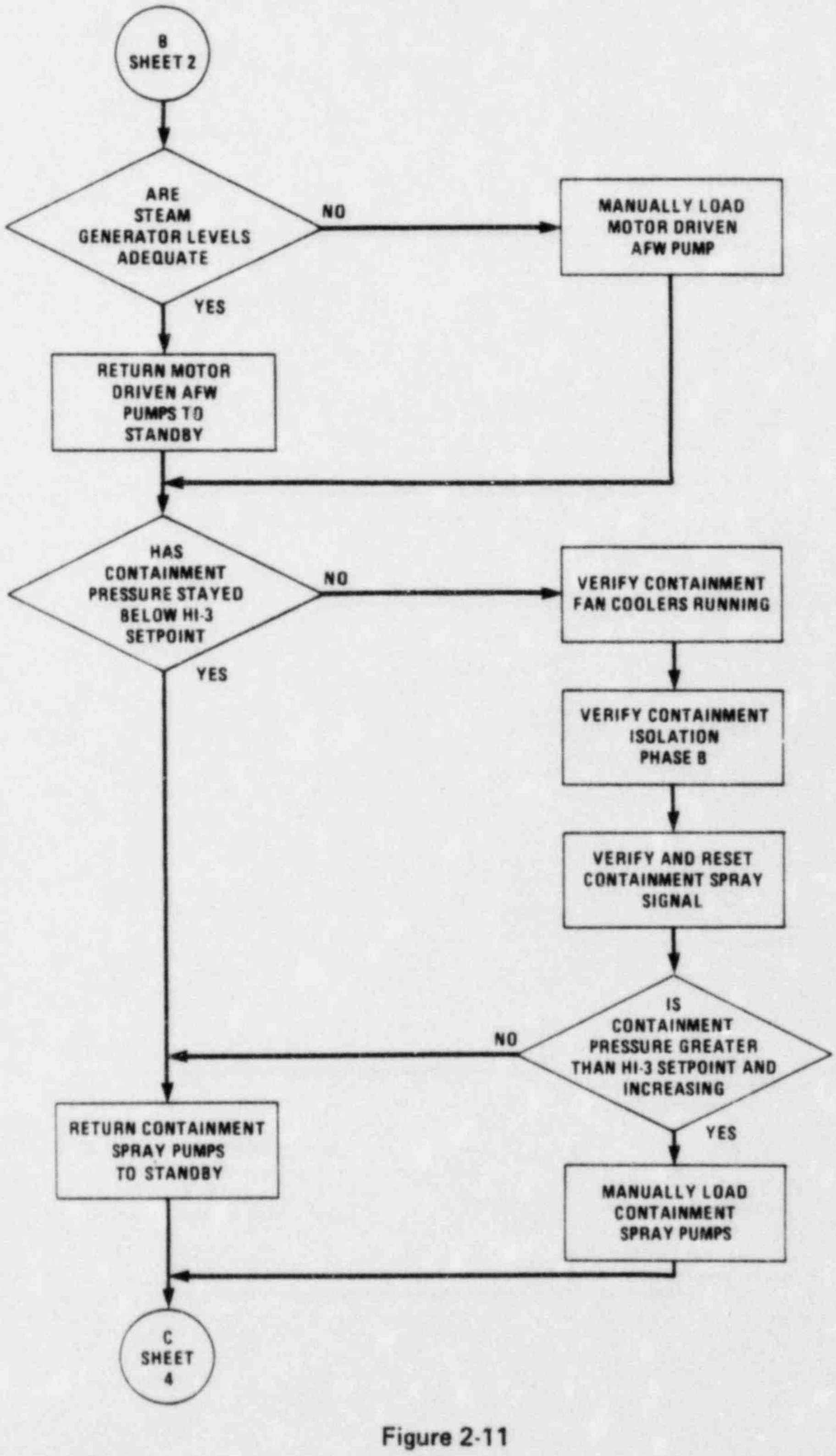


Figure 2-11

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
FUNCTIONAL SEQUENCE PER SELECTED OPERATIONAL EVENT

EVALUATOR ______________
SIGNATURE ______________
DATE ______________
PAGE ________ OF ________
REF ______________

EVENT TITLE: ______________

SYSTEMS STATUS AT ONSET OF EVENT		
NO.	TITLE	STATUS

FIGURE 2-12.1

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
FUNCTIONAL SEQUENCE PER SELECTED OPERATIONAL EVENT

EVALUATOR ______________________
SIGNATURE ______________________
DATE ______________________
PAGE __________ OF __________
REF ______________________

EVENT TITLE: ____

SEQUENCE NUMBER	LIST FUNCTIONS IN SEQUENCE	SYSTEMS/SUBSYSTEMS	PERFORMED BY	MONITORED BY	M/M CODE	PRINCIPAL CONTROL			PRINCIPAL COMMUN.
						AUTO	MANUAL	LOCAL	

FIGURE 2-12.2

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
OPERATOR TASK IDENTIFICATION AND ANALYSIS

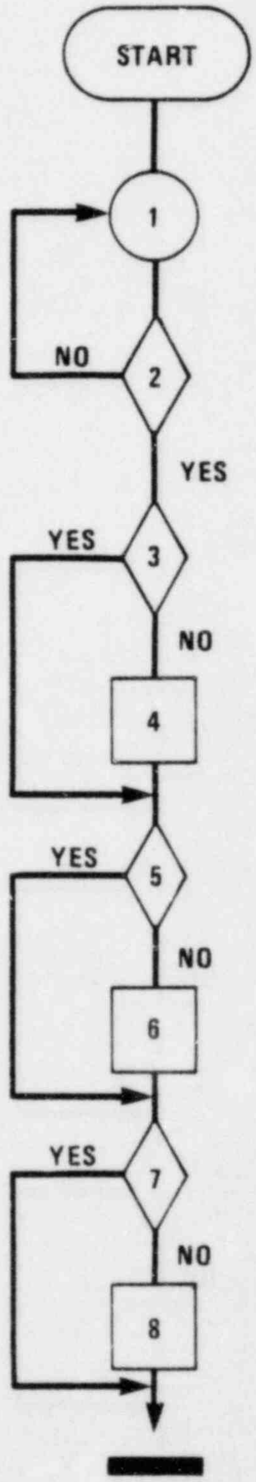
EVALUATOR ______________
SIGNATURE ______________
DATE ______________
PAGE ________ OF ________
REF ______________

LIST OF TASKS FOR FUNCTION: ______________

TASK NUMBER	TASK OBJECTIVE DESCRIPTION (LIST IN SEQUENCE)	TASK DECISION ACTION FIG. #	PERFORMED BY	MONITORED BY	M/M CODE	LIST EQUIPMENT REQUIRED TO COMPLETE TASK

FIGURE 2-13

DETAILED TASK(S) DECISION-ACTION DIAGRAM



(1) MONITOR RWST LEVEL

(2) RWST LEVELS LESS THAN OR EQUAL TO 3 FT.

(3) RAS INITIATED AND REQUIRED AUTO ACTIONS HAVE OCCURRED

(4) MANUALLY ACTUATE RAS

(5) LPSI PUMPS TRIP

(6) STOP LPSI PUMPS

(7) VERIFY MINIFLOW RECIRC VALVES CLOSED

(8) CLOSE MINIFLOW VALVES

Figure 2-14

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
TASK DETAILS

EVALUATOR ____________
SIGNATURE ____________
DATE ____________
PAGE ________ OF ________
REF ____________

TASK OBJECTIVE DESCRIPTION: ____________

SYSTEMS AND SUBSYSTEMS INVOLVED: ____________

INPUTS REQUIRED:

PARAMETERS	DEVICE NOS.	PANEL NOS.	RANGES	ACCURACIES	INITIAL VALUES	CONTROL DEVICES NUMBERS	PANEL NOS.	STATUS
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								

FIGURE 2-15 1

HOUSTON
LIGHTING
&
POWER CO.

CONTROL ROOM DESIGN REVIEW
TASK DETAILS

EVALUATOR ____________
SIGNATURE ____________
DATE ____________
PAGE ________ OF ________
REF ____________

TASK ACTIVITY NUMBER	TASK OBJECTIVE DESCRIPTION: ____________ SYSTEMS AND SUBSYSTEMS INVOLVED: ____________
STEP NO.	LIST ACTION REQUIRED, EQUIPMENT TO BE MONITORED AND/OR CONTROLLED, NEED FOR CONTINUOUS OR DISCRETE SETTINGS, DEGREE OF PRECISION REQUIRED, DECISIONS TO BE MADE, INPUTS REQUIRED FOR DECISIONS, RESULTS EXPECTED, AND PERFORMANCE CRITERIA IF APPLICABLE TO ACTIVITY. COMPLETE CR EQUIPMENT REQUIREMENT SHEETS, LIST POTENTIAL ERROR OR OMISSION, CONSEQUENCE THEREOF AND CORRECTIVE ACTION: ____________

FIGURE 2-15.2

HOUSTON LIGHTING & POWER CO.

SOUTH TEXAS PROJECT

CONTROL ROOM DESIGN REVIEW
TASK DETAILS

EVALUATOR ____________
SIGNATURE ____________
DATE ____________
PAGE ________ OF ________

PANEL INTERFACE EQUIP. REQUIRED FOR TASKS OF FUNCTION NO. ________ TITLED: ____________ REF ____________

TASK NUMBER AND DESCRIPTION	MONITOR/CONTROL		REQUIRED					LIST ASSOC. PANEL INTERFACE DEVICES		
	PARAMETER	WITH TAG NOS.	UNITS	RANGE	ACCURACY	RESPONSE TIME	LOCATION	DEVICE TYPE	REQ'D LOCATION	OTHER REQUIREMENTS (COMMUNICATIONS AND SUPPORT ACTIONS).

