Attachment to SLNRC 84-99

REVISION 1 TO
THE DETAILED CONTROL ROOM DESIGN REVIEW
SUMMARY REPORT FOR SNUPPS

Wolf Creek Plant - Kansas Gas and Electric Co.

Docket No. STN 50-482

Callaway Plant - Union Electric Company

Docket No. STN 50-483

In Response To:

NRC Generic Letter 82-33

Supplement 1 to NUREG 0737

Revised June 1984

Preface to Revision 1

Revision 1 to the Detailed Control Room Design Review (DCRDR) Summary Report for SNUPPS is the Supplement to the original Summary Report identified by reference 12. Commitments made subsequent to the reference 12 transmittal contained in NRC's "Results of Preimplementation Audit" are reflected in this revision. Revision bars are provided to identify areas of change from the original Summary Report and changes to responses from findings resulting from the Initial Essex and NRC Review (Preliminary Design Assessment), transmitted by reference 10. Except for the environmental survey results and the SNUPPS responses to the new NRC concerns identified in NRC (Youngblood) letter to UE (Schnell) and KGE (Koester) dated June 05, 1984, all of the revisions have been transmitted to or discussed with the Staff and are addressed by the Staff in their June 5th, letter. The decision for no action to selected findings has been previously agreed to by the NRC, except for those under the Environmental Survey. Preliminary results of Callaway's Environmental Survey were reviewed by telephone conversation with the NRC on April 20, 1984.

Note: The references listed within this Revision refer to those listed in Section 4.0 "References to SNUPPS Submittals to NRC on DCRDR".

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1.0 METHODOLOGY

1.1 Review Plan

1.1.1 General

The scope and dates of the Detailed Control Room Design Review (DCRDR) are summarized in Table 1.1.1.

The human engineering review of the control room was started by SNUPPS in mid-1980 in response to TMI Action Plan Item I.D.1. The review was initiated early, before construction of the Callaway and Wolf Creek control rooms was completed, in order to provide more time to make modifications resulting from the review. The availability of a working simulator of the SNUPPS control rooms, located at the Westinghouse Training Center in Zion, Illinois, made this early start practicable. The review is applicable to both Callaway and Wolf Creek, since the control rooms are of a standardized design, except for the site-specific panels, which control the off-site power systems, the circulating water system and the service water systems. These aspects of the Callaway and Wolf Creek panels were reviewed on a plant specific basis. In addition, Environmental Surveys have been performed independently at each SNUPPS Control Room and Auxiliary Shutdown Panel. The simulator at the Westinghouse Training Center has site-related control panels, indicators, displays and controls identical to the Callaway design.

Although the SNUPPS DCRDR began prior to issuance of NUREG-0700, the DCRDR includes all of the elements prescribed by NUREG-0700 and NRC Generic Letter 82-33. The SNUPPS review included the following tasks:

- o Establishment of a multidisciplinary review team
- o Review of operating experience
- o System functions review and task analysis
- o Control room inventory
- o Control room survey
- o Verification of task performance capabilities
- o Control room validation as an integrated system
- o Assessment of findings and implementation of resolutions

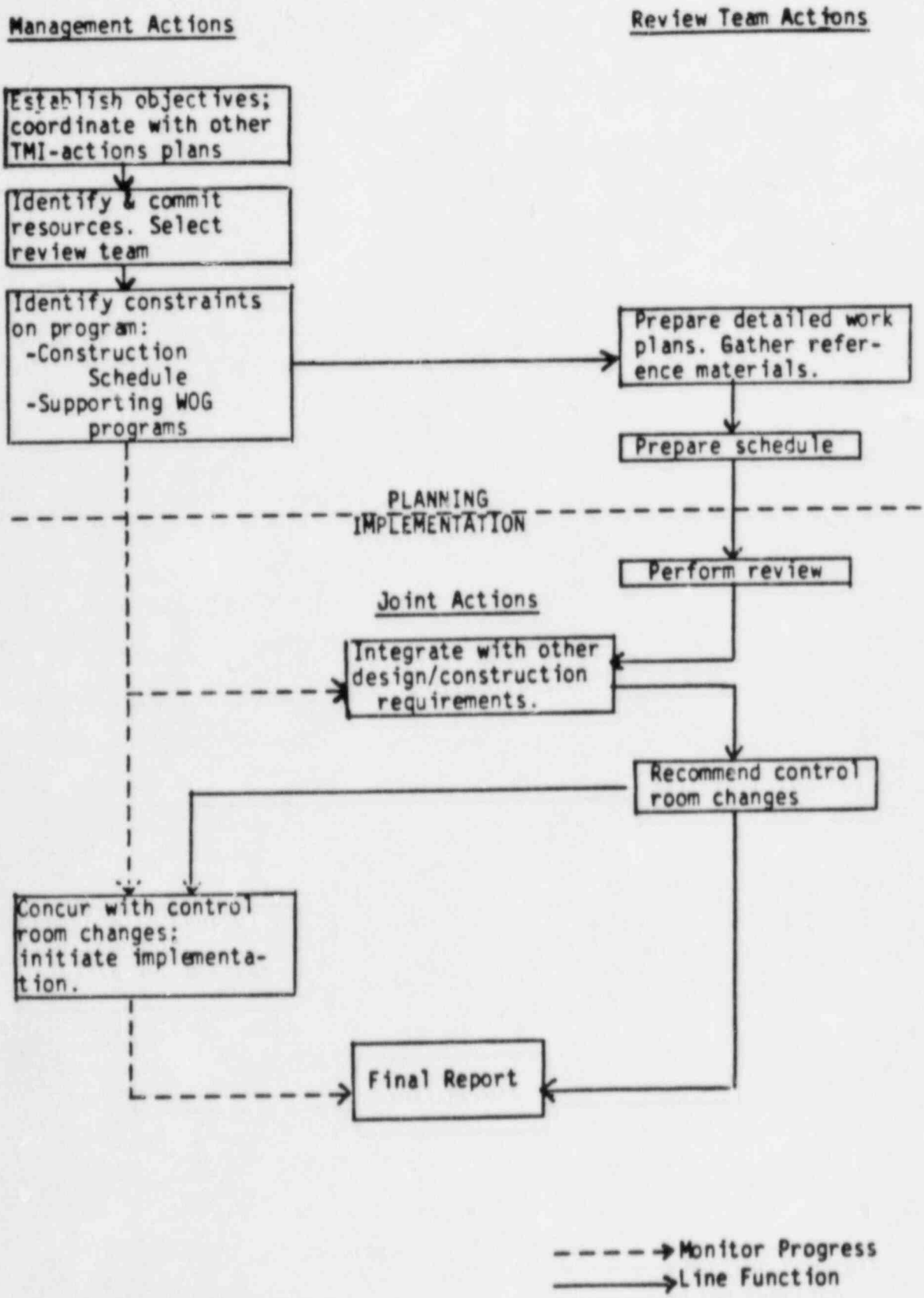
The initial control room survey was performed to the guidelines of NUREG/CR-1580. However, as will be described, the SNUPPS DCRDR included iterations that ensure responsiveness to the guidelines of NUREG-0700. For example, NUREG-0700 guidelines were used by SNUPPS to evaluate control board modifications and by NRC reviewers of the SNUPPS control room.

The planning and implementation phases of the SNUPPS DCRDR are shown schematically in Figure 1.1.1. Most of the actions described within the blocks are self-explanatory. Those requiring further explanation are discussed in the following sections.

TABLE 1.1.1
SCOPE OF EFFORT

REVIEW EFFORT	DATE OF PERFORMANCE	GUIDANCE DOCUMENT USED	REVIEW OF OPERATING EXPERIENCE	SYSTEM FUNCTION REVIEW AND TASK ANALYSIS	CONTROL ROOM INVENTORY	CONTROL ROOM SURVEY	VERIFICATION OF TASK PERFORMANCE CAPABILITY	CONTROL ROOM VALIDATION	REFERENCE
Preliminary Design Assessment (PDA)	August 1980 to June 1981	NUREG/CR-1580	X			X			Ref. 2, 3, 4, 6
NRC Audit		NUREG-0700				X			Ref. 4, 5, 10
Review of Auxiliary Shutdown Panel (ASP)	Sept. 1983	NUREG-0700				X			Appendix C
Verification of Task Performance Capabilities	Jan. 1983 to Jan. 1984	NUREG-0700	X	X	X		X		Appendix F
Validation of Integrated System	Sept. 1983	NUREG-0700						X	Appendix E
Supplementary Survey (SS)	Jan. 1984	NUREG-0700				X			Appendix B
Review of Environmental Aspects (ES)	April 1984	NUREG-0700				X			Appendix D

Figure 1.1.1
SCHEMATIC OF REVIEW PLAN



1.1.2 Constraints on Program

As previously noted, one of the constraints on the program was that the DCRDR was started when construction of the control rooms was still underway. The availability of a working SNUPPS-specific simulator, on which utility operating personnel had initial training, made it possible to perform detailed surveys of the control panels, indicators, displays and controls. The survey of the simulator was supplemented by surveys of the partially-completed control rooms, including the site-specific panels. However, review of control room environmental factors: lighting, noise level, communications had to be delayed until completion of construction of the first SNUPPS control room (Callaway).

A second major constraint was that the Emergency Response Guidelines (ERGs) generic to Westinghouse reactors were still under development by the Westinghouse Owners Group, when the SNUPPS DCRDR was begun. The ERGs are the basis for the system functional reviews and task analyses (SRTA) in the SNUPPS DCRDR. This constraint has been accommodated in the following ways. First, concurrent with the detailed survey of the SNUPPS control panels, operators who had trained on the SNUPPS simulator were interviewed about the effectiveness of the design and a limited set of emergency procedures was performed on the simulator under the observation of the Human Engineering Consultant. Second, following completion of the generic ERGs, a full set of emergency procedures was performed on the simulator at the Callaway site. The emphasis was on the adequacy of the ERGs, but the program was video-taped and selected procedures were later reviewed by a Human Engineering Consultant with respect to validation of the SNUPPS control room. Third, displays and controls identified by the SRTA as necessary for performance of emergency procedures were examined in the context of a task analysis that followed the guidelines of NUREG-0700.

1.1.3 Coordination of Control Room Improvements with Other Programs

An underlying concept of the control room design is that it must be possible to operate the plant if the plant computer and Safety Parameter Display System (SPDS) are inoperable. Therefore the primary review of the control room design assumed that the computer systems were unavailable. The review provided assurance that instruments and controls, annunciators and status light panels on the control boards are adequate for performance of normal procedures and emergency operating procedures. However, the task analysis considered the integrated system of control board instruments and controls, the SPDS, the Radiation Monitoring System (RMS) and plant computer.

The SPDS was also reviewed separately from a Human Engineering standpoint in the course of its development by a group of utilities with Westinghouse plants. The locations of the CRTs and printers for the plant computer and SPDS have been selected by Utility Operations personnel in concert with the architect/engineer and Utility and Staff engineering personnel. ARD Corporation reviewed and concurred with the SPDS location at each site during the review of control room workspace.

Management responsibility for ensuring human factors coordination of continuing activities of DCRDR task analysis, SPDS development and EOP

1.1.3 Coordination of Control Room Improvements with Other Programs, continued

development by each utility rests with the Project Manager. The Project Manager utilizes review by the DCRDR Team to ensure human engineering coordination among improvement programs.

Because of the relatively advanced state of the SNUPPS design relative to operating PWRs, the modifications in response to Reg. Guide 1.97 have been relatively minor. The instrumentation for post-accident monitoring was reviewed as part of the primary review of the control boards. So, too, were controls and displays associated with post-TMI modifications.

Plant specific emergency procedures have been validated on the Callaway simulator. Each SNUPPS site has a simulator. These simulators are being updated to provide virtually complete fidelity to the control rooms. Operator training at each site includes extensive training on the plant simulator.

1.2 Management and Staffing

The SNUPPS DCRDR has been coordinated by the SNUPPS Staff organization, which is the central organization established by the SNUPPS Utilities to manage the design and licensing of the SNUPPS plants. A Human Factors Plant Review Group (HFPRG), consisting of a group of professionals from the operations and engineering departments of the SNUPPS Utilities, has been continuously involved in the DCRDR. This core group of professionals was supplemented in one or more of the interrelated programs of the DCRDR by personnel from Bechtel (the architect/engineer), Westinghouse (the reactor supplier), and Human Engineering consultants.

The SNUPPS Staff and HFPRG members reviewed and became familiar with the methods and content of relevant NRC reports and general human factors engineering objectives and methodology. The HFPRG members are familiar with the design and operational aspects of the SNUPPS plants. Several members had training on the SNUPPS simulator at Zion and were able to apply that training directly in the review.

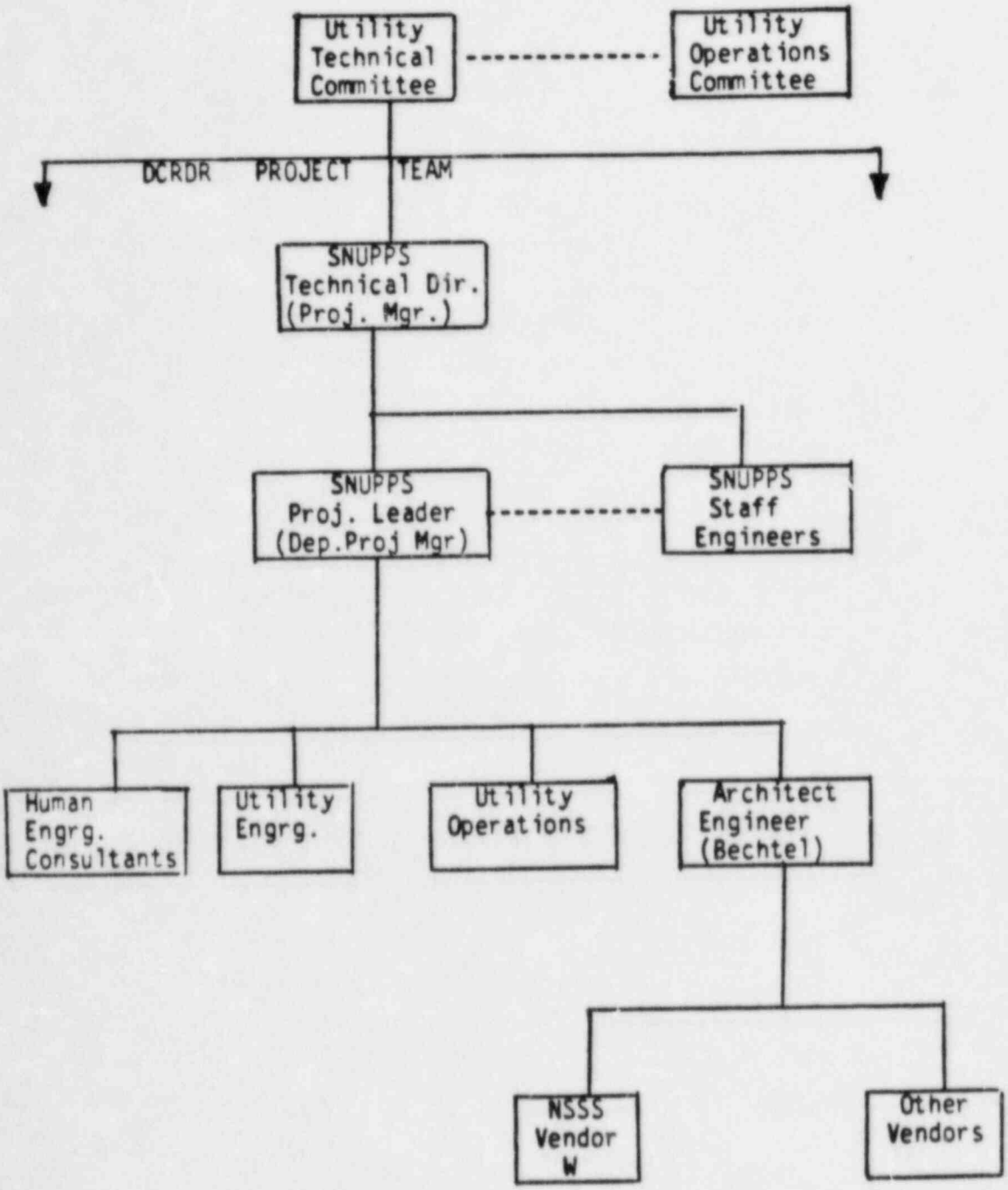
The organizational structure of the DCRDR Team is shown in Figure 1.2.1. The team is headed by the SNUPPS Technical Director, who serves as Project Manager. The Project Manager is responsible to the SNUPPS Technical Committee, which is constituted of the Nuclear Engineering Managers of the SNUPPS Utilities. The Technical Committee, throughout the SNUPPS project, represented the SNUPPS Utilities and has the responsibility for design decisions. The SNUPPS Operations Committee, which consists of the Plant Superintendants at Callaway and Wolf Creek, has also provided overview of the DCRDR and has provided input regarding design decisions to the Technical Committee.

A Project Leader, functioning as Deputy Project Manager, provides the day-to-day coordination of the activities of the DCRDR.

Other major participants in the DCRDR are Human Engineering Consultants, Utility engineering and operations personnel, SNUPPS Staff engineers and represenatatives of the architect/engineer, Bechtel. Three Human Engineering Consultant firms were utilized in order to benefit from special expertise offered by each. Essex Corporation was selected to perform the initial Control Room survey because it had authored NUREG/CR-1580 and had conducted several other control room surveys. ARD Corporation was selected to assist in the preparation of DCRDR Program Plan, because it had authored several other program plans, and to assist in the review of control room environmental factors and in the task analysis. ARD was also used as the Human Engineering Consultant by the group of utilities that cooperatively developed the SPDS. NUS Corporation was selected for the plant specific review of video tapes of walk-throughs of the emergency procedures on the Callaway simulator, because of the qualifications of NUS personnel.

The experience, qualifications and approximate time spent on the project for each of the core professionals of the HFPRG and SNUPPS Staff is given in Table 1.2.1. In addition to these people, there were several other engineers from Bechtel and Westinghouse involved in the implementation of design changes.

Figure 1.2.1
ORGANIZATIONAL STRUCTURE



Title	Person	License Held	Education(Degree)	Human Factors/ Nuclear Exp.	Time Spent on (with) HFPRG
Technical Director (Project Manager)	F. Schwoerer (S)	-	MS Marine E	26 yrs.	3 yrs.
Project Leader (Deputy Proj.Mgr.)	J. Klein (S)	-	BSME	6 yrs.	3 yrs.
SNUPPS Staff Engr.	J. Riley (S)	-	BSAeroE,MBA	7 yrs.	1 yr.
SNUPPS Staff Engr.	J. Cermak (S)	-	Phd Nuc Engr	23 yrs.	2 yrs.
Human Engr. Consultant	L. Avery (E)	-	MA Ind.Psyc.	5 yrs.	3/4 yr.
Human Engr. Consultant	S. Fleger (E)	-	MA Ind.Psyc.	4 yrs.	3/4 yr.
Human Engr. Consultant	R. Kane (E)	-	MA Exp.Psyc.	6 yrs.	3/4 yr.
Human Engr. Consultant	C. Krick (E)	-	BA Poly.Sci.	3 yrs.	3/4 yr.
Human Engr. Consultant	C. Baker (E)	-	BS Psyc.	6 yrs.	3/4 yr.
Human Engr. Consultant	P. Thurmond (N)	-	Ed.D.,Res.& Stat.	4 yrs.	2 mos.
Human Engr. Consultant	J. Gagnon (N)	-	MA Psyc.	5 yrs.	2 mos.
Human Engr. Consultant	E. Silverman (A)	-	Phd.H.F.Psyc.& MSHE	15 yrs.	2 mos.
Human Engr. Consultant	R. Kirshner (A)	-	MA H.F.Psyc.	9 yrs.	2 mos.
Human Engr. Consultant	D. Taylor (A)	-	MS, Human Factors	12 yrs.	2 mo.
Human Engr. Consultant	C. Weiss (A)	-	MSE, Indus. Engr.	4 yrs.	2 mo.
Utility Engr. (I&C)	D. Kern (K)	-	BSEE	3 yrs.	3 yrs.
Utility Engr	M. Hellman (U)	-	BSEE	9 yrs.	3 yrs.
Utility Engr.	S. Fu (K)	-	MSEE	4 yrs.	1/2 yr.
Utility Operations	D. Heinlein (U)	SRO certified	BSME	4 yrs.	3 yrs.
Utility Operations	J. McKinstray (K)	SRO certified	BSAeroE	11 yrs.	3 yrs.
Utility Operations	M. Taylor (U)	SRO certified	BSME	11 yrs.	1/2 yr.
Utility Operations	S. Putthoff (U)	SRO certified	-	9 yrs.	1/2 yr.
Architect/Engr. (I&C)	D. Grove (B)	-	MSME	7 yrs.	3 yrs.
Architect/Engr. (I&C)	J. Harrison (B)	-	BSME	2-1/2 yrs.	2 yrs.
Architect/Engr. (I&C)	R. Wu (B)	-	MSEng.Elec	13 yrs.	3 yrs.

S = SNUPPS Staff
U = Union Electric Company
K = Kansas Gas and Electric Company
N = NUS Corporation
E = Essex Corporation
A = ARD Corporation
B = Bechtel Power Corporation

Table 1.2.1 DCRDR Project Team Personnel and Experience

The manner in which the members of the DCRDR Team participated in the various tasks of the DCRDR is summarized in Table 1.2.2.

The HFPRG was established as a standing review group that will review all proposed control room modifications prior to implementation.

TASK	Proj. Mgr.	Dep. Proj. Mgr.	SNUPPS Staff Engr.	Human Engrg. Consult.	Utility Engr.	Utility Oper.	Arch/ Engr.
1. Program Definition	X(1)	●	●	●	●	●	
2. Master Schedule Preparation	X(1)	●			●	●	●
3. Sub-schedule preparation		X			●	●	●
4. Schedule Maintenance		X					●
5. Periodic update reports		X	●				
6. Define DCRDR technical requirements	X(1)	●		●	●	●	
7. Define DCRDR human factors requirements	0			X	●	●	
8. Authorize changes in #2 and #3		X					
9. Detail schedule for plant-specific review (DCRDR)		X		●	●	●	
10. Conduct plant-specific review (DCRDR); prepare HEFs.		●	●	X	●	●	●
11. Evaluate recommended changes (HEFs)	X(1)	●	●	●	●	●	●
12. Implement Changes		0		0	0		X
13. Program assessment	X(1)	●		0	0	0	
14. Corrective action sign-off	●	●			X(1)		
15. Final report preparation	●	X	●	●	0	0	●
16. Final report review	X	●	●	●	0	0	
17. Final report approval	●	●			X(1)		
18. Final report delivery	0						

X = Primary Responsibility
● = Support Responsibility
0 = Approval Authority

(1) Utility Technical Committee Approval Authority

Table 1.2.2 DCRDR Task Responsibility Chart for Project Management

1.3 Documentation

A data base library was established for the DCRDR process. This subsection describes the documentation system (input/output documents) and documentation management/control library used to support the Detailed Control Room Design Reviews.

1.3.1 Input Documentation

The following references were available and/or developed throughout the DCRDR program.

- o NUREG-0700
- o NUREG/CR-1580
- o FSAR
- o System Lists
- o System Specification & Functional Description for BOP Computer
- o Piping and Instrumentation Drawings
- o Control Room Floor Plan (Lighting, HVAC, Acoustics, etc.)
- o Panel Layout Drawings
- o List of Acronyms, Abbreviations
- o Color Coding Conventions for CRT
- o BOP Computer System Displays
- o Standardized Valve Nomenclature List
- o Procedures (Emergency, Abnormal and Operating)
- o Operational Procedure Preparation Guide
- o Preliminary Design Assessment Report
- o WOG Emergency Response Guidelines
- o WOG System Functions Review and Task Analysis Study
- o Full Scale Mockups of Control Panels
- o Other Human Factors/Control Room Studies

1.3.2 Output Documentation

A complete documentation of the review process was maintained during the DCRDR providing data traceability, retrievability and assurance of quality. The review documentation includes:

- o Completed Checklists
- o Human Engineering Findings (HEFs)
- o HEF Priority Sheet
- o Questionnaire Forms

Examples of a Human Engineering Finding Form and Priority Sheet may be found in Appendix G.

Examples of forms used in the Task Analysis are in Appendix J.

Examples of an Operating Sequence Diagram used during the Validation of Control Room Functions effort can be found in Appendix I.

The SNUPPS files contain information on HEFs, beginning with checklists from which they are generated, meetings that document their reviews and letters directing appropriate dispositions. Human Engineering Finding forms document discrepancies resulting from the data reduction process and priorities were assigned by completing a priority sheet for the finding. The actual data collected to produce findings for the PDA are recorded on checklists that are kept within the Human Engineering Evaluation Report (HEER) File at the SNUPPS Staff offices.

A detailed explanation of data collection and reduction for the initial control room survey (preliminary design assessment, or PDA) may be found in the Essex report, transmitted to the NRC by reference 2.

Copies of the general data and findings are distributed or otherwise made available to all DCRDR team members to allow access and research by any team member as appropriate.

Typical forms used for the remainder of the DCRDR are listed below and are included in Appendix H.

- o Air Velocity Survey Record
- o Humidity/Temperature Record
- o Lighting Survey - Luminance and Reflectance Record
- o Lighting Survey - Illuminance Record
- o Sound Survey Record

Maintenance of the DCRDR document control has provided for traceability, retrievability and assurance of quality throughout the review process.

1.4 Review Procedures

1.4.1 Operating Experience Review

As the SNUPPS plants were under construction at the time of the DCRDR, operating experience was factored into the DCRDR by (1) feedback provided by prospective operators from the Wolf Creek and Callaway plants who had training on the SNUPPS simulator, (2) utilization of industry experience obtained through involvement of SNUPPS personnel in Westinghouse Owners Group (WOG) activities, and (3) use of the Callaway simulator for the WOG emergency procedure validation program.

A SNUPPS Operating Personnel Survey was conducted by Essex Corporation as part of its PDA review in 1980. Prospective operators from the Wolf Creek and Callaway plants who had training on the SNUPPS simulators were given questionnaires and were interviewed regarding their evaluations of control room design features. The questionnaire addressed the areas of: staffing and workload, workspace design, control/display integration and placement, communications, annunciator/warning system, operator protective equipment, computers, procedures/documentation, and operation. The interview covered operator feedback as a result of the operators' initial training experiences on the SNUPPS simulator at Zion.

This survey technique provided the SNUPPS review team with feedback on specific problems with the control room design. Examples of these findings were: confusion with the Engineered Safety Features Actuation System (ESFAS) status panel; difficulty in following the mimics on the Engineered Safeguard Features panel; difficulty in reading annunciator windows from the operating station; and poor positioning of annunciator acknowledge controls. These observations reinforced the findings of Essex Corporation and were directly utilized in developing improved designs for these aspects of the control room.

Together with other utilities having Westinghouse designed plants in operation or under construction, SNUPPS has participated in the formation and functioning of a Westinghouse Owners Group (WOG). A key element of the WOG, accounting for approximately half of the total activity, is the Procedures Subcommittee. This subcommittee consists of senior operating personnel, many of whom hold or have held SRO licenses, from approximately 20 utilities. This subcommittee contributed direct operating experience, from many years of operation and several emergency events, to the development of improved Emergency Response Guidelines and the Systems Review and Task Analysis.

1.4.2 System Function Review and Task Analysis

The general procedure for the system review and task analysis is illustrated in Figure 1.4.1. The starting point is an emergency plant event or condition. The term "plant event" is applied to transients or accidents that have been postulated by the plant designers and are recognized by the operators from instrumentation available to them. The term "plant condition" applies to transients or accidents that may not have been postulated or are not recognized by the operators.

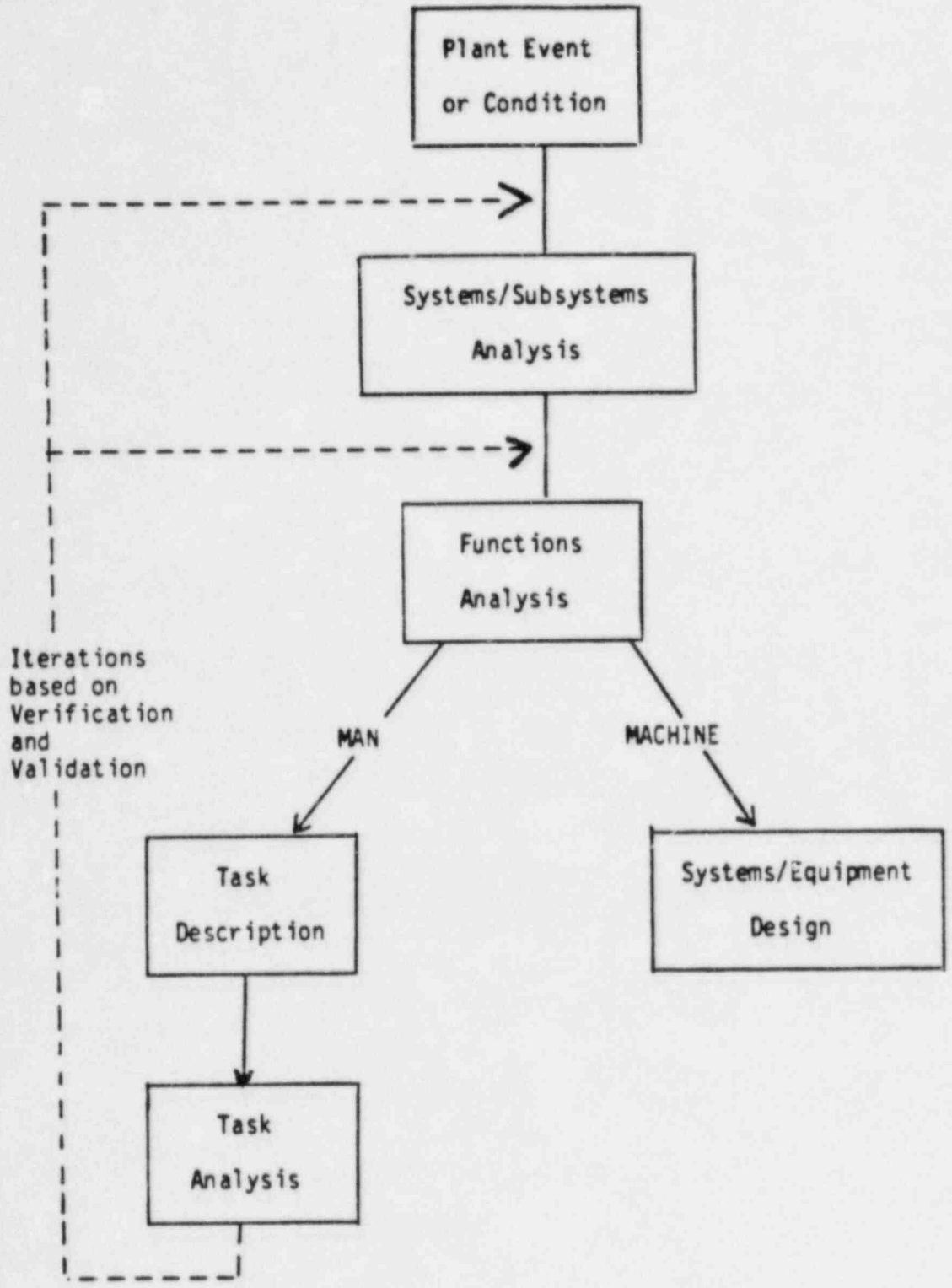


Figure 1.4.1 - System Review/Task Analysis Procedure

1.4.2 System Function Review and Task Analysis, continued

The systems/subsystems analysis referred to in Figure 1.4.1 has been performed on a generic basis for all Westinghouse plants by Westinghouse and the Westinghouse Owners Group (WOG). Plant events postulated include all combinations of initiating sequences and single or multiple equipment failures with calculated probabilities of occurrence greater than 10^{-8} per reactor year and many with probabilities lower than that. For these postulated plant events the systems and broad functional requirements to mitigate each event have been defined. This portion of the systems analysis is the basis for "event related" function analysis. Plant conditions (events not postulated or not recognized by the operators) have been addressed by identifying critical safety functions (CSFs) necessary to preclude or limit fuel damage and/or release of radiation. A set of generic CSF status trees and broad functional requirements to restore any compromised CSFs have been developed. This portion of the systems analysis is the basis for "symptom related" function analyses.

The function analysis consists of developing in detail generic event-related and symptom-related emergency procedures. This work has been done by experienced Westinghouse and utility operations personnel, under the sponsorship of the WOG. Collectively these procedures are termed Emergency Response Guidelines. Extensive background documentation has been developed for the ERGs. The background information includes calculations of emergency events, which serve to identify the ranges over which plant parameters are expected to vary and to identify parameter values at which operator actions should be taken. The background analysis has also considered which parameters are the most effective indicators to an operator of the plant condition and progress of events. This includes consideration of which instruments and controls are safety-grade and qualified for post-accident conditions and which are not. This bears on the accuracy with which an instrument indicates the true parameter value. The plant-specific emergency operating procedures for the Callaway and Wolf Creek plants are based on and closely follow the ERGs.

A standard Westinghouse plant design (RESAR-3) was the basis for the SNUPPS design. This standard design had evolved on the basis of many years of licensing and operation of Westinghouse-designed reactors. Most of the decisions of when the response to a functional requirement should be automatic (machine) and when manual (man) were made during that evolutionary design process. In only a limited number of cases have changes in the allocation of tasks between man and machine been indicated to be desirable by more recent reactor and simulator operating experience.

Task descriptions have also been developed on a generic basis by Westinghouse and the WOG. This program was begun in late 1981 to address the recommendation in Section 3.4 of NUREG-0700. It has consisted of a methodical review of the ERGs and identification of every monitoring task (instrumentation) and operational task (control) identified by each step of each event-related and each symptom-related procedure. These various tasks, many of which are required by more than one procedure, have been combined into one comprehensive set of tasks. Since the SNUPPS emergency operating procedures closely follow the ERGs, this system review and task analysis (SRTA) program conducted by Westinghouse is directly applicable to the identification of task descriptions for the SNUPPS control room. This effort has identified 141 categories of monitoring tasks (instrumentation) and 119 categories of operational tasks (controls).

1.4.2 System Function Review and Task Analysis, continued

The task analysis function was performed by the SNUPPS DCRDR Team on a SNUPPS-specific basis. The first step was to review the nature of each task description. Most of the tasks (all but 17 categories of the monitoring tasks and all but 10 categories of the operational tasks) are strictly "digital" in nature. That is, a typical monitoring task is to ascertain whether a component is operating or not, whether a valve or breaker is lined up one way or the other, or whether a flow meter is indicating other than zero flow. Or, in the case of controls, the typical task is to turn equipment on or off or to reposition a valve or breaker. Several of these "digital" operational tasks are manual backups to automatic actions.

An example category of monitoring tasks is the set of tasks requiring the operator to take action based on the value of reactor coolant system wide range pressure. There are approximately forty subtasks in this category and more than sixteen specific values of wide range pressure are cited as bases for operator action. These subtasks are explicitly defined in the ERGs and SRTA developed for the Westinghouse Owners Group. The task review process has been to examine each of these subtasks against the checklist in Appendix B. Similar procedures have been followed for each of the other 16 categories of monitoring tasks. In addition, since the majority of the monitoring tasks use instruments identified in Regulatory Guide 1.97, Rev. 2, the instrument range determined from the SRTA has been checked against the instrument range specified in RG 1.97, Rev. 2. It has been determined that these two sources of range data are consistent.

Ten categories of operational tasks require the operator to exercise some form of modulating control. These tasks were examined using the checklists in Appendix J and were also performed on the Callaway simulator to verify task performance capability.

1.4.3 Control Room Inventory

The inventory of instruments, controls and displays in the control room is shown on plant design drawings. These drawings include over-all arrangement drawings and drawings of each individual panel. The panel drawings include the labels, mimic lines, and demarcation lines that identify the instruments, controls, and displays by coded identification number, plant system and function. Individual instruments, controls, or displays are described in specifications, vendor manuals and/or drawings for each item. As-built drawings will be prepared as necessary to reflect differences between the as-built panels and design drawings. These design and as-built drawings will be maintained throughout the life of each plant and are sufficient to support the needs of the SNUPPS DCRDR.

By using the approach described in section 1.4.2 for task analysis, a formal itemization of control room components for comparison with instrumentation requirements was not necessary. A verification of the appropriate control room inventory to adequately perform control room functions as represented in the WOG task description was performed. This process is described in detail in section 1.4.5.

1.4.4 Control Room Survey

The control room survey was performed in several stages, as necessitated by the construction schedule.

The first stage was a comprehensive survey of all of the control panels, with coincident interviews of operating personnel and walk-through of a limited set of emergency procedures. Essex Corporation was the Human Engineering consultant for this phase. This initial review, which was performed prior to issuance of NUREG-0700, used the guidelines of NUREG-CR/1580 and this survey evaluated controls and displays located on the Callaway control room and a SNUPPS simulator, and led to the study of special areas, e.g. annunciator prioritization, safety status monitoring, and control/display enhancement. This survey is termed a Preliminary Design Assessment (PDA).

Instrumentation, controls and other equipment items were examined for human engineering acceptability as components, including reference to their specific uses in task performance. Discrepancies were based on design incompatibility with human perceptual, motor, psychological or size characteristics. Results of the SNUPPS review are listed in the Essex Report transmitted by reference 2. Sample checklists and actual Human Engineering Finding forms are kept in the SNUPPS HEER files.

Subsequent to the Essex review, the NRC (HFSB) performed a review in July 1981 using the human engineering design criteria identified in the NUREG-0700 checklist. A thorough audit was conducted and Findings were identified. Results were documented in the form of correspondence and the subsequent Technical Evaluation Report (TER). Actions taken by SNUPPS in direct response to these reviews have been documented in a series of letters, dated from June 1981 to April 1982 (references 2 through 6).

1.4.4 Control Room Survey, continued

The second stage of the control room survey, which took place from mid-1981 to late-1983, was a review of modifications made to correct findings of the Essex and NRC reviews and to install instruments and controls added in the final evolution of the design. These reviews were performed by the HFPRG, with assistance of a Human Engineering consultant, and were done to the guidelines of NUREG-0700.

The third stage of the control room survey was a review of previously unfinished items, as identified in the NRC's Technical Evaluation Report (TER). This review is termed the Supplementary Survey, or SS. This stage was started in late-1983 and is now complete. This portion of the review was addressed mainly to environmental characteristics of the control room.

The procedures for SNUPPS environmental measurements follow the guidance of NUREG-0700 Appendix E, and findings were handled in a manner similar to those of the control room survey.

1.4.4.1 Sound Survey Procedures

The locations for sound measurements were noted on a control room layout drawing. Measurements were taken at each operator position that requires verbal communication and/or auditory discrimination of a signal.

Considerations during measurement included ambient noise levels (where ambient noise is defined as background control room noise without the contribution of alarms, printers or communications equipment), annunciator alarm levels (work station annunciator and any other annunciators that must be heard at that work station) under both ambient and high noise level conditions (e.g., with printers, other alarms and signals), telephones and other communication equipment and evacuation signals and other alarms.

1.4.4.2 Lighting Survey Procedures

The location for the illumination measurements were noted on a control room layout drawing. Readings were taken:

- o In front of each front panel
- o In the center of the control room
- o In front of each back panel

Various combinations of power supplies were utilized.

1.4.4.3 Humidity/Temperature Procedures

Humidity and temperature were measured by setting meters in an area where they would not be disturbed. Readings at floor level and at 6 ft. above floor level every hour for at least one 24-hour period were taken.

1.4.4.4 Air Velocity Survey Procedures

The locations for air velocity readings were noted on a control room layout drawing. Measurements were taken at principal operator work stations at an elevation of 6 ft. for standing positions, and at 4 ft. for sitting positions.

1.4.5 Verification of Task Performance Capabilities

The objective of this part of the DCRDR is to compare the instrumentation and equipment requirements derived from the task analysis to items in the control room inventory. This has been done as follows.

Each task identified by the Emergency Response Guidelines is tabulated in the generic system review and task analysis (SRTA). For each of these tasks, the SNUPPS DCRDR team has identified the specific instruments and/or controls used to perform the task and the locations of these instruments and/or controls.

As described in Section 1.4.2, most of the required operator tasks are digital in nature. The verification of performance capabilities for these digital tasks emphasizes two points: (1) is the control or instrument properly located in the control room and (2) is the design of the control or instrument in accordance with Human Engineering principles?

Instruments that must be utilized in other than digital manner have received greater attention. The characteristics of these instruments, such as range, precision and units are compared with the values of the parameter(s) displayed at which operator tasks must be performed. The review also identified alternative sources of the information required by the task analysis.

Controls that perform a modulating (vs. digital) function are reviewed in the context of the objectives of the operator task and the relationship between the controller and the indication of the variable(s) controlled.

Checklists used to verify task performance capabilities of instruments and controls are contained in Appendix J.

1.4.6 Validation of Control Room Functions

An important feature of the DCRDR is the iteration process shown schematically in Figure 1.4.1. At several times during the systems function and task analyses, emergency procedures have been performed on simulators of the same design as the SNUPPS control boards and the ability for the operators to perform the necessary functions and tasks with the procedures, controls, and instrumentation provided has been validated.

The validation review determined if the operator tasks needed to implement the ERGs can be accomplished effectively within the structure of the established operating and emergency procedures and the design of the control room.

1.4.6 Validation of Control Room Functions, continued

An initial validation program was conducted for the SNUPPS control room using video-taped walk-throughs of selected procedures performed at the SNUPPS simulator at Zion. The following plant procedures were evaluated during this validation:

- o Immediate Action and Diagnosis
- o Loss of Primary Reactor Coolant
- o Loss of Secondary Coolant
- o Steam Generator Tube Rupture
- o High Wind/Tornado Station Blackout
- o Reactor Trip
- o Turbine Trip
- o Loss of One Feedwater Pump

Each procedure was taped twice, once with a full complement of operators without any interruptions and once with an operator explaining each step. The videotapes were then used to analyze the operator actions for each of these procedures. Instances of poor control/display relationships, lack of necessary information and inadequate presentation of information were identified from the analysis and identified as findings. These findings were included in the Essex Corporation report of the PDA.

A second verification and validation program, with focus on the Emergency Response Guidelines, was performed at the Callaway simulator in June 1982. The program consisted of a walk-through of forty-one of the ERGs (the entire set). The operators for this program were operating personnel from the Callaway and Wolf Creek plants. Westinghouse engineering and training personnel observed the program. An NRC representative was present part of the time. Though the verification and validation program was specifically focused on the ERGs, the program also served to validate that all necessary instruments and controls are available and conveniently located in the SNUPPS control room.

A structured evaluation of these aspects of the SNUPPS control room design was subsequently performed using video tapes made during the ERG verification and validation program. The following factors were included in this review of video tapes:

- o The indications and annunciators should be referenced in the procedure(s).
- o The units of measurement displayed should be appropriate and consistent with the procedure(s).
- o The operator actions expressed or implied by the procedure(s) should be within the capability of the operator(s).

1.4.6 Validation of Control Room Functions, continued

Operators in conjunction with human factors specialists performed the analysis. In addition, using a unit floor diagram, work station flow was recorded and the following issues addressed:

- Direction of movement
- Sequence of movement
- Frequency of the movement
- Estimated time criticality of the movement
- Real time estimate of the time that the operator(s) spend at each work station

2.0 REVIEW FINDINGS

2.1 General

Six processes are recommended by NUREG 0700 to establish benchmarks and identify findings for a complete Detailed Control Room Design Review (DCRDR):

(1) Review of Operating Experience
(2) System Function Review and Task Analysis
(3) Control Room Inventory
(4) Control Room Survey
(5) Verification of Task Performance Capabilities
(6) Control Room Validation

Table 1.1.1 outlines these six processes and the associated SNUPPS reviews performed to date to satisfy each. The DCRDR reviews have resulted in a total of 279 findings to date, as shown in Table 2.1. Because of the large number of findings, individual findings are treated only in summary fashion in the body of this report. More complete descriptions of the findings and the corrective actions are contained in Appendices A through F of this report.

All reviews except the Environmental Survey and review of site specific panels are generic to both SNUPPS control rooms. Environmental Surveys have been performed independently at each SNUPPS control room and Auxiliary Shutdown Panel. Appendix D contains results of Callaway's and Wolf Creek's Environmental Surveys.

The process for evaluation of findings by SNUPPS begins within the Human Factors Plant Review Group (HFPRG). Upon review of an HEF, the HFPRG first determines whether the finding is valid. Because the control room reviewer, Human Engineering Consultant or NRC reviewer, does not always fully understand the plant design, some of the HEFs have been determined to be not applicable. The HFPRG then takes the following factors into account in developing recommended resolutions to HEFs:

* Priority, which indicates the safety significance of the HEF
* Difficulty of backfitting changes, e.g., availability of space on control panels, Class IE separation requirements, etc.
* Complexity of change, e.g., straightforward change versus significant redesign.
* Impact on schedules for construction, startup and operation

High priority HEFs are considered first. In most cases the HEF includes a recommended change. If the HEF requires physical changes to the control boards or equipment mounted on the boards, the architect engineer evaluates the impact of the changes and advises the HFPRG of any constraints that may exist, e.g., Class IE separation requirements, ability of equipment supplier to change his equipment, schedular considerations. If the change involves significant redesign (e.g., re-prioritization of annunciators, change of system status panels, rearrangement of instruments and controls,

Table 2.1

Control Room Reviews - Summary of Findings

	Number of Findings									
	NUREG 0700 Section									Total
Review	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	
PDA	10	0	14	16	28	62	12	19	14	175
SS	1	8	1	6	21	0	18	5	1	61
ASP	6	3	0	5	11	5	0	3	0	33
ES	2	0	1*	0	0	0	0	0	0	3
Totals	19	11	16	27	60	67	30	27	15	272
Task Perf. Cap.										1
Valid. Prog.										6
								Total		279

PDA - Preliminary Design Assessment
SS - Supplementary Survey
ASP - Auxiliary Shutdown Panel
ES - Environmental Survey

* Callaway Only

2.1 General, continued

redesign of mimics), the HEPRG decides which organization, i.e., architect engineer, Utilities or SNUPPS Staff will have lead responsibility to develop the change. In a limited number of cases the HEF is deemed to be impractical to be implemented and/or of low importance and the HFPRG recommends against making the indicated changes.

The actions recommended by the HFPRG are documented by the Deputy Project Manager and referred to the Technical and Operations Committees for their review and endorsement. Upon concurrence by these committees, the actions necessary to implement the modifications are initiated by the Project Manager or Deputy Project Manager.

Prior to implementation of design improvements, the proposed redesign is reviewed by the DCRDR Team. The procedure for this review begins with an evaluation of the redesign against the HEF and recommended resolution (if provided). Changes involving significant redesign are usually depicted in a full-scale mockup of the control board or full-scale drawings prior to finalization of the proposed redesign. The revised design is always scrutinized from a human engineering viewpoint by the DCRDR Team during their evaluation and, in most cases, by the Human Engineering Consultant as well. The finalized redesign is reflected on control board drawings and the simulator panels at each site where Utility operations and engineering personnel review the modifications. Through these reviews it is determined that:

- The selected design improvements will provide the necessary correction
- The improvement does not introduce new HEFs.

These conclusions are verified by walk-through of selected procedures on a full-scale mockup, the simulator or the control room after the changes have been made. Any feedback on the redesign is conveyed to the DCRDR Team via the Utility operations or engineering representatives.

2.2 Control Room-Wide Survey Findings

2.2.1 Workspace and Environment

Section 6.1 of NUREG-0700 delineates the aspects of the control room evaluated in this context. A summary of the findings is as follows:

Review	No. of Findings	No. to be Corrected	Reference
PDA	10	4	App. A
SS	1	0	App. B
ASP	6	5	App. C
ES	2	Cal-2 WC-1	App. D

No corrective actions will be taken for 6 of the PDA findings. Only two of these no action findings (1.1, 1.8) are Category 1 or 2. The justifications for not taking corrective actions are given in Appendix A.

The SS finding for which no corrective action is to be taken is other than Category 1 or 2.

2.2.1 Workspace and Environment, continued

One finding of the ASP review (1.4) has been evaluated to require no corrective action and is Category 1 or 2. Justification is provided in Appendix C.

The single ES finding (1.2) for which no action will be taken applies to Wolf Creek. Justification for no action is provided in Appendix D.

2.2.2 Communications

Section 6.2 of NUREG-0700 delineates the aspects of the control room evaluated in this context. A summary of the findings is as follows:

Review	No. of Findings	No. to be Corrected	Reference
PDA	0	0	App. A
SS	8	3	App. B
ASP	3	2	App. C
ES	0	0	App. D

The 5 SS findings for which no corrective action is to be taken are other than Category 1 or 2.

The only ASP finding that does not require corrective action is other than Category 1 or 2.

2.2.3 Annunciator Warning System

Section 6.3 of NUREG-0700 delineates the aspects of the control room evaluated in this context. A summary of the findings is as follows:

Review	No. of Findings	No. to be Corrected	Reference
PDA	14	13	App. A
SS	1	0	App. B
ASP	0	0	App. C
ES	1	1	App. D

The one PDA finding for which no corrective action is to be taken (3.7) has been determined by SNUPPS to be an invalid finding.

The SS finding identified is other than Category 1 or 2 and was investigated further during the environmental sound study.

Action was taken on the single finding from the Callaway ES (3.1). Implementation was performed at Wolf Creek prior to their ES and was found to alleviate the finding. A similar correction was performed at Callaway.

2.2.4 Labels and Location Aids

Section 6.6 of NUREG-0700 delineates the aspects of the control room evaluated in this context. A summary of the findings is as follows:

2.2.4 Labels and Location Aids, continued

Review	No. of Findings	No. to be Corrected	Reference
PDA	62	54	App. A
SS	0	0	App. B
ASP	5	4	App. C
ES	0	0	App. D

Of the 8 PDA findings for which no corrective action will be taken, only 3 (6.1, 6.3 and 6.15) are Category 1 or 2. Justification is provided in Appendix A.

The one ASP finding for which no corrective action is to be taken is not safety-related. The justification for no corrective action is provided in Appendix C.

2.3 Panel/Work Station Findings

2.3.1 Controls

Section 6.4 of NUREG-0700 delineates the aspects of the control room evaluated in this context. A summary of the findings is as follows:

Review	No. of Findings	No. to be Corrected	Reference
PDA	16	13	App. A
SS	6	3	App. B
ASP	5	3	App. C
ES	0	0	App. D

Two of the three findings for which no corrective action is to be taken (4.4, 4.5) are Category 1 or 2. Justification for no action is provided in Appendix A.

Two of the 3 SS findings for which no corrective action is to be taken are other than Category 1 or 2. Subsequent to field verification, it was determined that the remaining finding (4.5) required no corrective action.

Two of the findings of the ASP review have been evaluated to require no corrective action and only one (4.1) is Category 1 or 2. Justification is provided in Appendix C.

2.3.2 Displays

Section 6.5 of NUREG-0700 pertains to these aspects of the control room. A summary of the findings is as follows:

Review	No. of Findings	No. to be Corrected	Reference
PDA	28	18	App. A
SS	21	14	App. B
ASP	11	2	App. C
ES	0	0	App. D

2.3.2 Displays, continued

Four of the 10 PDA findings for which no corrective action is to be taken (5.2, 5.9, 5.24, 5.27) are category 1 or 2. Justification for no action is given in Appendix A.

The 7 SS findings for which no corrective action has been identified are other than category 1 or 2.

Only one of the 9 ASP findings (5.11) for which no corrective action is to be taken is category 1 or 2. The justifications for no actions are given in Appendix E.

2.3.3 Process Computer

Section 6.7 of NUREG-0700 pertains to the computer. A summary of the findings is as follows:

Review	No. of Findings	No. to be Corrected	Reference
PDA	12	3	Ref. A
SS	18	2	App. B
ASP	0	0	App. C
ES	0	0	App. D

Only two (7.4, 7.11) of the 9 PDA findings for which no corrective action is to be taken is considered category 1 or 2.

All but one (7.1) of the sixteen SS findings that have been identified as needing no corrective action are other than category 1 or 2. Finding 7.1 was evaluated during the environmental lighting tests.

2.3.4 Panel Layout

Section 6.8 of NUREG-0700 applies to panel layout. A summary of the findings is as follows:

Review	No. of Findings	No. to be Corrected	Reference
PDA	19	14	App. A
SS	5	0	App. B
ASP	3	1	App. C
ES	0	0	App. D

Five of the 19 PDA findings are listed as no action. Only one of the five (8.17) is category 1 or 2.

Five SS findings have been identified as requiring no corrective action and are other than category 1 or 2.

One of the 2 no action findings for the ASP is considered category 1 or 2 (8.3) and appropriate justification for no action is provided in Appendix C.

2.3.5 Control-Display Integration

Section 6.9 of NUREG-0700 delineates the aspects of the control room evaluated in this context. A summary of the findings is as follows:

Review	No. of Findings	No. to be Corrected	Reference
PDA	14	9	App. A
SS	1	1	App. B
ASP	0	0	App. C
ES	0	0	App. D

Of the 14 findings discovered during the PDA, only 5 have been designated as no action. Three of these 5 findings are category 1 or 2 (9.4, 9.13, 9.14) and justification for no action is provided in Appendix A.

The SS finding identified has been listed as requiring corrective action.

The Safety Parameter Display System (SPDS) has been reviewed separately and is described in reference 11. The presence and displays of the SPDS have been considered in the Verification of Task Performance Capabilities and their location within the Control Room has been determined by the DCRDR Review Team and subsequently considered by ARD Corporation in their review of Control Room workspace.

2.4 Other Review Findings

2.4.1 Validation Program

The results of this review are given in Appendix E. There were 6 findings. Two of these will be corrected. Justification for no action on the remaining 4 is given in Appendix E.

2.4.2 Task Performance Capability

The results of this review are given in Appendix F. There was one finding related to labeling of indicator lights on auxiliary feedwater controllers. Upon further investigation, it was determined that this finding was simulator specific. Additional work on the Task Analysis is planned for the future and a supplemental report will be submitted to the NRC by July 1, 1985.

3.0 IMPLEMENTATION

3.1 Completed Improvements

The PDA was performed to provide advance information regarding the human factors acceptability of the Control Room and was accomplished prior to the issuance of NUREG 0700. This advance information allowed early implementation of findings, i.e., prior to fuel load, that would otherwise not be possible if the Control Room review had not begun until later. Altnough implementation of selected findings from other than the PDA will occur prior to fuel load, the vast majority will come from the PDA; therefore, these will be discussed in this subsection only.

Table 3.1 provides a status of implementation for PDA findings. A completed corrective action is shown as either "C" for Callaway jobsite, and/or "W" for Wolf Creek.

Of the total 175 findings, 128 are listed for action (7 findings are site specific to Callaway). Of the 128 findings, Callaway has implemented action for 122 findings and Wolf Creek has implemented 89 corrective actions. With the exception of findings 5.8 and 5.17, the remaining corrective actions for Callaway (findings 5.25, 5.28, 7.2, and 8.14) are scheduled to be implemented prior to exceeding 5% power.

3.2 Proposed Improvements

Findings resulting from the TER open items, ASP evaluation, and Validation Program are tracked by Table 3.2 and will have corrective actions implemented as noted. (Note changes in implementation dates for SS finding 4.2 and ASP finding 1.5 relative to the latest schedule transmitted by reference 13). One finding resulted from the Task Performance Capability Study and was determined to be specific to the Callaway simulator.

Status of Findings From Initial Essex and NRC Review (PDA) of SNUPPS Control Room

June 22, 1984

NRC FINDING AND PRIORITY	ACCEPT	ACTION	IMPLEM	NRC FINDING AND PRIORITY	ACCEPT	ACTION	IMPLEM	NRC FINDING AND PRIORITY	ACCEPT	ACTION	IMPLEM	NRC FINDING AND PRIORITY	ACCEPT	ACTION	IMPLEM
1.1 (1)	A1	N4	NA	5.6 (31)	A1	N4	NA	6.23 (1)	A1	F29	C	7.6 (3)	A2	N2	NA
1.2 (3)	A2	N2	NA	5.7 (3)	A6	N3	NA	6.24 (2)	A1	F25	C,W	7.7 (3)	A6	N6	NA
1.3 (1)	A1	F10	C	5.8 (2)	A1	U2		6.25 (3)	A2	F26	C,	7.8 (3)	A6	N3	NA
1.4 (1)	A4	F9	C,W	5.9 (2)	A1	N1	NA	6.26 (31)	A1	F25	C,W	7.9 (3)	A6	N3	NA
1.5 (1)	A1	F8	C,W	5.10 (1)	A1	F14	C,W	6.27 (31)	A1	F25	C	7.10 (31)	A1	N4	NA
1.6 (1)	A1	F9	C,W	5.11 (3)	A6	N3	NA	6.28 (1)	A1	F8	C,W	7.11 (1)	A6	N	NA
1.7 (3)	A6	N3	NA	5.12 (2)	A4	U2	C	6.29 (31)	A4	F25	C,W	7.12 (2)	A1	U2	C
1.8 (1)	A6	N6	NA	5.13 (2)	A1	203	C,W	6.30 (31)	A1	F25	C,W	8.1 (1)	A1	U1	C,W
1.9 (3)	A6	N3	NA	5.14 (31)	A1	F17	C	6.31 (2)	A4	202	C,W	8.2 (3)	A2	F25	C,
1.10 (3)	A6	N3	NA	5.15 (3)	A6	N3	NA	6.32 (31)	A1	F25	C,W	8.3 (31)	A1	N4	NA
3.1 (1)	A1	U1	C	5.16 (3)	A6	N3	NA	6.33 (31)	A6	F3	C,W	8.4 (31)	A1	F25	C
3.2 (3)	A2	F3	C,W	5.17 (1)	A4	U2		6.34 (31)	A4	F27	C	8.5 (31)	A1	F28	C,W
3.3 (3)	A5	F3	C,W	5.18 (1)	A1	U1	C,W	6.35 (1)	A4	F25	C,W	8.6 (31)	A1	U2	C,W
3.4 (1)	A1	F3	C,NA	5.19 (2)	A1	F9	C,W	6.36 (1)	A1	F25	C,W	8.7 (3)	A4	F8	C,W
3.5 (1)	A1	F22	C	5.20 (3)	A2	N2	NA	6.37 (31)	A1	F27	C	8.8 (3)	A6	N3	NA
3.6 (3)	A2	F3	C,W	5.21 (2)	A1	F4	C	6.38 (3)	A6	F25	C,W	8.9 (3)	A2	F25	C,W
3.7 (2)	A1	N4	NA	5.22 (31)	A6	U2	C,W	6.39 (31)	A1	F27	C,W	8.10 (3)	A6	N6	NA
3.8 (3)	A6	U1	C	5.23 (1)	A1	F15	C,W	6.40 (31)	A1	F25	C,W	8.11 (3)	A2	F25	C,W
3.9 (3)	A5	F3	C,W	5.24 (2)	A1	N4	NA	6.41 (31)	A1	U2	C,	8.12 (1)	A6	F7	C,W
3.10 (1)	A5	F3	C,W	5.25 (2)	A1	U2		6.42 (31)	A1	F9	C,	8.13 (2)	A1	F8	C,W
3.11 (31)	A5	F3	C,W	5.26 (31)	A1	F29	C,W	6.43 (31)	A1	U1	C,W	8.14 (2)	A4	F8	W
3.12 (1)	A5	F3	C,W	5.27 (1)	A1	N9	NA	6.44 (31)	A1	F25	C,W	8.15 (2)	A1	F8	C,NA
3.13 (1)	A1	U2	C	5.28 (1)	A4	U1	,NA	6.45 (31)	A4	F27	C,W	8.16 (2)	A6	F8	C,W
3.14 (1)	A1	F9	C,W	6.1 (1)	A1	N4	NA	6.46 (31)	A1	F27	C,W	8.17 (1)	A1	N4	NA
4.1 (3)	A2	N2	NA	6.2 (1)	A1	F9	C,W	6.47 (31)	A6	F25	C,	8.18 (3)	A6	N3	NA
4.2 (1)	A1	F8	C,W	6.3 (2)	A1	N4	NA	6.48 (3)	A6	N3	NA	8.19 (3)	A6	F23	C
4.3 (2)	A1	F26	C,W	6.4 (31)	A1	F27	C,W	6.49 (31)	A6	F28	C,W	9.1 (2)	A4	F25	C,W
4.4 (1)	A1	N4	NA	6.5 (31)	A1	F25	C,	6.50 (2)	A6	F28	C,W	9.2 (3)	A6	N3	NA
4.5 (2)	A1	N6	NA	6.6 (1)	A1	F25	C,W	6.51 (31)	A1	F28	C	9.3 (1)	A4	F25	C,W
4.6 (2)	A1	F9	C,W	6.7 (1)	A1	F25	C,W	6.52 (1)	A1	F28	C,W	9.4 (2)	A1	N4	NA
4.7 (1)	A1	F24	C W	6.8 (1)	A4	F25	C,W	6.53 (1)	A1	F28	C,W	9.5 (3)	A4	F8	C,W
4.8 (2)	A1	F9	C,W	6.9 (1)	A4	F25	C,W	6.54 (31)	A6	N6	NA	9.6 (2)	A1	F8	C,W
4.9 (2)	A1	F25	C,W	6.10 (1)	A4	F25	C,W	6.55 (31)	A1	F28	C,W	9.7 (2)	A1	F8	C,W
4.10 (2)	A4	F19	C,W	6.11 (3)	A6	N3	NA	6.56 (1)	A1	F28	C,W	9.8 (2)	A1	F8	C,W
4.11 (1)	A4	U2	C,W	6.12 (31)	A1	F25	C,W	6.57 (31)	A1	F28	C,W	9.9 (2)	A1	F23	C,NA
4.12 (1)	A4	F26	C,	6.13 (31)	A1	F25	C,W	6.58 (31)	A4	F28	C,W	9.10 (3)	A6	N3	NA
4.13 (1)	A6	RBC	C,W	6.14 (31)	A1	N4	NA	6.59 (1)	A4	F28	C	9.11 (2)	A6	F8	C,W
4.14 (3)	A2	F18	C,	6.15 (2)	A1	N6	NA	6.60 (1)	A4	F28	C,W	9.12 (2)	A4	F8	C,W
4.15 (31)	A1	F26	C,	6.16 (31)	A1	N4	NA	6.61 (1)	A1	F29	C,W	9.13 (2)	A1	N4	NA
4.16 (31)	A1	F9	C,W	6.17 (1)	A1	F29	C,	6.62 (1)	A4	F28	C,W	9.14 (2)	A6	N6	NA
5.1 (3)	A2	F21	C,W	6.18 (31)	A1	F9	C,W	7.1 (31)	A1	N4	NA				
5.2 (2)	A1	N4	NA	6.19 (31)	A1	F25	C,W	7.2 (2)	A1	F17					
5.3 (31)	A1	F11	C,NA	6.20 (2)	A1	F23	C,NA	7.3 (2)	A1	F18	C,				
5.4 (2)	A4	F12	C,W	6.21 (31)	A1	F25	C,W	7.4 (2)	A1	N4	NA				
5.5 (3)	A2	F13	C,W	6.22 (31)	A1	F25	C,NA	7.5 (3)	A6	N3	NA				

( ) - Priority

Table 3.1

ACCEPT - Acceptability of SNUPPS' Response

A1 - Accepted per NRC (Hopkins, Edison) letter to SNUPPS (UE, KGE) dated 02/16/82
A2 - Accepted per NRC (Youngblood) letter to SNUPPS (Schnell, Koester) dated 03/08/83
A3 - Acceptable per SLNRC 82-016, 03/16/82
A4 - Accepted per NRC (Youngblood) letter to SNUPPS (Schnell, Koester) dated 07/02/82
A5 - Acceptable per SLNRC 82-020, 04/12/82
A6 - Acceptable per SLNRC 84-0048, 03/21/84

ACTION - Action as follows:

F3	-	FCWP	FJ108	-	003	
F4	-	FCWP	FE094	-	004	
F8	-	FCWP	FJ200	-	008	
F9	-	FCWP	FJ200	-	009	
F10	-	FCWP	FJ200	-	010	
F11	-	FCWP	FJ200	-	011	
F12	-	FCWP	FJ200	-	012	
F13	-	FCWP	FJ200	-	013	
F14	-	FCWP	FJ200	-	014	
F15	-	FCWP	FJ200	-	015	
F16	-	FCWP	FJ200	-	016	
F17	-	FCWP	FJ200	-	017 or FCWP	FJ106 - 017 or FJ-200-213 or 2RJ-200S-703
F18	-	FCWP	FJ200	-	018 or FCWP	FJ106 - 018
F19	-	FCWP	FJ200	-	019	
F20	-	FCWP	FJ200	-	020	
F21	-	FCWP	FJ200	-	021	
F22	-	FCWP	FJ200	-	022	(FJ200-209 for Wolf Creek for Finding 3.5)
F23	-	FCWP	FJ200	-	023	(and FJ-200-210 for Finding 3.19)
F24	-	FCWP	FJ200	-	024	
F25	-	FCWP	FJ200	-	025	
F26	-	FCWP	FJ200	-	026	
F27	-	FCWP	FJ200	-	027	
F28	-	FCWP	FJ200	-	028	
F29	-	FCWP	FJ200	-	029	
202	-	FCWP	FJ200	-	202	
203	-	FCWP	FJ200	-	203	

RBC - Rework Plans RJ200-B & RJ-200-C
F - Work Plan expected to be issued in the near future.
N - No action required per this transmittal.
N2 - No Action Required per NRC (Youngblood) letters to SNUPPS (Schnell, Koester) dated 03/08/82
N3 - No Action Required per SLNRC 82-016, 03/16/82
N4 - No Action Required per NRC (Youngblood) letter to SNUPPS (Schnell, Koester) dated 07/02/82
N6 - No Action Required per SLNRC 83-0063, 11/30/83
U1 - Utility administrative function
U2 - Utility to perform hardware change (FJ200-020 for W.C.-Finding 4.11)
(FJ200-017 for W.C.-Finding 5.22)
(FJ200-025 for W.C.-Finding 8.6)

IMPLEM - Implementation as follows:
C - Modification has been made to Callaway control panel
W - Modification has been made to Wolf Creek control panel
NA - Not applicable (no action required)