FIGURE 2-16

OPERATIONAL SEQUENCE DIAGRAM

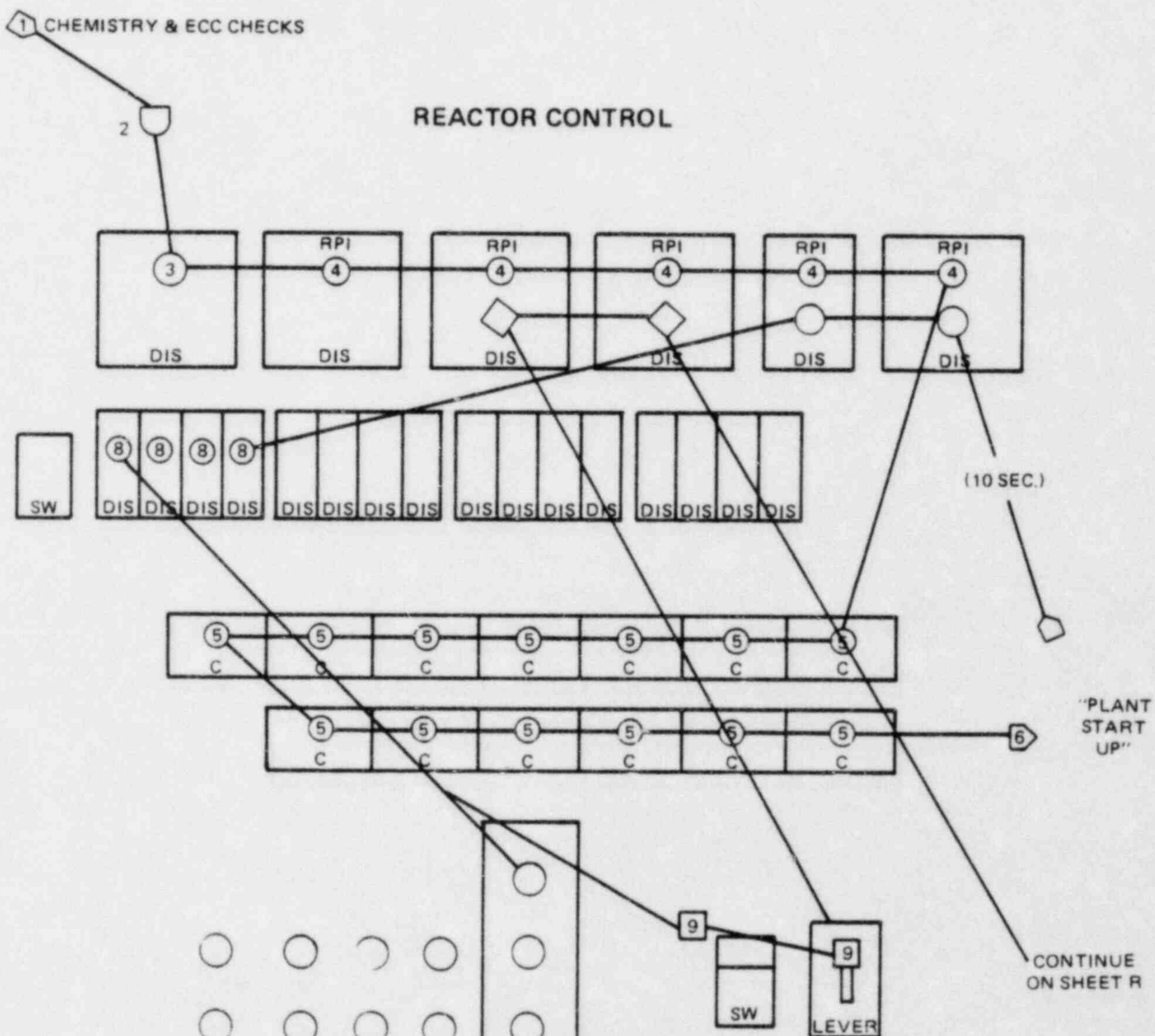


Figure 2-17

TRAFFIC LINK DIAGRAM

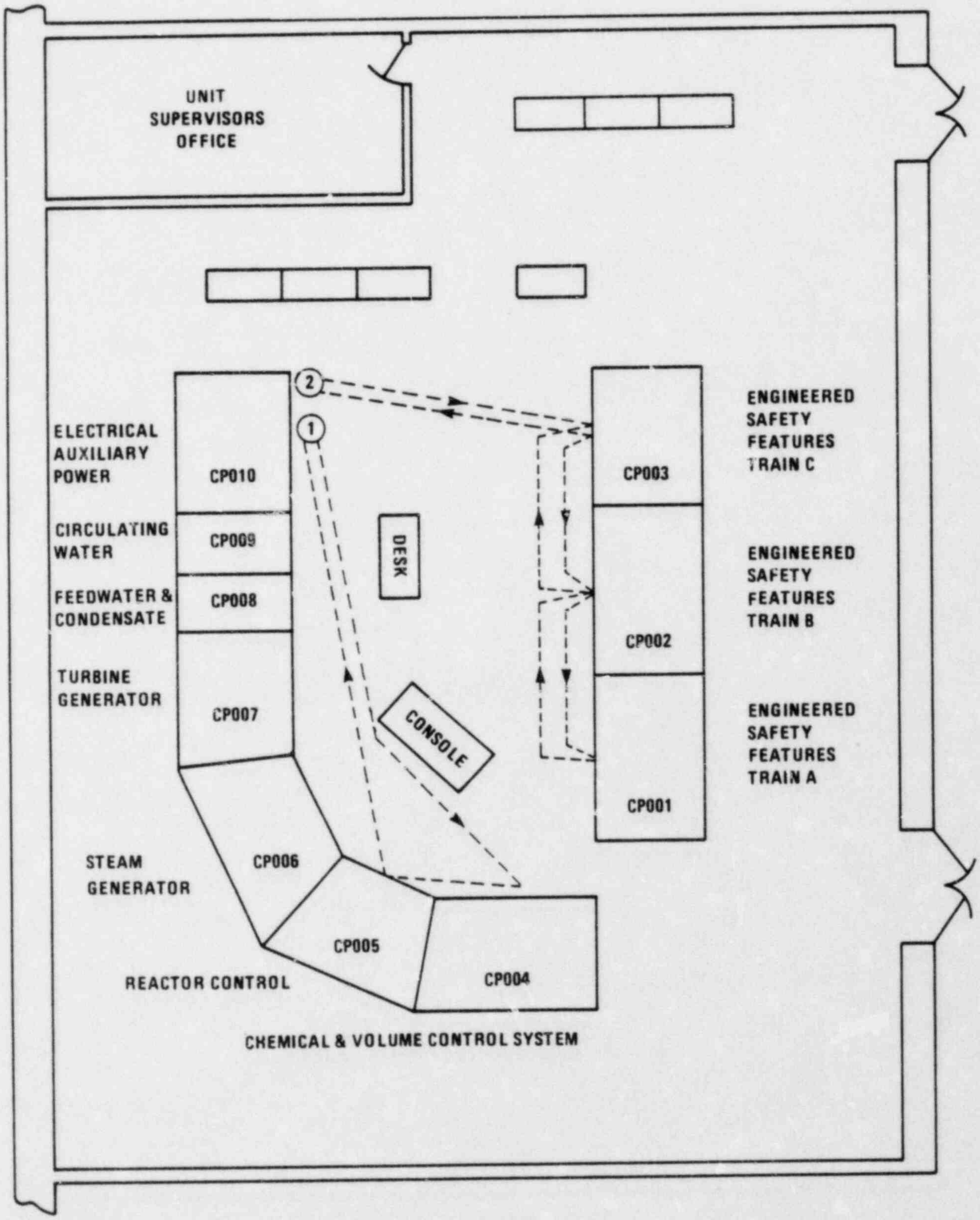


Figure 2 - 18

3.0 MANAGEMENT AND STAFFING

3.1 CONTROL ROOM DESIGN REVIEW MANAGEMENT PROCEDURE

- The management planning activity is described in Section 2.2.
- The basic organization and functions are shown in Fig. 2.2.
- The management team will meet throughout the program as required to perform its basic functions. Meetings will be called by the Principal Investigator, and directed by the HL&P Project Engineering Manager. In addition, it may be necessary to hold special meetings to meet scheduled requirements.
- The CRDR consultant will be available for these meetings as needed to facilitate completion of meeting agenda items.
- Minutes of all meetings will be taken and recorded.

3.2 INTEGRATION OF CRDR WITH OTHER HUMAN FACTORS PROJECTS

The overall relationship of NUREG 0660 task action items are shown in Fig. 1.1. The human factors aspect of the basic activities shown in Fig. 1.1 will be reviewed by the Project Review Team working with the HL&P and Bechtel licensing groups.

3.3 CRDR TEAM STRUCTURE AND PERSONNEL

The basic CRDR team structure and personnel are defined in Fig. 2-2 and 2-3. Resumes of assigned personnel are included in Appendices A and B and are consistent with the review criteria of NUREG-0801.

4.0 CRDR ASSESSMENT AND IMPLEMENTATION

All observations identified during the review phase will be processed according to the assessment and implementation methodology presented in Figures 4.1 through 4.3. The Design Review and Technical Task Team will document these observations and recommendations on Checklist Observation forms (CLOs) which are then submitted to the Project Review Team for assessment.

The initial step by the Project Review Team will be to accept or reject the formatted information where, in the latter case, they returned the CLO to the Design Review and Technical Task Team for further evaluation and resubmittal. Accepted CLOs will be categorized according to the Assessment Factor Criteria (Figure 4.2). The criteria chosen provides for a simple, but effective, relationship between assessment factor and implementation requirements commensurate with the significance of the observation. This approach greatly reduces the need to consider various levels of safety while still accomplishing the assessment objectives of NUREGs 0700 and 0801. To aid the Project Review Team in selecting the appropriate assessment factor for each finding, a set of statements or questions will be developed to the extent that the affected guideline(s) is inadequate in this respect.

All observations assigned Categories A, B or C will be identified as Human Engineering Discrepancies (HEDs) and will be analyzed for correction (Fig. 4-3). Correction of Category D results are optional. The first step in this process will be to identify those HEDs which can be corrected by enhancement. The remaining HEDs will be analyzed to identify design improvement alternatives and to select solutions. In addition, some HEDs may be corrected through training. An integral part of this step will be a re-application of the control room review process as appropriate to ensure that:

- Other guidelines are not violated.

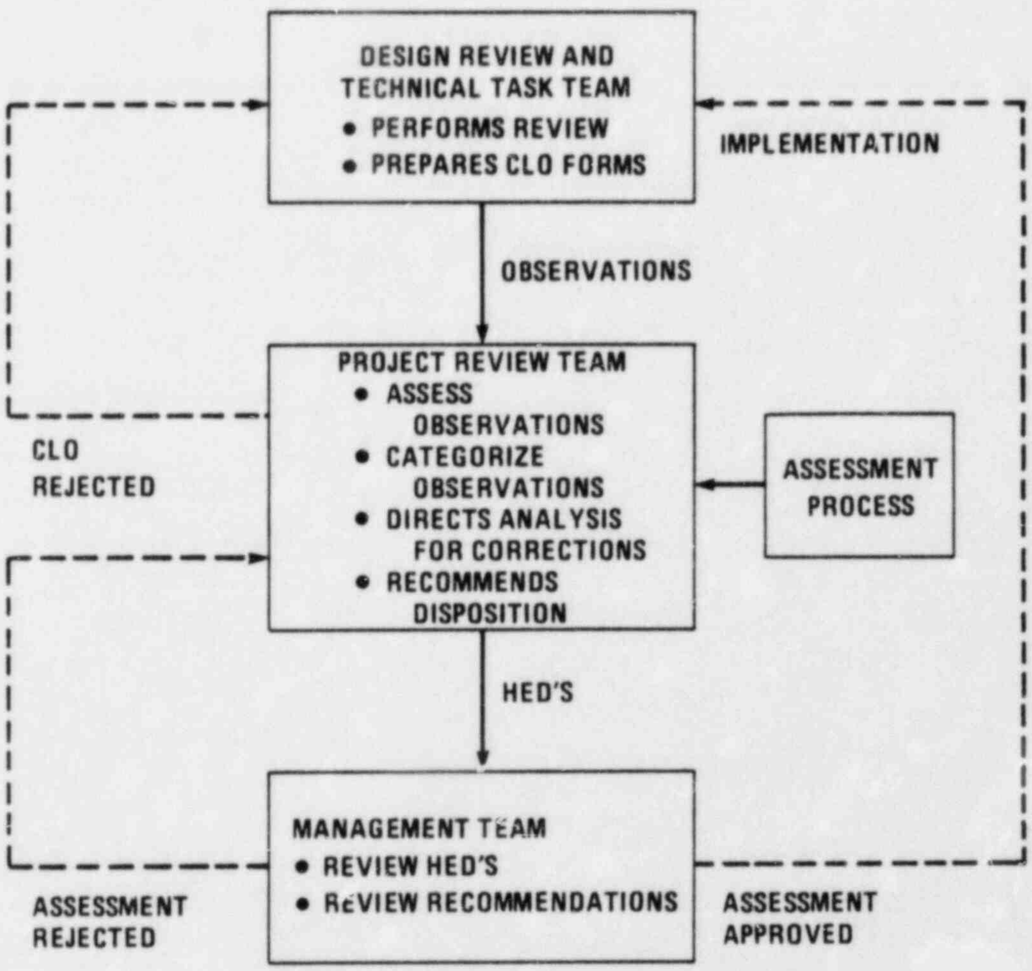
- Other corrections are not invalidated.

- Any resulting increase in significance of other findings is identified and accommodated.

Solutions which do not bring the discrepancies into full compliance with the guidelines will be identified and justified accordingly.

The Project Review Team will submit the processed CLO and their recommended solutions to the management team for approval. Rejected CLOs and/or solutions will be returned to the Project Review Team for additional assessment. Approved solutions will be returned to the Design Review and Technical Task Team for implementation planning.