IMPLEMENTATION SCHEDULE FOR SUPPLEMENTARY SURVEY AND AUXILIARY SHUTDOWN PANEL FINDINGS

June 22, 1984

SUPPLEMENTARY SURVEY

FINDING AND PRIORITY	ACT	IMP	5%FL	REF	A/T
1.1 (5)		N			
2.1 (5)		N			
2.2 (0)	X	C,	X		
2.3 (5)	X	C,	X		
2.4 (6)		N			
2.5 (5)		N			
2.6 (5)		N			
2.7 (5)		N			
2.8 ( )	X	C,W	X		
3.1 (4)		N			
4.1 (6)		N			
4.2* (0)	X			X	
4.3 (6)		N			
4.4* (0)	X	C	X		
4.5 (0)		N			
4.6* (0)	X	C	X		
5.1 (6)	X	C			X
5.2 (0)	X	C,W	X		
5.3 (5)	X			X	
5.4 (5)	X			X	
5.5 (5)		N			
5.6 (5)		N			
5.7 (5)		N			
5.8 (5)	X			X	
5.9* (0)	X	C	X		
5.10 (5)	X			X	
5.11 (5)	X			X	
5.12 (5)	X	C,	X		
5.13 (6)		N			
5.14 (5)	X	C,W	X		
5.15 (5)	X	C,W	X		
5.16 (0)	X	C,W		X	
5.17 (5)		N			
5.18 (0)	X	C,	X		
5.19 (0)	X		X	X	
5.20 (6)		N			
5.21 (6)		N			
7.1 ( )		N			
7.2 (5)		N			
7.3 (5)		N			
7.4 (5)		N			
7.5 (5)		N			
7.6 (5)	X	C,			X
7.7 (5)		N			
7.8 (5)		N			
7.9 (5)		N			
7.10 (6)		N			
7.11 (5)		N			
7.12 (6)		N			
7.13 (5)		N			
7.14 (5)		N			
7.15 (5)		N			
7.16 (6)		N			
7.17 (5)	X	C	X		
7.18 (5)		N			
8.1 ( )		N			
8.2 (5)		N			
8.3 (5)		N			
8.4 (5)		N			
8.5 (5)		N			
9.1 ( )	X	C,W			X

VALIDATION PROGRAM

1 ( )		N			
2 ( )		N			
3 ( )	X			X	
4 ( )		N			
5 ( )	X		X		
6 ( )		N			

ASP REVIEW

FINDING AND PRIORITY	ACT	IMP	5%FL	REF	A/T
1.1* (2)	X	C	X		
1.2 (1)	X	C	X		
1.3 (2)	X	C	X		
1.4 (2)		N			
1.5 (2)	X			X	
1.6 (2)	X	C,W	X		
2.1 (2)	X	C,			X
2.2 (5)		N			
2.3 (1)	X			X	
4.1 (2)		N			
4.2 (4)	X	C,W	X		
4.3 (5)		N			
4.4 (5)	X			X	
4.5 (5)	X			X	
5.1 (5)		N			
5.2 (5)		N			
5.3 (5)		N			
5.4 (5)		N			
5.5 (5)		N			
5.6 (5)		N			
5.7 (5)		N			
5.8 (5)	X			X	
5.9 (5)	X	C,	X		
5.10 (5)		N			
5.11 (2)		N			
6.1 (5)	X			X	
6.2 (5)	X	C,W	X		
6.3 (2)	X	C,	X		
6.4 (5)	X	C,W	X		
6.5 (5)		N			
8.1 (5)		N			
8.2 (1)	X	C,W	X		
8.3 (2)		N			

ENVIRONMENTAL SURVEY

(CALLAWAY)

1.1* ( )	X				X
1.2* ( )	X				X
3.1* ( )	X	C	X		

(WOLF CREEK)

1.1 ( )	X				X
1.2 ( )		N			

ACT - Action to be taken

IMP - Resolution Implemented as follows:
- C - Callaway
- W - Wolf Creek
- N - Not Applicable; no action to be taken

FL - Implementation expected by Fuel Load

5%P - Implementation planned prior to exceeding 5% power

REF - Implementation planned prior to completion of first refueling outage

A/T - Administratively controlled or handled through training

* - Applicable to Callaway Only

Table 3.2

4.0 REFERENCES TO SNUPPS SUBMITTALS

TO NRC ON DCRDR

1. SLNRC 81-26, 04/21/81: Human Factors Control Room Design Review

2. SLNRC 81-51, 06/26/81: Human Factors Evaluation of the SNUPPS Control Room - Essex Report

3. SLNRC 81-65, 08/12/81: Human Factors Evaluation of the SNUPPS Control Room - Proposed Resolutions to Findings in the Essex Report

4. SLNRC 82-04, 01/19/82: NUREG-0737, Item I.D.1 - Responses to NRC Audit Report Findings

5. SLNRC 82-016, 03/16/82: NUREG-0737, Item I.D.1 - Revised Responses to NRC Audit Report Findings

6. SLNRC 82-020, 04/12/82: NUREG-0737, Item I.D.1 - Results of Annunciator Prioritization Study

7. SLNRC 83-0019, 04/15/83: Generic Letter 82-33 - SNUPPS Response

8. SLNRC 83-0035, 06/30/83: SNUPPS Program Plan for the DCRDR - Issued 06/83

9. SLNRC 83-0062, 11/28/83: SNUPPS Program Plan for the DCRDR - Revised 11/83

10. SLNRC 83-0063, 11/30/83: NUREG-0737, Item I.D.1 - Revised Responses to NRC Audit Report Findings

11. SLNRC 84-0003, 01/13/84: SPDS Safety Analysis

12. SLNRC 84-0019, 02/02/84: DCRDR Summary Report for SNUPPS

13. SLNRC 84-0048, 03/21/84: NRC Audit of SNUPPS CRDR, Week of February 27, 1984

14. ULNRC-790, 04/06/84: Callaway Plant CRDR

15. KMLNRC 84-077, 05/11/84: Wolf Creek Human Factors Modifications

16. ULNRC-822, 05/15/84: Callaway Plant CRDR

Appendix A

INITIAL ESSEX AND NRC REVIEW (PDA)

1.0 Control Room Workspace

Finding 1 (1) Some controls are located too high to be accessible to a 5th percentile operator. One J-handle switch is located 73" above the floor. Some emergency controls for the BORON INJ RECIRC PUMP are located 66" above the floor. The maximum recommended height for controls is 56".

Response On panel RL014 at Callaway, the switchyard breaker control switches are located above the recommended height in order to retain their proper relationship to the switchyard mimic which is arranged to show the correct association of the transmission lines, busses and circuit breakers. Manual operation of these control switches is infrequent and is performed only after discussion with and at the direction of the Union Electric system dispatcher so that the operator action is deliberate and unhurried. These control switches can be operated by a 5th percentile operator as the attached picture illustrates.

The referenced control (Boron Inj. Recirc. Pump) which is in panel RL017 is not an emergency control. The pump is operated only when required to adjust the boron concentration in the boron injection tank (BIT). With its present location (66" above the floor) a 5th percentile operator can perform any necessary functions required as the attached picture illustrates.

Finding 2 (3) Controls on the test and maintenance operations panels have not been placed in the vertical area between 34" and 70" above the floor. Controls on these back panels are located significantly above and below the recommended range.

Response The controls on the panels behind the main control boards are not used on any kind of routine basis by the operator. They are, in fact, exactly as described, for test or maintenance functions. This creates no problems for the reactor operator because the operator will be aware of test or maintenance activities on these panels and can take appropriate actions without undue or adverse effects.

Finding 3 (1) There are several J-handle control switches that are located closer to the front edge of the panels than the recommended 3". These switches can be inadvertently actuated. These switches are located on RL001, RL013, RL015, RL019, RL021, RL023, and RL025.

Response Metal guardrails will be installed on all outer-ring control board consoles and on the RL001 inner-ring console. This will maintain approximately 2-1/2" of

1.0 Control Room Workspace, continued

free space between the operator body and the front edge of the console benchboard.

Finding 4 (1) Both of the SOURCE RANGE BLOCK and RESET pushbutton switches are located very close to the edge of the panel and are subject to inadvertant activation. If the reset pushbutton was accientally activated, it would clear the system for start-up, tripping the unit off line if the reactor power level was less than 10%.

Response Shrouds will be added to pushbuttons SE-HS-5 and SE-HS-10.

Finding 5 (1) The critical TD AUX FW PUMP TRIP/RESET control is located in a position where it can be inadvertently actuated.

Response This trip/reset control switch has been deleted and will be removed from the panel.

Finding 6 (1) The annunciator response controls are located on the fronts of the benchboards and can be easily activated by leaning against the panels.

Response The test and first-out annunciator reset controls will be guarded to prevent accidental actuation. The acknowledge buttons will be equipped with mushroom type actuators and will remain on the front of the benchboards. This location is highly desirable because its uniqueness allows the operator to operate it by feel with no danger of actuating any other type of control, while devoting his visual attention to the annunciator. There are no adverse consequences of accidentally activating the acknowledge button.

Finding 7 (3) Some controls are located further in from the front edge of the inner ring consoles than the recommended 24". These controls will not be accessible to a 5th percentile operator.

Response All controls located on the inner ring consoles can be operated by 5th percentile operators as the attached pictures illustrate.

Finding 8 (1) Some vertical and horizontal meters are located higher than the recommended 70" above the floor. These displays will not be readable or accessible to a 5th percentile operator. Most of these meters are located between 75" and 84" from the floor. Some meters are

1.0 Control Room Workspace, continued

located as high as 92", and the top rows of the annunciator panels are all located 117" above the floor. This problem exists on all of the main control room outer ring panels and on the Remote Shutdown panel.

Response When viewed from the leading edge of the benchboard, it has been determined that all instruments in question can be read from the viewpoint of a fifth percentile operator.

The meters used on the SNUPPS Main Control Board are of the "bi-level anti-parallax" design. These meters have a curved scale face and indicator movement which allow for easy readability when placed above 70". The annunciator tile lettering has been enlarged (see SLNRC 82-020) to provide readability from the front consoles. In general, displays must be located more than 70" above the floor to prevent the lateral spread of displays from exceeding guideline measurements (NUREG 0700 Sec. 6.1.2.2.f). The SNUPPS Main Control Board configuration represents the optimum compromise between grouping displays above the 70" guideline and within the 72" lateral spread guideline.

Finding 9 (3) The annunciators are mounted out of the visual field of the 5th percentile operator (recommended maximum = 75^{o} above the horizontal line of sight). The viewing angle was measured to be approximately 80^{o}.

Response The intent of the 75^{o} guideline is to avoid placement of indicators where uncomfortable neck strain would result from prolonged observation. The annunciators are legible to a 5th percentile operator. By their nature, annunciators do not require more than a few seconds of scrutiny before the operator would move on to other tasks. In this time it is unlikely that any adverse physiological problems would develop from looking up at an 80^{o} angle. Additionally, the operators will usually acknowledge and read the annunciators from the consoles instead of the main board, where the viewing angle is less than 75^{o}.

Finding 10 (3) The annunciator tiles are mounted with less than the recommended minimum 45^{o} viewing angle from the tile plane to the 5th percentile operator's line of sight at the acknowledge controls. The viewing angle was measured to be approximately 33^{o}.

Response Enlargement of the annunciator engravings, as described in 3.12, will alleviate this problem. Additionally, the operators will usually acknowledge alarms from the consoles instead of the main control boards. The viewing angle from console is not strongly dependent on the operators' height, and is greater than 45^{o}.

2.0 Communications

Reviewed during the Supplementary Survey

3.0 Annunciator Warning System

Finding 1 (1) A reflash capability is not provided that allows subsequent alarms to activate the auditory alert mechanism and reflash the visual tile even though the first alarm may not have been cleared.

Response This statement is incorrect, with the exception of the auditory alert mechanism. If the time delay relay associated with an annunciator group times out before an alarm is acknowledged (adjustable from 0 to 60 seconds), that auditory device is silenced automatically and will not reset until the acknowledge button is pressed. This feature has no effect on the visual indications, which do have reflash capability on all windows with multiple inputs. The annunciator time-out feature is desirable in that it eliminates a distracting and repetitive chore during conditions of high stress, i.e. a time when several alarms are being generated in rapid sequence as during a trip. The initial auditory signal alerts the operator of a problem. Allowing the timer to run out and silence its initial and subsequent auditory signals will reduce the need for extraneous activity (repetitivly acknowledging alarms) and allow the operators to concentrate on assessing the situation and taking corrective action. Once the immediate actions have been taken, the operator resets the auditory alarm simply by pressing the acknowledge button.

Administrative Controls will be established to prevent adjusting the alarm to time out in less than 3 seconds. Operators will be required to reset the alarms at the earliest reasonable time after response to previous alarms.

Finding 2 (3) The "first out" alarms that are provided for the reactor system and the turbine-generator system are not located on physically separate panels from the remainder of the annunciators. The proposed prioritization scheme for the annunciators will further interfere with easy recognition of the first out alarms.

Response The "first out" alarms that are provided for the reactor system and the turbine-generator system are each grouped separately on the annunciator window panels. In addition, a black demarcation line will be used to separate the "first out" annunciator windows.

Finding 3 (3) There is no prioritization of annunciator alarms by location, color, or other coding scheme.

3.0 Annunciator Warning System, continued

Response Results of the Annunciator prioritization study were previously transmitted to the NRC.

Finding 4 (1) The annunciator indicating breaker trip is on RL014 while the associated breaker control is on RL006.

Response The referenced annunciator window will be moved to the matrix on panel RK026. This is the closest annunciator matrix to the breaker control location. This is site specific to Callaway.

Finding 5 (1) The tile coordinate labels and panel identification labels for the annunciators have not yet been engraved or otherwise permanently attached. Also, annunciator response procedures are not indexed by panel identification and tile coordinates.

Response The annunciator matrices will be indexed by means of a coordinate system utilizing letters to denote rows and numbers to denote columns. In order to facilitate rapid location of a tile, each column will have its own unique number (1 through 134). Labels for each row and for every other column will be attached to the panels. The annunciator response procedures will be revised to include tile coordinates.

Finding 6 (3) Annunciator windows are not keyed or coded to prevent inadvertent interchange.

Response Tile locations will be engraved into each tile.

Finding 7 (2) The flash rates of the annunciators are not the recommended three to five flashes per second with approximately equal on and off times. The rates are approximately one flash per second, or slightly less.

Response The Finding is incorrect. During the "alert" portion of the annunciator sequence, the flash rate is rapid, about 3 flashes per second. The slow flash rate referred to occurs during the "return to normal" phase of the sequence for first out annunciators and those other annunciators equipped with the ringback feature.

Finding 8 (3) There is no distinctive coding to indicate annunciator tiles that are illuminated for extended periods of time.

Response The dark board concept while at normal power operation will be supported. Lights to be lit for extended periods of time while at power operation and that are due to maintenance related activites will be identified administratively to the operator. Reactor Operator shift turnover documentation will include information on annunciators that are locked in, or are out of service.

3.0 Annunciator Warning System, continued

Finding 9 (3) The annunciator panel matrix density is too high on some panels. For example RL026 is a 23 x 6 matrix with 138 tiles. The recommended maximum is 50 tiles per matrix.

Response Demarcation lines have been added to the panels to divide the matrices into groups of alarms related to similar equipment. The location of these lines will be subject to change in the future based on operational experience or operator preference.

Finding 10 (1) Some annunciator tiles do not adequately specify the alarm condition (e.g., "RHR PUMP TROUBLE" and "ACCUM TANK - LEVEL HI/LO").

Response All annunciator legends have been reviewed as part of our annunciator prioritization study. The examples given above are not deficient in our view. The use of a high level "Trouble" alarm reduces the total number of annunciators in the control room. Amplifying information is available from the computer and from local control panels. HI-LO alarms also reduce the number of annunciators needed in the control room. This type of alarm alerts the operator to a level problem. Other instrumentation will then be used to identify the exact nature of the problem, i.e. whether the level is HI or LO.

Finding 11 (3) The annunciator legend character height-to-width ratio was measured to be approximately 7:3. It should be no more than 5:3.

Response The annunciator character size that will be used is 3/8 inch high by 5/16 inch wide with a .06 inch stroke width and 1/4 inch line spacing. This results in a height to width ratio of 3.6:3, and a height to stroke width ratio of 6.25:1.

Finding 12 (1) The annunciator legends are difficult to read from the inner ring of control consoles due to inadequate character size, stroke width, and spacing; but they can be acknowledged from that location. For viewing the annunciators from the 12' distance within the inner ring of control consoles, the character stroke width should be at least .058 inch and the height-to-stroke width ratio should be 6:1.

Response See response for Finding 3.11.

3.0 Annunciator Warning System, continued

Finding 13 (1) The annunciator response controls do not include all of the following: silence, acknowledge, reset, and test controls. There is no separate silence control. The acknowledge control will silence the alarm before 10 seconds have elapsed from the time of alarm initiation. The auto silence function will silence the alarm after 10 seconds from initiation. Only the first out alarm panels have reset capability. The remainder of the annunciator alarms are automatically reset.

Response

(1) The silence function is incorporated in the acknowledge control. This is desirable because it reduces the number and complexity of controls associated with the annunciators without any function loss or ambiguity. This feature reduces the visual search time and memory requirements for the operator, enhancing overall performance.

(2) The auto-silence function is adjustable from 0 to 60 seconds. A discussion of the merits of this system is included in the position statement on NRC item 3.01.

(3) The statement concerning reset capability is incorrect. First of all, the terminology that applies is "Ring back." This means that an auditory and visual signal (slow flash rate) are generated when the alarm condition clears on annunciators with the ring-back feature. All "First Out" annunciators have ring-back, and the others may be converted to ring-back by changing a card in the logic cabinet. We are using the ring-back feature only for annunciators that convey important information to the operator by clearing.

The timer circuits, to prevent adjusting alarms to time out in less than the designated time, will not be adjusted by operation's personnel. A name tag will be placed on, or near, the device with instructions stating a minimum setting is to be maintained.

Alarms typically are not equipped with ring back if its presence prompts short term corrective action in the control room. Exceptions have been made to this rule when a ring back would indicate that a critical parameter has returned to an acceptable value. For example, the "pressurizer low level-heaters off-letdown isolated" alarm (B-032) is corrected from the control room but is equipped with ringback.

This selection process for annunciators "ring back" was based on the following criteria:

1. The operator must perform some function that is either required or allowed by virtue of the change in the alarmed parameter.

2. The operator should be alerted to the clearing of an alarm that indicates a significant change in an important system for which he has no direct control or indication.

3. The operator should be alerted when corrective action that he has initiated has been effective when a prolonged amount of time will elapse between initiation of corrective action and the clearing of the condition.

4. The operator should be alerted when critical systems or components have been returned to operation.

The ring back feature was incorporated on annunciators which met these criteria. The ring back feature is a relatively easy feature to incorporate and the list of annunciators requiring it may very well be changed as operational experience and plant specific need dictate.

Finding 14 (1) The location order of the annunciator controls is inconsistent from one panel to another (e.g., Test, Acknowledge on RL015; Acknowledge, Test on RL019 & RL023; Acknowledge, Reset, Test on RL019; Acknowledge, Test, Reset on RL025; First Out Acknowledge, First Out Reset and Annunciator Acknowledge on RL005).

Response The annunciator controls will be repositioned so that they are consistent. In addition, all controls, except the acknowledge buttons, will be recessed to prevent inadvertent operation. These controls (test and First-out reset) will require deliberate attention to activate, thereby minimizing inadvertent actuation of the test function, and preventing loss of the First-out information. Labels will be placed immediately above each button on the gently-sloped portion of the control panel.

4.0 Controls

Finding 1 (3) Some of the Cutler-Hammer pushbuttons will be difficult to operate while wearing protective equipment gloves.

Response An operator can operate the Cutler-Hammer pushbuttons without difficulty while wearing switching gloves. These gloves consist of a heavy rubber liner and an outer leather glove. As the attached picture illustrates, wearing protective gloves even as bulky as switching gloves, does not cause any diffuculty for the operator.

Finding 2 (1) The guarding mechanism for several controls on RL018 consists of a red plastic cover with a sliding plastic plate that is removed to operate. Some of the red covers are not permanently attached and will be easily lost. The sliding plates will also be easy to misplace.

Response The red plastic collars will be attached permanently to the switch bezels. The transparent sliding plate is not necessary for the guarding device to perform its function. The transparent plate will be eliminated.

Finding 3 (2) The intentional or accidental tripping of the two unguarded 480V BREAKER J-handle switches on RL016 (Rod Drive Power Supplies) would result in a reactor trip if both are tripped at the same time. Some guarding mechanism is needed for these controls.

Response These J-handles (Breakers: 52PG1901, 52PG2001; Switches: PGHIS-16, PGHIS-18) will be replaced with red J-handles and labels will be added to identify these breakers as the power supply to the rod drive motor-generator sets.

Finding 4 (1) The OPEN and CLOSE pushbuttons on some Cutler-Hammer switch arrays can be actuated and latched simultaneously.

Response These pushbutton switches are used in 11 applications on the main control board. They are not available from the supplier with mechanical interlocks between the OPEN and CLOSE pushbuttons. These 11 switches are used in non-IE solenoid valve circuits designed such that the valve will travel to the safe position should both the OPEN and CLOSE pushbuttons be actuated and latched simultaneously. The OPEN and CLOSE pushbuttons on these switches are separated by indicating lights eliminating the possibility of an operator inadvertently actuating both functions simultaneously. A more likely occurrence would be operator error in forgetting to unlatch a position before actuating the other position. In

this case the valve stays IN or travels to the safe position and the actual valve position is reflected by the pushbutton indicating lights thus alerting the operator if this is not the desired valve position. In addition the operator would notice that both OPEN and CLOSE pushbuttons are depressed particularly if the indicated valve position is not the desired valve position.

In the design of the main control board, Cutler-Hammer type E-30 switches have been utilized for valves and dampers and electroswitch type 20 for pump, fan, and breaker controls. This practice was followed to aid the operator in quick recognition of devices by switch type. In order to maintain this standardization some few cases exist where credit must be taken for operator training and procedures. In these few cases we believe maintaining the recognition and standardization of function has greater merit than introducing new manufacturers or types of switches. In addition, the schematic design has been accomplished to nullify improper operator actions for these switches by design of predictable valve travel. Based on the switch and schematic design described herein and the main control board switch standardization concept, we conclude that the switches are adequate and proper for their intended use.

Finding 5 (2) Some of the Cutler-Hammer pushbutton arrays are arranged so that they violate plant convention and population stereotypes for the position of the OPEN and CLOSE functions. Some arrays are arranged OPEN/CLOSE rather than the conventional CLOSE/OPEN. Some arrays are arranged with CLOSE on the top row of the array, rather than the conventional OPEN=top and CLOSE=bottom.

Response The plant convention for the Cutler-Hammer pushbutton switches is CLOSE=left, OPEN=right; OPEN=top and CLOSE=bottom. Switches with only OPEN-CLOSE pushbuttons were inspected and found to conform.

However, there are other switch arrangements. For example: CLOSE-norm on the upper row with the bottom row left blank. While it confirms the CLOSE-left convention, it does not follow the CLOSE-bottom convention. If this switch is reversed, it will satisfy the CLOSE-bottom convention but in so doing will violate the CLOSE-left convention. Since the "norm" is only a release of the main switch, the CLOSE-left

4.0 Controls, continued

convention is maintained. It should be noted, there will be no adverse effect if the wrong button is actuated. Operators will look for feedback indication after actuation. Errors can be quickly detected and corrected.

Finding 6 (2) The SYNC CHECK RELAY BYPASS J-handle control violates direction-of-movement stereotypes. The ON function is at the center, upright position, and the OFF function is at the right-hand position.

Response The SYNC CHECK BYPASS control switch will be replaced with a new switch having the correct direction of movement; off at center, upright position and on at right-hand position. Handle will be removable only when it is in the center off position.

Finding 7 (1) The BTRS CONTROL SW has an unconventional arrangement of functions. The DILUTE function is located on the left, the BORATE function is located in the center, and the OFF position is located on the right. This implies that the control, when leaving the OFF position, must actuate the BORATE function before it can actuate the DILUTE function.

Response This BTRS CONTROL switch will be charged to a type similar to the one on the simulator. The new switch will have the OFF position located in the center with DILUTE and BORATE functions located on the left and right, respectively.

Finding 8 (2) The TURBINE TRIP and OVERSPEED controls are placed adjacent to each other. The controls are extremely similar in appearance and could be easily confused.

Response Red plastic collar-type guards will be placed on the MFWP Turbine Trip/Reset controls FCHIS-18 and FCHIS-118.

Finding 9 (2) The two 4.16 kV Bus NB02 Breaker 152 J-handle controls on RL015 are alternate breakers that are not differentiated from the adjacent normal breakers. These controls could be easily confused and incorrectly activated.

Response The alternate breaker to feed Bus NB02 and the alternate breaker to feed Bus NB01 (152 NB0212 and 152 NB0109, respectively) will have their nameplate engravings changed to indicate they are the alternate feeds. The normal and alternate feeds are also electrically interlocked to prevent both breakers from being closed and causing incorrect activation.

4.0 Controls, continued

Finding 10 (2) There is no way to visually distinguish controls that require continuous pressure to operate from momentary contact switches.

Response All pushbuttons that require the operator to hold the button until the valve or damper has completely changed state or is used to jog the valve to a mid position will be engraved with an "H" indicating "hold." This change will be implemented for all applicable motor operated and air operated valves and dampers.

Finding 11 (1) It is difficult to distinguish the legend pushbuttons from the legend lights on the MAIN TURBINE EHC PANEL.

Response Modifications will be made to either the legend lights or the pushbuttons on the EHC so that there is a clear distinction between the two.

Finding 12 (1) The REACTOR COOLANT M/U WATER control has a STOP position, a RUN position, and a PULL TO LOCK position. There is a stop provided at the RUN position that would indicate to the operator that this function had been activated. However, there is no such stop for the STOP function. There are no other indications associated with this control that would indicate that the STOP function had been activated.

Response A line will be engraved on the switch face of BG-HS-26 adjacent to "STOP" to indicate the stop position. Since this switch provides an input to the Westinghouse reactor makeup system and controls the action of more than one device, addition of indication lights on the switch will not be made.

Finding 13 (1) Some J-handle controls have excessive spring tension for their return to center function. When an operator releases the handle from a function activation position, the handle can spring back with such force that the activation of the opposite function occurs. In less extreme cases when the opposite function is not activated, a mechanical indicator flag incorporated into the control is sometimes thrown to the opposite function indication, creating a position/indication mismatch.

Response The J-handle controls described are being replaced with switches of an upgraded design that will reduce or eliminate the spring back occurrence detected.

Finding 14 (3) On some of the J-handle switches it is possible to mistake the handle of the switch for the position indicator, since there are no other position pointers used.

4.0 Control, continued

Response — An engraved arrow will be added on to the J-handle of all applicable J-handle switches. The engraved arrows will be filled with white paint and clear filler for easy identification.

Finding 15 (3^1) — The pointer for the AUDIBLE COUNT RATE CONTROL-AUDIO MULTIPLIER partially obscures the position labels associated with the control. In addition, the pointer is not always visible from the normal position of the operator.

Response — An engraved line will be added on to the knob for this selector switch. The line will be filled with white paint and clear filler for easy identification.

Finding 16 (3^1) — The handle on the MAIN GEN VOLTMETER PHASE SELECT switch obstructs both the position labels associated with the control and the switch pointer.

Response — The MAIN GEN VOLTMETER PHASE SELECT switch handle will be replaced with an oval handle which will offer less obstruction of the pointer and position labels.

5.0 Displays

Finding 1 (3) There is no indication of PRESSURIZER PRESSURE in the range between 700-1700 psig on RL002.

Response A new pressure indicating channel will be provided for the reactor coolant system. This new instrument channel will have a range of 0 - 3,000 psig. It will be located on RL002 in the area where other pressurizer instruments are located.

Finding 2 (2) When displays fail or become inoperative, the failure is not always apparent to the operator.

Response All safety-related displays have a redundant display and/or display of diverse variable(s). Therefore, if any safety-related display fails in a manner that is not obvious (e.g., other than failure off-scale low or high), the operator(s) will have no difficulty identifying the failure or operating the plant in accordance with approved procedures.

Finding 3 (3[1]) The scales for the COOLING TOWERS BASIN LEVEL meters are indexed in feet above sea level rather than actual basin level.

Response The scales for the COOLING TOWERS BASIN LEVEL meters will be changed to reflect actual basin level in feet of water.

Finding 4 (2) The scale on a VARMETER on RL006 is inappropriate to measure vars. The zero mark is currently located at the bottom of the scale. The zero should be at the middle of the scale so that the operator could monitor lead/lag by the location of the pointer above zero or below.

Response The meter (MA-JI-4) will be revised to a zero centered scale and provide indication of VARS "IN" or "OUT."

Finding 5 (3) The measurement variable labeling on the scale face of the displays is oriented vertically from top-to-bottom, rather than horizontally, from left-to-right. The vertical label on the face of the TRANSFER VOLTMETER on RL006 is especially difficult to read because of the length of the legend.

Response The transfer voltmeter on RL006 has more information than necessary and is difficult to read. The scale legend will be changed to read D.C. VOLTS from top to bottom. A review of the remainder of the meters on the control boards has produced no other meters with legends containing excess information.

5.0 Displays, continued

Finding 6 (3*) The process controller scales (0-100) are not labeled to indicate which is full open and which is full closed.

Response The scales on the controllers are not position indicators, they are controller output meters. Labeling them with "open" and "closed" could result in an operator assuming that the meter is a position indicator and thereby make an incorrect judgement.

Finding 7 (3) Several display scales begin with an unnumbered major graduation mark.

Response Subsequent to an evaluation of all Control Room display scales that were found to begin with unnumbered major graduation marks, it was determined that with the exception of the Rod Speed Counter (SI412) on RL003, indicator pointers will remain within numbered graduations whenever their associated system is operating. Operators with extensive training on SNUPPS simulators have indicated that the relatively short duration that readings may be outside numbered graduations on the Rod Speed Counter has presented no problems to system operation, and they support the decision that no further action will be taken.

Finding 8 (2) The lengths of the graduation marks on some of the display scales are not large enough to be read from the required distances.

Response The vital information is mostly on the front panels where the graduations can be easily read from the required distance. The back panel and front panel scales will have tolerance ranges marked on them as soon as these tolerances are defined, therefore, being able to read each graduation is not required from any required distance, only that the readings are within tolerance. We also have annunciators to alert the operators of conditions out of tolerance.

Finding 9 (2) The size and contrast of the scale markings and numerals on many of the outer ring displays are inadequate to be read from the inner ring consoles.

Response With the tolerance zones marked on the scales, the numerals and scale markings will not need to be read, only that the meters are reading within the tolerance zones which will be easily determined from the inner ring console.

Finding 10 (1) Some vertical displays use scales which contain both positive and negative numbers. However, no positive (+) or negative (-) markings appear on the scale face.

5.0 Displays, continued

Response — Five vertical meters have been identified which contain both positive and negative numbers and do not readily identify which are positive and negative. These meters are: SE N1-41C, 42C, 43C, 44C on RL004 and SC TI-412A on RL003. The scales on these meters will be changed to identify that positive (+) is towards the top and negative (-) is towards the bottom.

Finding 11 (3) — The indicator lights for the ROD DIRECTION and the ROD DIRECT DEMAND violate the plant color-coding convention. The IN indicator lights are green and the OUT indicator lights are red.

Response — This statement is incorrect. Green is used on the reactor trip breaker indication to show that the breakers are open and the rods tripped into the core. This is in accordance with industry color convention for breaker position indication. The effect of rod insertion on power (i.e. decreases power) corresponds to the "cold" - green, "hot" - red convention for breakers. For this reason, the current application of green for rods in and red for rods out should be retained.

Finding 12 (2) — The REACTOR TRIP BREAKER A and B indicator lights violate the plant color-coding convention for the use of red and green. These breaker indicators use red = open and green = closed. The plant convention is red = closed and green = open.

Response — The REACTOR TRIP BREAKER indicators will be revised to indicate red when closed and green when open.

Finding 13 (2) — The movement of the scale pointers on the Hagan process controllers violates the left-to-right increase convention. The magnitude of the scale reading increases as the pointer moves from right-to-left. The CLOSE/OPEN position convention is also violated. The OPEN position is to the left of the center, and the CLOSE position is to the right.

Response — Labels will be added to the seven Hagan controller faceplates indicating the direction of vernier rotation for Open. The seven controllers identified are:

Silver: BGHC123, BGHC128, EPHC943
Black: BGHC182, BGHC387, EJHIC606, EJHIC607

Finding 14 (3[1]) — The pointers obscure the shortest graduation marks on the scales of some of the trend recorders on RL018. The pointers on some of the recorders on RL022 totally obscure all graduation marks along with the numerals.

5.0 Displays, continued

Response — The scales for pointers located on RL018 and RL022 recorders will be adjusted to allow maximum visibility.

Finding 15 (3) — The numerals on the MFW PUMP TURBINE SPEED circular meters on RL005 are placed on the same side of the meter graduations as the pointer. This causes the pointer to obscure the indicated value.