ASSESSMENT AND
IMPLEMENTATION METHODOLOGY

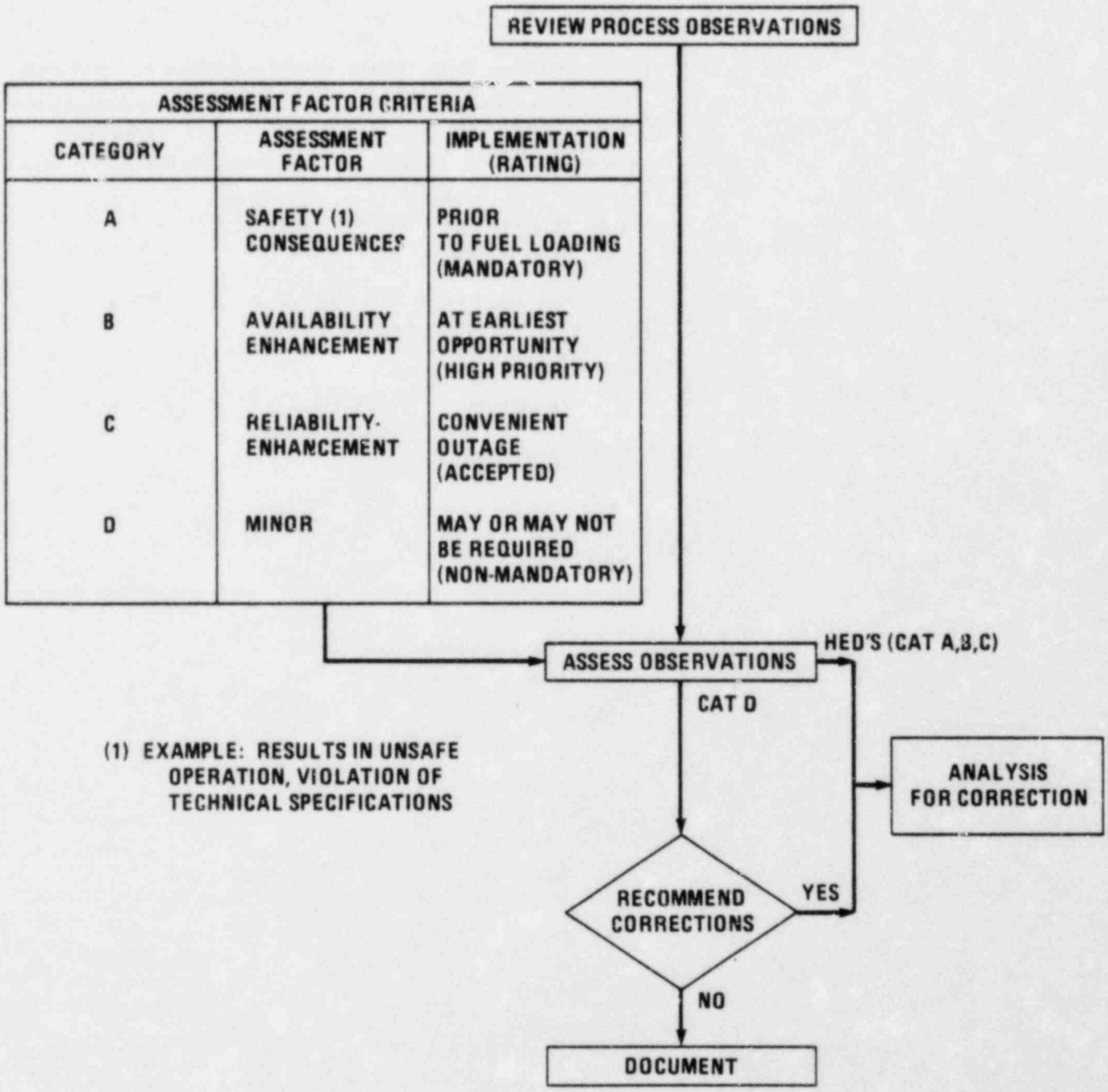


LEGEND:
CLO – CHECKLIST OBSERVATIONS
HED – HUMAN ENGINEERING DISCREPANCY

Figure 4 - 1

SELECTION OF HED'S TO BE ANALYZED FOR CORRECTION

ASSESSMENT FACTOR CRITERIA		
CATEGORY	ASSESSMENT FACTOR	IMPLEMENTATION (RATING)
A	SAFETY (1) CONSEQUENCES	PRIOR TO FUEL LOADING (MANDATORY)
B	AVAILABILITY ENHANCEMENT	AT EARLIEST OPPORTUNITY (HIGH PRIORITY)
C	RELIABILITY ENHANCEMENT	CONVENIENT OUTAGE (ACCEPTED)
D	MINOR	MAY OR MAY NOT BE REQUIRED (NON-MANDATORY)



(1) EXAMPLE: RESULTS IN UNSAFE OPERATION, VIOLATION OF TECHNICAL SPECIFICATIONS

Figure 4-2

SELECTION OF DESIGN IMPROVEMENTS

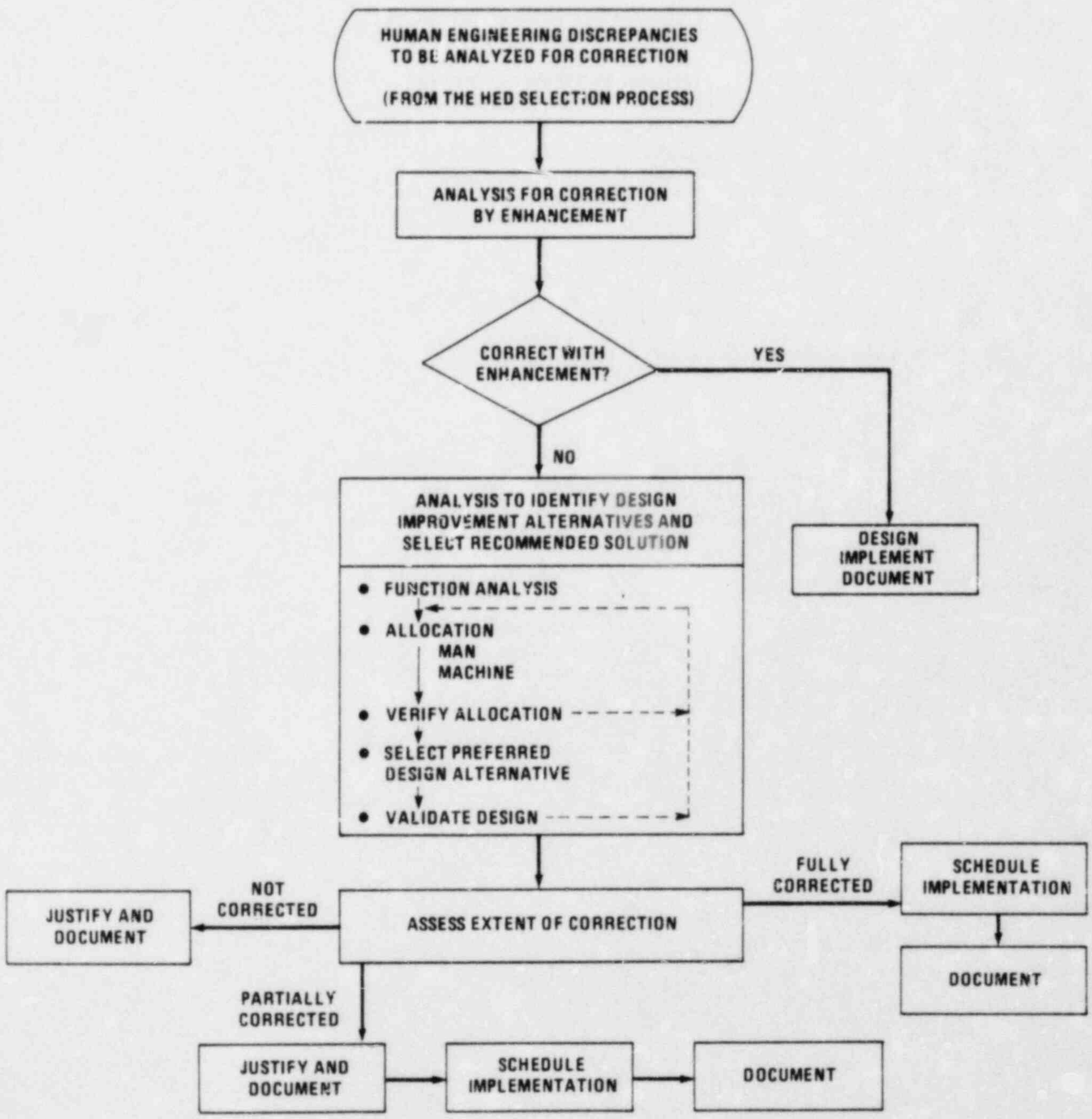


Figure 4 - 3

5.0 DOCUMENTATION AND DOCUMENT CONTROL

5.1 DOCUMENTATION USED TO SUPPORT THE CRDR

- o Bechtel has established a library in the mock-up facilities at the Houston engineering offices to assist the Design Review and Technical Task Team. The documents contained therein are the latest plant construction documents consistent with Section 2.4.1 of NUREG 0700. Houston Lighting & Power is participating in the Westinghouse owners group meetings that are producing generic reference material that will be used in this review.

- o The consultant has also established a reference library of pertinent human factors documents including many of those listed in NUREG 0700, as well as relevant documents generated in other CRDRs and relevant EPRI and INPO documents.

5.2 DOCUMENTATION GENERATED BY THE CRDR PROCESS

5.2.1 The following basic documents will be produced in this review:

- o Program Plan Report (this document).

- o Control Room Design and Review Criteria Report.

- o Final Executive Summary Report, which will address methodology, review findings, and implementation.

- o Detailed CRDR Report, which will provide the support material for the Executive Summary Report.

o Basic checklists, forms, sketches, and photographs used in the review and assessment phases; typical forms are included in Section 2.0 and Appendix C of this report.

5.2.2 The following material is currently under consideration for the Final Report.

5.2.2.1 The CRDR Report will contain two volumes: Executive Summary (Volume 1) and Discussion and Data (Volume 2).

5.2.2.1.1 The following format is proposed for Executive Summary (Volume 1):

Section 1. Introduction

1.1 Objectives
1.2 Program Overview
1.3 Plant Description

Section 2. Methodology

2.1 Management and Staffing
2.2 Use of Support Materials
2.3 Use of Guidelines and Checklists
2.4 Documentation

(These sections will reference the original program plan report, and will provide only material which updates and revises the original planning material submitted to the NRC.)

Section 3. CRDR Procedures

This section will summarize the actual procedures used in the review process. Topics shall be as follows:

3.1 Operating Experience Review

- o Identify types and time period of records reviewed.
- o Review operator survey procedures (e.g., interview) and summarize experience levels of surveyed operators.
- o Provide samples of the interview questions.

3.2 System Function Review and Task Analysis

The following processes will be summarized. Where this material may be covered in other licensee-applicant documents (e.g., Task I.C.1 emergency procedure guidelines and reporting analyses), reference to these documents will be made.

- o Charts or lists of major systems and subsystems and their components.
- o Basis for selecting operating events and failure sequences for analysis.
- o Scenario/assumptions necessary to define the operating events.

- Functional flow block diagrams showing systems, subsystems, and major components involved in the selected operating events, coded to identify where control of the function resides (e.g., manual, automatic, local).

- Hierarchial diagrams developed in the program.

- Functional sequence charts for control room operators (for each selected event).

- Task descriptors, organized by functional objective and system.

- Work station instrumentation and control requirements as drawn from the task analyses.

3.3 Control Room Inventory

- Summary of the actual control room inventory process.

- Sample inventory forms.

3.4 Control Room Survey

- Summary of control room survey process.

- Samples of survey forms (e.g., checklists, HED forms, and measurement forms) used in the survey process.

3.5 Annunciator Review

3.6 Verification of Task Performance Capabilities

- o Summary of the verification procedures used.

3.7 Validation of Control Room Functions

- o Summary of the validation procedures used.

Section 4. CRDR Findings

This section shall review the findings by listing the summaries of discrepancies and highlighting results of the reviews.

Section 5. Implementation

This section will summarize (1) recommended design changes, (2) proposed solutions, (3) methodology for implementation, (4) schedule for implementaton.

5.2.2.1.2 Discussion and Data (Volume 2) will contain the design criteria documentation and the detailed evaluation results to support the Executive Summary. It will expand the following topics.

1. Operating Experience Review
2. System Function Review and Task Analysis
3. Control Room Inventory
4. Control Room Survey
5. Annunciator Review
6. Verification of Task Performance Capabilities
7. Validation of Control Room Functions
8. Completed and Proposed Control Room Improvements

5.3 DOCUMENTATION SYSTEM AND CONTROL

The Design Review and Technical Task Team will develop a data base which will be reviewed by the Project Review Team. This data base will consist of computerized printouts and hard copy files of cross referenced information including:

- Listings of reference plant documents used.
- Listing of human factors referenced documents used.
- The Program Plan Report (this document).
- Pertinent Bechtel documents defining requirements for the CRDR.
- The control room criteria report.
- The outputs of the individual task groups (see Fig. 2-4).
- Minutes of meetings.
- All findings, HEDs, and dispositions as processed.
- Executive Summary Report.
- Detailed CRDR Report.
- Pertinent correspondence.

6.0 SUMMARY

The Houston Lighting & Power Company considers that the program planned for the review of the South Texas Project is extensive, complete and consistent with the pertinent document noted herein.

The program is in progress and it is our intention to comply with the content of this Program Plan Report. Houston Lighting & Power reserves the right to make changes in its best interest and will notify the NRC of all planned or executed deviations.

APPENDIX A

Qualifications of Management Team Members

STEPHEN M. DEW
Engineering Manager, STP
Houston Lighting & Power

Education:	BSCE, University of Missouri at Columbia	
Summary:	1 Year :	Assistant Engineering Project Manager, Brown & Root
	6 Years:	Assistant Project Engineer, Stone & Webster
	6 Years:	Startup Engineer, Babcock & Wilcox

Experience:

Mr. Dew joined Houston Lighting & Power (HL&P) in 1981 and is presently the Engineering Manager for the South Texas Nuclear Project. His responsibilities include providing direction, coordination and administration of the project engineering effort to ensure that it is accomplished in an effective, timely, economical and technically competent manner. He is specifically responsible for: directing the project engineering team in their daily coordination with the architect-engineer; directing the development of specific HL&P procedures necessary to accomplish the work; directing HL&P's review of engineering and pertinent licensing documents; assuring the preparation of technical specifications and provisions of engineering input to bidder's lists for the procurement of equipment, systems, materials and engineering services. Other responsibilities include resolution of critical problems; interfacing with various project management members and A-E Project Engineering Manager for the purpose of administering the project; and interfacing with representatives from vendors.

As an Assistant Engineering Project Manager with Brown & Root, Mr. Dew was assigned to the South Texas Project. He was in charge of the Systems Engineering Group and his responsibilities included: managing a group of mechanical, civil, electrical, instrument and controls, licensing, materials engineering, heavy civil, architectural and nuclear analysis personnel. Within his group, he was responsible for establishing the basic design criteria for his area of responsibility; controlled a budget in excess of three million manhours; provided design information for other portions of the project and construction; had technical responsibility, through the desciplines, for subcontracts totaling several million dollars; monitored cost and schedules for the group; and coordinated with other personnel on the project.

Mr. Dew was an Assistant Project Engineer for Stone & Webster and was assigned to the Beaver Valley Power Station, two 888 MW PWR units, in charge of the site engineering office. His responsibilities included: managing a staff of professional and semi-professional personnel; coordinating detailed engineering activities;

establishing and controlling the site budget of over one million manhours; resolved items of nonconformance; supervised the maintenance of the model; and was responsible for coordinating the engineering efforts of all site agencies to ensure a quality product. Mr. Dew performed various startup activities while with Babcock & Wilcox (B&W) as both a fossil and nuclear startup engineer. He was instrumental in the development of B&W's PWR test program, supervised the shipment and receipt of B&W's first nuclear fuel shipment to the Oconee Nuclear Station. Also, Mr. Dew had considerable involvement with the testing program on fossil and nuclear plants totaling 4300 MWe.

Professional Affiliations: Professional Engineer, Texas
Member, American Nuclear Society, South Texas Section

JERROLD G. DEWEASE
Vice President, Nuclear Plant Operations
Houston Lighting & Power

Education: BSEE, Christian Brothers College

Summary:

13 Years: Various positions with Tennessee Valley Authority

8 Years: Electrical Engineer, Memphis Light, Gas and Water

Experience:

Mr. Dewease joined Houston Lighting & Power in 1981 as Vice President, Nuclear Plant Operations and has direct responsibility for operation of the South Texas Project, Allens Creek and other nuclear operations support activities.

Mr. Dewease joined the Tennessee Valley Authority in 1968 as an Instrument Engineer at the Browns Ferry Nuclear Plant. He initially worked on establishing the instrument program and technical specifications.

In 1971 he became the Assistant Engineering Supervisor at the Browns Ferry Nuclear Plant and had supervisory responsibility over the reactor engineering, radio-chemistry, testing and instrumentation and control groups. In this position, Mr. Dewease supervised the establishment of the initial surveillance program which implemented the technical specifications and participated in the initial startup of units 1 and 2.

Mr. Dewease became the Quality Assurance (QA) Supervisor in 1974 at the Browns Ferry Nuclear Plant. He was responsible for plant QA during the recovery from the March 1975 fire, the restart of units 1 and 2 after the fire and the initial startup of unit 3. During 1976, Mr. Dewease became the Assistant Plant Superintendent. In 1977, he became the Plant Superintendent at the Browns Ferry Nuclear Plant.

In 1979, Mr. Dewease was promoted to Assistant Director of Nuclear Operations, with responsibility for the plant operations staffs of four TVA nuclear plants: Browns Ferry, Sequoyah, Watts Bar, and Bellefonte.

For Memphis Light, Gas and Water as an Electrical Engineer and later as Assistant Electrical Maintenance Supervisor at the T.H. Allen Electric Generating Station, Mr. Dewease was involved in providing engineering support and technical guidance to the electrical maintenance section.

JAMES L. HURLEY
Systems Project Engineer, STP
Bechtel Power Corporation

Education:	BA, Physics, St. Mary's College, Minnesota U.S. Navy Nuclear Power School, Mare Island, California U.S. Navy Nuclear Power Training Unit, S3G Prototype, West Milton, New York MS, Nuclear Engineering, Oregon State University

Summary:

1/2 Year:	Project Manager
3-1/2 Years:	Project Engineer
4-1/2 Years:	Assistant Project Engineer
1 Year:	Mechanical Design Group Supervisor
1-1/2 Years:	Reactor Plant Group Leader
1 Year:	Nuclear Engineer
2-1/2 Years:	Naval Nuclear Power Officer

Experience:

Mr. Hurley has fifteen years experience in nuclear power plant engineering and management and is currently Bechtel Power Corporation's Systems Project Engineer on the South Texas Project. In this position, he is responsible for mechanical, electrical, controls, and nuclear design; procurement, licensing, and engineering quality. Prior to this, Mr. Hurley was Project Manager for the Duane Arnold Energy Center, a 544 MWe nuclear power plant operated by Iowa Electric Light and Power Company. His responsibilities included generation of IELP's responses to NUREG's 0578, 0612, and 0737, and to NRC Bulletins 79-01B, 79-02, 79-14, 80-06, and 80-11. He also collaborated with the utility in the generation of their emergency response plan.

He was the initial Project Engineer for Bechtel's onsite support work at Three Mile Island (TMI), and served as the Ann Arbor Power Division coordinator of all TMI related work. He was also the Project Engineer for the Midland Nuclear Plant Studies Group which, together with Consumers Power Company and Babcock & Wilcox personnel, reviewed 30 safety-related issues for their potential impact on Midland Units 1 and 2, a nuclear project with a total output of 1,375 MWe and 4 million pounds per hour of process steam, being built for Consumers Power Company. He also worked with EDS Nuclear preparing safety and operational sequence diagrams for Midland Units 1 and 2. As the assistant project engineer on Midland Units 1 and 2 he was responsible, at various times, for mechanical design and procurement, engineering cost and scheduling, plant layout, electrical and control systems design and procurement, engineering quality, project administration, engineering aspects of plant startup, and plant licensing, including responsibility for initial submittal of the Midland FSAR. He was the resident project engineer at the jobsite for the last four months of this assignment.

He acted as a consultant for the Detroit Edison Company on the Greenwood 2 and 3 nuclear project and for Consumers Power Company on the Palisades nuclear project. He was the project engineer for the American Electric Power nuclear plant studies project. This was a year long effort to assist the utility in selecting a nuclear power plant to duplicate at a site within its system.

Prior assignments with Bechtel include mechanical design group supervisor on the Midland project; reactor plant group leader on Arkansas Nuclear One, Unit 2, a 950 MWe plant for Arkansas Power and Light Company; and evaluator of the Westinghouse and KWU-Siemens bids (including balance-of-plant designs) for the Jervis Bay 600 MWe unit for the Australian Atomic Energy Commission.

Prior to joining Bechtel, and while obtaining his advanced degree at Oregon State University, he collaborated in the design of a deep ocean nuclear moisture meter for the U.S. Navy Civil Engineering Corps. This work is described in U.S. Naval Civil Engineering Laboratory Report CR 70.016, which he co-authored.

He was the reactor control division officer on the USS Long Beach (CGN-9). In this capacity, he was in charge of the operation, maintenance, and testing of all reactor control and radiation monitoring equipment for two shipboard reactor plants. He also supervised the training of all reactor operators and technicians.

Proffesional Affiliations:

Registered Professional Engineer, Michigan
Member, American Nuclear Society

WARREN HUGH KINSEY, JR.
Assistant Plant Superintendent
Houston Lighting & Power

Education:	BSME, University of Missouri U.S. Navy Nuclear Power Training Program	
Summary:	7 years:	Mechanical Engineer/Engineering Supervisor, Tennessee Valley Authority
	4 years:	Senior Reactor Operator, University of Missouri
	6 years:	Senior Reactor Operator, U.S. Navy

Experience:

Mr. Kinsey joined Houston Lighting & Power Company in 1982 as Assistant Plant Superintendent, Acting Plant Superintendent and is responsible for plant staffing and preparation for startup for operational phase.

Mr. Kinsey joined the Tennessee Valley Authority in 1975 as a mechanical Engineer (Equipment Performance Group). He was responsible for re-start of numerous BWR systems following a major fire at the Brown Ferry Nuclear plant. He was responsible for initial startup of BWR systems on a new unit and was instrumental in developing the first TVA ASME Section XI program. He also prepared procedures for startup and performance tests of mechanical equipment.

As an engineering Section Supervisor on the Sequoyah Nuclear project, he was responsible for the nuclear startup test program for the two unit PWR reactor, including water chemistry, radio-chemistry and environmental regulations (NPDES). He also had responsibility for the ASME Section XI and Appendix J testing and equipment testing, (e.g. HEPA and charcoal filter tests, heat exchanger and pump performance tests, water treatment plant performance and condensate full flow demineralizer performance).

Prior to joining TVA, Mr. Kinsey was a Senior Reactor Operator at the University of Missouri. He was a licensed Senior Reactor Operator on a 10MW research reactor which was operated for experimental and industrial uses. He performed maintenance and modifications on the equipment and participated in upgrade work on a 5 to 10 MW conversion.

From 1965 to 1971, Mr. Kinsey was a Senior Reactor Operator (Technician and Instructor) in the U.S. Navy. He operated the reactor and performed maintenance on reactor control instrumentation. He also instructed other Navy personnel in reactor operations maintenance. As an instructor, he was responsible for shift crew of reactor operators and technicians and participated in inplant and classroom training of Navy and civilian employees. He also participated in refueling activities.

Professional Affiliations:

Member, American Society of Mechanical Engineers
Member, American Nuclear Society

M. G. (JIMMY) ZAALOUK
Principal Engineer - Nuclear,
Houston Lighting & Power

Education:	BSEE, Cairo University, Egypt MSNE, North Carolina State University PHD NE, North Carolina State University	
Summary:	9 Years:	Principal Engineer, Carolina Power & Light
	3 Years:	Assistant Professor, North Carolina State
	1 Year:	Visiting Engineer, Norwegian Institute for Atomic Energy
	2 Years:	Engineering Unit Supervisor, Egyptian Atomic Energy
	3 Years:	Reactor Engineer, Egyptian Atomic Energy

Experience:

Mr. Zaalouk joined Houston Lighting & Power in 1981 as a Principal Engineer-Nuclear, responsible for providing the nuclear engineering discipline technical support for the South Texas Project and Allens Creek Nuclear Generating Station.

Prior to joining HL&P, Mr. Zaalouk was with Carolina Power and Light Company as a Senior nuclear engineer. He was promoted in 1974 to Project Engineer-Nuclear and in 1977 to Principal Engineer Mechanical/Nuclear. He was involved in Nuclear Systems design review and construction support of the Shearon Harris Nuclear Power plant, 4 PWR units, 900 MWe each. This included the review and timely implementation of regulatory and code requirements and assured design compliance including safety analyses and ALARA requirements. He gave startup and operations support for the Brunswick Steam Electric plant, a 2 unit BWR, 820 MWe each. He later became responsible for the engineering management of all mechanical and nuclear plant design modifications for the H.B. Robinson Nuclear Power plant, 700 MWe PWR and the Brunswick plant. He headed the company TMI-2 Corporate Investigative Team PWR following the Three Mile Island incident. Mr. Zaalouk served on the task force to develop the corporate emergency plan for the company's three nuclear power plants. He also directed development of the in-house ALARA design review program.