Response — The MFW Pump Turbine Speed meters are not used for precise control of the feed pump turbine. They are used primarily during startup of the turbine to give the operator an indication of how fast the turbine is accelerating. The numerals are large enough that they are not totally obscured.

Finding 16 (3) — The long hand of the potentiometer dial on the Hagen "Full Station" process controllers obscures the dial numerals.

Response — The potentiometer dials on process controllers are very similar to a clock face, with the short hand in-dicating major divisions of the pot range and the long hand indicating fractions of the major division much as the long hand on a watch indicates minutes. As on a wristwatch, the presence of numerals is not necessary for accurate interpretation of the long hand's position, provided the major divisions are clearly visible, which they are. Mistakes in setting these pots are therefore unlikely. Should a mistake occur, that fact will be readily apparent from other control room indicators and annunciators, and such a mistake would be easily correctible.

Finding 17 (1) — Displays do not have normal operating ranges or set points indicated.

Response — Tolerance zones will be marked on most meters. The markings should be applied so that they are in the plane of the meter face to avoid parallax error. As this involves partial disassembly of the meter, plant I&C personnel would be involved. Actual application of marking will follow system turnover to operations; it is anticipated that this will be completed by the end of the first refueling. Temporary markings will be used on the glass meter faces until sufficient operating experience is gained.

Finding 18 (1) — Single filament incandescent lamps are used without the means of test for bulb or circuit failure.

Response — Single filament incandescent lamps are used for position and status indication. It is preferred to neon bulbs

since neon bulbs provide lower level of illumination in a well lighted control room environment. The single filament bulbs being used have an estimated 20,000 hours life span. This is a result of the fact that the voltage supplied to the bulbs has been reduced approximately 7% to increase bulb life. A burnt bulb can be traced by observation alone. Each switch or a group of lights for a component contains at least two status lights, one for OPEN (RUN, ON) and the other for CLOSE (STOP, OFF). At any given time during normal operation, at least one of the two lamps is lit, otherwise bulb or circuitry problem is indicated. This can be remedied by either replacing both bulbs or repairing circuit failure. Verification that the lights are energized will be made at shift turnover.

There will be procedural steps for an operator to check for burnt light bulbs in the Control Room and Auxiliary Shutdown Panel at shift turnover.

Finding 19 (2) The legend lights for STEAM DUMP VALVE POSITION violate the OPEN=top and CLOSE=bottom convention. The CLOSED (green) indicators are located above the OPEN (red) indicators.

Response These legend lights will be rearranged so that the OPEN (red) is on top and CLOSED (green) is on the bottom.

Finding 20 (3) The legend plates for the DEMINERALIZER TRAIN "A" and "B" legend lights are not keyed or coded to prevent inadvertent interchange during bulb replacement.

Response There are two identical demineralizer trains located next to each other. The likelihood of inadvertently interchanging legend lights is very remote if not inconceivable. The one demineralizer train will act as a pattern for the other train if more than one lens cover is removed for multiple bulb replacement. These lights are strictly indication and interchange of lens covers would be apparent to the operator when he initiated a function on the controls.

Finding 21 (2) The redundant ESF SYSTEM STATUS INDICATION legend lights lack identical layout between the matrices. They also make inconsistent use of abbreviations. In addition, inconsistent logic is used in the NSSS monitoring system that interfaces with these two display matrices.

Response The redundant legend lights have been arranged consistently. NSSS logic has been revised to be consistent

5.0 Displays, continued

with the logic of balance of plant components and to maintain a dark board concept. Abbreviations have been made consistent to those used in the annunciator prioritization study.

Finding 22 (3[1]) The bottom scale on each of the RCP A,B,C, and D SEAL LEAKOFF trend recorders obscures the top of the recorder paper. In addition, the pointer for the bottom scale of each recorder is located behind the scale, prohibiting the reading of current information.

Response Clear scales have been installed on these recorders.

Finding 23 (1) The top of the NIS RECORDER window obscures the exponential values at the top of the recorder scale when the scale is viewed from a normal standing position.

Response The recorder window will be modified so that it will not obscure the exponential values at the top of the recorder scale.

Finding 24 (2) Many of the two- and three-pen recorders have one pen that is mounted below and/or behind the scale. This location creates parallax which will make the reading of trend information difficult.

Response The "trending information" is obtained by comparison of data over some period of time; not at the exact moment it is printed on the chart paper. Therefore, the area of focus is the larger picture presented by the lines on the chart paper in the large viewing area provideo. In addition, the scale printed on the chart paper provides reference to orders of magnitude.

"Current information" is obtained from the individual parameter indicator and not from recorders.

Finding 25 (2) The recorded data on the MAIN TURBINE VIBRATION AC and MAIN TURBINE TEMP + EXPAN impact recorders is printed on top of other data, making the information totally illegible. The graph lines on these recorders are a light blue color which provides poor legibility and contrast. In addition, the scaling on the graph paper does not correspond to the horizontal scale on the impact recorders. The data is recorded in the form of a number (1-16 or 1-20) of very small size that is difficult to read.

5.0 Displays, continued

Response The turbine recorders will print points that touch each other when all points have the same value. The operator uses the information on the recorder to determine points that vary from the norm. When a point varies from the remainder of the points, it will be obvious to the operator. The color of the graph lines and the scaling on the graph paper will be changed to improve legibility and correspond to the horizontal scale on the recorder. When a single point prints by itself on the paper, the number is legible and the print wheel also has a larger number on it to identify which point is printing. More detailed information can be obtained from the plant computer whenever the operator suspects a point is trending out of its normal range.

Finding 26 (3[1]) There are no units of measurement provided for the counters on RL002.

Resonse Nameplates with GALS engraved on them will be installed directly to the right of the flow counters on BG-FY-111BB, BG-FY-111B, BG-FY-110BB and BG-FY-110B.

Finding 27 (1) The red covers installed over the counter numbers obscures the numbers from view. To read the counter accurately, the cover must be raised.

Response The red translucent cover is used to prevent anyone from trying to use the predetermining wheels to see how many counts are remaining. These wheels flip/flop during the count such that the numbers have no meaning, and therefore are of no meaning to the operator.

Finding 28 The glass potentiometers covers on some of the Hagen process controllers are missing.

Response This problem is unique to construction. This type of problem should be noticed and corrected during turnover.

6.0 Labels and Location Aids

Finding 1 (1): There are several horizontal meters on RL013 that are missing their associated component labels.

Response: Ammeters located in the feeder circuits are positioned above the associated circuit breaker control switch. These meters are adequately identified due to location in mimic and proximity to associated circuit breaker control switch nameplate.

Finding 2 (1): Two CIRCUIT/LAMP TEST pushbutton arrays on RL017 are not labeled. This makes it impossible to determine which of the buttons serves each function (circuit test or lamp test).

Response: The engravings on the two CIRCUIT/LAMP TEST pushbutton switches will be changed. The upper pushbutton will read "INTLK TEST" and the lower pushbutton, "VLV TEST".

Finding 3 (2): There is no label with the REACTOR TRIP BREAKER A and B indicator lights to indicate that the red and green mean closed and open, respectively.

Response: Red for closed and green for open is a color convention used throughout the control room for breaker position indication. Since the reactor trip breakers do not differ from this convention, no special labeling will be used. The indicator lights will not be labeled "open/closed" because those that are labeled are push-buttons.

Finding 4 (3[1]): There are no permanent panel number identification labels. Temporary labels made of dark gray duct tape that are very hard to read have been put on some of the higher numbered panels.

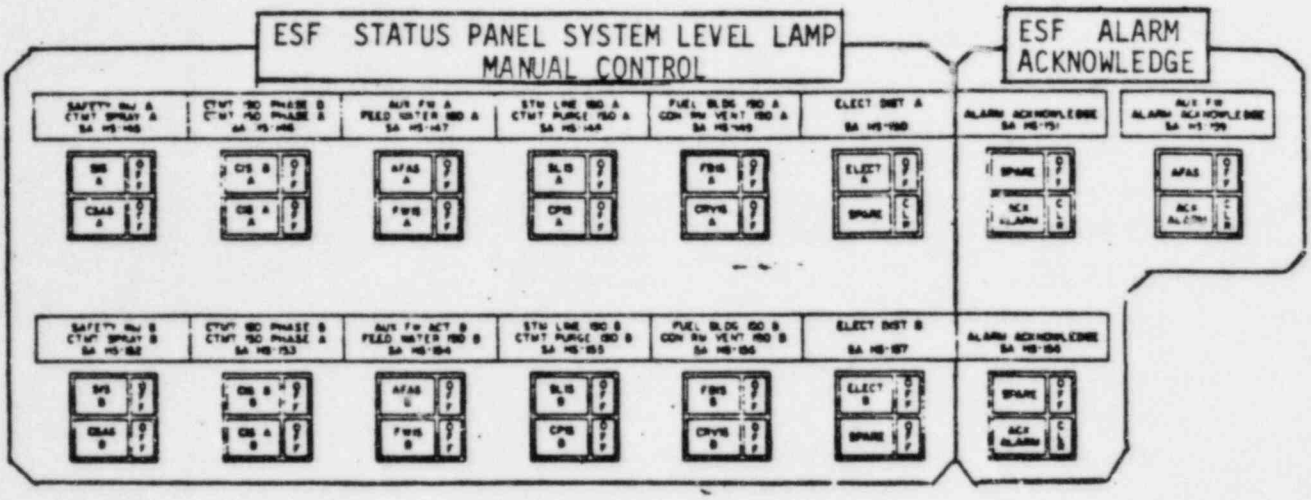
Response: Labels with the panel numbers will be added to the control boards.

Finding 5 (3[1]): The SAFEGUARD SYSTEM switches on RL003, which illuminate to acknowledge/clear status indicators on RL018, have no labeling to indicate their function.

Response: Demarcation lines and a summary label will be added to clarify the purpose of this group of buttons. (See sketch)

6.0 Labels and Location Aids, continued

Sketch to Finding 5:



Finding 6 (1) The label on RL002 that reads BORIC ACID TO VCT INLET is incorrent. Boric acid is not sent to the VCT because of possible fouling of the VCT spray system.

Response The label on RL001 for BG HIS 111B will be changed to read: MAKEUP TO VCT INLET.

Finding 7 (1) There is an incorrect label for the TRAIN A RETURN VALVE. This label should indicate that this is a SUPPLY/RETURN VALVE.

Response This label will be changed to read "SPLY/RETURN VALVE" on RL019.

Finding 8 (1) The J-handle label XMR01 TO XNB01 BREAKER 252PA0201 on RL016 is wrong. This label should read XMR01 TO XNB02 BREAKER 252PA0201.

Response The label for NB-HIS-1 will be revised to read 13.8KV XMR01 TO XNB02 BKR PA0201.

Finding 9 (1) The label for the CONTAINMENT ISOLATION PHASE B SB-HS-47 J-handle control is incorrect and should read PHASE A.

Response The label for switch SB-HS-47 will be revised to read "CISA" (RL018).

Finding 10 The label for the N_2 SUPPLY CTMT ATMOS ISO VLV EP-HC-93 is incorrect. This process controller is for a vent valve, not an isolation valve.

Response The label for process controller EP-HC-943 will be changed to "ACC N2 SPLY VENT VLV CTRL".

6.0 Labels and Location Aids, continued

Finding 11 (3) There are no functional or system summary labels.

Response Panel numbers are being added. The close functional relationships that exist on each panel segment are well understood by trained operators. Addition of summary labels is unnecessary and would add visual clutter.

Finding 12 (3^1) The heirarchical labels for the PZR RELIEF TANK indications and the REACTOR COOLANT LOOP FLOW indications do not clearly fulfill their purpose. The system portion of each label is engraved with the same size type face as the indication identifier portions of the label. Since the system portion of each label is engraved over the center indication identifier, it appears only to apply to that indication identifier rather than to the whole group.

Response The labels for Reactor Coolant Loop Flow and PZR Relief Tank will be changed as below to make it apparent that the system portion refers to the group of indicators rather than just to a specific indicator.

LOOP ___ REACTOR COOLANT FLOW
BB FI-___ BB FI-___ BB FI-___
PRESSURIZER RELIEF TANK
BB TI-468 BB PI-469 BB LI-470

Finding 13 (3^1) The EXCESS LETDOWN OUTLET TEMPERATURE and PRESSURE display labels on RL002 do not follow the recommended guidelines for hierarchical labeling. The group label for the pair of meters does not include the word OUTLET, which is, therefore, engraved before PRESSURE and before TEMPERATURE. Labels on displays directly adjacent to this group do follow the hierarchical labeling guidelines.

Response The label for Excess Letdown Temperature and Pressure will be changed to follow the hierarchical labeling guidelines as shown below.

EXCESS LTDN HX
OUTLET TEMP OUTLET PRESS
BG TI-122 BG PI-124

6.0 Labels and Location Aids, continued

Finding 14 (3[1]) The size of the lettering on the component labels for controls is not 25% larger than the lettering on the control position labels, as recommended. The position label lettering for all of the J-handle controls is the same size or larger than the associated component label lettering.

Response Component labels have a distinctive shape and lettering and are always located above the device to be operated. After locating the correct device, the operator then determines the desired position by the labeling on device escutcheon. Due to this serial operating activity, adequate emphasis is provided by the labeling distinctions now provided.

Finding 15 (2) The labels for some indicator lights on RL013, RL014, and RL018 are located below the lights. Labels are conventionally placed above their associated components elsewhere in the control room.

Response On panels RL013 and RL014, the nameplates for some indicator lights are located below the lights in order to provide needed information while maintaining the mimic to a reasonable size. On RL013, pump dischage valve position lights are located at the bottom of the panel and due to the specific arrangement, the identification of these lights is positive and unambiguous. On panel RL014, the 345kV circuit breaker controls consists of time-proven control switches and indicating lights. This arrangement provides the most compact arrangement possible for these devices considering back panel wiring. Operation of these controls is infrequent and does not require rapid component identification. In some cases control switches are only shown by the mimic, these nameplates are also located below the lights for consistency within the switchyard mimic.

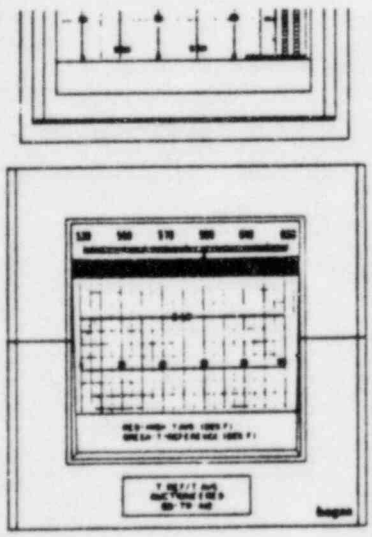
Generally, all controls and indicators located on panels RL013 and RL014 are related to systems and equipment which are ancilliary to the main unit operation and do not serve safety related systems. Operation of the controls on these panels is infrequent and requires unhurried responses. Additionally, these panels are located at the left extremity of the control board and will have minor effect to the operation of the other control panels.

6.0 Labels and Location Aids, continued

Subsequent to the mimic study performed on panels RL017 and RL018, it was determined that locating indicator light nameplates below the indicator lights and above their associated control label helped draw the operator's attention to their close association and also allowed more freedom in relocating the mimic lines. See also finding 9.1.

Finding 16 (3[1]) The label for the T REF/T AVG AUCTIONEERED trend recorder is located at the bottom of the recorder, rather than above as is the plant convention.

Response The location of the label is such that there is no question at all as to which device it refers to. There is inadequate room to locate the label above the recorder. See sketch



6.0 Labels and Location Aids, continued

Finding 17 (1) The labels for the displays that are located at high positions on the outer ring panels are not readable by an operator at the front edge of the panel. These labels are obscured from this position by their associated displays.

Response In those high locations where the labels are not readable due to obstruction of associated display devices, the labels will be moved or installed with adequate spacers underneath the labels so that the labels are readable by any operator at the front edge of the panel.

Finding 18 (3[1]) The central annunciator response control labels are not visible from a standing position at the benchboard edge.

Response All labels for annunciator response pushbutton switches will be relocated to the top of console benchboard. These labels will be situated on the edge of the console benchboard directly lined up with corresponding pushbutton switches.

Finding 19 (3[1]) The STM GEN A through D DUMP CTRL AT SHUTDOWN PNL labels are placed such that they can be associated with indicator lights that they do not apply to. These labels apply only to the white light in each group of one red, one green, and one white indicator light. The red and green lights in each group are associated with the STM GEN A through D STM DUMP TO ATMOS VLV POS labels.

Response The labels will be rearranged. A label bearing "SG B STEAM DUMP TO ATMS" will be centered above the red and green lights. A label bearing "SG B STEAM DUMP CTRL AT S/D PANEL" will be centered on top of the white light (RL006).

Finding 20 (2) The ESF XFMR XNB01 UNIT 2 and the XFMR SPB 218 AND MISCELLANEOUS TRANSFORMERS labels are located side by side in association with an indicator light. It is not clear from this label arrangement what the associated indicator light refers to.

Response One nameplate (ESF XFMR XNB01 UNIT 2) will be removed. This is site specific to Callaway.

Finding 21 (3[1]) The DG NE01 REGULATOR NULL INDICATION label ON RL015 is not attached to the panel. The screw holes in the label are drilled in the wrong places to fit the holes drilled in the panel.

6.0 Labels and Location Aids, continued

Response — A new label indicating "DG NE01 REGULATOR MAN/AUTO SIG MATCH NEII-5" will be made and affixed to the RL015 benchboard.

Finding 22 (3[1]) — Some labels in the control room have come loose. Most of the loose labels were glued to the painted panel surface rather than screwed on.

Response — All labels will be inspected for proper installation. Those which became loose will be secured.

Finding 23 (1) — The label relating pen color to displayed parameter on some recorders is located in the recorder window. This label location obscures part of the chart paper when the recorder door is closed, and the information provided by the label is not available when the door is open.

Response — The label relating pen color to displayed parameter will be relocated from the window to the bottom part of the door.

Finding 24 (2) — In addition to the standard component labels, there are one or two labels incorporated into the top and/or bottom edges of some of the Hagan process controllers. These labels generally provide either redundant or confusing information. In some cases, the incorporated labels which use small print, contain the information that is necessary to differentiate between adjacent controllers.

Response — A study of Control Panel labels was being performed and redundant information will be deleted. Along with this all necessary information to differentiate between controllers will be included on nameplate labels.

Finding 25 (3) — Several J-handle controls on RL015 are designed with the numeral "1" occupying the central position between OFF and ON. The numeral "1" is used as a procedure step to enable synchronization of offsite power sources with the diesel generators, but as presently labeled does not convey any meaningful information to the operators.

Response — The "1" occupying the center position between OFF and ON J-handle controls on RL015 will be changed to "I". The "I" stands for indication.

6.0 Labels and Location Aids, continued

Finding 26 (3[1]) The J-handles on RL006 that are labeled STEAM FLOW SELECT SW, FW FLOW SELECT SW, and STEAM GENERATOR LEVEL SELECT SW do not select flow or level, as the labels indicate. They select the channel from a flow or level sensor that will be used as an input to the Reactor Protection System.

Response This statement is incorrect. These switches select the channels of each of the three parameters, steam flow, feed flow, and steam generator level that are to be displayed on the associated trend recorder, and that are input to the steam generator level control system and main feed pump speed control. These switches have no control over inputs to the Reactor Protection System. The word "channel" will be added to each applicable nameplate to show selection of channels.

Finding 27 (3[1]) Five valve control switches in a group of eight on RL024 do not have component labels that indicate that they actuate valves. This problem also occurs other places in the control room.

Response A study on Control Panel labels is being performed to insure consistent labeling is used to denote what a switch is actuating.

Finding 28 (1) The TD AUX FW PUMP TRIP/RESET pushbutton has an integral label that reads TRIP. This integral label makes it unclear whether the button can also perform a reseting function, as the component label implies.

Response This switch is being eliminated from the main control board.

Finding 29 (3[1]) A label on RL002 which refers to the emergency boration system imprecisely reads IMMEDIATE BORATE FLOW.

Response The label for indicator BG-FI-183A will be revised to read "EMERG BORATE FLOW."

Finding 30 (3[1]) A label on RL002 which refers to the emergency boration system imprecisely reads IMMEDIATE BORATE TO CHARGING PUMP SUCTION.

Response The label for the emergency boration system on RL001 will be changed to read - "EMERG BORATE TO CHG PUMP SUCT".

6.0 Labels and Location Aids, continued

Finding 31 (2) The labels for the MAIN TURBINE LIFT PUMPS J-handles and indicator lights do not clearly imply the association between the components.

Response Demarcation will be used to make clear the association between indicator and label (see response to finding 6.47).

Finding 32 (3[1]) The labels do not consistently use terminology or abbreviations even in directly adjacent applications. There is no consistent application of abbreviations in place of complete words. This is a wide-spread problem throughout the control room. For example, adjacent display groups on RL001 use VCT and VOLUME CONTROL TANK. There is no space constraint that would require the use of the abbreviation VCT on the one label.

Response Some components are recognized as readily by their abbreviation as they are by their whole name (for example, RCP, or RWST). For these items, only the abbreviation will be used on labels. For all other components, the entire name will be used where there is room on the label to do this. Where there isn't room an abbreviation will be used. A study on Control Panels is underway to ensure that abbreviations, when used, will be uniquely defined and consistently applied for each component.

Finding 33 (3[1]) There is no standard abbreviations list for the control room. Abbreviations are used inconsistently throughout the control room.

Response A SNUPPS Control Room abbreviation list has been generated by the annunciator prioritization and label study. It will be controlled and used for all main control board abbreviations.

Finding 34 (3[1]) The RCIC DRAIN TANK HX DISCHARGE pushbutton does not use the abbreviation for "normal" used elsewhere in the Control Room. Instead of the standard NORM, this pushbutton reads:

NOR
MAL.

Response The pushbutton for HB-HIS-7176 will be revised to read "NORM" in order to provide consistency with other pushbutton labeling.

Finding 35 (1) Three labels on RL004 are missing the delta symbol that indicates temperature change. The labels incorrectly read RCLP 2T, RCLP 3T, and RCLP 4T.

6.0 Labels and Location Aids, continued

Response The labels for indicators BB-TI-421A, 431A and 441A will be revised to indicate ΔT.

Finding 36 (1) The label on RL004 for RCLP 1 has an "A" instead of a delta symbol.

Response A new label with the correct "Delta" symbol will be made and affixed to the RL004 panel.

Finding 37 (3[1]) The engraved lettering on the small red pushbuttons on the Cutler-Hammer switch arrays is too small to be easily read. The letters are filled with white paint that has become dirty, which has further degraded their legibility.

Response The referenced Cutler-Hammer switch is comprised of main pushbutton (PB) switches and corresponding small red PB switches integrated in one switch assembly. These switches are situated right next to each other and bear the following engraved lettering:

MAIN SWITCH	SMALL RED PB SWITCH
OPEN	CLS
CLOSE	NORM
NON-ISO	ISO

It is therefore evident, the small red PB switch serves only one function - to negate the main switch function. It deactivates, or releases, the main switch.

Operating personnel executing a switching operation will observe the main switch function - to open, close, or non-isolate. When he wishes to perform the opposite function, he will actuate the small red PB and has no real need to refer to the lettering on the PB. The lettering is merely provided as a backup reminder to assure him of its function. Improperly engraved/finished engraving will be replaced.

Finding 38 (3) All of the labels in the control room appear crowded. The inclusion of the engineering number on the component labels in the same size lettering as the primary identification information contributes to this crowded appearance.

Response A study on the Control Panel labels has been perfomed to alleviate the crowded appearance.

Finding 39 (3[1]) The character height of the position labels on J-handle controls is under the recommended minimum size for the normal viewing distance of 28 inches.

6.0 Labels and Location Aids, continued

Response — The existing circular label engraving will be changed to horizontal format. Larger letters/numbers will be engraved on the escutcheon.

Finding 40 (3^1) — The contrast of a majority of the colored labels is poor Some of the combinations of background/lettering colors are: black/white, white/black, red/yellow, yellow/black, etc. Only the white/black are optimally legible. The red/yellow labels are especially hard to read.

Response — The use of colored labels to identify controls and indications by separation group is an exceptionally useful tool during many plant transients. It is particularly useful when responding to a loss of power in a specific train, including AC power and DC or AC instrument power. The operator can quickly identify degraded controls and indicators based on the colored labels. The label engravings are legible at the viewing distance that exists when an operator is operating an associated control. When an operator is at a greater distance (the center of the control room, for example) he can make a rapid review of critical component status on a train basis using the color of the labels, component status lights, and knowledge of panel layout. At this distance (12'-15') engravings of any color combination would not be legible. Replacing the colored labels with black and white ones would eliminate a vital form of information. A yellow border will be provided around red labels that currently have yellow lettering and the yellow lettering will be changed to white.

Finding 41 (3^1) — The engraved legends on the keys of the process computer keyboard are hard to read. The magenta function key legends have especially poor contrast, and some of the other keys have inadequate engraving depth.

Response — Magenta function keys will be changed to a neutral color along with the remaining function keys. The legend engravings for the new key caps have been verified to be satisfactory.

Finding 42 (3^1) — The label script on the TEST INTERLOCK LOSS OF PWR PRESS SIGNAL and STEAM DUMP VALVES POSITION engraved indicator lights on RL006 is barely readable due to inadequate engraving depth and lack of script filler pigment of contrasting color.

6.0 Labels and Location Aids, continued

Response — The two indicator light lenses for the TEST INTERLOCK LOSS OF PWR PRESS SIGNAL and STEAM DUMP VALVES POSITION will be replaced with new lenses bearing adequate engraving and proper script filler pigment of contrasting color.

Finding 43 (3^1) — The engraved surfaces of the labels have no clear filler to prevent the buildup of dirt. This will result in eventual reduction of legibility.

Response — All labels will be inspected for adequacy of engraving and smoothness of label surface finish. Those which are found unsatisfactory for any reason, including susceptibility to accumulation of dirt, will be replaced. Periodic surveillance to review board cleanliness will be performed and boards will be cleaned as required.

Finding 44 (3^1) — The label engraving style makes it impossible to differentiate the letter "I" from the numeral "1". Both letter and numeral are represented by a vertical slash.

Response — During the label study, engravings will be reviewed and corrected where necessary to allow the letter "I" to be distinguished from the numeral "1". In general,the context informs the operator whether a "1" or "I" is intended.

Finding 45 (3^1) — The AUTO position label for several control switches on RL025 is a decal and therefore subject to easy removal.

Response — Control Switches CB-HIS-4, 5, 6, 7, 8, 9 and 10 will be replaced with switch plates having "AUTO" engraved rather than stick-on labels.

Finding 46 (3^3) — Several J-handle selector switches on RL005 and RL006 have position labels that are decals that can be easily removed.

Response — RL005 has no decals on any of the J-nandle switches. RL006 has four (4) J-handle selector switches with decals. (AE LS/519C, AE LS/529C, AE LS/539C, and AE LS/549C) These decals will be removed, and the required lettering will be engraved on the switch cover.

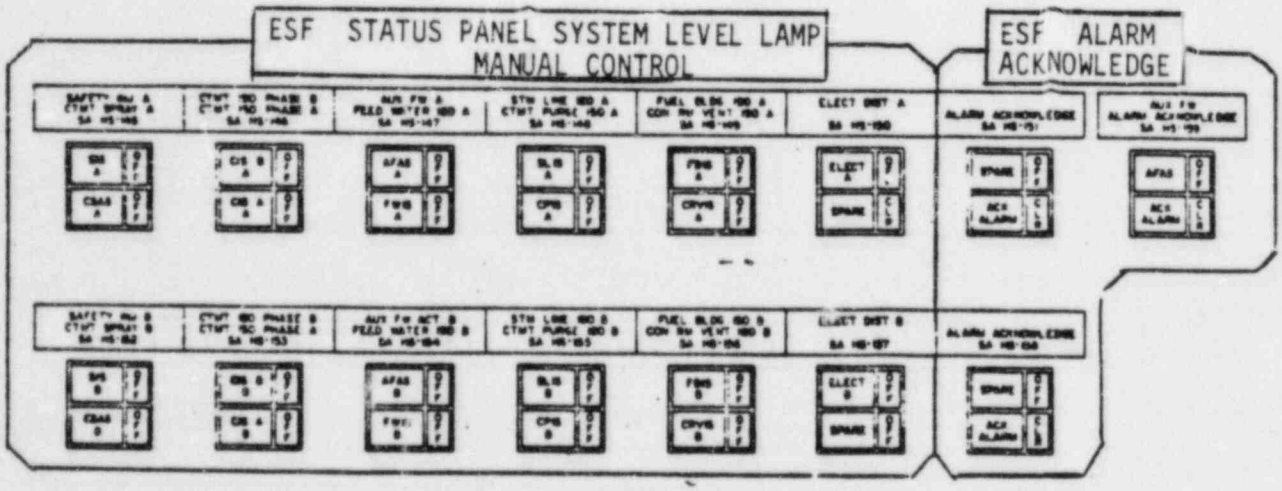
Finding 47 (3^1) — Demarcation is not adequately used to visually isolate separate system components or to enhance existing relationships between components contained within the same system.