While an Assistant Professor for power systems at North Carolina State University, Mr. Zaalouk taught undergraduate courses in power systems engineering and analysis. He co-directed an NSF and NRC (AEC) funded research program to develop a temperature control system to prevent burn-out of heating elements when exceeding critical heat flux values under severe conditions such as LOCA. Results were published in 22 technical papers.

As a nuclear engineering unit supervisor for the Egyptian Atomic Energy Establishment, he directed R&D in the areas of reactor systems, core design and safety analysis. Developed and implemented a reactor training program and directed the reactor power uprating engineering effort.

Mr Zaalouk spent a year at the Norwegian Institute for Atomic Energy where he developed an advanced computer code now in use by the industry in light water reactors core design and analysis.

As a Reactor Engineer for the Egyptian Atomic Energy Commission he was responsible for nuclear systems design review and construction and startup support of a 2 MWt research reactor.

Professional Affiliations:

American Nuclear Society: Member (Since 1972); Co-chairman of Reactor Operations Division Technical Program Committee (1979-1981); and appointed to the ANS National Program Committee in 1982.

North Carolina State University, School of Engineering: Adjunct Associate Professor (1972-1981).

ANS Standards Committee: Member of ANS Standards Committee ANS-19, "Reactor Core Design" (1973-1981).

IEEE: Technical Reviewer - Journal of Instrumentation and Control (1972-present)

APPENDIX B

Qualifications of Project Review Team and Design Review and Technical Task Team Members

WILLIAM R. ARNOLD
Task Analysis Leader,
Torrey Pines Technology

Education: BSEE, University of Texas
Graduate Courses, Electrical and Nuclear Engineering

Experience: Review of qualification data for safety-related equipment for PWR projects. Responsible for assuring that the data packages met the general requirements of NUREG-0588 and the specific requirements referenced and that the equipment represented is satisfactory for use in a harsh environment.

Review of safety-related plant control and protection system logic and operation to confirm that components important to safety are properly classified for PWR projects at Bechtel.

Field investigation and solution of reactor protection system trips and transients during startup of Fort St. Vrain station. Liaison on operational and licensing aspects with utility operations and with NRC.

Field engineer in successful construction and startup of all internal and adjacent external reactor instruments, pressure test and hot flow test support, and control rod drive checkout for Fort St. Vrain station.

Completed design and documentation for licensing of reactor plant protection systems. Accomplishments included logic design, cabling, customer liaison and review of specifications and layout for compliance with applicable NRC design criteria.

Electrical design of aerospace launch control hardware and systems.

Professional Affiliations: Registered Control Systems Engineer, California

DANNA M. BEITH
Human Factors Specialist,
Canyon Research Group

Education: B.A., Psychology, University of California, Santa Barbara, California

Summary:
2 Years: Research Scientist Project Manager
2 Years: Associate Human Factors Designer
1 Year: Assistant Researcher
2 Years: Field Investigator
1 Year: General Assistant
1 Year: Counselor

Experience: Mrs. Beith is presently a Human Factors Specialist with Canyon Research Group, Inc. and is participating in the NUREG-0700 evaluation of the South Texas Project.

As a Research Scientist/Project Manager for Essex Corporation, she was a project manager for the development and production of approximately 300 nuclear power plant surveillance test procedures for South Carolina Electric and Gas Company. Work involved technical review and editing of developed procedures, technical direction of all project staff, and coordination of the production of the procedures from initial writing through final word processing. Responsible for the technical work and personnel affairs of a staff composed of technical writers, editors, nuclear plant operations specialists, and word processors.

During this time, Mrs. Beith organized and planned the Electric Power Research Institute Seminar which introduced the EPRI guidebook, "Humans Factors Design of Nuclear Power Plants" to the nuclear industry. Duties included speech preparation for major speakers, workbook preparation, and mock-up design and implementation.

She was the on-site supervisor for the rewriting and formatting of nuclear power plant emergency, general and system operating procedures at South Carolina Electric and Gas Company's Virgil C. Summer Nuclear Station. Procedure formats were reviewed using criteria concerned with readability, legibility, and consistency.

She directed the Human Factors evaluation of the on-site data collection for the Comanche Peak 1 Nuclear Power Plant control room. This evaluation included criteria specified in NUREG/CR-1580 and NUREG-0700. Duties also included documenting and identifying Human Engineering discrepancies and backfits.

DANNA M. BEITH

As a Research Associate, Mrs. Beith participated in the Human Factors evaluation of three nuclear power plants for Carolina Power & Light. One plant evaluation included a control board assessment of engineering drawings for a plant under construction. Duties consisted of procedures development for control room evaluation and identifying, reporting and suggesting suitable backfits for Human Engineering Discrepancies found in the control room. Duties also include the establishment of permanent records for all data and report writing.

She has prepared checklists and surveys to meet evaluation requirements specified in NUREG/CR-1580. Also conducted an analysis of NUREG-0700 to assess new human factors criteria. Validated checklist items from first sources references.

During Mrs. Beith's two years with Xerox as an Associate Human Factors Designer, she gave support to the Human Factors Department in the Business Machine and Copies/Duplication Division. Duties included control system design, behavioral testing and new product assessments. She also wrote machine operating procedures and developed dialogues used for operator assistance.

At Canyon Research Group, Inc., Mrs. Beith was an Assistant Researcher as a contract research assistant to Xerox Corporation, Industrial Design/Human Factors Department. Support to the Human Factors Department in the Business Machines Division. Duties consisted of control system design and behavioral testing.

As a Field Investigator for Bio Technology, Inc. she conducted a "Large Truck Accident Study" for the Federal Highway Administration of the Department of Transportation. Supervised Field Investigators conducting interview with truck owners, drivers and California Highway Patrol officers and analyzed accident sites and accident reports. Conducted highway surveys involving road characteristics, traffic density and speed data using remote control cameras and radar equipment.

Other experience included General Assistant - Office of the Dean, Graduate School of Education, University of California where she conducted a study of Professor-Student contact hours and performed general office duties. She was a Counselor for the Arnold Homes for Children, Inc. and a behaviorist for emotionally disturbed childern. Acted as an Assistant to the Administrative Counselor as a Project Research to refine and update Behavior Modificaton Programs.

Professional Affiliations: Member, National Human Factors Society

FRANK C. BURSIC

Education: B. S., Electrical Engineering, University of Pittsburgh
Graduate Courses: Electrical-Industrial Engineering
Specialty Courses: Human Factors - University of Pittsburgh and Westinghouse Electric Corporation.

Experience: Mr. Bursic is with Westinghouse Electric Corporation in the Instrumentation and Control Department, Electrical Power Systems and Control Board Group. His work experience has been in the area of main control board/panel layout and design. He is also the cognizant engineer for annunciator systems.

He participated in the Westinghouse support to Georgia Power, Caroline Power and Light, and Commonwealth Edison Control Room Design Reviews. These design review efforts required the involvement of Westinghouse design engineers to evaluate the control panel layout and annuciator system for system information/arrangment (flow & functional) and human factor concerns. In addition, recommendations were provided for resolution of identified HEDs.

He also participated in the design of a modular operation console which can act as an information gathering/diagnostic center and integrate requirements of Reg. Guide 1.97 and NUREG-0696 into existing control rooms.

Mr. Bursic assisted in the design of the advanced control room layout and control consoles which included integration of the modular consoles, human factors engineering, and a full scale simulator.

Directed the development of a computerized procedures retrieval system.

Assisted in the development of an internal training program which addresses human factors involvement in control room design reviews.

Professional Affiliations: Member, IEEE

JERRY M. CHILDS
Human Factors Specialist

Education:	Ph.D., Engineering Psychology, Texas Tech University B.A., Psychology, Texas Tech University	
Summary:	Present:	Project Director, Seville Research Corporation
	2 Years:	Staff Scientist, Canyon Research Group, Inc.
	3 Years:	Asst. Professor, Wayland College
	2 Years:	Instructor, Texas Tech University

Experience:

Mr. Childs is presently a Project Director for Seville Research Corporation and is responsible for management and conduct of human factors research and development in the areas of control-display evaluation, training, operator and system performance measurement, and simulation. Activities include the conduct of mission, function, and task analyses, development of performance evaluation techniques, development of techniques for evaluating the use of advanced displays and controls, and development of training programs.

As a Staff Scientist, Principal Investigator for Canyon Research Group, Inc. he was responsible for the identification, analysis, and evaluation of critical training elements, and the design and development of objective performance measurement procedures. Specific activities included the conduct of task, function and mission analyses, the development of concepts and procedures for assessing operator performance, and the generation and evaluation of system performance criteria and procedures for sampling system performance.

While at Wayland College, Mr. Childs was an Assistant Professor to Associate Professor and Head, Behavioral Science Department and was responsible for the general administration of undergraduate psychology programs, including the development, scheduling, and instruction of courses, assignment of personnel, and budgeting. Activities included organization of behavioral science symposia, development and management of internship programs and supervision of strudent research projects. Major teaching emphases were experimental/quantitative (experimental psychology, statistics, learning, perception, motivation); also taught courses in psychological systems and theories, and in psychopathology.

Mr. Childs was an Instructor at Texas Tech University and was responsible for instructing experimental psychology laboratories. Activities included instrumentation, writing and administering exams, and instructing concepts of experimental design, statistical and experimental control, and descriptive and basic inferential statistics, correlational methods, graphing, and scientific writing and referencing.

JERRY M. CHILDS

Professional Affiliations:

Member, Human Factors Society
Member, Americn Psychological Association
Member, Southwestern Psychological Association
Recipient of Southwestern Psychological Association's Publishers Award, 1975, Houston, TX; 1976, Albuquerque, NM
Licensed Psychologist

Publications:

Childs, J. M. & Halcomb, C. G. Effects of noise and response complexity upon vigilance performance, Perceptual and Motor Skills, 1972, 35, 735-741. (Also presented at the Southwestern Psychological Association Conference, Oklahoma City, Oklahoma, April 1972.)

Childs, J. M. Signal complexity, response complexity, and signal specification in vigilance, Human Factors, 1976, 18, 149-159. (Also presented at the Southwestern Psychological Association Conference, Houston, Texas, April 1975; received SWPA's 1975 Publisher's Award from Brooks-Cole Publishing Co.)

Childs, J. M. Caffeine consumption and target scanning performance, Human Factors, 1978, 20(1), 91-96. (Also presented at the Southwestern Psychological Association Conference, Albuquerque, New Mexico, April 1976; received SWPA's 1976 Publisher's Award from Brooks-Cole Publishing Co.)

Childs, J. M. The identification and measurement of critical IERW performance variables (Contract No. DAHC19-77-C-0008, Research Memo). Westlake Village, CA: Canyon Research Group, Inc., March 1979.

Childs, J. M. Development of procedures and techniques for inflight performance assessment (Research Memorandum FTR-07-79). Westlake Village, CA: Canyoun Research Group, Inc., April 1979.

Childs, J. M. An analytic technique for identifying inflight performance criteria (Contract No. DAHC19-77-C-0008). Westlake Village, CA: Canyon Research Group, Inc., April 1979.

Childs, J. M., Hennessy, R. T., Hockenberger, R. L., Barneby, S. F., Vreuls, D., Siering, G. D., & Van Loo, J. A. Human factors research in aircrew training performance enhancement: Summary Report No. 1 (Technical Report). Westlake Village, CA: Canyon Research Group, Inc., April 1979.

Childs, J. M. Development of an objective grading system along with procedures and aids for its effective implementation in flight (ARI Research Note 79-18). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, May 1979.

Childs, J. M., Siering, G. D., Smith, B. A., & Hockenberger, R. L. Human factors research in aircrew training performance enhancement: Summary Report No. 2 (Contract No. DAHC19-77-C-0008). Westlake Village, CA: Canyon Research Group, Inc., June 1979.

Childs, J. M. The development of objective inflight performance assessment procedures. In Proceedings of the Human Factors Society-23rd Annual Meeting, 1979, 329-333.