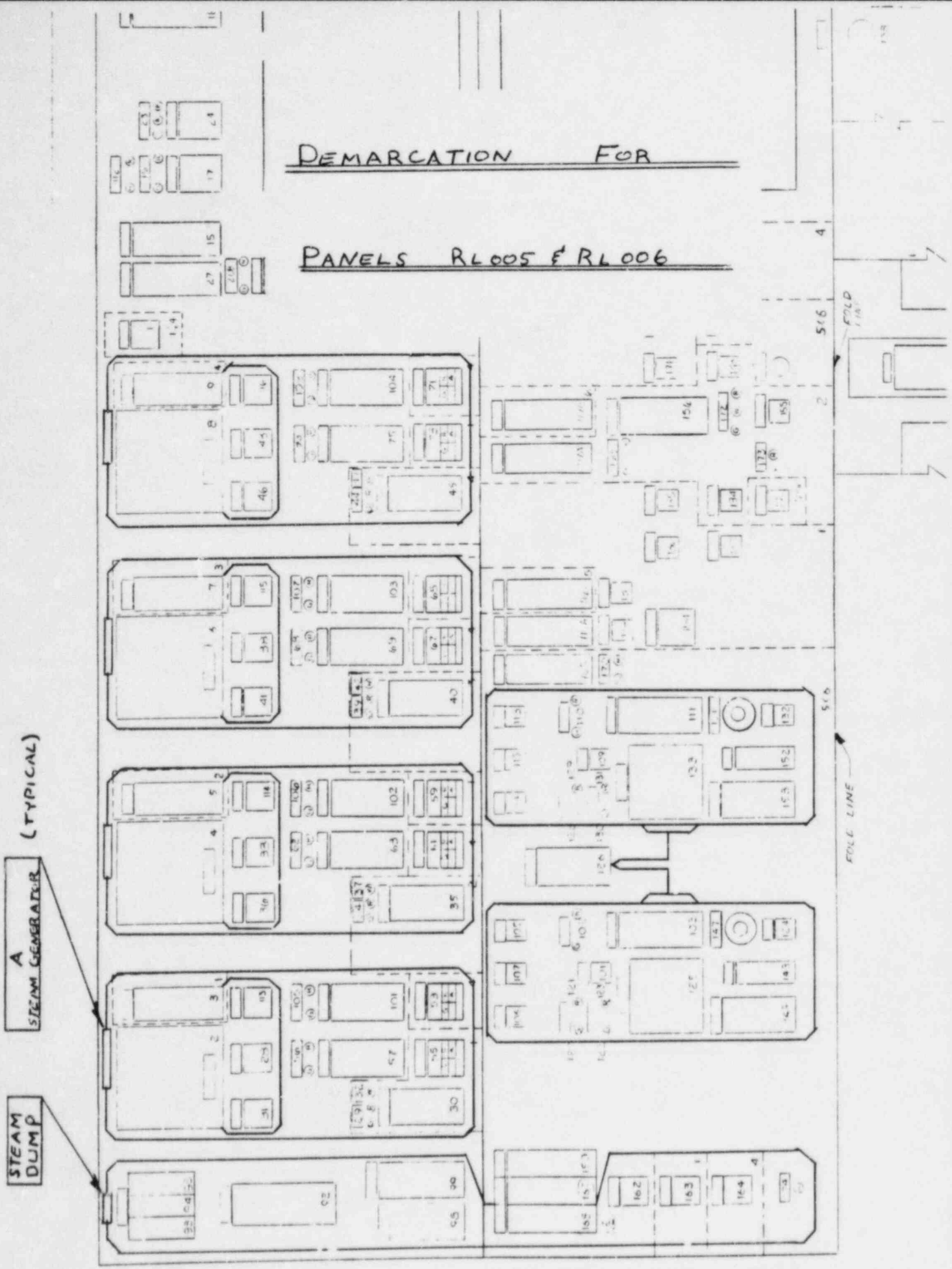
6.0 Labels and Location Aids, continued

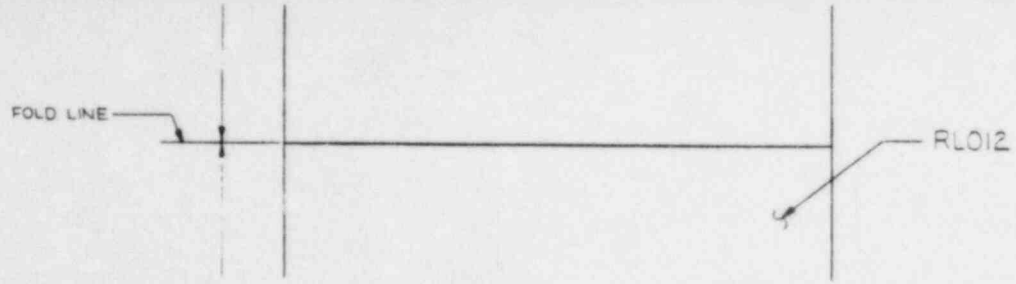
Response	PANEL	DEMARCATION PLAN	REMARKS
	RL001	none	panel contains extensive mimic
	RL002	none	mock-up was constructed and evaluation showed no need for demarcation.
	RL003	see sketch	Same as finding 6.05.
	RL004	none	simple panel layout, requires no demarcation
	RL005,RL006	see sketch	
	RL011	see sketch	
	RL012	none	
	RL013,RL014 RL015,RL016 RL017,RL018 RL019	none	These panels contain extensive mimics. Use of demarcation lines is not needed to improve clarity, and would interfere with mimics.
	RL020	none	
	RL021,RL022	see sketch	
	RL023,RL024	none	These panels contain mimics and do not require demarcation.
	RL025,RL026	see sketch	
	RL027	none	This simple panel arrangement contains a mimic and does not require demarcation.
	RL028	none	

DEMARCATION FOR

PANEL RL003

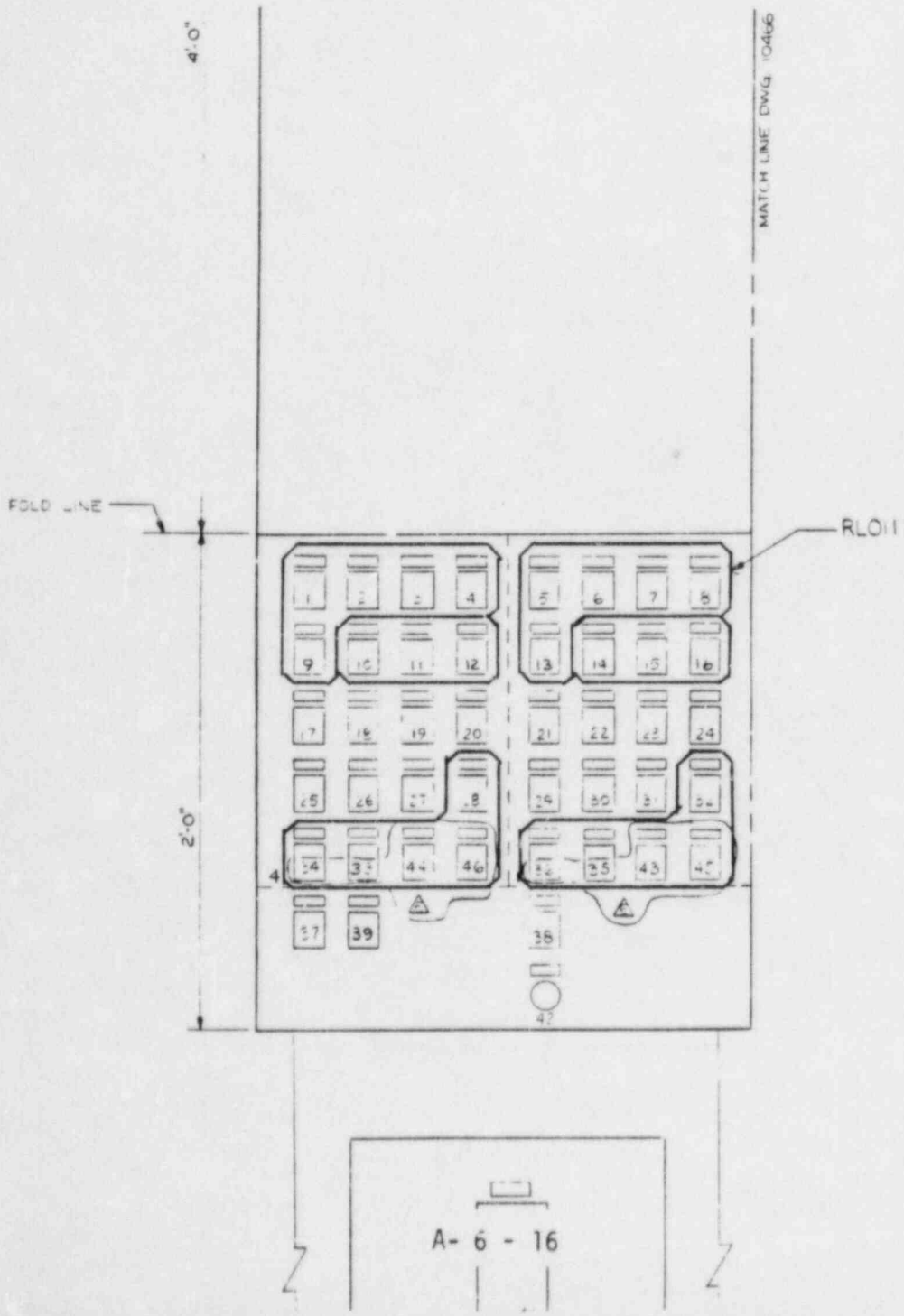


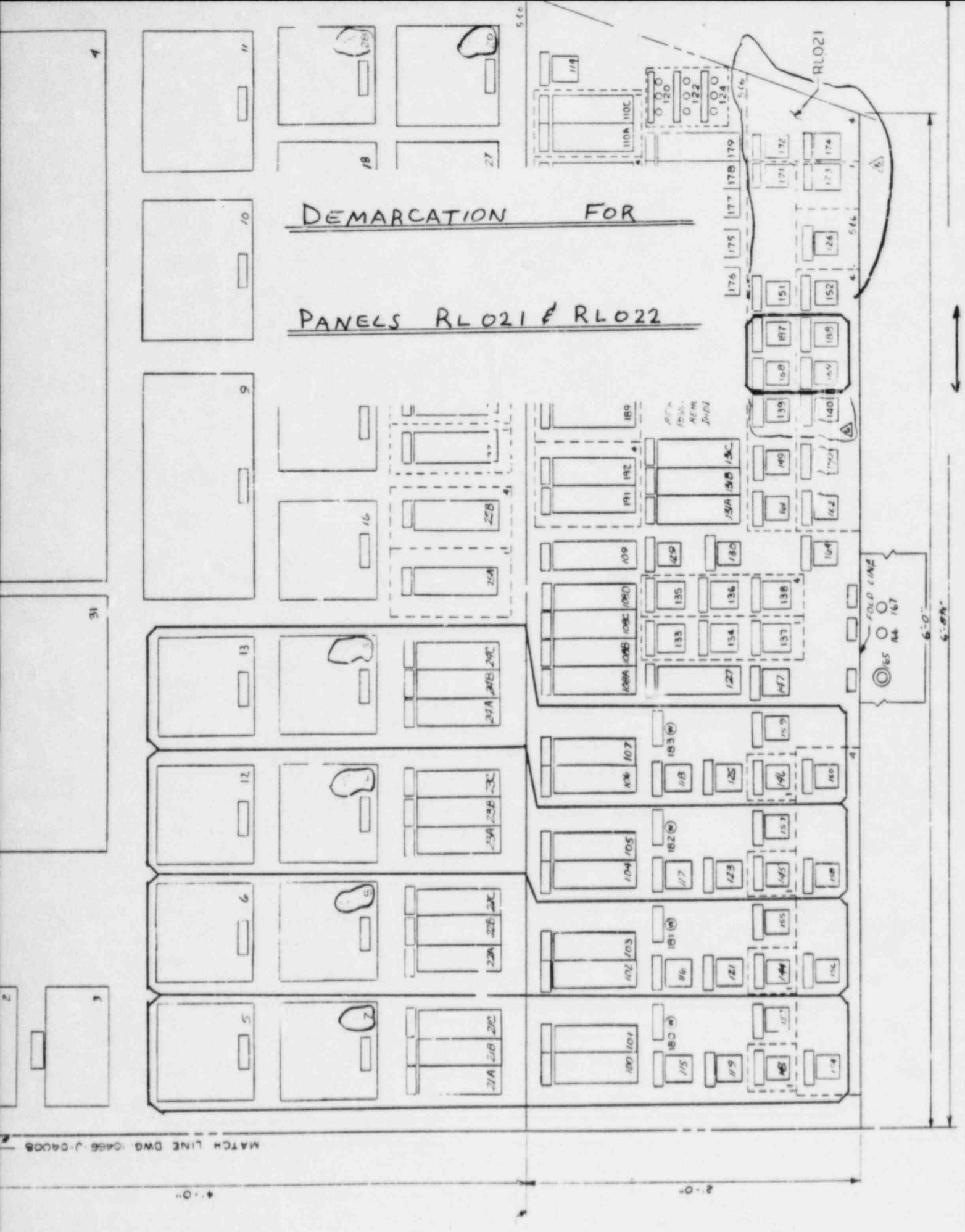

DEMARCATION FOR
PANELS RL005 & RL006
FOLD LINE
FOLD LINE
A
STEAM GENERATOR
(TYPICAL)
STEAM
DUMP



DEMARCATION FOR

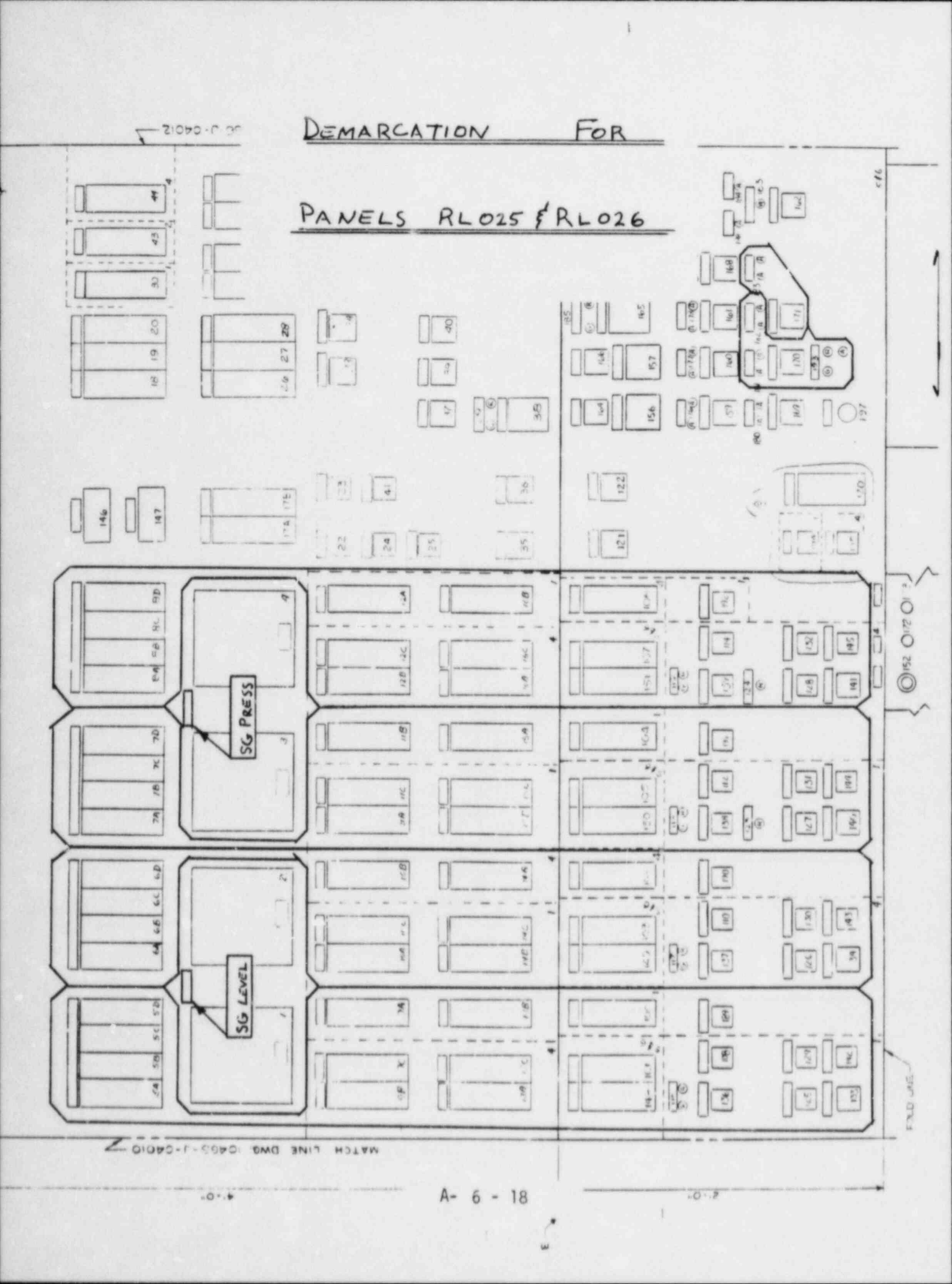
PANEL RL011




DEMARCATION FOR
PANELS RL021 & RL022
RL021
FOLD LINE
MATCH LINE DWG. 0486-J-04008

DEMARCATION FOR

PANELS RL025 & RL026



6.0 Labels and Location Aids, continued

Finding 48 (3) The label color-code used to differentiate between electrical trains is not consistent with the other uses of color in the control room.

Response Identification of safety-related electrical trains provides the operator with significant information regarding potential train degradation. The essential safety functions provided by these electrical trains during an event requires significant operator awareness regarding train status during all modes of plant operation. Train color coding as now used provides added emphasis consistent with these safety requirements.

Finding 49 (3^1) The mimic on RL001 incorrectly implies that the CHARGING HDR FLOW control only controls the rate of flow in the flow path, since a single mimic line goes to the control and a single line leaves the control. The mimic does have a second outlet line to indicate the portion of the inlet flow that is used for reactor coolant pump seal injection.

Response The CHARGING HDR FLOW CONTROL (BG HC 182) will influence RCP seal injection flow by manually varying backpressure in the main flow line. Overall flow is controlled by CHARGING PUMP FLOW CONTROL (BG FK 121) which automatically compensates for changes made by BG HC 182. A label indicating "RCP SEALS" will be added to the mimics to improve clarity.

Finding 50 (2) The mimic on RL001 does not show flow from the CENTRIFUGAL CHARGING PUMPS through the CHARGING PUMP (mini) FLOW VALVES.

Response The CVCS mimic has been evaluated and modified to include this flow.

Finding 51 (3^1) The mimic lines have warped and come loose from the panel surface in several places. Several mimics are missing portions of mimic because the lines have broken completely off.

Response All mimic lines will be inspected for correctness in shape and security on board. Defective or missing lines will be replaced. Those that came loose from the panel surface will be secured.

Finding 52 There is a missing section of gray mimic lines between the 480V XPG20-LCPG20 BREAKER 52PG2001 J-handle control and the 480V LC PG19-PG20 TIE PKR 52PG1916 J-handle control. There is also a missing section of

6.0 Labels and Location Aids, continued

mimic lines between the 13.8KV PA02-XPB04 BREAKER 252PA0208 J-handle control and the 13.8KV BUS TO XFMR XPB04 AMPS vertical meter.

Response All mimic lines will be inspected for completeness. The two missing sections will be replaced.

Finding 53 (1) The transformer symbol label in the mimic for the 480V XPG25-LC PG25 BREAKER 52 PG2501 J-handle breaker control is upside down. The gray portion of the label which symbolizes the 480V side should be on the bottom, and the black portion of the label which symbolized the 13.8KV side should be on the top.

Response All mimic symbol labels will be inspected for correctness of orientation. The transformer symbol label for the "480V XPG25-LC PG25 BREAKER 52PG2501" will be reversed so that the gray portion of the label is on the bottom and the black portion of the label is on the top.

Finding 54 (3^1) There is no consistent color-coding of mimic lines. For example, nine different colors are used for electricity.

Response Control panel mimics were reviewed and colors were assigned as described below:

For electricity, the following colors apply:

Yellow - 345KV	Orange - 4.16KV
Black - 13.8KV	Silver Gray - 480V

For water, the following colors apply:

Red - Containment Spray
Blue - Borated Water except Safety Injection
Gray - Unborated Demineralized Water
Tan - Test Lines and Boron Injection Recirculation
Orange - Condensate and Feedwater
Light Green - Essential Service Water
Yellow - Component Cooling Water
Purple - Safety Injection

For other processes, the following color applies:

White - Nitrogen

Finding 55 (3^1) The mimic lines are not graduated in size to differentiate primary flow paths from secondary flow paths.

6.0 Labels and Location Aids, continued

Response — A complete review of the mimic display was made. Mimic line size for primary flow paths will be larger than mimic line size for secondary flow paths.

Finding 56 (1) — Some mimic line flow arrows indicate the wrong direction of flow.

Response — All mimic line flow directions will be inspected. Those showing the wrong direction of flow will be corrected.

Finding 57 (3^1) — Several labels within mimics on RL019 are intersected by mimic lines when no actual connection exists between the components indicated by the labels and the flow paths represented by the mimic.

Response — The mimics on RL019 have been reviewed and will be modified to correct this finding.

Finding 58 (3^1) — The label leading to the 4.16 KV BUS NB01 BREAKER and the 4.16 KV BUS NB02 BREAKER J-handle controls on the breaker mimic on RL015 is not clear in its specification of the origin of the mimic. The label reads OFFSITE POWER, while it should more appropriately read FROM ESF XFMR XNB01.

Response — The Mimic label on RL015 will be revised to read "FROM ESF XFMR XNB01."

Finding 59 (1) — Several of the line origination and termination labels for the mimics on RL017 and RL018 provide the operator with inaccurate information. Some of the origination labels indicate where the line should be going (TO) as a termination label should, while some of the termination labels indicate the origination of the line (FROM) as an origination label should.

Response — The mimics on RL017 and RL018 have been reviewed and will be modified to correct this finding.

Finding 60 (1) — The accumulator mimics on RL018 have lines that terminate without labels to indicate their destinations.

Response — The mimics on RL018 have been reviewed and will be modified to include labels to indicate destinations.

Finding 61 (1) — The arrangement of valves in the mimic that depicts the flow of boric acid and make-up water to the volume control tank indicates that boric acid can be sent to the volume control tank spray. An operator reported

6.0 Labels and Location Aids, continued

that the valves can even be arranged to accomplish this. If a check valve exists that prevents flow in the indicated direction, an arrow or check valve symbol is needed on the mimic. If there is no such flow restriction in the system, a label is needed to caution the operator not to arrange the valves in this way.

Response There is no check valve that would prevent the flow described. A label will be placed next to the switch with the engraving: CAUTION: DO NOT BORATE VIA BG FCV111B. This is not a safety concern with the SNUPPS design but merely a delay in the boric acid response.

Finding 62 (1) The N_2 SUPPLY CTMT ATMOS ISO VLV EP-HC-93 process controller relates to two separate mimic loops but visual connection is poor. This is due to the lack of a mimic line termination label.

Response This HEF was corrected with the mimic changes on RL017 and 18 mock-up. A direction label will be added to the mimic indicating "TO ACC TANKS A & C."

7.0 Process Computer

Finding 1 (3[1]) The computer system does not include a file of operator entries. The sequence of events log will include operator entries, but these will not be isolated, grouped or coded in any way.

Response All operator entries are printed on the operator's printer, located in the control room. Each entry is logged as it occurs. This is desirable in that control room personnel are immediately cognizant of the status of computer displays, logs, trends, etc. Operator entries are positively identified by the nature of the printed message. We propose no further coding as it would tend to clutter the printout.

Finding 2 (2) The CRT displays can be affected by each of the keyboards. This means that an operator at one location can disrupt and lose data on a CRT that another operator is using. In addition, there are no signals on the displays or elsewhere to indicate which keyboard is being used to effect a particular display.

Response A software change will be made to insert a verification step into the computer code. The user at the engineer's console will request a display to be brought up on a control room CRT. At this point the computer will ask the user if he wants to change the display. He will answer "yes" and the display will be brought up. Inserting this extra step will insure that inadvertent removal of displays does not occur. The two keyboards in the control room are in such close proximity as to preclude any problem. Therefore the verification step will not be inserted for control room users as it would introduce unnecessary delay. A message on the displays indicating the originating keyboard would unnecessarily clutter the screen.

Users at the computer engineers' console have no need to change displays on the control room CRT's. However, if the control room CRT keyboards are inoperable, the engineers' console can serve as a back-up keyboard and change CRT displays in the control room as directed by the plant operators. The verification step being added will prevent users at the engineers' console from inadvertently changing displays on the control room CRT's.

7.0 Process Computer, continued

Finding 3 (2) The red, green, and white colored keys on the process computer keyboard are not grouped together and are not in any functional sequence.

Response Keys will be grouped by function and be of a neutral color except for Alarm Acknowledge, DC Power, and Display Color Assignment keys. Grouping by use of color is therefore unnecessary.

Finding 4 (2) The dark blue characters on the CRT displays are difficult to read due to poor contrast with the screen background. This color should only be used for non-critical information.

Response The color blue is not used for alphanumeric characters on the CRT's. On Piping and Instrument Diagrams, blue is used for pressurized hydrogen and nitrogen process lines, which is not critical information.

Finding 5 (3) The two CRT displays on RL020 are located between 76-91 inches above the standing surface. This location exceeds the recommended height for CRT displays.

Response A study was conducted and CRT readability was verified. For both the alarm and trend displays, the text letter height exceeds the guidelines for the fifth percentile female operator viewing distance.

Finding 6 (3) The colors red and yellow are not used on the CRT displays according to the recommended guidelines applications of danger and caution, respectively. On the alarm list display, red is used to indicate digital points in the alarm and yellow is used to indicate analog alarms.

Response The present arrangement of alarm indications (red indicating digital alarms and yellow indicating analog alarms) is functionally equivalent to the recommended guidelines. A digital alarm such as a breaker trip, equipment failure, partial trip bistable, valve misalignment, etc., would indicate a condition requiring immediate analysis and action. With the use of conservative alarm limits, analog points in alarm would indicate the beginning of an undesirable trend, and allow the operators time to respond to keep parameters within the desired operating limits.

Finding 7 (3) The color-coding of information used on the CRT displays is not consistently applied. One color may be used to convey different types of information. Conversely, the same information type may be presented in different colors on different display pages.

7.0 Process Computer, continued

Response: The color coding of information used throughout the control room is applied as follows:

Computer Terminals

BOP Function Keyboard: White - Alarm Acknowledge
Neutral Colors - Remaining Function Keys

BOP/Displays:

General Displays

Green - Points in Normal Status
Red - Points in Alarm
Yellow - Out-of-Service/Failure Messages
- Operator Request for Information
White - Message Types (headers, etc.)

Piping and Instrument Diagrams

A. Process lines of In-line Equipment:

Cyan - Flowing liquid fluid
Magenta - 1) Pressurized steam
- 2) Energized Elec. Sys.
White - Operating ventilation air
Blue - Pressurized hydrogen and nitrogen
Green - 1) Non-flowing liquid fluid
- 2) Non-pressurized steam
- 3) De-energized elec. sys.
Yellow - 1) Process line w/undefined status
- 2) Outline of equipment
- 3) Electrical Sys W/Undefined Status

B. Alphanumeric Information

White - Current updated values for displayed Process parameters w/normal operating conditions
Red - Current updated values for displayed process parameters in alarm conditions
Yellow - Static, nonvariable information for titles, equip. labels and other notes

SPDS Keyboard: Active keys are of neutral colors

SPDS Displays:

Primary Displays

Green - Parameters Normal Status
Red - Parameters Not Normal
Yellow - Alert Status/Failure

7.0 Process Computer, continued

RMS Keyboard:	White with Black Letters	
RMS Displays:	Green	- Normal Radiation
	Red	- High Radiation
	Yellow	- Alert Radiation
	Cyan	- Monitor Equip. Failure
	Magenta	- Communications Failure
	Blue	- System Failure
	White	- Monitor Off Line
	Yellow & Cyan	- Text

NOTE: The colors used for the SNUPPS RMS are General Atomic's Standard which is utilized throughout the Nuclear industry.

RRIS Keyboard:	Charcoal with White Letters	
RRIS Displays:	White	- Text
	Red	- Alarms

Panel Colors

Piping Mimic:	Blue	- Borated Water, Except SI
	Gray	- Unborated Demin. Water
	Light Green	- Essential Service Water
	Violet	- Safety Injection
	Red	- Containment Spray
	Tan	- Test Lines & Boron Inj. Recirc.
	White	- Nitrogen
	Yellow	- Component Cooling water
	Orange	- Steam
Electrical Mimic:	Yellow	- 345 KV
	Black	- 13.8 KV
	Orange	- 4.16 KV
	Gray	- 480 V
Nameplates:	Red/White Letters	- Separation Group #1
	White/Black Letters	- Separation Group #2
	Blue/White Letters	- Separation Group #3
	Yellow/Black Letters	- Separation Group #4,
	Red Face, Yellow Border, White Letters	- Manual Initiation of both protection trains for RX trip, SI manual actuation CSAS, CISA and CISB
	Black/White Letters	- Separation Groups 5 and 6, panel nameplates, general nameplates

7.0 Process Computer, continued

Annunciators:

Main Control Board

White/Black Letters, Backlit White - General
White/Black Letters, Backlit Red - First Out

ESF Status Panel

White/Black Letters, Backlit either White or Amber

Reactor Partial Trip Panel

Yellow - Blocks and Bypasses
Blue - Permissives
Red - Activation
Violet - Trouble Alarm
White - Trips

Process Control Status Panel

Red - Steam Dumps
Blue - Permissives
White - Trips

General Indicating Light Philosophy

Red - Valves open, equipment running, breakers closed.

Green - Valves closed, equipment not running, breakers open.

Amber - Auto Trip.

White - Status (e.g. auto, reset, control select).

Controls:

Colors are used to highlight certain controls to enhance operator actions.

7.0 Process Computer, continued

Finding 8 (3) Location references are not provided in the viewable portion of the frame when the operator is required to scroll or pan on the point summaries, system index, and other summary type displays. The system displays are referenced acceptably.

Response The only multipage displays besides the system displays are the point summaries and alarm summaries. These summaries are generally only used by computer maintenance personnel, as one control room CRT is dedicated to alarms for operator use. The summaries are always displayed in alph-numeric order and convenient page forward and page back functions allow movement among pages. The alphanumeric nature of these displays allows the operator to determine whether he is at the front, middle or end of a list. In addition, if a page is full, this clues the operator to the possibility of additional pages. In light of this, no further action is deemed necessary.

Finding 9 (3) There is no printer located in the control room for hard copy information, including alarm printouts. This deprives the operator of useful information.

Response There is a control room printer included in the system. It was located in the computer room at the time of the audit for startup purposes.

Finding 10 (3) Although computer feedback messages are generally provided to the operator, there is no message to indicate that a request for a remote printout has been received and confirmed or denied.

Response There is a "function initiated" message which indicates that a request for a remote printout has been accepted. If a printer has failed, is off-line or out of service, the system will print a message on the operator's printer, display a secondary alarm on the alarm CRT, and switch to an assigned alternate printer. This provides a high degree of assurance that the requested function has actually been performed.

Finding 11 (1) Several functions available on the control room process computer keyboard are for the use of the computer programers, not the reactor operators. For example, operators have the ability to insert values into the system status displays. No indication appears to identify these as inserted values rather than actual values.

7.0 Process Computer, continued

Response — During normal operation, control room operators are not required to use the "insert value" function button on the computer keyboard. It is anticipated that modification of point values will be infrequent. If point modification is required, it will be performed under the direction of the Shift Supervisor. If values have been inserted via this function button on the computer keyboard, the modified values would be available on the inserted value summary display. The control room operator has access to the inserted value point summary display via the same computer keyboard and CRT as is being used for the system status displays. Therefore, no further action on this finding is necessary.

Finding 12 (2) — There are no procedures available to the operator which cover the necessary actions to take in the event the process computer fails.

Response — The utilities will develop a procedure and log sheet to be used in case of computer failure.

8.0 Panel Layout

Finding 1 (1) During emergency procedures, the operator is required to compare the REACTOR COOLANT PRESSURE meter on RL002 and the STEAM GENERATOR PRESSURE meter on RL026. These displays are separated by about 25 feet.

Response The most probable emergency for which RCS pressure and S/G pressure must be compared is Steam Generator Tube Rupture. After taking the immediate actions for safety injection, it is necessary to depressurize the RCS to the pressure of the faulted S/G. If RCP's are still running, the depressurization is performed at RL001 with the spray valves. If RCP's have been stopped, the depressurization is done at RL021 with the PORV('s). For this reason, the depressurization of RCS to S/G pressure is a two man job. At the point in the procedure where two operators are needed, a second reactor operator will be available.

All licensed operators will be trained and practiced on a plant specific simulator for the coordination required to perform this procedure. The high level SPDS display for steam generator tube rupture will also be useful in evaluating the depressurization of the RCS.

Finding 2 (3) The SAFEGUARD SYSTEMS STATUS SELECT switches on RL003 are placed between the CRT and the keyboard, but they are not related to the process computer.

Response The Safeguards System Status Select switches will be labeled and demarcated. See 6.05 for a sketch.

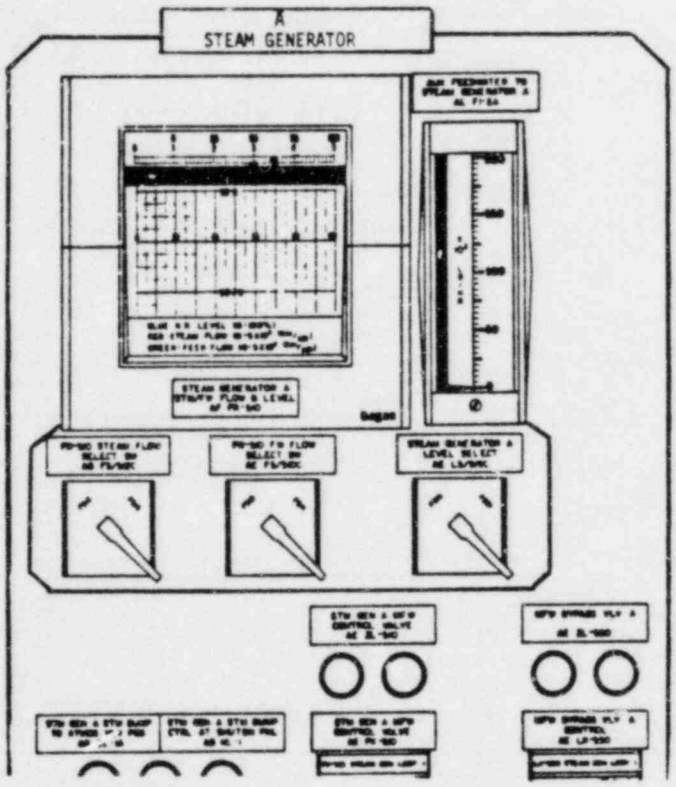
Finding 3 (3[1]) The two MN STM/FW VLV ACCUM CHARGE TEST and the two MN STM/FW ISO VLV EXERCISE ACTUATE controls are functionally and sequentially related but are not grouped together.

Response The two cited groups of controls are not functionally related. The two "MN STM/FW VLV ACCUM CHARGE TEST" switches are directly associated with the two Accumulator Charge Test Select switches. The two "MN STM/FW EXERCISE ACTUATE" control switches are directly associated with the exercise select switches. These four switches are grouped together with their respective "Test" and "Actuate" select switches. The grouping is adequate since "Test" or "Actuate" will normally follow "Select."

8.0 Panel Layout, continued

Finding 4 (3-1) The STM GEN A through D LVL SEL SW controls are not located directly below their associated trend recorders. These switches may be inadvertently associated with the AUX FEEDWATER display that they are located directly beneath.

Response Demarcation lines will be added to clearly group these three switches (see sketch).



Finding 5 (3-1) The ACCUMULATOR TANK FILL LINE ISO VALVE pushbutton on RL018 is located where it is only clearly associated with the B and D accumulator tanks although it is actually associated with all of the trains.

Response Due to the distance between the two mimic groups, it is impractical to associate the two groups with a mimic line. Labels will be provided to clearly show the connection. The label on B & D accumulator tanks will read "TO ACC A & C" the label on A & C accumulator tanks will read "ACC FILL LINE FROM SI PUMP"

8.0 Panel Layout, continued

Finding 6 (3[1]) The two RC DRAIN TANK HX DISCHARGE ISO VALVE controls and the two RC DRAIN TANK VENT CONTAINMENT ISO VALVE controls on RL022 are not sufficiently separated or demarcated from the unassociated RELIEF TANK valves to their left.

Response Demarcation will be used to indicate the separation of these components (the actual panel affected is RL021).

Finding 7 (2) The BORIC ACID TOTALIZER is located over the COMBINED REACTOR M/U & BA COUNTER. The COMBINED M/U & BA FLOW TOTALIZER is located over the BORIC ACID COUNTER. The counters are not related and the totalizer locations should be reversed.

Response The locations of the Boric Acid Totalizer (BG-FY-110BB) and the Combined M/U and Boric Acid Totalizer (BG-FY-111BB) on RL002 will be reversed as recommended by Essex.

Finding 8 (3) The STEAM DUMP SELECT SW AB US-500Z on RL005 selects the mode for the STEAM HEADER PRESSURE CONTROL, but the select switch and process controller are not located adjacent to one another.

Response Switch AB US-500Z and Steam Header Pressure Controller AB PK-507 are located together in a compact section of the Balance of Plant console (RL005 & RL006). ABUS 500Z is located in a cluster of 3 switches that control the status of the steam dump system. AB US500Z is located directly below an important related indication, Steam Dump Demand. The Steam Header Pressure Controller is located above the instrument cluster containing Steam Dump Demand and Main Steam Pressure and below the Steam Dump valve position indication. Moving any one component to improve a control-display relationship will result in loss of desirable relationship that now exists.

Finding 9 (3) It is not clear from the panel layout of the BTRS DEMINERALIZER INLET TEMP controllers and the associated BTRS TEMPERATURE display at what point in the flow path the displayed temperature is sensed. The B controller is located below the display and to the left of the A controller. The actual flow path is through the B heat exchanger then through the A heat exchanger. The temperature sensor for the display is located at the outlet of the A heat exchanger.

8.0 Panel Layout, continued

Response The BG TK381B and BGTK381A controllers work together to control BTRS demineralizer inlet temperature during the the borate mode by controlling letdown divert flow through the tube side of the Letdown Reheat Heat Exchanger. To clarify this, the labeling will be changed as follows:

Controller	BG TK-381B
1st Line:	LTDN DIVERT
2nd Line:	BYPASS CTRL
3rd Line:	BE TK-381B

Controller	BG TK-381A
1st Line:	LTDN DIVERT
2nd Line:	FLOW CTRL
3rd Line:	BG TK-381A

Finding 10 (3) The STEAM GENERATOR A & B and C & D WIDE RANGE LEVEL and the STEAM GENERATOR A & B and C & D PRESSURE trend recorders are not grouped according to the different steam generators. For example, the STEAM GENERATOR A trend information is not grouped with the other STEAM GENERATOR A information.

Response The hook-up for the four steam generator level and pressure trend recorders will remain grouped by pressure and level to aid in diagnosing transients such as tube rupture or steam line break. These groupings will then be demarked.

The trend recorders are grouped together by wide range level and steam generator pressure. They have demarcations around them with nameplates clearly indicating the parameters they are displaying and setting them off from the rest of the steam generator information. The information grouped together in this way is valuable in assessing accident conditions, i.e.: steam breaks, feed breaks, tube ruptures.

In these instances a Reactor Operator must compare the pressures of all four steam generators to each other and must also compare the levels of all four steam generators to each other to diagnose the accident conditions mentioned above. Comparing a single steam generators' pressure to its level will not be useful information to the operator. With the use of the demarcations and nameplates, we do comply with basic display position relationship guidelines given in section 6.9.1 of NUREG 0700.

8.0 Panel Layout, continued

Finding 11 (3) The two BTRS DEMINERALIZER INLET TEMP controllers on RL002 appear to be located in an unconventional alphabetical sequence. The B controller is located to the left of the A controller. However, the plant drawings indicate that the associated equipment is also arranged with the B heat exchanger before the A heat exchanger in the flow path.

Response Both controllers work together to control flow to a single heat exchanger, the Letdown Reheat Heat Exchanger. The label changes suggested for 8.09 should resolve this finding.

Finding 12 (1) The pushbutton orientations of two switches on the RL001 mimic do not match their positions in the mimic. Switch BG-HIS-112A has HUT on the top pushbutton of the switch, with VCT on the bottom. These pushbutton locations should be reversed. Switch BG-HIS-129 has DEMIN on the top pushbutton of the switch, with VCT on the bottom. These locations should also be reversed.

Response The pushbutton orientations will be changed.

Finding 13 (2) The RCP A SEAL LEAKOFF & INJ FLOW chart recorders on RL022 are arranged in an unconventional numerical sequence - 2, 4, 1, and 3.

Response Instrumentation for the four reactor coolant loops are arranged in the order of, from left to right, A, B, C, and D (or Loop 1, 2, 3, and 4). The RCP SEAL LEAKOFF & INJECTION FLOW Chart Recorders are presently arranged in that order. The Loop Hot & Cold Leg Temperature Recorders will be rearranged such that they will correspond to the order of the RCP Seal Leakoff & Injection Flow Recorder located immediately above these temperature recorders.

Finding 14 (2) The NIS RECORDER SELECT SW SE HS-1 and the NIS RECORDER SELECT SW SE HS-2 are arranged in an unconventional numerical sequence. The NIS RECORDER SELECT SW SE HS-2 is located to the left of the NIS RECORDER SELECT SW SE HS-1.

Response The positions of NIS Recorder Select switches SE HS-1 and 2 on RL003 will be reversed as suggested by the HEF.

Finding 15 (2) The BLOWDOWN VALVE #1 CONDUCTIVITY RATIO/AUTO-MAN CONTROLLER and the BLOWDOWN VALVE #2 CONDUCTIVITY RATIO/AUTO-MAN CONTROLLER are located in an unconventional left to right numerical sequence. The #2 controller is located to the left of the #1 controller.

8.0 Panel Layout, continued

Response Unit 1 controller will be placed to the left of the Unit 2 controller and the Unit 2 controller will be marked future. See also finding 9.09.

Finding 16 (2) The RHR PUMP ROOM SUMP PUMP A through D controls are arranged in an unconventional alphabetical sequence. The controls are arranged in two rows with B in the top left location, A in the top right location, D in the bottom left location, and C in the bottom right location.

The CENTRIFUGAL CHARGING PUMP A and B controls on RL001 and the DEMINERALIZER TRAIN A and B AUTO-MAN FLOW controls on RL014 are also located in an unconventional B = left, A = right arrangement.

Response The controls for the four RHR pump room sump pumps, A through D, will be rearranged in the following manner:

Pump A - Top left
Pump B - Top right
Pump C - Bottom left
Pump D - Bottom right

The controls for the centrifugal charging pumps A and B are enwrapped in mimics on RL001. Reversing these controls would require not only additional separation barriers at the back of the board which would be extremely difficult to accommodate due to limited space but would also result in poorly defined mimic displays. Demineralizer train A and B Auto-Man flow controllers on RL014 will remain as presently installed.

Demineralizer train A and B Auto-Man Flow controls on RL014 are designed in the present unconventional arrangement B = left, A= right to preclude control rewiring if an additional demineralizer train ('C') is required in the future. In this instance, the additional train, due to space limitations, would be located to the left (RL011), adjacent to the present train B. This permits a logical progression from right to left of A, B, C. Since the Auto-Man Flow Controls do not affect and are not associated with safety-related equipment, Union Electric is of the opinion that it is unnecessary to rewire the controls A = left, B = right.

Finding 17 (1) The indicator lights for the INTAKE PUMP C DISCHARGE VALVE control are located in an unconventional red = left and green = right arrangement. The related A and B indicator lights are arranged conventionally with green = left and red = right.

8.0 Panel Layout, continued

Response — The lens covers for the Intake Pump C Discharge Valve were inadvertently reversed. This condition has now been corrected to agree with convention of green = left and red = right.

Finding 18 (3) — The CONTROL BANK and SHUTDOWN BANK STEP counters are grouped together. Since these counters are identical, an operator could easily read a count from the wrong group, especially since the same numbering system is used on the labels of each (e.g., A-1, A-2, etc.)

Response — These step counters are grouped and sequenced in order of withdrawal, with the first rods to be withdrawn on the lower left and the last to be withdrawn on the upper right of the matrix. The operator compares these step counters with the digital rod position indication. Any erroneously perceived differences would be quickly detected. The step counters are also clearly labeled as either control bank or shutdown bank, including the group identification.

Finding 19 (3) — Several component groups on RL005, RL006, RL014, RL015, RL017, RL018, and RL019 are mirror imaged. In some of these groups the mirror imaging is not exact. The ESF CONTROL PANEL (RL017 and RL018), in particular, exhibits significant problems in mirror imaging and mixed mirror imaging. These arrangements will create transference of training problems for the operator.

Response — The mimics have been reviewed for upgrading to enhance the visual grouping of controls. On RL014 the mimic layout represents the actual physical arrangement as much as feasible. Many of the redundant systems have portions common to both making a quasi-symmetrical layout desirable. This is particularly true of panels RL017 and RL018. A full-scale mockup of those panels was constructed and revisions to the mimics, labels and the locations of some indicators were made to improve the clarity to the operator. A representative of our Human Factors consultant (Essex Corporation) participated in the review of the final arrangement of RL017 and RL018.

One of two groups of containment spray system displays on RL017 will be rearranged to be identical to the other group.

The Callaway mimic bus on RL014 for future switchyard circuits will be removed.

8.0 Panel Layout, continued

Although mirror imaging also exists on RL005, RL015 and RL019 and is not exact in all areas, the present arrangement of the panel devices does not create operational problems. The devices that are not completely mirror imaged are already in the same general area (within a few inches) of their mirrored image location, and the specific device can be rapidly identified by the nameplate. Also, the operator will not operate a device without nameplate verification, and one result of the nameplate study is increased ease of identification. Furthermore, the operators have been training extensively on the SNUPPS simulators which have the same arrangement as the Main Control Panels and interchanging the locations of the devices may create more confusion for the operators at this stage.

Therefore the present arrangement of these control panels is considered acceptable from an operational standpoint.

9.0 Control-Display Integration

Finding 1 (2) Several pairs of indicator lights on RL017 and RL018 are located to the right of their associated controls rather than above them. In addition, the associated identification labels are located below rather than above these lights.

Response Indicator lights on RL017 and RL018 will be located above their respective controls. Labels for both the lights and the controls will be located between the actual light and control. This provides a close association between control and indicator.

Finding 2 (3) Related controls, displays, and indicator lights throughout the control room are often located on both the inner and outer rings of panels. These rings are separated by approximately 8 feet. This arrangement prevents close visual association between the associated displays and controls. For example, the SEAL WATER OUTLET ISOLATION VALVE controls are located on RL001, while the associated LEAKAGE FLOW indicators are located on RL021.

Response The design objective is to maintain close association between instruments/controls located on the inner-ring and outer-ring control boards. However, due to factors such as split system association and mimic display arrangement, it is not always possible to accommodate one close visual association without sacrificing some other aspects of association. The cited seal water outlet isolation valve controls are part of the reactor coolant & support system and are shown in the mimics on RL001. The RCP Seal Leakage Flow indicators which are a part of the RCP instrumentation system are grouped together with other RCP indications on RL021.

The control room layout supports normal and emergency operating conditions whereby key controls and displays are clustered together. Infrequently used controls and displays are sometimes separated.

Finding 3 (1) There is inconsistent labeling between some trend recorders on RL018 and their associated controls on RL017. The numbers "1" and "2" are used for component identification within trains on the trend recorders, while the letters "A" and "B" are used for component identification within trains on the controls.

9.0 Control-Display Integration

Response — The labels on recorders EJ-TR-613 and 612 will be changed to read "A" and "B" in lieu of "1" and "2".

Finding 4 (2) — The ROD INSERTION LIMIT and NEUTRON FLUX DETECTOR recorders on RL022 that will be monitored during control manipulation on RL003 are not located sufficiently close that an operator can read them clearly and without parallax from a normal operating position.

Response — There is an abundance of information on neutron flux on RL003, both recorded and on meters, for the operator to use during normal plant operation. The recorders on RL022 are 0-200% over power recorders used only in post-trip diagnosis. Constant monitoring of the Rod Insertion Limit computer output is not necessary. An annunciator (Rods at Low Limit) sounds when rods are 10 steps from the rod insertion limit, informing the operator of a need for action (boration). A second alarm sounds when the rods reach the insertion limit. Even at this point the operator has two hours to correct the situation before exceeding a limiting condition for operation.

Finding 5 (3) — The AIR COMPRESSOR C indicator lights are located over the AIR COMPRESSOR A RESET CONTROL. In addition, the AIR COMPRESSOR A and B indicator lights are located in an unconventional alphabetical sequence. The AIR COMPRESSOR A indicator lights are located to the right of the AIR COMPRESSOR B lights.

Response — The location of the AIR COMPRESSOR indicator lights for COMPRESSOR A (QL-3) and COMPRESSOR C (QL-1) will be reversed.

Finding 6 (2) — The MAIN STM RHTR vertical displays are offset to the left of their associated controls by about 6" to 12". The MAIN STM RHTR indicator lights are offset to the left in a 2x2 matrix rather than being located under their associated vertical displays.

Response — The vertical displays located on RL024 are for indication of steam flow to the reheaters. These indicators are provided for indication of tube leakage and are not directly associated with the controls located below. The indicator lights for the second stage low load valves will be relocated to the left.

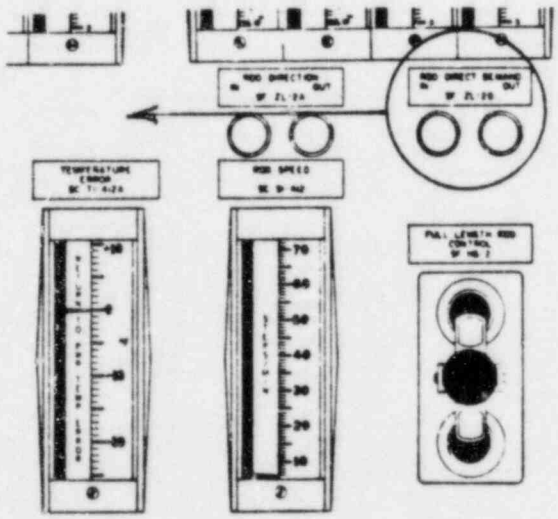
Finding 7 (2) — The FUEL POOL COOLING PUMPS B and A controls are located in an inconsistent order with their associated DISCHARGE displays. The displays are correctly ordered A - B, while the controls are ordered B - A.

9.0 Control-Display Integration

The ROD DIRECT DEMAND and ROD DIRECTION indicator lights on RL003 are also located in inconsistent order with their associated controls.

Response The Fuel Pool Cooling Pump controls and the Fuel Pool Heat Exchanger CCW Discharge Isolation Valve controls will be rearranged. Pump A and valve A controls will be located immediately below the A-loop flow indicator and Pump B & valve B controls, immediately below the B-loop flow indicator.

The Rod Direction demand lights will be relocated to above the temperature error meter, SCTI-412A, on RL003, as shown on the following sketch:



Finding 8 (2) The OVER PWR/OVER TEMP T RECORDER SELECT switch is located beneath its associated trend recorder, but an unrelated trend recorder is located between the associated components.

Response The recorders SETR411 and BGLR102 will be exchanged so that the SETR411 recorder (over pwr/over temp) will be immediately above its select switch.

Finding 9 (2) The association between the PLANT BYPASS VALVE MAN controller and the PLANT BYPASS display is not clear. The display is below and to the left of the controller and two unrelated controllers are between the associated components.

9.0 Control-Display Integration, continued

Response — The Plant Bypass Valve Controller will be relocated closer to the Plant Bypass display. The controllers will be rearranged so that when viewed from left to right will be Blow Down Valve 1 Controller, Plant Bypass Valve Controller, and Future Controller.

Finding 10 (3) — Related controls and displays are not always easily identified as being associated. For example, the reactor operations controls and displays on RL003 and RL004 are not well arranged by specific functions (e.g. startup).

Response — The example given as having poor association between related controls and displays (e.g. reactor controls) follows a very definite pattern. The primary control of the reactor is with the control rods during startup. The operator will be controlling the reactor with the rods while observing the Source Range counts and start-up rate meters located above and to the left of the rod control. As reactivity is increased and Source Range counts increase, the Intermediate Range meters located directly to the right of the Source Range meters will begin to indicate. The Power Range meters and recorder are located on the panel (RL004) directly above the rod controls. The reactor coolant average temperature is also located above the Power Range meters so the operator can observe it along with power. To the left of the Power Range and reactor coolant temperature located on RL002, the Pressurizer level and pressure indicators give the operator indication of Reactor coolant water volume and pressure. All of these controls and indications are located on a section of the board approximately 4' x 4' which will require little if any movement of the operator during startup.

The primary controls and displays necessary to operate the plant are located in a very systematic layout and secondary displays and controls are located directly behind these, on the outer ring of boards, to the highest degree possible.

Finding 11 (2) — The arrangement of indicator lights and their associated controls is not consistent from application to application. For example, the CCW PUMP A through D RESET indicator lights are placed to the right or left of their associated control rather than above, as is the convention.

9.0 Control-Display Integration, continued

Response — The CCW Pump A through D reset lights on RL019 will be removed as they are not required.

Finding 12 — The displays for the MFW PUMP TURB A and MFW PUMP TURB B are arranged in the following horizontal sequence: TURB A TURB BRG OIL PRESS, TURB B TURB BRG OIL PRESS, TURB A PUMP BRG OIL PRESS, TURB B PUMP BRG OIL PRESS. BRG OIL PRESS (right-hand pair of meters). The associated controls for PUMP A are in a vertical column below the TURB BRG OIL PRESS meters (left-hand pair of meters). This is poor functional grouping of the TURB A and TURB B displays with their associated controls.

Response — The locations of indicators FC-PI-164A and FC-PI-68A will be interchanged as indicated by this HEF.

Finding 13 (2) — The control groups in the CVCS mimic are in reversed orientation from their associated displays. The LETDOWN HX OUTLET control is located on the left half of RL001. The LETDOWN HX OUTLET display is located on the right half of RL002. The BORIC ACID TO VCT controls are located on the right half of RL001. The BORIC ACID TO VCT display is located on the left half of RL002.

Response — The Letdown HX Outlet display is located towards the center of RL002. Pressurizer controls and displays are on the right half of RL002. The existing arrangement places the key displays and controls concerning pressurizer level, and pressure immediately adjacent to the reactivity controls and indications where one person can readily monitor the major reactor system parameters. The controls and indication on RL002 for boric acid constitute a stand alone control station for boration and dilution. The controls on RL001 would be used manually only if those on RL002 malfunction. Automatic controls are located on RL002. The operator has the option of selecting either "manual" or "automatic" functions. Boration and dilution are not fast response actions.

Finding 14 (2) — Three PRESSURIZER HEATER controls and three PRESSURIZER PRESSURE and LEVEL controls are reversed with respect to their associated displays.

9.0 Control-Display Integration, continued

Response The current arrangement is considered to be adequate as described below:

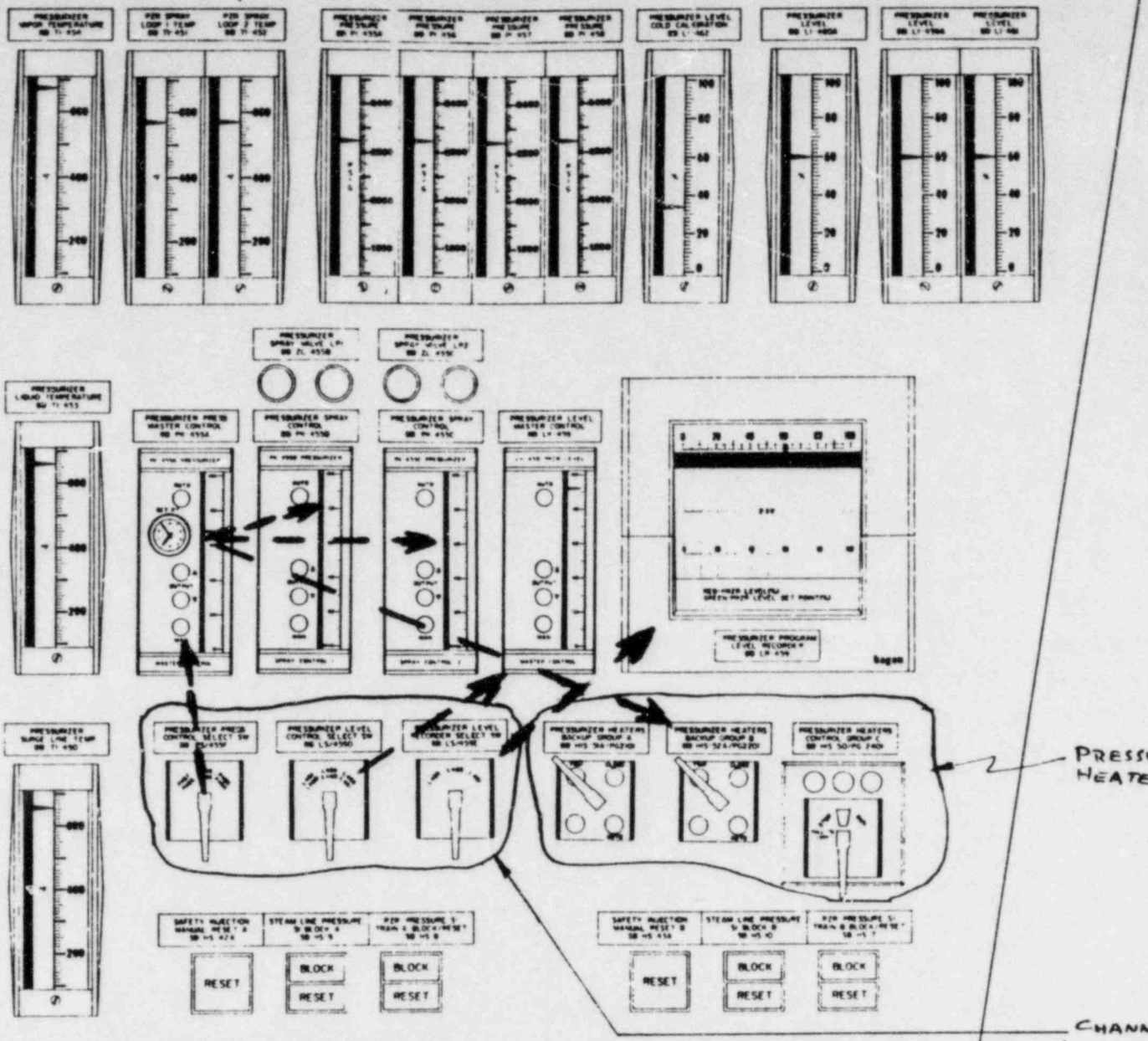
1. On the attached drawing, the Pressurizer Heater controls are the three switches indicated on the lower right.

2. The switches referred to in the finding as Pressurizer Pressure and Level controls are the three switches to the left of the Heater controls. These are actually channel select switches, not controls.

3. None of the six switches listed in 1. or 2. above are normally used as controls. The channel select switches determine which channels input to the process controllers for Pressurizer Pressure and Level. Once set, these switches need be changed only when the Operator has indications of an instrument channel failure. If the failed channel is selected for use by a controller, the Operator selects another channel for input. The Heater switches set up the Pressurizer Master Controller. Once these are set, they are changed only when specified by procedure. Specifically, the backup Heaters are energized manually during boration or dilution to force the Pressure Controller to open the spray valves, and establish flow through the Pressurizer for mixing.

4. The channel select switches are logically located with respect to the Process Controllers that they affect. See the drawing for signal relationships.

5. Normal operation of the Pressure Control System is completely automatic, and does not involve any Operator manipulation of these switches. Manual operation uses the push buttons on the Process Controllers, and again, does not involve these switches.



PRESSURIZER HEATER CONTROLS

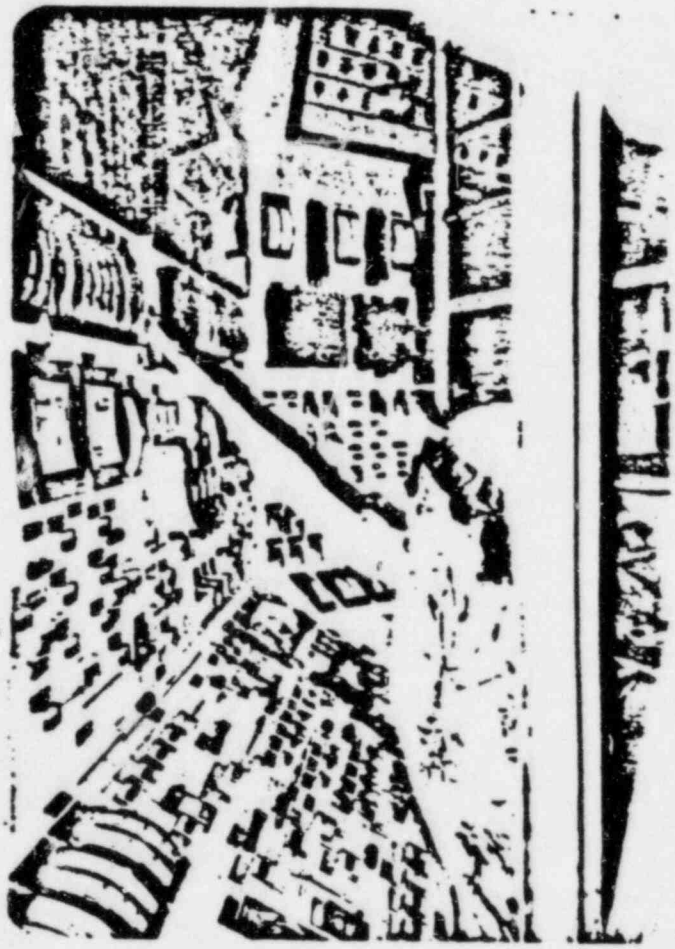
CHANNEL SELECT SWITCHES (REFERRED TO AS PRESSURE AND LEVEL CONTROLS IN FINDING 9.14)

Westinghouse Electric Corporation

MAIN CONTROL BOARD RL002

Attachment to Finding 1.1

RL014

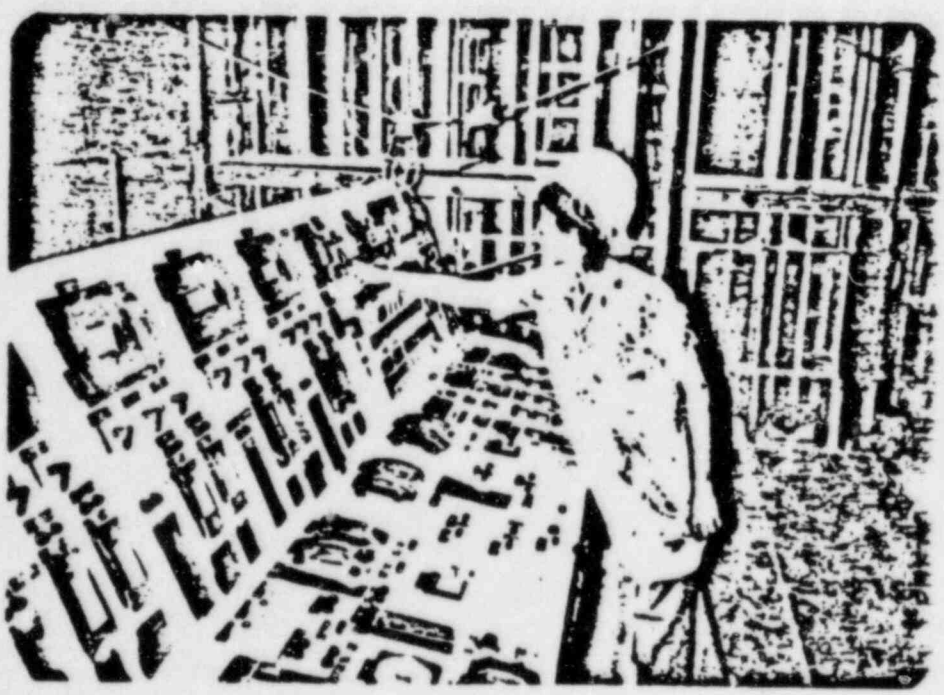


RL018

NOTE: The person illustrated measures approximately 5'-1" in height, with shoes.

Attachment to Finding 1.7

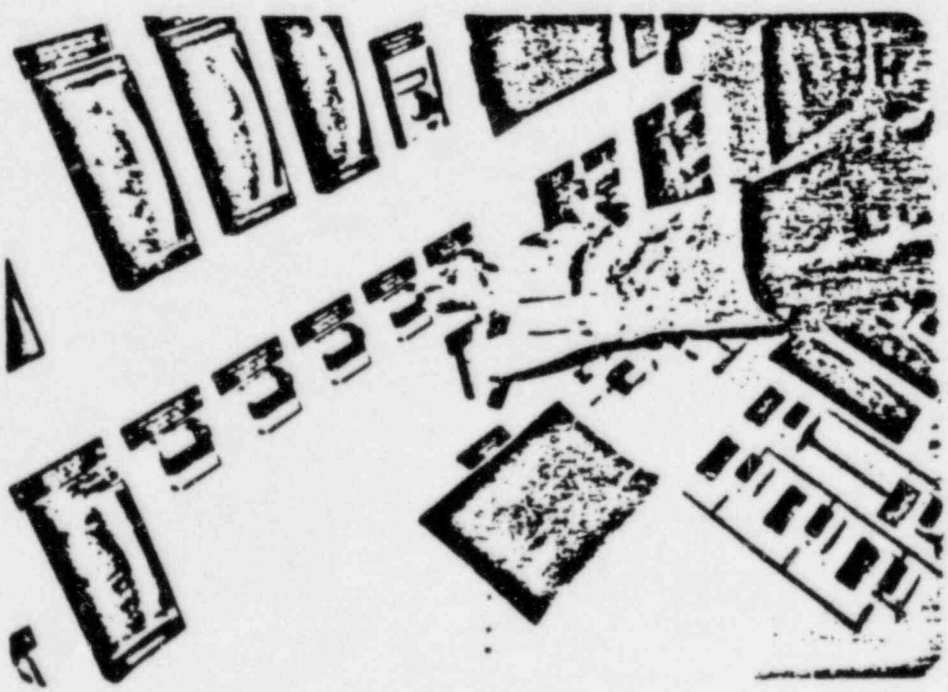
RL002



RL006

NOTE: The person illustrated measures approximately 5'-1" in height, with shoes.

Attachment to Finding 4.1



APPENDIX B

Supplementary Survey

1.0 Control Room Workspace

Finding 1 (5) There is no coding scheme established to clearly differentiate different types, sizes, and styles of expendables and spare parts from each other.

Response Due to the relatively small amount of spare parts required in the control room, combined with most parts having identifying markings, a rigid coding scheme is unnecessary. Unlabeled parts will be labeled as deemed necessary.

2.0 Communications

Finding 1 (5)	Periodic testing is not planned for communication equipment.
Response	The routine use of communications equipment will ensure the equipment is operating properly.
Finding 2 (0)	Control room personnel do not have override priviledges on outside telephone lines.
Response	Direct lines out of the control room are provided. Direct lines to TSC and EOF will also be provided.
Finding 3 (5)	The location and design of the phone on RL003 makes it inconvenient and in the way of the control room operators. Also the cords are not long enough.
Response	A cord clamp is being used to keep the cord for the Public Address off the floor. The length of the existing cord is acceptable.
Finding 4 (6)	The headsets associated with sound powered phones are uncomfortable.
Response	These headsets are for use by maintenance personnel and their use would result in minor consequences and inconvenience to control room operations. No further action is required.
Finding 5 (5)	The drawer in which headphones are stored is not labeled.
Response	This finding would result in minor consequences and inconvenience to control room operations. No further action is required.
Finding 6 (5)	There are no speakers associated with the control room public address system located in the control room bathrooms.
Response	Speakers in the control room bathroom are unnecessary as operators in the control room can attract the attention of operators in the bathroom.
Finding 7 (5)	The audio gain on the public address system is designed so that the operators could turn the volume down to an inaudible level.
Response	It is normal practice to adjust the audio gain to an audible level, therefore, this should not be a problem. No action is required.
Finding 8 ( )	There is not adequate communication equipment available to control room operators when they are wearing protective gear. Specifically it is impossible to hear the operators when they talk through face masks.
Response	Face masks containing provisions to facilitate voice communications will be provided.

3.0 Annunciator Warning System

Finding 1 (4)	The computer alarms and annunciator horns are not loud enough to properly distinguish the sound from the ambient noise.
Response	This finding was investigated in the environmental sound study.

4.0 Controls

Finding 1 (6) — It is not possible to operate CH E-30 switches or the controls on the Foxboro meters when wearing emergency gloves.

Response — This finding is a duplicate of NRC finding 4.1. See SNUPPS response per reference 10.

Finding 2 (0) — The scale face for the setpoint on the Letdown Hx Outlet Pressure control (BG-PK-131) on RL001 is broken.

Response — This finding will be corrected at system turnover.

Finding 3 (6) — The design of all of the annunciator acknowledge buttons is such that the operator can inadvertently activate them by leaning against the panel.

Response — The annunciator controls have been redesigned based on NRC finding 3.14.

Finding 4 (0) — The startup reset control (SF-HS-3) on RL003 is missing an escutcheon plate.

Response — The label for this control will be modified to indicate switch position.

Finding 5 (0) — There is an inconsistent CH E-30 switch configuration for several controls.

Response — Refer to NRC finding 4.5 for the SNUPPS response.

Finding 6 (0) — The "open" and "close" positions are reversed on the following controls:

Panel #	Component #
RL014	QLDA-3101A
RL014	QLDA-3101B
RL014	QLDA-3101C

Response — This finding will be resolved through modifications to the control room.