Childs, J. M. Time and error measures of human performance—A note on Bradley's optimal-pessimal paradox, Human Factors, 1980, 22(1), 113-117.

Siering, G. D., Ruffner, J. W., & Childs, J. M. Identification of key elements and procedures for inflight performance assessment (WP FR/FU-80-4). Westlake Village, CA: Canyon Research Group, Inc., March 1980.

Roscoe, S. N., & Childs, J. M. Reliable, objective flight checks. In S. N. Roscoe, Aviation Psychology. Ames, IA: Iowa University Press, 1980.

Hockenberger, R. L., & Childs, J. M. An integrated approach to pilot performance assessment. In Proceedings of the Human Factors Society-24th Annual Meeting, 1980, 462-465.

Shelnutt, J. B., Childs, J. M., Prophet, W. W., & Spears, W. D. Human factors problems in general aviation (Technical Report FAA-CT-80-194). Washington, DC: Federal Aviation Administation, April 1980.

Childs, J. M., Prophet, W. W., & Spears, W. D. The effects of pilot experience on acquiring instrument flight skills - Phase I (Technical Report FAA-CT-81-38). Washington, DC: Federal Aviation Administration, March 1981.

Holmes, C. W., & Childs, J. M. The effects of pilot experience of acquiring instrument flight skills - Phase II (Technical Report FAA-CT-82/35. Washington, DC: Federal Aviation Administration, January 1982.

JERRY M. CHILDS

Shelnutt, J. B., Childs, J. M., Prophet, W. W., Smith, J. P., & Strauch B. Development of guidance for evaluating the use of electronic flight instrument systems in general aviation aircraft (Draft Final Report). Pensacola, FL: Seville Research Corpora.ion, February 1982.

JOEL L. COLSTON
Training General Supervisor,
Houston Lighting & Power

Education:	Naval Enlisted Scientific Education Program (NESEP), 80 quarter hours toward a Mechanical Engineering Degree	
Summary:	1 Year:	Operating General Supervisor, Houston Lighting & Power
	2 Years:	Operations and Training, Houston Lighting & Power
	20 Years:	U. S. Navy, Reactor Controls and Operations

Experience:

Mr. Colston joined Houston Lighting & Power in 1978 as a Training Instructor on the South Texas Project staff responsible for developing training programs for reactor operators. During this time he completed a five week systems training course and a two week simulator training course at the Westinghouse Nuclear Training center in Zion, Illinois. In July 1978, he was assigned the additional duties of Operating Coordinator and was responsible for both the Operating Section and the Training Group. In this capacity Mr. Colston also coordinated the Three Mile Island (TMI) Operations Task Force responsible for reviewing and studying the impact of the TMI incident on STP operations in the areas of staffing, training, and procedures. In October 1979 he assumed responsibility for procurement of the STP training simulator. He was promoted to Training General Supervisor in 1981.

Mr. Colston joined the Navy in 1958 and during his 20 year's service he was assigned many duties. He served as a Training Instructor teaching Reactor Control and Instrumentation theory. He was the Reactor Controls Division, Leading Petty Officer on the USS Bainbridge and USS Enterprise responsible for maintenance of reactor control and instrumentation systems. In this capacity he qualified as Reactor Technician and Reactor Operator aboard both ships. He also qualified as Propulsion Plant Watch Supervisor and Propulsion Plant Officer aboard the USS Enterprise. In January 1969 he was assigned to Glynco Naval Air Station in Brunswich, Georgia as the Ground Electronics Maintenance Supervisor. There he supervised Navy electronic technicians and civilian electronic mechanics in the repair of various electronic gear. He was reassigned to the USS Bainbridge in as Reactor Controls Division Chief Petty Officer. In that capacity he supervised reactor operators and technicians involved in the operation, maintenance, and repair of reactor controls and instrumentation systems.

During his assignment on the Bainbridge, Mr. Colston also held the Reactor Controls Division Officer and the Engineering Controls Division Officer positions. In February 1978 Mr. Colston was assigned to the Staff, Commander Naval Surface Force, Pacific Fleet. In this capacity he was responsible for the support of operation of the Naval Nuclear Surface Ships in the Pacific Fleet.

E. L. (RETT) CONSIDINE
Principal Investigator

Education: U.S. Naval Schools
Electronic Technician "A", Treasure Island, California
Enlisted Submarine School, New London, Connecticut
Basic Nuclear Power School, Mare Island, California
Nuclear Power Training Unit, Idaho Falls, Idaho

Undergraduate Engineering Courses, El Camino College

Summary:

Present:	Engineering Group Supervisor, Control Systems, Bechtel
4 Years:	Engineering Group Supervisor on a major coal fired power project
1 Year:	Engineering Group Leader on a major international power project in Spain
1/2 Year:	Control Systems Supervisor on a seawater injection pipeline
5 Years:	Engineering Group Leader on several major power plant projects with responsibility for control room and control systems design
1/2 Year:	Field liaison during computer modifications at Southern California Edison's Alamitos and Huntington Beach Generating Stations
8 Years:	Power plant operation and maintenance, pressurized water reactors

Experience: Mr. Considine has over 19 years experience in the design, operation, and maintenance of power plants and is presently an Engineering Staff Specialist responsible to the South Texas Project for development and implementation of the Control Room Design Review per NUREG 0700. He was a supervising engineer on the Gulf States Utilities' Roy S. Nelson Station where, for three years, he was responsible for Control Systems. Prior to this, he was assigned to the Sayago project in Spain with supervisory responsibilities for Bechtel and the client organization. He was directly responsible for the analog controls, computer, annunciator, and control room designs.

As a Staff Engineer he was instrumental in the Control Systems design concept for a three-boiler, two-turbine cogeneration unit.

Previously, he was Control Systems Supervisor on the Seawater project, responsible for the design of 16 interacting control systems. Other Bechtel experience includes Control Systems Staff responsibilities in the areas of chemical laboratories, nuclear controls, and control rooms for fossil and nuclear projects; proposal and Preliminary Safety Analysis Report Technical support for domestic and international efforts; and conceptual design of several nuclear unit control rooms.

Prior to joining Bechtel, Mr. Considine qualified as Senior Reactor Operator on Naval reactors, and supervised reactor operators and technicians. He also served as Senior Reactor Control Instructor and was a member of a reactor operator qualification board.

Professional Affiliations: Member, American Nuclear Society, South Texas Station

ERROL P. GAGNON
Systems and Licensing Specialist

Education:	B.S., San Diego State University	
Summary:	Present:	Assistant Project Engineer, Torrey Pines Technology
	13 Years:	General Atomic Company
	4 Years:	Dynamic analyses of missile control systems, General Dynamics Corp.

Experience: Assistant Project Engineer, Torrey Pines Technology

Experience at General Atomic Company includes: Chairman of the Results Review Committee of the Human Factors Evaluation program for the Palo Verde Nuclear Power Generating Station control room and responsible for coordination of the program tasks.

Developed safety/licensing positions and criteria for various applications of nuclear power plants; evaluated nuclear power plant systems and components to identify and prioritize technical, safety and licensing issues; developed nuclear power plant transient performance specifications.

Mr. Gagnon was a senior Technical Representative at Fort St. Vrain responsible for technical coordination and guidance on the conduct and evaluation of the startup test program.

He was Manager of the French Licensee Program responsible for the administrative and techincal-transfer aspects of the nuclear power plant licensing agreements and contracts.

Mr. Gagnon performed simulation studies and evaluations of nuclear power plant transient performance/safety analyses, control systems, control room configurations and plant startup procedures and performed dynamic analyses of missile control systems.

Professional Affiliations: Member, American Nuclear Society

M. R. GROSS
Engineering Supervisor, Control Systems
Bechtel Power Corporation

Education:	BSME, University of Illinois MBA, University of San Francisco	
Summary:	1 Year:	Control Systems Lead Resident Engineer
	2 Years:	Control Systems Deputy Group Supervisor and Licensing Coordinator
	6 Years:	Control Systems Group Supervisor
	1 Year:	FSAR Administrator
	10 Years:	Mechanical Design ENgineer and Lead Instrument Engineer
	20 years:	Controls Systems, Nuclear Projects

Experience:

Mr. Gross is presently the Control Systems Deputy Group Supervisor for Bechtel Power Corporation and is assigned to the South Texas Project, where he is responsible for supervising the NSSS and Control Room/TMI Groups including main control boards and control room design review.

As the Control Systems Lead Resident Engineer assigned to the Midland Plant, Units 1 and 2, he was responsible for organizing and directing C.S. construction support activities at the Midland jobsite including approval of instrument isometric drawings and support designs. Acted as deputy to resident Project Engineer. As the Control Systems Deputy Group Supervisor and Licensing Coordinator he was responsible for C.S. group management and licensing review and FSAR update.

As Control Systems Group Supervisor while assigned to the Greenwood Units 2 and 3 Project he was responsible for the C.S. portion of project planning, scheduling, design criteria, PSAR preparation, and process system development. He directed engineering design of an advanced control room and supporting computer system.

As Control Systems Group Supervisor for the Monroe Fuels and Emissions Modification Project, he was responsible for new instrumentation, development of test instruments, and addition of the Stack Gas Analysis System.

Mr. Gross' second assignment on the Midland project was as FSAR Administrator responsible for organizing and directing a multi-discipline engineering team for writing the Midland FSAR.

During a short assignment on Vandalia Project as Control Systems Group Supervisor, he was responsible for project planning, C.S. design criteria, and preparation of the PSAR.

As Control Systems Group Supervisor, on Mr. Gross' first Midland Plant assignment he was responsible for defining control systems design criteria, control room design, plant computer, and equipment specifications.

For a period of ten years, Mr. Gross was a Mechanical Design Engineer and Lead Instrument Engineer on various power projects and was responsible for C.S. design and procurement for the Monticello and Trojan Nuclear Plants, including control room design.

GARY R. HELGESON
Operating General Supervisor, Project Review Team
Houston Lighting & Power

Education: Completed 110 credit hours toward a degree in Industrial Nuclear Operations at Glendale Community College and Memphis State University

Completed U. S. Navy technical training Courses

Summary:

11 Years:	Reactor Operator/Training Supervisor, Wisconsin Electric Power
2 Years:	Shift Supervisor, Arizona Public Service
3 Years:	Reactor Operator, U.S. Navy

Experience: Mr. Helgeson joined Houston Lighting and Power in 1982 and is presently the Operating General Supervisor at the South Texas Nuclear Project.

For two years, Mr. Helgeson was a shift supervisor, assigned to the Palo Verde Nuclear Generation Station. Responsibilities included construction follow-up, startup testing, procedure writing, shift administrative duties, and system qualification.

For Wisconsin Electric Power he was a Reactor Operator and Operating Supervisor assigned to the Point Beach Nuclear Plant. He participated in construction surveillance, startup testing, procedure writing and power escalation. Acquired Reactor Operator License for Point Beach Units 1 and 2 in 1970 and Senior Reactor Operator License for both units in 1972. He later became the training supervisor assigned to Point Beach Nuclear Plant. He established and conducted formal training programs for the operation, maintenance, instrumentation and controls, and health physics departments. Also he was assigned responsibilities of refueling core loading supervisor, security supervisor, health physics supervisor and fire brigade chief at various times during this period.

Attended the Naval Nuclear Power Training Program and qualified as a reactor operator. He was assigned to the U.S.S. James Monroe and was qualified on all engineering space watch stations. He supervised all reactor startups, shutdowns, tests and special operations; ensured safe and proper operation of the reactor at all times; and was responsible for the maintenance and preventive maintenance of all reactor control, protection and radiation monitoring equipment.

SAL F. LUNA
Project Engineer

Education: B.S., Chemistry, Magna Cum Laude, Niagara University
Specialty courses: Seismic - Wyle Labs, Human Factors - University of Tennessee and Electric Power Research Institute.

Summary: Present: Manager, Human Factors Evaluation, Torrey Pines Technology

Experience: Mr. Luna has been involved in a variety of projects such as: Technical director, human factors engineering, management of Human Factors review of Palo Verde Nuclear Generating Station. Performed Annunciator Prioritization Study for same.

Design of a wide variety of systems for advanced HTGR plants. Special studies for application of all technology for modernizing existing nuclear power plants featuring a "Diagnostic Console."

Directed development of in-core and ex-core instrumentation to study Fort St. Vrain core fluctuation phenomena. Directed site engineering and craft effort to provide fire protection of critical Fort St. Vrain cabling.

Prepared specifications, designed special testing equipment conducted qualification tests, evaluated results and prepared reports for cabling and instrumentation for Fort St. Vrain equipment qualification program.

Directed design of advanced control room control consoles and unitized cabinets including: human factors engineering, full scale mockups, modular construction and seismic qualification.

Managed a wide variety of instrumentational control and development groups at Westinghouse Electric Corp. for the nuclear navy and commercial nuclear programs. Cognizant engineer for Annunciator Systems for same.

Directed the design and development of a wide variety of processing plant instrumentation systems for Catalytic Construction Co.

Publications: Editor of Cassette Control Valve Training Program
Author of chapter on Maintenance - ISA control Valve Handbook
Author of chapter on Liquid Level Measurement - ISA publication

SAL F. LUNA

Professional Affiliations:

Registered Professional Engineer, California
Fellow Grade Member, ISA
Vice President Long Range Planning Department, ISA
Nuclear Power Plant Standards Committee, ISA
Member, Human Factors Society

GEORGE J. MALEK
Systems Specialist,
Torrey Pines Technology

Education: B.S., Mechanical Engineering, Case Institute of Technology
M.S., Engineering Science, UCLA

Experience: Mr. Malek was responsible for the auxiliary feedwater system on assignment to Bechtel Power Corporation, SONGS 2 and 3 Project. This involved coordination with the client, construction, startup testing, and engineering disciplines; resolved startup problems from the field on various plant systems; reviewed test procedures for safety class equipment.

He coordinated in-plant activities of technical support team during startup tests at Fort St. Vrain site. The areas of involvement were primary system performance, steam system performance and overall plant control system. Mr. Malek performed preliminary "on the spot" evaluation of plant performance during startup tests. Prepared test procedures for portions of the plant startup tests and for special tests to investigate unexpected plant performance phenomena.

Performed optimization studies on the major design parameters for nuclear reactor power plants. Formulated analytical models for design and cost of systems, developed a major computer program and prepared a comprehensive report. Coordinated with the architect-engineer on the interfaces between NSS systems and the balance of the plant. The interfaces included schedules, system specifications, overall plant performance, safeguards and licensing.

Mr. Malek directed the design activities on various reactor heat transfer and fluid flow systems. These activities included reactor safety analyses, turbulent mixing and diffusion analyses, flow stability in once-through boilers, flow distribution studies in the reactor core, and design analyses of the core auxiliary cooling system (CACS). Made numerous presentations to the customers, the NRC and the ACRS on the performance of the CACS.

Also, Mr. Malek has performed design analysis on nuclear reactor heat transfer and fluid flow systems. Major accomplishments were lead engineer on the development of fuel element concepts for a BeO moderated reactor, development of computer codes to analyze core performance characteristics, and principal investigator of an analytical and experimental investigation to study flow induced vibrations in a reactor core.

GEORGE J. MALEK

Professional Affiliations:	Registered Mechanical Engineer, California Associate Fellow, AIAA Member, American Nuclear Society Member, American Society Mechanical Engineers

MARY B. MORETON
Chairman, Project Review Team

Education:	BS, Systems Engineering, University of Arizona	
Summary:	Present:	Control Systems Group Leader
	3 Years:	Control Systems Group Leader
	5-1/2 Years:	Bechtel Control Systems Engineer engaged in design of nuclear steam power stations

Experience:

Ms. Moreton is currently a Control Systems Group Leader on the South Texas Project responsible for all Control Systems post-TMI design activities and main control panel. Previously, she was a Control Systems Group Leader on the Palo Verde Nuclear Power Project, a three unit 3900-MW generating station. She was responsible for the System 80 (2 loop) Nuclear Steam Supply System controls and instrumentation, control systems licensing, specifications, and development of post-TMI control systems design changes. Earlier Ms. Moreton was responsible for reviewing and approving vendor documents for the Traning Simulator to ensure correct simulation of the power plant process. SHe also reviewed various control systems to provide comprehensive training for power station operators.

Earlier design responsibilities for a nuclear power station included developing Preliminary Safety Analysis Reports, Design Criteria, Piping and Instrument Diagrams, Logic Diagrams, Loop Diagrams, Specifications and Bid Evaluations for the Control Systems discipline. She has a thorough knowledge of NRC Regulatory Guides, IEEE Standards, and requirments for their implementation. Ms. Moreton has also worked on the integration of the NSSS safety and control systems into the plant design, as well as design of the plant annunciator, computer and safety features actuation systems. She has also been involvsd with the instrumentation and control of safety-related and radwaste process systems.

Professional Affiliations:

Member, Instrument Society of America
Member, Society of Women Engineers
Registered Professional Engineer, California

ROBERT D. NEIL
Unit Supervisor,
Houston Lighting & Power

Education: Associate of Science, Mohegan College, Norwich, CN

Summary: 1 Year: Unit Supervisor, Houston Lighting & Power
20 Years: U.S. Navy

Experience: Mr. Neil joined HL&P in 1978 as a control room operator. During 1979 and 1980 he participated in various workshops conducted by EPRI, G.E. and Sandia Laboratories on Human Factors Engineering in the Control Room and participated in evaluating South Texas Project and Allens Creek main control boards. In 1981 Mr. Neil was promoted to Unit Supervisor.

Completed U.S. Navy Nuclear Power School in 1963 and served as Operator/Instructor and engineroom supervisor at A1W Prototype until 1966. Served on USS Bainbridge as Engineroom Leading Petty Officer and inport Engineering Duty Officer from 1966 to 1968. He completed the EOOW Water Chemistry School in 1969. At D1G Prototype from 1968 to 1971, he qualified as an Engineering Officer of the Watch. He assisted the plant Material Manager in scheduling maintenance activities during core depletion tests. While in Bainbridge as Leading 'M' Division Petty Officer in 1972, he qualified as Engineroom Supervisor.

Mr. Neil was assigned to USS Enterprise as an Assistant Reactor Division Officer from 1972 to 1976. As such he coordinated and directed the efforts of mechanics, electricians and electronics technicians in the operation and maintenance of two reactor plants. He qualified as a propulsion Plant Watch Officer and at various times acted as Division Officer in the absence of a commissioned officer. Prior to his transfer to the U.S. Navy Fleet Reserve in 1978, he was the Repair Department Leading Petty Officer and Senior Enlisted Advisor for the Trident Refit Facility at Submarine Base, Bangor, Washington. In 1978, he concluded the Westinghouse Reactor Operator Training, Phase II, Option III.

RICHARD C. POTTER
Systems Specialist,
Torrey Pines Technology

Education: B.S., Mechanical Engineering, University of Minnesota
M.S., Mechanical Engineering, University of Southern California

Experience: Mr. Potter was recently responsible for a fire vulnerability study of three Northeast Utilities nuclear power plants. Study involved the use of probabilistic risk assessment techniques.

He participated in a probabilistic risk assessment of the Fort St. Vrain plant to determine clean up costs versus probability for on-site contamination due to an interruption of cooling event.

Mr. Potter was assigned to the Fort St. Vrain Nuclear Generating Station project responsible for: modifying and maintaining computer models for the simulation of steady-state and transient plant performance; overall performance review which included data monitoring and analysis as required to ensure proper plant operations; and performing steady-state and dynamic analysis to support the plant startup testing program.

Another project involved a conceptual analysis of a natural convection, drum-type and condenser-type shutdown cooling system.

On the HTGR nuclear project he was responsible for the following: modifying and maintaining the steady-state plant performance program, the pipe rupture analysis program and the core afterheat analysis program; predicting power plant nominal, shutdown and refueling performance for use by design and analysis groups within the company and for use by the customers; and performing parametric and application studies relating to the overall plant design and performance.

Prior to joining Torry Pines Technology, he was a design engineer responsible for design and detailing of ground support equipment for rockets. Performed propulsion analyses, application studies and computer simulation work on large liquid rocket engines.

Professional Affiliations: Professional Mechanical Engineer, California
Member, American Society of Mechanical Engineers
Member, Pi Tau Sigma

ROBERT H. STURTEVANT
Inventory

Education: San Diego State University, Physics

Experience: Mr. Sturtevant is with Torrey Pines Technology and his area of specialty is process plant system layout and design, specializing in structural/piping and electrical system layouts, pressure vessel design and layout, and massive concrete/steel design. He is currently identifying safety-related components that appear on P&I diagrams and one-line electrical diagrams, and providing technical support for seismic analysis of nuclear core and core support elements, including design studies, and reports.

He has participated in design of pilot plant for nuclear fuel recycling from mechanical and structural considerations to solvent extraction processes.

He has designed an environmentally compatible tertiary waste treatment facility including equipment and material specifications and applications.

Earlier, he conducted design studies of core support systems including thermal growth and gap analysis of both metallic and graphite materials, with dimensional and tolerance analysis.

He has performed sizing and stress calculations and layout drawings of prestressed concrete reactor vessels. Determined optimum routing and space requirements of steam and feedwater piping, and designed power distribution layouts and operator consoles for stage lighting systems.

FREDERICK W. TODT
Annunciator Review Leader,
Torrey Pines Technology

Education:	B.S., Physics, Wayne State University
Experience:	Mr. Todt has coordinated proposal efforts to supply computer hardware and software for emergency response facilities for nuclear plants and implemented computer demonstration of plant disturbance detection concept.

He has developed real time application programs to support startup testing and reactor operation; monitored system behavior during startup, located deficiencies and made modifications as needed; and trained plant personnel to use computer facilities.

Mr. Todt was a section leader for a large plant computer system application software development and has written specifications for plant computer hardware and software and participated in the vendor evaluation process.

He has performed nuclear design and analysis calculations associated with reactor power shaping, fuel cycles, control poison worth, and safety evaluations of HTGR and PWR reactors.

In the past, Mr. Todt has developed methods and computer programs for nuclear fuel cycle studies, fuel cost analysis, and automation of reactor design parametric studies; performed nuclear design studies on small power, research, and space reactor concepts using a variety of fuels, moderators, and coolants; evaluated nuclear design calculation programs (computer codes) by comparison with critical experiments; and performed laboratory work with radioactive isotopes including sample counting, dosage preparation, standardization. Calibrated x-ray machines and radiation measurement equipment. Performed radiation shielding surveys.

Professional Affiliations: Member, American Nuclear Society

PETER VANDEVISSE
Lead Engineer, I&C, Project Review Team
Houston Lighting & Power

Education: BSME, San Jose State University

Summary:
1 Year: Consultant, Brown & Root
8 Years: Various Positions, Quadrex Corporation
6 Years: Reactor Operator, U.S. Navy
4 Years: Control Systems Engineer, General Motors

Experience: Mr. VandeVisse joined Houston Lighting & Power in 1982 as the South Texas Project Lead Engineer for intruments and controls. He is responsible for review of instrumentation and control systems and component analysis, design, procurement, fabrication, installation and construction, testing, start-up and operational support. His duties also include development and maintenance of the I&C engineering budget, review of A/E activities, supervision of the I&C engineering group, support of STP project management, quality assurance, licensing, and other engineering and technical activities.

During Mr. VandeVisse's tenure with Brown & Root, he was the consultant to the I&C department for the implementation of TMI requirements. He also assisted in project transition when Bechtel Power Corporation was named as Architect-Engineer for the South Texas Nuclear project.

During the eight years that Mr. VandeVisse was employed by Quadrex he had various assignments and responsibilities. He was the site manager for Quadrex personnel at the Grand Gulf Nuclear Station, where he provided technical assistance to the utility during construction and plant startup. He was also responsible for the surveillance programs used to comply with the plant technical specifications. During his assignment at Commanche Peak Steam Electric Station he assisted in FSAR review, utility response to TMI, preparation of engineering QA procedures and other technical programs. As a project leader, Mr. VandeVisse designed and supervised the fabrication and implementation of the process sensor time response test equipment and response time test surveillance programs or several nuclear power plants. He also supervised the development of I&C maintenance and surveillance programs for several utilities. As project leader at the Farley Nuclear Plant in Alabama, he assisted the I&C department in startup and operation. This included responsibility for startup and operational test, maintenance, calibration and surveillance procedure programs, the development of instrument scaling and the response time test program.