5.0 Displays

Finding 1 (6)	The individual rod position labels (H6, H10, F8, etc.) cannot be read from RL003.
Response	During plant operations when moving control rods, one operator would normally be stationed at the rod position panel and another operator would be stationed at the control panel. The operator at the IRPI would compare bank position at the rod control panel to the IRPIS. This issue will be further addressed through training.
Finding 2 (0)	The totalizer and counter do not identify the units of measure for the Boric Acid Counter and Totalizer (BG-FY-110BB) or the Combined Makeup and BA Totalizer and Counter (BG-FY-110B, BG-FY-111BB, BG-FY-111B).
Response	Refer to NRC finding 5.26 for the response (see reference 10).
Finding 3 (5)	More than nine graduations separate the major numerals on sixty nine displays.
Response	Tolerance zones will be marked on displays where practical throughout the control room and will reduce or eliminate the potential for misreading displays.
Finding 4 (5)	Linear scales are not used on several displays.
Response	Where practical, tolerance zones will be marked on displays to improve readability.
Finding 5 (5)	All Foxboro controllers, which have demand and actual status do not distinguish between pointers which indicate demand/ actual status.
Response	All Foxboro controllers were reviewed and were found to differentiate between actual and demand.
Finding 6 (5)	All Foxboro controllers have a poor contrast between black numerals and a cream colored background. The readability is degraded by this contrast.
Response	The readability is only slightly degraded and does not warrant a scale change.

5.0 Displays, continued

Finding 7 (5)	On all Foxboro controllers, the unit and multiplier information is presented in the upper left hand corner. Due to the position, contrast, and size, this information is difficult to read.
Response	With training and repetitive use of these controllers, the information will be readily apparent to the operators.
Finding 8 (5)	Display scales for several meters do not use an optimal numeral progression:
Response	Although the scales are not optimal by NUREG 0700 guidelines, the operators have found that the numeral progressions are adequate and were practical and usable. Also, tolerance zones will be marked on displays to aid operators in reading the displays.
Finding 9 (0)	There is an unlabeled recorder on RL014. Neither the scale nor the label provide identification information.
Response	This is a construction related problem that should be corrected at turnover.
Finding 10 (5)	More than four graduations are used on 42 displays without use of major and minor graduations.
Response	On many of these displays, there are intermediate markings. Vital information is mostly on the front panels where the graduations can be more easily read from the required distance. The back panel and front panel scales will have tolerance ranges marked on them as soon as these tolerances are defined, thereby simplifying the operators reading task with an aid to easily identify if readings are within tolerance. We also have annunciators to alert the operators of conditions out of tolerance.
Finding 11 (5)	Graduation lengths or contrast thickness is not sufficient to distinguish intermediate graduation marks on 87 displays.
Response	See previous response (finding 5.10).
Finding 12 (5)	The display units for the Fuel Pool level (EC-LI-39A), Fuel Pool Pump Discharge (EC-FI-17A), and Fuel Pool Pump Discharge (EC-FI-18A) on RL021 are not appropriate for use by the operators.
Response	The display units and the units provided in the procedures will be made to agree.

5.0 Displays, continued

Finding 13 (6) Legend labels for the permissive/blocked/partial trip status panel (SB069) on RL022 are not readable from the operator's console.

Response This finding was previously reported and the display has been redesigned to establish a light pattern to aid the operator with the reading of the display. Legend labels are readable from the panel workstation.

Finding 14 (5) The label inside the trend recorders for Steam Generator wide range level and pressure (AE-LR-501, AE-LR-503, AB-PR-514, AB-PR-535) on RL026 are not consistent with the component labels. The component labels identify steam generators as A, B, C, D where as the inside recorder labels use LP1, LP2, LP3, and LP4.

Response The labels inside the trend recorders will be changed to agree with the component labels.

Finding 15 (5) There are no scale label indications on the Steam/Feedwater flow and level trend recorders (AE-FR-510, AE-FR-520, AE-FR-530, and AE-FR-540) on RL006 and the Boric Acid flow recorder (BG-FR-110) on RL002 to indicate the measured variable.

Response Colored dots will be added to the scales inside the above recorders to indicate the correct association.

Finding 16 (0) The scale values for the Charger Header Control (BG-HC-182) on RL001 and the BTRS Demineralizer Bypass Control (BG-HC-387) on RL002 increase from right to left.

Response A label will be added to Hagan controller faceplates identifying the direction of vernier rotation required to open the valve.

Finding 17 (5) All Foxboro meters have pointers which overlap the scale markings.

Response The overlap is minor and will have only minor, if any, consequences to the operator.

Finding 18 (0) The scale values for the Battery Chargers (NK22, NK12, NK13, NK14, NK24, NK23) on RL016 do not increase from left to right.

Response This finding will be resolved through modifications to the control room. Ammeters for battery chargers NK22 and NK23 are correct as is and will not be modified.

5.0 Displays, continued

Finding 19 (0)

The scales printed on the recorder paper for BG-FR-110 (RL002), BB-TR-412 (RL004), GN-PR-934 (RL018), EJ-TR-613 (RL018), EJ-TR-612 (RL018), PR-938 (RL020). BB-PR-403 (RL022), BB-PR-455 (RL022), BG-FR-154 (RL022), BG-FR-155 (RL022), BG-FR-156 (RL022, BG-FR-157 (RL022), BB-TR-413 (RL022), BB-TR-423 (RL022), BB-TR-433 (RL022), BB-TR-443 (RL022), AB-PR-514 (RL026), and AB-PR-535 (RL026) do not match the scales on the recorders.

Response

Union Electric will place orders for all chart paper by 04/13/84 and, by fuel load, paper with 0 to 100% scales will be used in any recorder that does not have its proper paper installed. It is anticipated that the bulk of the paper ordered will be received and installed prior to exceeding 5% power. In the interim, until the remainder of the paper is installed, the recorder tag number and ON/OFF times and dates will be noted on the 0 to 100% paper being used in its place.

By Fuel Load, KGE will install the proper chart paper on all but seven of the chart recorders. It is anticipated that the paper for these seven chart recorders will be received and installed prior to exceeding 5% power. In the interim, until the remainder of the paper is installed, the recorder tag number and ON/OFF times and dates will be noted on 0 to 100% scale paper that will be used on the seven chart recorders.

Finding 20 (6)

There is no label on the trend recorder (RJ-UR-2) located on the RL002 panel to identify the recorded parameters.

Response

The parameters displayed on this recorder are selectable by the operator from all those parameters available in the computer and will therefore vary. No corrective action will be taken.

Finding 21 (6)

The megawatt recorder (MA-JR-1) on RL024 does not have a scale printed on the recorder paper.

Response

The design of the recorder allows for the meter scale on the display to act as the scale for recorded data. This finding does not result in significant consequences or inconvenience to control room operations.

6.0 Labels and Location Aids

No findings were detected on this section.

7.0 Process Computer

Finding 1 ( )	Excess glare is reflected from the two computer CRTs on RL007.
Response	This finding was investigated in the environmental light study.
Finding 2 (5)	The alphanumeric characters on the CRTs have 6.4 picture elements per character height. Seven picture elements per character height is recommended by NUREG 0700.
Response	All alphanumeric characters are easily read from all operator workstations. No corrective action is necessary.
Finding 3 (5)	The luminance, contrast, and color of the CRTs can be adjusted by the control room operators.
Response	This versatility is beneficial if used properly. The operators will refrain from adjusting these controls without prior approval from the Shift Supervisor.
Finding 4 (5)	The display data on the computer systems require interpolating and mathematical calculations. For example, data is presented in units of k lbm/hr on the computer and must be converted to gal/min for the operator's use. Also, there is an inconsistent use of words. For example, open is used synonomously with not closed.
Response	There is no inconsistency between CRT's and the control boards. No change is necessary.
Finding 5 (5)	Indentation of subclassifications is not used in the lists generated on the CRTs.
Response	The use of color as well as spacing between lines and paragraphs adequately separates the subclassifications.
Finding 6 (5)	Numbers with and without decimal points are intermixed in columns and therefore do not line up consistently.
Response	All alphanumeric characters are easily read from all of the operator workstations and operators will be made aware of this inconsistency through training.
Finding 7 (5)	Individual data groups do not have descriptive titles. They are identified by numbers (1-10) and the operator must refer to other documentation to determine the corresponding title.

7.0 Process Computer, continued

Response — Data from operator logs are operator selectable and are considered temporary and it is the responsibility of the operator to input and retrieve their own information.

Finding 8 (5) — Lists of options are not organized on the computers according to any logical scheme.

Response — These lists of options are not meant to guide operators. This finding does not result in significant consequences or inconvenience to control room operations. No action will be taken.

Finding 9 (5) — When data are contained on multiple pages, the page does not display the page number or the total number of pages.

Response — This finding is a duplicate of NRC finding 7.8 and its response will be handled as noted in reference 10.

Finding 10 (6) — Feedback messages are not provided to the operators to indicate changes in the status of the computer system functioning.

Response — This finding is incorrect. Function initiated messages are displayed for all operator requests that are accepted by the the computer (Refer to NRC finding 7.10).

Finding 11 (5) — Periodic feedback is not provided to the operator to indicate normal system operation and the reason for any system delays.

Response — Periodic feedback is provided in the form of a flashing purple cursor to indicate normal system operation. A white steady cursor is indication of the computer not in communication with the CRT terminal. During normal operation, system delays are seldom incurred.

Finding 12 (6) — Colors used on the CRT to convey information are not consistent with all other color codes in the control room.

Response — The process lines of the P&ID displays were originally designed to use mimic line colors for the various plant systems, however, this resulted in diagrams that were difficult to assimilate because of color clutter. This significantly detracted from the purpose of the displays, particularly when the dynamic state is considered. Accordingly, the use of the mimic colors was modified and line colors were primarily based on the fluid media and its dynamic status, i.e., static, pressurized, flowing, undefined status. Process line segments within each P&ID have the capability of changing color based on their current state. Generally, based on more than 40 displays, only one

7.0 Process Computer, continued

fluid is represented in any given P&ID display. This results in a clear understanding of the fluid media and dynamic status which therefore justifies the inconsistency between the CRT and mimics.

Yellow is used in the P&ID alphanumeric information to depict static, nonvariable information for titles, equipment labels and other notes, whereas white is used for similar type information (message types, headers, etc.) on General Displays. This difference in colors is minor and should not affect operator performance. For points in normal status in the P&ID alphanumeric information, the current updated numeric values are white rather than green (as in the General Displays) to provide improved readability. These differences have been identified to the operators through training and have been determined to be non-problematic.

Based on previous experience with revising colors on the BOP computer system, changes are very expensive and, in conjunction with the above explanation, are not cost effective. No further changes to BOP computer system colors are planned.

Finding 13 (5) Red and green are both used in the Primary plant graphic (BB1).

Response The colors in this graphic conform to the CRT color coding scheme. The operators report no problems associated with the use of both red and green in this display.

Finding 14 (5) All data relevant to a specific operator entry are not displayed on a single page.

Response In some cases, there is too much information to contain on one page. Operators are aware of the use of multiple page entries.

Finding 15 (5) There is no date or headings on the trend data.

Response Trend data is operator selectable and therefore no date or headings are used. A trend pen summary is available to identify points trended.

Finding 16 (6) The printer does not have the capability of 150 lines a minute print speed.

Response The TermiNet 1200 has the capability to output information at 60 lines per minute (120 characters per second). Based on the alarm field size on the printer (70 characters per line)

7.0 Process Computer, continued

the actual printer capability is greater than 100 lines per minute. However, a 300 line per minute printer is located immediately adjacent to the control room. The TermiNet printer has a "fail over" capacity so that the operator can channel output to the high speed printer. During emergency situations the 60 line per minute is more than adequate for providing essential sequential alarm information to the operator in the control room without resulting in an information overload condition. Given that the TermiNet terminal has advantages to the operator not available on a high speed printer and under circumstances where a high speed printer is available to the operator adjacent to the control room, no further action is anticipated. The buffer capacity for the BOP computer system is greater than 1500 alarms and the buffer capacity for the annunciator system is about 1000 additional alarms. The SNUPPS alarm system and printer, therefore, are capable of handling the anticipated quantity of alarms in any emergency situation.

Finding 17 (5) There are no instructions attached to the printer for reloading paper, ribbon, ink, etc.

Response An instruction sheet will be attached to the printer.

Finding 18 (5) The printer is set up such that the last line of print is obscured from the operators' view.

Response The operator has the ability to page up if he wants to read the last line of print. Also, utility personnel will replace the ribbon and/or clean the plastic cover as needed to ensure proper readability. No further action is required.

8.0 Panel Layouts

Finding 1 ( )	The NIs are located on the back panels. This instrumentation may be needed during an emergency event.
Response	All information required for emergency events is given on the front panels.
Finding 2 (5)	The demarcation of RC Pump groups lacks hierarchical labeling of groups.
Response	The arrangement of these groups precludes the need for hierarchical labels.
Finding 3 (5)	The Permissives/Block Partial Trip Status (SB069) on RL022 are located high on the panel. The upper tiles are difficult to read due to parallax and the size of the legends.
Response	The operator can adjust his position to correct for parallax. In addition, the light patterns are used to give the operator indication of status.
Finding 4 (5)	The control used in adjusting RC Seal Injection Flow is the Charging Header Flow Control (BG-HC-182) located on RL003 while the associated displays for setting injection flow are located on RL022.
Response	This display is only used during its initial setup. Moving the display and control close together would be unnecessary.
Finding 5 (5)	The RCP Bearing Temperature recorder (BB-TR-500) is located on the back panel. The operator can select to have temperatures displayed on the CRT but this cuts the signal to the recorder so the trending is lost. If the recorder is selected, the CRT does not have the values for the display.
Response	Normally, bearing temperatures will only be displayed on the BOP computer. The trend recorder may be used during startup and other selected times.

9.0 Control/Display Integration

Finding 1 ( )	The Reactor Vessel level range on RL022 is confusing to the operators. The range is from 0 to 120%.
Response	Operators will be trained to realize that changes in water density can cause the reactor vessel level indicator to read above 100%, which also explains the reason for a scale range of 0 to 120%. Wolf Creek's scale range was inconsistent and it was determined that the range of 0 to 120% is correct. Wolf Creek's scale has been modified.

Table 3. HEF Prioritization Scheme

Severity Criteria

1. If an error occured, could plant safety be jeopardized or degraded?
   - Yes - enter a "1" in Question 1
   - No - enter a "0" in Question 1

2. If an error occured, could plant reliability be reduced?
   - Yes - enter a "1" in Question 2
   - No - enter a "0" in Question 2

3. Would the plant's response to the error both:
   a. Provide the operator sufficient time to correct it, and
   b. Provide a positive warning (e.g. alarm) that the error has been committed?
      - Yes - enter a "1" in Question 3
      - No - enter a "0" in Question 3

Prioritization Formula

1	2	3		Priority	Type
1	X	1	=	1.0	Safety Related
1	X	0	=	2.0	Safety Related
0	1	1	=	3.0	Reliability Related
0	1	0	=	4.0	Reliability Related
0	0	1	=	5.0	Performance Problem

Note: The following additional priorities were used in prioritizing the HEFs identified in this review:

Priority	Type
0	HEF will be corrected without further assessment
6	HEF meets acceptable HF criteria

Appendix C

HUMAN FACTORS REVIEW OF AUXILIARY SHUTDOWN PANEL

1.0 CONTROL ROOM WORKSPACE

Finding 1 (2) RP118A and B are located less than the recommended 50 inch separation between vertical panel and opposing wall. In particular, door box TV14131 reduces the separation for RP118B by 10 inches, providing only 30 inches available for operator movement. Location of door box TV14131 is site unique to Callaway.

Response Relocate the Callaway door box TV14131 elsewhere within the room or directly outside the room. The resulting 40 inch separation between panels and wall is sufficient.

Finding 2 (1) There is no identified area for procedure and/or document storage within the Auxiliary Shutdown room.

Response A 2-drawer file cabinet will be bolted within the ASP room for procedure/document storage and will be identified accordingly.

Finding 3 (2) There is no identified area for spare parts storage (bulbs, fuses, etc.) nor provisions for maintaining a record of parts.

Response A 2-drawer file cabinet will be bolted within the ASP room for spare parts storage and will have provisions for maintaining a record of parts.

Finding 4 (2) Some controls are located outside the recommended height of between 34 inches and 53 inches above the floor for precise or frequent and emergency operation. All controls have been placed between 43 inches and 64 inches above the floor.

Response All controls are located within the recommended height of between 34 inches and 70 inches above the floor for normal operation.

Finding 5 (2) Some displays are located outside the recommended height for both normal (between 41 inches and 70 inches above the floor) and frequent or precise readings (between 50 inches and 65 inches above the floor). All displays are located between approximately 65 inches and 80 inches above the floor.

Response Resolution to this finding was proposed by ULNRC-822, 05/15/84 with NRC's reply made on 06/11/84. UE is investigating this finding further and will propose an alternate resolution in future correspondence.

1.0 CONTROL ROOM WORKSPACE (continued)

By fuel load KGE will provide a temporary step in Wolf Creek's ASP room and, prior to exceeding 5% power, will install a raised floor as the permanent resolution to this finding.

Finding 6 (1) There were no apparent forms of acceptable fire detection/protection equipment located in the vicinity of the Remote Shutdown Panel at the time of review.

Response The SNUPPS design provides for 4 ionization detectors to be located within Room 1413. A portable CO_2 extinguisher will be located immediately around the corner from the exit to Room 1413.

2.0 COMMUNICATIONS

Finding 1 (2) A periodic check should be performed to ensure all communications are operating properly.

Response During routine inspections of the Auxiliary Shutdown Panel and room, communications equipment will be checked.

Finding 2 (5) Procedures should be established dealing with handling incoming and outgoing emergency messages.

Response All incoming/outgoing emergency messages at the Auxiliary Shutdown Panel will be coordinated by the Shift Supervisor, or his designee.

Finding 3 (1) Reliable means should exist for communicating with support facilities, on and off site, during Auxiliary Shutdown Panel use.

Response A Public Address and telephone will be provided as means for communicating with support facilities both on and off site, respectively.

3.0 ANNUNCIATOR WARNING SYSTEMS

Not applicable

4.0 CONTROLS

Finding 1 (2) Manual control stations for the auxiliary feedwater control valves may be inadvertently actuated.

4.0 CONTROLS (continued)

Response When the stations are in their normal mode of control, moving the lever will have no effect on the valve position. Any inadvertent actuation of the station during the local mode of control will only result in momentary valve movement resulting in a minor change in flow. Any significant change in flow would be apparent to the operator through the Aux. Feedwater flow indicator.

Finding 2 (4) The Control Room instrumentation transfer switches follow a different convention for switching than that followed by the steam dump transfer switches and valve transfer switches, as follows:

	Left Position	Right Position
Control Xfer Sw:	ISO CTRL ROOM	NORMAL
Stm Dump Xfer Sw:	REMOTE	LOCAL
Valve Xfer Sw:	REMOTE	LOCAL

Response Conventions for the 3 control transfer switches will be reversed and will indicate "ISO CTRL ROOM" inthe Right Position and "NORMAL" in the Left Position. The 12 steam dump and valve transfer switches will remain unchanged.

Finding 3 (5) Covers for legend pushbuttons should be keyed to prevent the possibility of interchanging the covers after lamp replacement.

Response Due to the small number of covers and only one existing stereotype (i.e. "AUTO" on left and "MAN" on right), these covers will not be keyed, as the probability of confusing the proper location is very low.

Finding 4 (5) To maintain consistency with the Control Room, there should be some indication made for pushbuttons that require holding to complete a valve stroke.

Response Any pushbuttons of this nature will be appropriately identified and marked.

Finding 5 (5) Cutler-Hammer switches are black with white lettering, which is inconsistent with those on the Main Control Board.

Response Cutler-Hammer switches will be changed to agree with those on the Main Control Board.

5.0 VISUAL DISPLAYS

Finding 1 (5) Scale range and units should be the same as those used on similar displays located in the Control Room.

5.0 VISUAL DISPLAYS (continued)

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 2 (5) The following displays contain extraneous information on their scales, such as duplication of label information or the addition of vendor trademarks:

RP 118A	RP118B
ABPI-524B, ABPI-544B	ABPI-516X, ABPI-535X
AELI-501A, AELI-503A	AELI-502A, AELI-504A
AELI-528X, AELI-548X	AELI-517X, AELI-537X

Response The above display scales were checked against similar scales located in the control room and no differences were found.

Finding 3 (5) The units provided for the motor driven and turbine driven auxiliary feedwater pump discharge pressures (psig) are inconsistent with the units provided for the suction pressures (psia). Displays affected are:

ALPI-15B (psig), ALPI-21B (psig), ALPI-24B (psia), ALPI-26B (psia)

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 4 (5) Some displays are provided with more than the recommended 9 graduations between numerals.

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 5 (5) Values indicated by unit graduations on ABPI-516X, ABPI-524B, ABPI-535X and ABPI-544B are other than those recommended by paragraph 6.5.1.5.c of NUREG 0700. Values on these indicators are shown as 0 300 600 900 1200. In addition, some scales begin with an unnumbered graduation mark (e.g. BBTI-443A).

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 6 (5) The pointer on the RCS HOT LEG LOOP 4 indicator (BBTI-443A) is red while all other pointers are black.

Response All display scales were checked against similar scales located in the control room and no differences were found.

5.0 VISUAL DISPLAYS (continued)

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 2 (5) The following displays contain extraneous information on their scales, such as duplication of label information or the addition of vendor trademarks:

RP 118A	RP118B
ABPI-524B, ABPI-544B	ABPI-516X, ABPI-535X
AELI-501A, AELI-503A	AELI-502A, AELI-504A
AELI-528X, AELI-548X	AELI-517X, AELI-537X

Response The above display scales were checked against similar scales located in the control room and no differences were found.

Finding 3 (5) The units provided for the motor driven and turbine driven auxiliary feedwater pump discharge pressures (psig) are inconsistent with the units provided for the suction pressures (psia). Displays affected are:

ALPI-15B (psig), ALPI-21B (psig), ALPI-24B (psia), ALPI-26B (psia)

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 4 (5) Some displays are provided with more than the recommended 9 graduations between numerals.

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 5 (5) Values indicated by unit graduations on ABPI-516X, ABPI-524B, ABPI-535X and ABPI-544B are other than those recommended by paragraph 6.5.1.5.c of NUREG 0700. Values on these indicators are shown as 0 300 600 900 1200. In addition, some scales begin with an unnumbered graduation mark (e.g. BBTI-443A).

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 6 (5) The pointer on the RCS HOT LEG LOOP 4 indicator (BBTI-443A) is red while all other pointers are black.

Response All display scales were checked against similar scales located in the control room and no differences were found.

Finding 7 (5) Pointer tips on the Steam Generator Steam Dump to Atmosphere controls obscure the smallest graduation marks on the scale.

Response The pointer tip width on ABPIC-1B, ABPIC-2B, ABPIC-3B, ABPIC-4B is small enough for an operator to observe which graduation mark has been selected as the setpoint.

5.0 VISUAL DISPLAYS (continued)

Finding 8 (5) Zone markings should be placed on displays as necessary to provide operators with information regarding range, setpoints, etc. Zore markings should not interfere with quantitative markings.

Response Tolerance zones will be marked in accordance with similar displays located in the Control Room.

Finding 9 (5) The following indicator light do not have bulb test capability

ABZL-1B through ABZL-4B, FCZL-312DB, -315B, -317B, -312AD, -312AE, -312AF.

Response Most indicator lights on the Auxiliary Shutdown Panel are in groups of 2 or 3 and will always have one light lit. If FCZL-312DB fails, sufficient information is provided by the governor valve position lights and the Auxiliary Feed Pump speed control. Procedural steps will provide for checking for burnt light bulbs (refer to NRC finding 5.18).

Finding 10 (5) Provisions should be made to prevent interchanging indicator lenses.

Response Due to the small number of indicator lenses and existing stereotyping for color coding, it is unnecessary to modify the lens to prevent interchangeability.

Finding 11 (2) Nomenclature and abbreviations for legend light indicators should be consistent with standard Control Room usage.

Response Legend light indicators were reviewed against the Standard SNUPPS abbreviations list and no inconsistencies were detected.

6.0 LABELS AND LOCATION AIDS

Finding 1 (5) The label for RPHIS-3 should be located above the switch.

Response The label position for RPHIS-3 will be relocated above the switch.

Finding 2 (5) The label for BGHIS-8149CB is loose.

Response Loose labels will be detected and corrective actions implemented at system turnover.

6.0 Labels and Location Aids (continued)

Finding 3 (2) Labels should be consistent with existing abbreviations and nomenclature.

Response A label study will be performed on all labels located on the Auxiliary Shutdown Panels. This study will be similar to that performed on Control Room labels.

Finding 4 (5) Blue nameplates provide insufficient contrast when compared to black nameplates.

Response Blue nameplates will be made the same shade as those in the Control Room.

Finding 5 (5) A procedure should be in place for periodic cleaning of labels.

Response Routine inspection of the panels will indicate any required cleaning.

7.0 PROCESS COMPUTERS

Not Applicable

8.0 PANEL LAYOUT

Finding 1 (5) The arrangement of ABPI-535X, BBTI-443A and BBTI-423X on RP118B appears to be inconsistent with the arrangement of similar displays on RP118A.

Response Since the indicators are not used for control purposes but for verification of heat removal, and the indicators can be located quickly on the panels, the present arrangement is acceptable.

Finding 2 (1) Demarcation should be used to enhance recognition of groups of controls and displays.

Response Demarcation will be provided as shown on the attached sketch. Tape may be used in lieu of paint as an interim fix. Demarcation will eventually be painted on prior to the end of the first refueling outage.

Finding 3 (2) On panel RP118B, the indicators for M.D. auxiliary feedwater pump suction and discharge pressures are located one above the other, whereas the indicators for TD auxiliary feedwater pump suction and discharge pressures are located side by side.

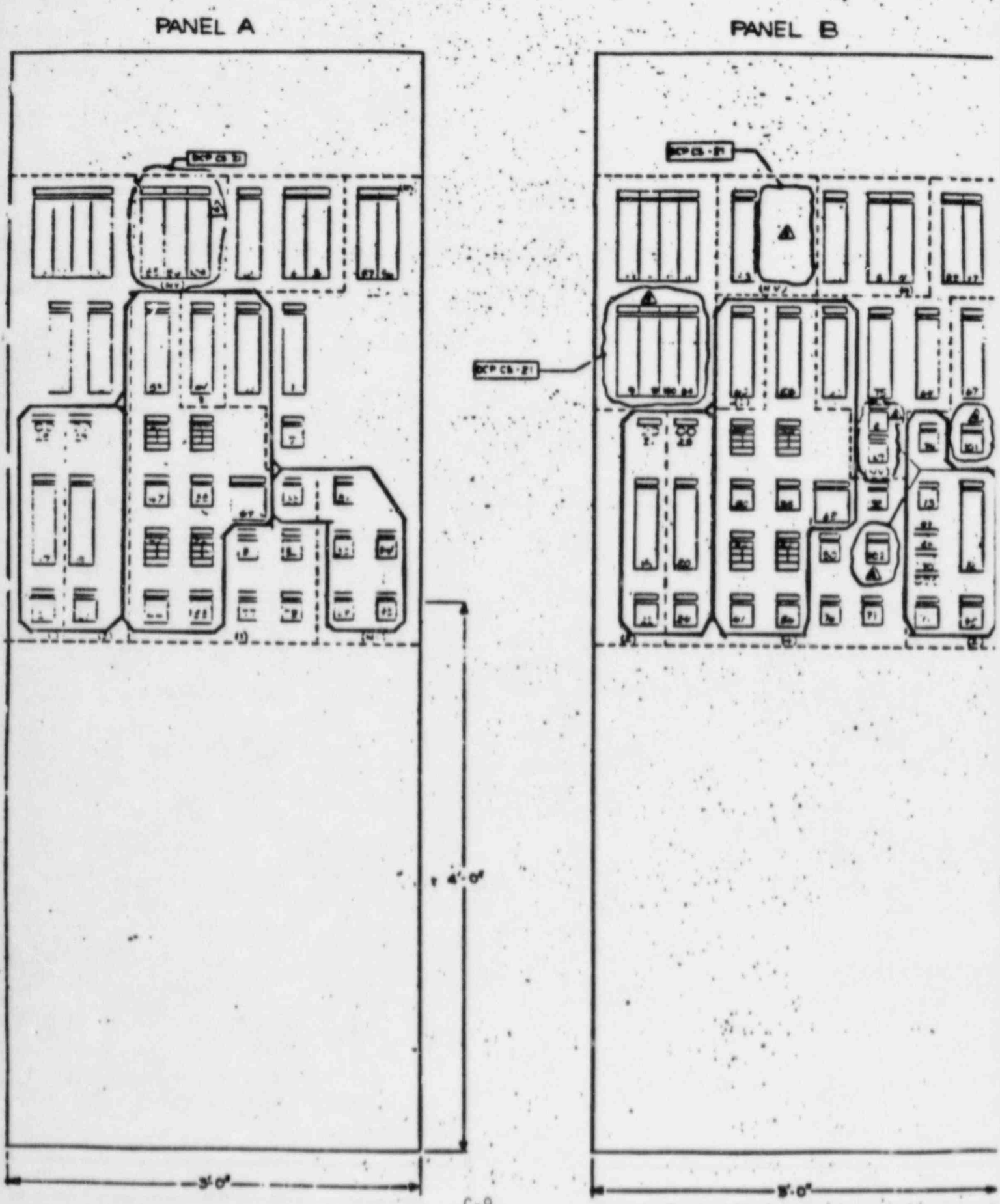
Response Since these indicators are used as status monitors and not for control purposes, and the indicators can be located quickly, it is acceptable to leave the indicators in there present arrangement.

9.0 CONTROL-DISPLAY INTEGRATION

No findings were detected on this section.

RP 118

AUXILIARY SHUTDOWN PANEL



MEF PRIORITY SHEET FOR AUXILIARY SHUTDOWN PANEL FINDINGS

A. Questions

1. If an error occurred, could plant safety be jeopardized or degraded?
   - o Yes - enter a "1" in Question 1
   - o No - enter a "0" in Question 1

2. If an error occurred, could plant reliability be reduced?
   - o Yes - enter a "1" in Question 2
   - o No - enter a "0" in Question 2

3. Would the plant's response to the error both
   a. Provide the operator sufficient time to correct it and
   b. Provide a positive warning (e.g. alarm) that the error has been committed?
      - o Yes - enter a "0" in Question 3
      - o No - enter a "1" in Question 3

B. Prioritization Formula

1	2	3	Priority	Type
1	0 or 1	1	1.0	Safety Related
1	0 or 1	0	2.0	Safety Related
0	1	1	3.0	Reliability Related
0	1	0	4.0	Reliability Related
0	0	1	5.0	Performance Problem

C. Priority

Finding	Question 1	2	3	Priority	Finding	Question 1	2	3	Priority
1.1	1	0	0	2.0	5.4	0	0	1	5.0
1.2	1	0	1	1.0	5.5	0	0	1	5.0
1.3	1	0	0	2.0	5.6	0	0	1	5.0
1.4	1	0	0	2.0	5.7	0	0	1	5.0
1.5	1	0	0	2.0	5.8	0	0	1	5.0
1.6	1	1	1	1.0	5.9	0	0	1	5.0
2.1	1	0	0	2.0	5.10	0	0	1	5.0
2.2	0	0	1	5.0	5.11	1	0	0	2.0
2.3	1	0	1	1.0	6.1	0	0	1	5.0
4.1	1	0	0	2.0	6.2	0	0	1	5.0
4.2	0	1	0	4.0	6.3	1	0	0	2.0
4.3	0	0	1	5.0	6.4	0	0	1	5.0
4.4	0	0	1	5.0	6.5	0	0	1	5.0
4.5	0	0	1	5.0	8.1	0	0	1	5.0
5.1	0	0	1	5.0	8.2	1	0	1	1.0
5.2	0	0	1	5.0	8.3	1	0	0	2.0
5.3	0	0	1	5.0					

Appendix D

ENVIRONMENTAL SURVEY

1.0 Control Room Workspace

Finding 1 Although NUREG-0700 recommends a maximum air velocity of 45 fpm based on MIL-STD-472B, the updated standard, MIL-STD-472C, recommends using 100fpm as the maximum air velocity. The values at the Callaway vertical panels range from 102-184fpm. These values are high in order to meet the cooling requirements in the control room.

Response According to the Industrial Engineering Handbook, high air velocity values do not degrade physical or mental operator performance. The only impact is regarding the comfort of the operator. In addition, high air velocity values act to reduce the perceived temperature of the room. Therefore, at the current air velocity, the temperature of the control room should be greater than the 74-77°F recommended levels. For this reason, the temperature of the Callaway control room (77-80°F) does not need to be altered. In addition, Operations personnel will be questioned after several months of operation to determine if subsequent adjustments are necessary.

Finding 2 At the auxiliary shutdown panel, all illumination levels fall above the recommended 20-30fc range. In addition, one value (68fc) exceeds the recommended maximum value of 50fc. The lighting level on this panel should be reduced to obtain approximately one half of the current illumination levels.

Response The illumination level in the Auxiliary Shutdown Panel will be reduced as noted.

3.0 Annunciator Warning System

Finding 1 The sound survey revealed that there was no perceivable difference between the ambient noise level and the noise level of the annunciator horns. The discrimination of the horns is critical for the operators to recognize alarms.

Response The annunciator horns have been repositioned such that the sound is directed into the control room and is perceivable by the operator.

1.0 Control Room Workspace

Finding 1 Air velocities in the control room exceed the 45fpm specified maximum (by NUREG-0700) only at the vertical panels. MIL-STD-472C recommends using 100fpm as the maximum air speed. The values at the Wolf Creek vertical panels range from 25-130fpm.

Response According to the Industrial Engineering Handbook, high air velocity values do not degarde physical or mental operator performance. The only impact is regarding the comfort of the operator. In addition, high air velocity values act to reduce the perceived temperature of the room. Therefore, at the current air velocity, the temperature of the conrol room should be greater than the 74-77°F recommended levels. For this reason, the temperature of the Wolf Creek control room (72-78°F) does not need to be altered. In addition, Operations personnel will be questioned after several months of operation to determine if subsequent adjustments are necessary.

Finding 2 At the auxiliary shutdown panel, illumination levels fall between 12-24fc. This level needs to be increased in order to fall into the 20-30fc range recommended by NUREG-0700.

Response Subsequent to the initial survey, the existing overhead light diffuser was cleaned and a minimum reading of 18fc was obtained. This lighting level is considered adequate.

Appendix E

VALIDATION OF CONTROL ROOM FUNCTIONS

APPENDIX E

Validation of Control Room Functions

FINDING 1: An operator initially incorrectly identified valves during letdown isolation in executing Procedure ECA-2. Upon further investigation, it was found that panel RL001 is to be modified and mimiced in order to facilitate the operator interface.

Resolution: The mimic reconfiguration was developed to alleviate problems of this nature. In addition, the operators, such as the one discussed above, were relatively inexperienced with the SNUPPS panels at the time of the Verification and Validation effort. Their additional training would also help reduce or eliminate future occurances of this type.

FINDING 2: Boron injection bank (BIT) temperature was requested during RCS temperature control in executing procedure ECA-2. BIT temperature was not available on the control boards or CRT displays and had to be specially requested from the computer technician.

Resolution: Procedure ECA-2 has no requirement for BIT temperature. If BIT temperature were required during a Loss of All AC Power, an operator could be dispatched locally to obtain BIT temperature. Any requirements for reading BIT temperature would be picked up during the Control Room Inventory and limited Task Analysis.

FINDING 3: (a) Procedure E-3 references pressurizer level to less than 9%. The scale on the indicator is marked in major increments of 20% and minor increments of 2%. The operator has to interpolate to read a value of 9%.

(b) Narrow range steam generator level is specifically referenced in procedures E-0, E-1, E-2, and E-3 to determine SG level as low as 9%. The scale is marked in major increments of 20% and minor increments of 2%. The operator has to interpolate to read a value of 9%.

Resolution: The actual value indicated in the procedures will be rounded off to the nearest readable increment.

FINDING 4: No ESW valve position indication was available in the simulator control room during the loss of all AC power sequence (3). The information required in executing procedure ECA-2.2 was obtained by requesting ESW valve position from auxiliary operators who have to verify position locally.

Resolution: During a Loss of All AC Power sequence, it would be appropriate for operators to verify valve position locally since the normal position indication in the control room would be lost.

FINDING 5: The steam generator pressure indicator on panel RL026 has a scale with major graduations marked in 400 lb. increments, and minor graduations of 200 lbs increments. Procedure RF-C.1, Step 13, requires operators to dump steam to decrease pressure to 215 psig. Steam pressure readings as low as 15 psig are required by Step 17 of Procedure RF-C.1. The operator has to interpolate to read these values.

Resolution: The actual scales have graduations in 20 psi increments. The value indicated in the procedures will be rounded off to the nearest readable increment.

FINDING 6: Panel RL017 required long search times for operators to locate necessary controls in performing Attachment 3 of Procedure ECA-2 in response to loss of all AC power (sequence 3).

Resolution: The mimic on panels RL017 and RL018 was reconfigured to alleviate problems of this nature. In addition, operators such as those described above, were relatively inexperienced with the panels. Additional training and experience are expected to help in reducing search time.

Appendix F

VERIFICATION OF TASK PERFORMANCE CAPABILITIES

APPENDIX F

Verification of Task Performance Capabilities

F.1 Monitoring Tasks

As described in the text of this report, only 17 sets of monitored parameters are used for tasks that depend on the value of the parameters. All of the other monitoring tasks are "digital" in that they depend on observing whether a parameter is in one of two possible states. The actions associated with each of the 17 parameters used in a non-digital way are considered to be a "task category". For each of these "task categories" there are several "subtasks", e.g., determine whether reactor coolant system pressure is less than 1405 psig. Each such "subtask" has been separately evaluated, even though there are close similarities among subtasks in a given category. However, this similarity of subtasks has been used to compress the tabular summary of the evaluation of monitoring tasks contained in this appendix.

Most of the information in the accompanying tables is documented in plant emergency procedures, the control room inventory, the FSAR, and the specifications for the individual displays. The data on precision of the displays is based to some extent on the judgement of the reviewers. The tabulated values of required precision are judgemental values based on the analyses of the task requirements, which considers the effects of an operator performing the task at a value of the parameter different from the value specified in the emergency procedures. In general the tolerances tabulated under task requirements are in the range of 25 to 50% of the instrument uncertainties, which have been considered in development of the parameter values specified in emergency procedures. The numerical values tabulated under instrument characteristics are based on the judgement that an operator can discriminate to within $\pm$ 1/4 of the smallest subdivision on the instrument scale.

F.2 Control Tasks

The verification of the ability to perform control tasks was accomplished by actually performing the tasks on the Callaway simulator. These tasks are summarized in the accompanying table headed "Control Tasks".

The only finding that resulted from the Verification of Task Performance Capabilities deals with engravings or backlit pushbuttons for the following Auxiliary Feedwater regulator valve control switches on panel RL006:

AL HK-5A, -6A, -7A, -8A, -9A, -10A, -11A, -12A

The backlit pushbuttons should be engraved with "OPEN" and "CLOSE" in lieu of "MAN" and "AUTO". It was subsequently determined that this finding is specific to the Callaway simulator.

MONITORING TASKS

Parameter	Range & Units		Precision of Display		Primary Indication	Alternative Indications	Evaluation
	Task Reqmts	Instr Charstics	Task Reqmts	Instr Charstics			
1. Power Range Neutron Flux - Decreasing - Rapidly decreasing - 5%	0 to 110% full power (RG 1.97)	0 to 120% full power	±1%(at best)	±0.5%	Analog Indicators NI-41B, 42B,43B,44B (RL004)	-Intermediate Range Neutron Flux -SPDS -BOP Computer CRTs -Power Range Flux Recorders (4 on RL022)	OK
2. Intermediate Range Neutron Flux - Decreasing - Rapidly decreasing - Below 10^{-10} amps	10^{-11} to 10^{-3} amps (RG 1.97)	10^{-11} to 10^{-3} amps (~10^{-6}-200% full power)	± 1/10 decade (at best)	± 1/10 decade	Analog Indicators NI-35B, 36B (RL003)	-Intermediate Range Startup Rate Indicators -P6 Permissive Lights (actuated at 10^{-10} amps) -Intermediate Range Flux Recorder (RL004) -SPDS	OK
3. Containment Radiation - Normal - 1 R/hr	0.1 to 10^4 mR/hr 1 to 10^7 R/hr (RG 1.97)	0.1 to 10^4 mR/hr 1 to 10^8 R/hr	± 1/5 decade	± 1/10 decade	Computerized Radiation Monitoring System (Digital Output)(SP056A)	-Hi and Hi-Hi Alarms -Analog Display in C.R. (RE 59 on RL020)(1 to 10^8 R/hr) -SPDS	OK
- Setpoint for isolating containment ventilation	1×10^{-4} μCi/cc gaseous	10^{-7} to 10^{-4} μCi/cc	± 1/5 decade	± 1/10 decade	Computerized Process Monitoring System (Digital Output)		

MONITORING TASKS

Parameter	Range & Units		Precision of Display		Primary Indication	Alternative Indications	Evaluation
	Task Reqmts	Instr Charstics	Task Reqmts	Instr Charstics			
4. Containment Pressure - Normal - 17 psig - 27 psig - 60 psig	0 to 60 psig (RG 1.97)	0 to 70 psig (normal design range)	±1 psi	±0.25 psi (analog)	Analog Indicators PI-934,935,936, 937 (RL018)	Analog Recorders, PR934,938 (RL018 & RL020)	OK
	-5 to 180 psig (RG 1.97)	0 to 180 psig (wide range)	±5 psi	±1.3 psi (analog)	Analog Indicators PI-938,939 (RL020)		
		-3 to +3 psig (normal operating range)	±0.2 psi	±0.1 psi (digital)	BOP Computer		
5. Containment Recirculation Sump Level - Normal - Increasing - 10 ft	28 to 144 in (RG 1.97)	0 to 156 in	±1 in	±0.5 in	Analog Indicators LI-7, 8,9,10 (RL018)	Analog Recorder: LR-6 (RL020) BOP Computer	OK
6. RCS Wide Range Pressure - 2645 psig - 2445 psig - 2335 psig - 2310 psig - 1920 psig - 1900 psig - 1849 psig - 1536 psig - 1405 psig - 1000 psig - 700 psig - 600 psig - 405 psig - 400 psig - 200 psig - 195 psig	0 to 3000psig (RG 1.97)	0 to 3000 psig	±10 psi (approx.)	±12 psi (analog) ±0.5 psi (digital) ±3 psi (analog-narrow range)	Analog Indi- PI 403,405 (RL022) Digital Indicator on Panel RL022 (driven by BOP Computer)	Analog Recorder: PR403(RL022) BOP Computer CRTs Pressurizer Pressure (1700 to 2500psig) Wide Range Pressure (0 to 70C psig indicator) PI 403A (RL002) SPDS High & Low Alarms Automatic Actuations (Reactor Trip, SI,PORVs)	OK

Parameter	Range & Units		Precision of Display		Primary Indication	Alternative Indications	Evaluation
	Task Reqmts	Instr Charstics	Task Reqmts	Instr Charstics			
- SG pressure - 50 psi below SG Press. - 200 psi above SG press.							Comparisons with SG pressure are required in response to a SGTR. These actions are part of the recovery sequence, and occur 30 min. or more after the event.
7. Pressurizer Pressure - Normal range - Stable or increasing - 1849 psig - 2235 psig	1700 to 2500 psig	1700 to 2500 psig	±5 psi	±3 psi (analog)	Analog Indicators PI-455A,456,457, 458 (RL002)	-RCS Wide Range Pressure (Digital Indicator-RL022) -BOP Computer CRTs SPDS -SI Actuation at 1849 psig	OK
8. RCS Hot Leg Wide Range Temperature - Stable - Increasing/ Decreasing - 564°F - 557°F - 550°F - 400°F - 350°F - 200°F	0 to 600°F (50 to 750°F per RG 1.97)	0 to 700°F	±2.5°F	±2.5°F (analog) ±0.5°F (digital)	Analog Indicators TI-413A,423A (RL021)	BOP Computer CRTs SPDS	OK

Parameter	Range & Units		Precision of Display		Primary Indication	Alternative Indications	Evaluation
	Task Reqmts	Instr Charstics	Task Reqmts	Instr Charstics			
- 160°F - Equal to Cold Leg Temp.							
9. RCS Cold Leg Wide Range Temperature - Stable - Increasing/ Decreasing - 564°F - 550°F - 160°F - 50°F decrease/ hr	0 to 600°F (50 to 750°F per RG 1.97)	0 to 700°F	±2.5°F	±2.5°F (analog) ±0.5°F (digital)	Analog Indicators TI-413B,423B (RL021)	-BOP Computer CRTs -SPDS	OK
10. RCS Average Temperature - 564°F - 557°F	540 to 590°F	530 to 630°F	±1°F	±0.5°F	Analog Indicators TI-412,422,432, 442 (RL004)	-BOP Computer CRTs -Digital Indicator on Panel RL022 (driven by BOP Computer)	OK
11. Core Exit TC Temperature - Stable - Increasing/ Decreasing - 1200°F - 700°F - 400°F - 350°F - 50°F below pzr water temperature	200 to 1200°F (200 to 2300°F RG 1.97)	0 to 2300°F	±10°F ±5°F	±1°F	SPDS	-BOP Computer CRTs -Digital Indication at Subcooling Monitor (RP081) -Subcooling Monitor (for comparison with pzr temp.)	OK

MONITORING TASKS

Parameter	Range & Units		Precision of Display		Primary Indication	Alternative Indications	Evaluation
	Task Reqmts	Instr Charstics	Task Reqmts	Instr Charstics			
12. Pressurizer Water Temperature - 200°F - Equal to saturation temp. of ruptured SG - 50°F above core exit TC temp.	100 to 700°F	100 to 700°F	±5°F	±2.5°F	Analog Indicator TI-453 (RL002)	Subcooling Monitor (for comparison with core exit TC)	OK Comparison with SG temp. involves indications on 2 panels and conversion of measured pressure to saturated temp. This task is associated with an optional long-term recovery procedure from SGTR (i.e., more than 30 min - 1 hr after event)
13. Pressurizer Level - Stable - Increasing/ Decreasing - 92% of span - 90% of span - 70% of span - 60% of span - 50% of span - 40% of span - 35% of span - 30% of span - 25% of span	0 to 100% of span (Bottom to top per RG 1.97)	0 to 100% of span	±1%	±0.5%	Analog Indicators LI-459A,460A, 461,462 (RL002)	SPDS BOP Computer CRTs	OK

MONITORING TASKS

Parameter	Range & Units		Precision of Display		Primary Indication	Alternative Indications	Evaluation
	Task Reqmts	Instr Charstics	Task Reqmts	Instr Charstics			
- 20% of span - 17% of span - 10% of span							
14. RCS Subcooling - 0°F - 50°F	200°F Subcooling to 35°F Superheat (RG 1.97)	200°F Subcooling to 2000°F Superheat	±5°F Subcooling ±25°F Superheat	±3°F Subcooling ±12°F Superheat	Analog Indicators TI-1390A,B (RL022)	- Subcooling Panel (RP018A,B) (Digital Indication) - SPDS (Digital)	OK
15. Reactor Vessel Level - Stable - Increasing/ Decreasing - Specific Values Corresponding to: o 3-1/2 ft above bottom of fuel plus uncertainties o Top of core plus uncertainties o Full upper-head o Avg. system void fraction with RCP(s) running	0 to 100% (RG 1.97)	0 to 120%	±1%	±1%	Analog Indication LI-1311,1312, 1321,1322 (RL021)	- SPDS (Digital) - Analog Recorder (RP080)	OK
16. Steam Generator Pressure (each of 4 SG) - Stable - Decreasing	0 to 1300 psig (0 to 1420 psig per RG 1.97)	0 to 1300 psig	±10 psi	±7.5 psi	Analog Indication PI-514A,515A, 516A,PI-524A, 525A,526A,	- SPDS (Digital) - BOP Computer CRTs (Digital)	OK

MONITORING TASKS

Parameter	Range & Units		Precision of Display		Primary Indication	Alternative Indications	Evaluation
	Task Reqmts	Instr Charstics	Task Reqmts	Instr Charstics			
- 1234 psig - 1185 psig - 985 psig - 800 psig - 698 psig - 585 psig - 400 psig - 250 psig - 215 psig - 0 psig - greater than RCS pressure - Lower in one SG than in others					PI-534A,535A, 536A,PI-544A, 545A,546A, (RL026)		
17. Steam Generator Level-Narrow Range (each of 4 SG) - 78% of span - 65% of span - 59% of span - 50% of span - 25% of span - 9% of span - Increasing/ Decreasing - In range	0 to 100% of span	0 to 100% of span	±1%	±0.5%	Analog Indicators LI-517,518,519, LI-527,528, 529 LI-537, 538,539, LI-547,548, 549 (RL026)	- BOP Computer CRTs (Digitial) - SPDS (Digital) - Wide Range SG Level (Analog)	OK

CONTROL TASKS

Task	Control(s) Used	Parameter Indication	Control Range Sufficient	Control Precision Sufficient	Unnecessary Duplication Avoided	Type of Control Sufficient
1. Charging Line Flow Control Valve - Control Charging Flow	HC182 (RL001)	FI-121A (RL002)	OK	OK	OK	OK
- Control Pressurizer Level	↓	LI-459A, 460A,461, 462 (RL002)	OK	OK	OK	OK
- Place valve in auto. control mode	FK 121 (RL001)	NA	NA	NA	OK	OK
2. Charging Line Hand Control Valve -Adjust seal injection flow	HC8357A,B (RL001)	FI 215A,B (RL001)	OK	OK	OK	OK
3. Low Pressure Letdown Control Valve -Adjust letdown flow by adjusting set-point of letdown HX outlet pressure control	PK 131 (RL001)	PI 131 FI 132 (RL002)	OK	OK	OK	OK
4. Control Charging Flow -Control pzr level	HC 8357A,B or HC 182* (RL001)	LI-459A,460A 461,462 (RL002)	OK	OK	OK	OK
-Control RCS pressure (Adjust charging or letdown as required to reduce pressure to less than 2260psig)	↓	PI-455A,456, 457,458 (RL002)	OK	OK	OK	OK

CONTROL TASKS

Task	Control(s) Used	Parameter Indication	Control Range Sufficient	Control Precision Sufficient	Unnecessary Duplication Avoided	Type of Control Sufficient
-Equalize charging and letdown (adjust charging flow)	↓	FI-917A,B (RL018) or FI-121A* (RL001)	OK	OK	OK	OK
-Set in auto. control mode	FK-121 (RL001)	NA	NA	NA	OK	OK

* Cannot use HC-182 or FI-121A if SI is in effect.

5. Control Letdown Flow -Control pzr level	HIS-8153A,B 8154A,B HC-8157A,B or PK-131* (RL001)	LI-459A,460A, 461,462 (RL002)	OK	OK	OK	OK
-Control RCS Pressure	↓	PI-455A,456, 457,458 (RL002)	OK	OK	OK	OK
-Equalize charging and letdown (adjust letdown flow)	↓	FI-138A,B (RL001) or FI-132* (RL002)	OK	OK	OK	OK

* Cannot use PL-131 or FI-132 if cont. isol. is in effect.

CONTROL TASKS

Task	Control(s) Used	Parameter Indication	Control Range	Control Precision Sufficient	Unnecessary Duplication Avoided	Type of Control Sufficient
5. Component Cooling Water						
- Establish CCW flow to RCP thermal barriers	HIS 61 (RL019)	FAHL-17,18 19,20 (RK022)	OK	OK	OK	OK
7. Steam Generator Atmospheric Relief Valves						
- Decrease FCS average temp. to 557°F	PIC 1A,2A, 3A,4A (RL006)	TI 412,422, 432,442 (RL004)	OK	OK	OK	OK
- Cool RCS at a specified rate/control RCS cooldown rate	↓	↓	OK	OK	OK	OK
- Establish/maintain RCS subcooling		TI 1390A,B (RL022) or SPDS	OK	OK	OK	OK
- Rapidly cool SGs 50°F		Steam line pressure* (RL026)	OK	OK	OK	OK
- Decrease SG pressure to a specified value		PI 514A thru 546A (RL026) or SPDS	OK	OK	OK	OK

*Procedure contains table of pressures corresponding to 50°F temp. reduction.

Task	Control(s) Used	Parameter Indication	Control Range Sufficient	Control Precision Sufficient	Unnecessary Duplication Avoided	Type of Control Sufficient
8. Condenser Steam Dump Valves						
- Decrease RCS avg. temp. to 557°F	PK507 (RL006)	TI-412,422, 432,442 (RL004)	OK	OK	OK	OK
- Cool RCS at a specified rate/control RCS cooldown rate	↓	↓	OK	OK	OK	OK
- Establish/maintain RCS subcooling		TI-1390A,B (RL022) or SPDS	OK	OK	OK	OK
- Rapidly cool SGs50°F		Steam pressure * PI-507 (RL005)	OK	OK	OK	OK
- Decrease SG pressure to a specified value		PI-507 (RL005)	OK	OK	OK	OK
* Procedure contains table of pressures corresponding to 50°F temp. reduction.						
9. Auxiliary Feedwater Flow						
- Control AFW flow	HK-5A,6A, 7A,8A,9A, 10A,11A, 12A* (RL002)	FI-1A,2A,3A, 4A (RL006) & SG Level (RL026)	OK	OK	OK	OK
- Isolate AFW flow to a SG	↓	↓	OK	OK	OK	OK

* Normal control is by throttle valves. Can stop/start motor driven AFW pumps by HIS 22A, 23A (RL005) and turbine driven AFW pump by HIS 312A (RL005).

CONTROL TASKS

Task	Control(s) Used	Parameter Indication	Control Range Sufficient	Control Precision Sufficient	Unnecessary Duplication Avoided	Type of Control Sufficient
10. Turbine Electro-Hydraulic Control						
- Runback turbine	AC XX1 (RL005)	AC XX1 (RL005)	OK	OK	OK	OK

STANDARD FORMS USED IN THE PDA

APPENDIX VIII
HUMAN ENGINEERING FINDING

NO: _____ PLANT-UNIT: _____ DATE: _____

REVIEWER NAME: _____

a) HEF TITLE: _____

_____

_____

b) ITEMS INVOLVED:

ITEM TYPE	NOMENCLATURE	LOCATION	PHOTO NO.

c) FINDING DESCRIPTION (GUIDELINES AT VARIANCE WITH):

d) SPECIFIC OPERATOR ERROR(S) THAT COULD RESULT FROM HEF:

c) SUGGESTIONS FOR POTENTIAL BACKFIT

BSEX REVIEW	NAME	DATE
HFE RESEARCHER		
DATA COLL. MGR.		
PROGRAM MGR.		

HEF COMMITTEE REVIEW

DATE: _____

DISPOSITION:

☐ FURTHER REVIEW BY:

_____ DUE DATE: _____

☐ TO BE CORRECTED BY FCR

_____

(FCR #/DATE)

☐ TO BE CORRECTED BY MR

_____

(MR#/DATE)

☐ REFER TO OPERATIONS

☐ NO ACTION REQUIRED (EXPLANATION BELOW OR ATTACHED)

☐ OTHER: _____

_____

EVALUATION COMPLETED
SNUPPS PROJECT DIRECTOR: _____ DATE: _____

ITEMS f & g ARE TO BE COMPLETED ONLY IF UTILITY QUESTIONS THE NECESSITY FOR THE BACKFIT.

f) LIST THE PROCEDURES OR OPERATIONS THAT USE THE LISTED ITEMS IN A MANNER TO INDUCE THE OPERATOR ERROR:

g) LIST THE CONSEQUENCES OF OPERATOR ERROR DURING ALL MODES OF OPERATION:

HEF PRIORITY SHEET

HEF NO._____

A. Questions

1. If an error occurred, could plant safety by jeopardized or degraded?
   - Yes - enter a "1" in Question 1
   - No - enter a "0" in Question 1

2. If an error occurred, could plant reliability be reduced?
   - Yes - enter a "1" in Question 2
   - No - enter a "0" in Question 2

3. Would the plant's response to the error both
   a. Provide the operator sufficient time to correct it and
   b. Provide a positive warning (e.g. alarm) that the error has been committed?
   - Yes - enter a "0" in Question 3
   - No - enter a "1" in Question 3

B. Prioritization Formula

1		2		3	Priority	Type
1	X	1	=		1.0	Safety Related
1	X	0	=		2.0	Safety Related
0	1	1	=		3.0	Reliability Related
0	1	0	=		4.0	Reliability Related
0	0	1	=		5.0	Performance Problem

C. Priority

Question			Priority
1	2	3	

Appendix H

FORMS FOR ENVIRONMENTAL SURVEY

AIR VELOCITY SURVEY RECORD

Plant: _____ Date: _____ Time: _____

Measurements made by: _____ Sheet # ____ of ____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Location	6 ft.	4 ft.

HUMIDITY/TEMPERATURE RECORD

Plant: _____ Date: _____ Time: _____

Measurements made by: _____ Sheet # ____ of ____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Time	Height	Temperature	Humidity	Remarks
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			
	Floor			
	6 ft.			

LIGHTING SURVEY - LUMINANCE AND REFLECTANCE RECORD

Plant: _____ Date: _____ Time: _____

Measurements made by: _____ Sheet # ____ of ____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Location Ref. No.	Panel # and Surfaces	Record					Calculations				
		Panel		Meter/Display			Luminance Ratio of Display: Panel		Reflectance Ratio		
		Reflect. Pad	Panel Background	Reflect. Pad	Surface w/Glare	Surface w/o Glare	w/Glare	w/o Glare	Panel: Pad	Meter/Display: Pad w/Glare	Meter/Display: Pad w/o Glare

LIGHTING SURVEY ILLUMINANCE RECORD

Plant: _____ Date: _____ Time: _____

Measurements made by: _____ Sheet # ____ of ____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Location Ref. No.	Panel I.D. No.	Full AC Ambient	Full Emergency	Other Conditions (Specify)

SOUND SURVEY RECORD

Plant: _____ Date: _____ Time: _____ Sheet # ____ of ____

Measurements made by: _____

Equipment/Instrument used: _____

Serial #: _____ Calibration date: _____

Operator Work Station	db(A)	Octave Band Center Frequency					Remarks
		250	500	1K	2K	4K	

Appendix I

FORMS USED IN THE VALIDATION OF CONTROL ROOM FUNCTIONS

Notes:
(1) Large Numbers 1 & 2 indicate physical location of RO & BOP oper.
(2) Letters (see key below) indicate what action is being taken and the column the letter is in indicates the console or vertical panel the action is taken on.
(3) Subscripts are always with a letter indicating who is taking the action

OPERATING SEQUENCE DIAGRAM

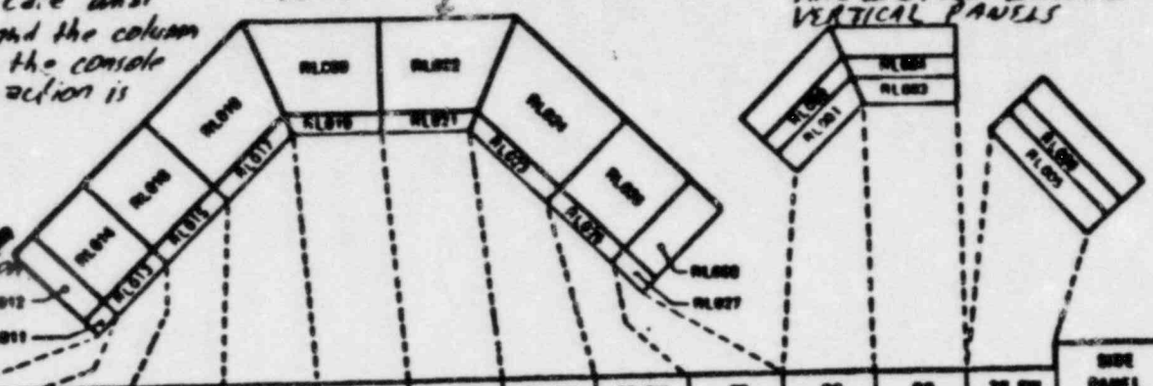
EVENT _____

PROCEDURE _____

DATE _____

VERTICAL PANELS

CONSOLES WHICH ARE LOCATED INSIDE VERTICAL PANELS



Procedure Step	Minute Second	STEP	TIME STEP STARTED	TIME SENSITIVE STEP (YES/NO)	BACK PANEL	SAMP	SRI	EB	ESF	ESF	RMSR	TG FW	TG FW	TS	RC	RB	TG FW	SIDE PANEL	COMMENTS
		11a	15:19		RO is standing in front of vertical panel observing some displays				$O_{1,2}$		IC_1					2_2			Reactor level
			15:35								IO_1					2			RC heated up
			15:45								1	I_1					20_1		reference pressure
			16:40									IO_2			20_2				should be restored
			16:20		This combination indicates that RO is standing behind console but observing displays on vertical panel						O_1				D		20_2		
		13	16:35						$O_{1,2}$						10_1		2		
		12	16:39												1		2		Reactor level
		11a	16:45						O_1						1				
		10a	16:47								O_1	2_2			1				water temp. stable
		9a	16:49								O_1		O_2		1		2		
		8a	16:51										O_2		1		2		
			20:00						O_2						IO_1	2			starting RCS temp. adj. group
			20:48		RO is behind console and BOP is in front of vertical panel both are observing displays on vertical panel								D_2		IC_1O_1		2_2		
			23:12								$IC_{2,1}$				K				
			23:23												D				
		14b	24:05												IC_1O_2	2			of RCS level
		14c	25:20												IC	2			
		15a	25:37		RO is performing a control action and observing console that he is behind. BOP is behind console - taking no actions				C_1						1	2			
		15b	25:50												IC_1	2			
		1	26:03						IC_2							$2O_2$			

KEY:
C - CONTROL ACTION
P - PROCEDURE/ REFERENCE
O - OBSERVE
T - TELEPHONE COMMUNICATIONS
A - ANNUNCIATOR ACK.
R - CRT REQUEST

Number 1 = RO
" 2 = BOP Operator
STA = STA

Subscript 1 = RO
2 = BOP
STA = STA

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Appendix J

FORMS USED FOR THE TASK ANALYSIS AND VERIFICATION OF TASK PERFORMANCE CAPABILITIES

DISPLAY Containment Pressure (PI 934, 935, 936, 937)

TASK CONTEXT	DISPLAY RANGE			DISPLAY PRECISION			DISPLAY UNITS			UNNECESSARY DUPLICATION AVOIDED	CRITICAL PARAMETERS EASILY MONITORED	DISPLAY TYPE SUFFICIENT	
	REQ'D	ACTUAL	SUFFICIENT	REQ'D	ACTUAL	SUFFICIENT	REQ'D	ACTUAL	SUFFICIENT				
- Has remained below Hi-2 setpoint (17psig)	0-30	0-60	✓	±0.5	±0.25	✓	psig	psia	✓	✓	✓	✓	
- Has remained below Hi-3 setpoint (27psig)	0-30	0-60	✓	±0.5	±0.25	✓			✓	✓	✓	✓	
- Normal (0 psig)	0-30	0-60	✓	±0.5	±0.25	✓			✓	✓	✓	✓	
- Less than 2psig	0-30	0-60	✓	±0.5	±0.25	✓			✓	✓	✓	✓	
- Greater or less than 60 psig	0-60+	0-180	✓	±2.5	±1.3	✓	↓	↓	✓	✓	✓	✓	PI 938, 939

01/09/84

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CONTROL Aux Feedwater Flow

TASK CONTENT	CONTROL RANGE REQ'D	CONTROL RANGE ACTUAL	CONTROL RANGE SUFFICIENT	CONTROL PRECISION REQ'D	CONTROL PRECISION ACTUAL	CONTROL PRECISION SUFFICIENT	UNNECESSARY DUPLICATION AVOIDED	TYPE OF CONTROL SUFFICIENT
Control AFW flow			✓			✓	✓	ALHK-5A, -6A, -7A, -8A, -9A, -10A, -11A, -12 BACKUP "AUTO/MANUAL PUSHBUTTONS ON CONTROL SHOULD BE LABELED "OPEN CLOSE"

01/10/84

Appendix K

SPECIFIC NRC CONCERNS

Appendix K

SPECIFIC NRC CONCERNS

Concern	Discussion of Results	Page Reference from NRC (Youngblood) letter to UE (Schnell) and KGE (Koester) dated 06/05/84
1. Hagan Controller Convention	App. A, PDA Finding 5.13 and App. B, SS Finding 5.16	Page 18
2. Check for Burnt Light Bulbs	App. A, PDA Finding 5.18 App. C, ASP Finding 5.9	
3. Mirror Imaging	App. A, PDA Finding 8.19	
4. Homemade Scales	Reference 14	Page 20
5. Public Address Cord Clamp	App. B, SS Finding 2.3	
6. Environmental Survey	App. D	Page 10
7. Annunciator Auto Silence Adjustment	App. A, PDA Finding 3.13	
8. Label to Indicate Switch Position	App. B, SS Finding 4.4	Page 18
9. Differentiation between "Actual" and "Demand" for Foxboro Controllers	App. B, SS Finding 5.5	
10. Chart Paper	App. B, SS Finding 5.19	Page 19
11. Inconsistency in Display Data on CRT's vs Control Boards	App. B, SS Finding 7.4	
12. Existing Design Information for Feedback Messages and Periodic Feedback	App. B, SS Findings 7.10 and 7.11	Page 19
13. CRT Color Convention	App. B, SS Finding 7.12	
14. Printer Speed	App. B, SS Finding 7.16	
15. Reactor Vessel Level Range	App. B, SS Finding 9.1	Page 20
16. Charging Pump to RCP Seal Flow Indicators	Below	
17. Spare Parts and Procedures Storage in ASP	App. C, ASP Finding 1.2 and 1.3	
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Concern: The Charging Pump to RCP Seal Flow indicators (BG-FI-215A, B) have non-linear scales from 0 to 80 GPM whereas normal flow is approximately 32 GPM. The NRC requested that the utilities study this situation to determine why this scale was chosen and if it should be replaced with a new scale. Page 20

Response: The original Westinghouse system design would have provided flow readings as high as 80 GPM, which accounts for the present non-linear scale of 0 to 80 GPM. Subsequently, Westinghouse revised the system design which will now provide flows only as high as 32 GPM. A square root extractor will be incorporated in the indicator circuitry to provide a linear output and the scale will be revised.