PETER VANDEVISSE

Prior to joining Quadrex, he was a reactor operator and electronics technician in the U.S. Navy where he scheduled and supervised reactor control division plant maintenance, qualification programs and operational activities. During a major overhaul he coordinated naval and civilian personnel in repair and maintenance of nuclear and electronic systems.

While attending college, he was a control system engineer and co-op student at General Motors Institute.

Y. M. YUFIK
Process Computers Leader,
Torrey Pines Technology

Education: M.S., Electronics, Odessa Polytechnic Institute, Odessa, USSR
Ph.D., Experimental Physics, Kalinin University, Kalinin, USSR
Postdoctoral Training, Experimental Psychology, Leningrad University, Leningrad, USSR
Postdoctoral Training, Cognitive Psychology, University of California, San Diego
Man-machine Interaction in Nuclear Industry, Massachusetts Institute of Technology

Experience: Mr. Yufik is a Process Computers Leader for Torrey Pines Technology and is responsible for analysis of decision support for power plant operators.

Other experience includes: research in mathematical modeling and analysis of decision making processes; researched and supervised development of computer based systems for pyschological testing and evaluation; supervising and/or performing analysis of human reliability and decision making strategies,and developing programs for training in problem solving and rational decision making.

Mr. Yufik supervised and/or performed systems analysis and development in computer assisted design, developed mathematical models for a variety of engineering and scientific problems, and reduced engineering problems to computer processible form.

Publications: Authored 13 papers in Experimental Physics, Computer Assisted Instruction and Evaluation, Simulation of Cognitive Strategies

Professional Affiliations: Member, Human Factors Society
Member, Cognitive Science Society
Member, National Society for Performance and Instruction

APPENDIX C

Typical Review Forms

EVALUATION CRITERION	MEETS STANDARD HUMAN ENGINEERING PRACTICES*	DOES NOT MEET STANDARD HUMAN ENGINEERING PRACTICES	N/A	GUIDELINE REFERENCE NO.	IF THE ITEM DOES NOT MEET STANDARD HUMAN ENGINEERING PRACTICES, WERE THERE EXTENUATING CIRCUMSTANCES THAT CAUSED THE ORIGINAL DESIGN DECISION? EXPLAIN.	IDENTIFY ITEM	NOTES
17. Is panel B sloped between 90^0 and 100^0 from the horizontal? Anthropometric Reach Guideline (ARG) and (VG)				A5 E1			
18. Is panel C sloped between 55^0 and 65^0 from the horizontal? (ARG) and (VG)				A2 E1			
19. Is panel D sloped between 10^0 and 15^0 from the horizontal? (ARG) and (VG)				A2 E1			
20. On consoles where the operator has to stand close to the front surface is there a kick space of at least 4 in. (100 mm) x 4 in. (100 mm)? (AG) and (CG)				B5 E1			
21. For control operation above 36 in. is there a minimum of 20 in. (500 mm) between the front of any console and unmovable objects? (CG)				B1 B5			

*IF THERE ARE FEATURES WHICH ARE CONSIDERED TO BE OUTSTANDING EXAMPLES OF HUMAN FACTORS ENGINEERING, PLEASE NOTE ON BACK.

Typical checklist material

HUMAN ENGINEERING GUIDELINE CONSIDERATIONS FOR CL# 1 , WORKSPACE

GUIDELINES	GUIDELINE FUNCTION	CHECKLIST ITEM NUMBERS	POTENTIAL HUMAN ERROR
A) Visibility	1. Have unrestricted views of all displays from his normal working positions.	3, 24, 25	Operational errors resulting from misreading the displays, delay in reading the displays, and/or misinterpretation of displays. Operating the wrong control, operating a control in the wrong direction and/or a lack of timely control response.
	2. Utilize the displays without inducing eye fatigue by placing the display in the optimum visual zone.	4, 18, 19, 26	
	3. Utilize "Normal Line of Sight" to minimize muscular neck fatigue.	5	
	4. Utilize "Effective Viewing" distances.	14	
	5. Minimize reflection.	16, 17, 34, 39	
	6. Utilize "Visual Recognition Cues".	29, 28	
B) Clearance/ Comfort	1. Allow enough space to allow access to and from workplaces.	21, 22	Operational errors resulting from fatigue or the inability to read displays. Inadvertent activation of controls.
	2. Allow enough space to eliminate feelings of confinement.	8	
	3. Eliminate physical discomfort.	10, 33, 37	
	4. Allow for proper adjustment of the body.	11, 13	
	5. Allow enough space to prevent anthropometric man/machine conflicts and man/man conflicts.	20, 9, 12, 21, 22, 23, 48	

Typical guideline

B. Workspace Design

1. Can the status of your plant be monitored from one central position?

B1. ____yes ____no

OP 2. Are specific stations assigned to operators and watch foreman?

B2. ____yes ____no

OP 3. During normal or off-normal operations, do the actions or tasks of another operator ever interfere with performance of your tasks?

B3. ____yes ____no

4. Have you ever experienced any difficulty in reaching a required control or seeing/reading a required display?

B4. ____yes ____no

5. Have you ever experienced any problems locating the correct control or display (for example, operating the wrong switch or inaccurately operating the correct switch)?

B5. ____yes ____no

6. Are panels arranged within your CR in a manner which is logical for normal and emergency operations?

B6. ____yes ____no

7. Are controls and displays pertaining to systems or subsystems grouped logically and distinctively within each panel?

B7. ____yes ____no

8. Does your panel lack important information, controls of displays, which would help you perform your job more effectively or safely?

B8. ____yes ____no

9. Are important data, controls or displays, inaccessible or difficult to access because of placement (for example, located in back panels out of operator's view)?

B9. ____yes ____no

10. Does your CR contain controls, displays or other equipment which is inoperative, not used, or unnecessary for you to do an effective job?

B10. ____yes ____no

11. Do you find mimics or graphic/pictorial panel arrangements, if used, helpful in performing your job?

B11. ____yes ____no ____N/A

a. If "no," please describe why you feel they are not helpful and any recommendations you may have on improvements.

B11a. ____

12. Have you ever inadvertently disturbed control settings (for example, accidentally bumping a switch)?

B12. ____yes ____no

13. Have groups of controls or displays which look identical or very similar been marked or coded to permit easy discrimination between them?

B13. ____yes ____no

a. If "no," please describe areas where you feel marking or coding would enhance your ability to discriminate between components.

B13a. ____

14. Please describe the administration procedure for adding operator-recommended modifications to labeling, demarcation lines, mimics, or for adding guarding for certain controls, or otherwise modifying the panel.

B14. ______________________________

15. Do you find operator-added modifications helpful?

B15. ____yes ____no

a. If "no," please describe those modifications which you find to be [illegible] nce.

B15a. ______________________________

16. Are major panels, sub-panels and panel segments clearly and consistently labeled?

B16. ____yes ____no

OP 17. Is the CR arranged to be effectively operated by the minimum shift required?

B17.

During normal operations? ____yes ____no

During transients/emergency operations? ____yes ____no

I. Integration

1. How and how well are displays, annunciators and controls grouped, integrated and related?

I1. ______________________________

2. Are the same versions of the same procedures used in training and in the control room?

I2. ______________________________

3. Are the same terms and abbreviations used on the control panel, in all documents, diagrams and procedures, and in all training courses and written materials?

I3. ______________________________

F. Control Room Equipment, Displays and Instrumentation

1. What do you think about the size, shape and arrangement of the control room?

F1. ____________________

2. What do you think about the systems arrangement of the control boards?

F2. ____________________

3. Does any thing stick in your mind as being in a poor location? Do you have any trouble reaching any control or reading any display?

F3. ______________________________

4. What is your opinion of the displays? What's bad — what's good?

F4. ______________________________

5. Do any of the switches give you trouble?

F5. ______________________________

6. Do you see any problem with accidental switch operation?

F6. ______________________________

7. Any problems with control stations?

F7. ____________________

8. What do you think about the panel labeling?

F8. ____________________

9. How about the labeling of individual devices?

F9. ______________________________

10. Are there any color schemes that you think may be confusing?

F10. ______________________________

11. Do you have any likes or dislikes for the graphics used on the boards?

F11. ______________________________

OP 12. Are you satisfied with the facilities for preparing your shift paperwork?

F12. ______________________________

13. Is there any thing about the board that is confusing?

F13. ______________________________

14. Have you ever made or are you thinking of making any recommendations for modifying the control boards or control room?

F14. ______________________________

15. What is your opinion of the annunciators?

F15. ______________________________

16. Do you have any suggestions for improvements?

F16. ______________________________

17. Same questions as 15, 16 relative to CRT displays.

F17. ______________________________

18. What is your opinion of the control board color?

F18. ______________________________

19. What do you think about the overall illumination?

F19. ______________________________

OP 20. How do you get information on plant/maintenance status?

F20. ______________________________

OP 21. Are all aspects of status available from more than one source?

F21. ______________________________

OP 22. Which sources do you prefer? Why?

F22. ______________________________

OP 23. Give some examples of information sources that are easy to use.

F23. ______________________________

OP 24. Give some examples of information sources that are hard to use.

F24. ______________________________

OP **25.** Do you have any other comments on: F25.

What you like? ______________________________

What you dislike? ______________________________

What needs improvement? ______________________________

26. What is your confidence level of operating the plant safely from the control board?

F26. ______________________________

27. How important do you judge yourself to be relative to plant safety and plant operations?

F27. ______________________________

SYSTEM FACTOR CHECKLIST

(General Questions)

CL No. 13-B. Rev. 0 (10/30/80)

Date of interview ____________ System ______________________________

Person(s) Interviewed ______________________________

Data Collector(s) ______________________________

Affiliation ______________________________

Title ______________________________

Plant Mode Identifier

I — Normal

II — Loss of Coolant Accident

III — Loss of Electrical Power

IV — Safe Shutdown from Outside CR

V — ____________

QUESTION	ANSWER	COMMENTS
7. In considering plant mode operations, are there any devices that should be relocated or duplicated in another section of the board or off the board?: (Note reasoning in answer)	For Mode II	

SYSTEM FACTOR CHECKLIST

(General Questions)

CL No. 13-B. Rev. 0 (10/30/80)

Date of interview ____________ System ______________________________

Person(s) Interviewed ______________________________

Data Collector(s) ______________________________

Affiliation ______________________________

Title ______________________________

Plant Mode Identifier

I — Normal

II — Loss of Coolant Accident

III — Loss of Electrical Power

IV — Safe Shutdown from Outside CR

V — ____________

QUESTION	ANSWER	COMMENTS
6. Are there any board functions which are better handled in a different board or off board location?: (Note reasoning in answer)	For Mode II	

SYSTEM FACTOR CHECKLIST

(General Questions)

CL No. 13-B. Rev. 0 (10/30/80)

Date of interview ____________ System ______________________________

Person(s) Interviewed ______________________________

Data Collector(s) ______________________________

Affiliation ______________________________

Title ______________________________

Plant Mode Identifier

I — Normal

II — Loss of Coolant Accident

III — Loss of Electrical Power

IV — Safe Shutdown from Outside CR

V — ____________________

QUESTION	ANSWER	COMMENTS
5. What additional function and corresponding board devices do you think should be added for each plant mode?: (Note reasoning in answer)	For Mode III	

SYSTEM FACTOR CHECKLIST

(General Questions)

CL No. 13-B. Rev. 0 (10/30/80)

Date of interview ____________ System ______________________________

Person(s) Interviewed ______________________________

Data Collector(s) ______________ ______________________________

Affiliation ______________________________

Title ______________________________

Plant Mode Identifier

I — Normal

II — Loss of Coolant Accident

III — Loss of Electrical Power

IV — Safe Shutdown from Outside CR

V — ____________

QUESTION	ANSWER	COMMENTS

SYSTEM FACTOR CHECKLIST

(General Questions)

CL No. 13-B. Rev. 0 (10/30/80)

Date of interview ____________ System ______________________________

Person(s) Interviewed ______________________________

Data Collector(s) ______________________________

Affiliation ______________________________

Title ______________________________

Plant Mode Identifier

I — Normal

II — Loss of Coolant Accident

III — Loss of Electrical Power

IV — Safe Shutdown from Outside CR

V — ______________

QUESTION	ANSWER	COMMENTS
7. In considering plant mode operations, are there any devices that should be relocated or duplicated in another section of the board or off the board?: (Note reasoning in answer)	For Mode V	