Summary Report

DETAILED CONTROL ROOM DESIGN REVIEW FOR THE DAVIS-BESSE NUCLEAR POWER PLANT

Prepared For:

Nuclear Regulatory Commission

Prepared By:

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1.0 INTRODUCTION

This report has been prepared in response to NUREG-0737 item 1.D.1 and details the means by which a Detailed Control Room Design Review was conducted for the Davis-Besse Nuclear Power Station owned and operated by the Toledo Edison Company. The review was conducted using NUREGs-0700, -0737, Supplement 1, and -0801. The review was conducted during the period from May 1983 through June 1984.

2.0 OVERVIEW

2.1 Background

The review was conducted in four phases, as follows:

Phase 1 - Project Planning.

- o Preparation of a review planning document (Program Plan) which addressed
  - Review methodologies
  - Review documentation
  - Staffing, personnel qualifications, and project organization
  - Assessment and prioritization of discrepancies
  - Reporting (findings, assessment, and schedules).

Phase 2 - Control Room Review. This represents the period in which data collection, reduction, and analysis was conducted, resulting in Human Engineering Discrepancy (HED) reports and draft reports.

Phase 3 - Assessment and Disposition of HEDs. HEDs were assessed with regard to their potential for inducing operator error and the effects of such errors on plant safety. HEDs were dispositioned accordingly. Dispositions included enhancements, design changes, and more detailed studies to determine specific design solutions required.

Phase 4 - Reporting. Detailed Control Room Design Review results were provided to the Nuclear Regulatory Commission.

Figure 2-1 shows, in general, the phases and task flow for the Detailed Control Room Design Review. A brief discussion of the activities conducted in phases 1-3 of the review follows this figure. The Detailed Control Room Design Review was conducted using the NUREG-0700 guidelines. Planning, staffing, technical approach, and prioritization were conducted in accordance with the guidelines as stated in NUREG-0700.

The present Detailed Control Room Design Review report closely follows the outline recommended in Section 5.2 of NUREG-0700. Specifically, this final report discusses:

- o The Detailed Control Room Design Review phases
- o The technical activities
  - review of operating experience
  - assembly of control room documentation
  - conduct of control room surveys
  - system/function/task analysis
  - verification of task performance capability
  - validation of control room functions
- o Method of assessment of discrepancies

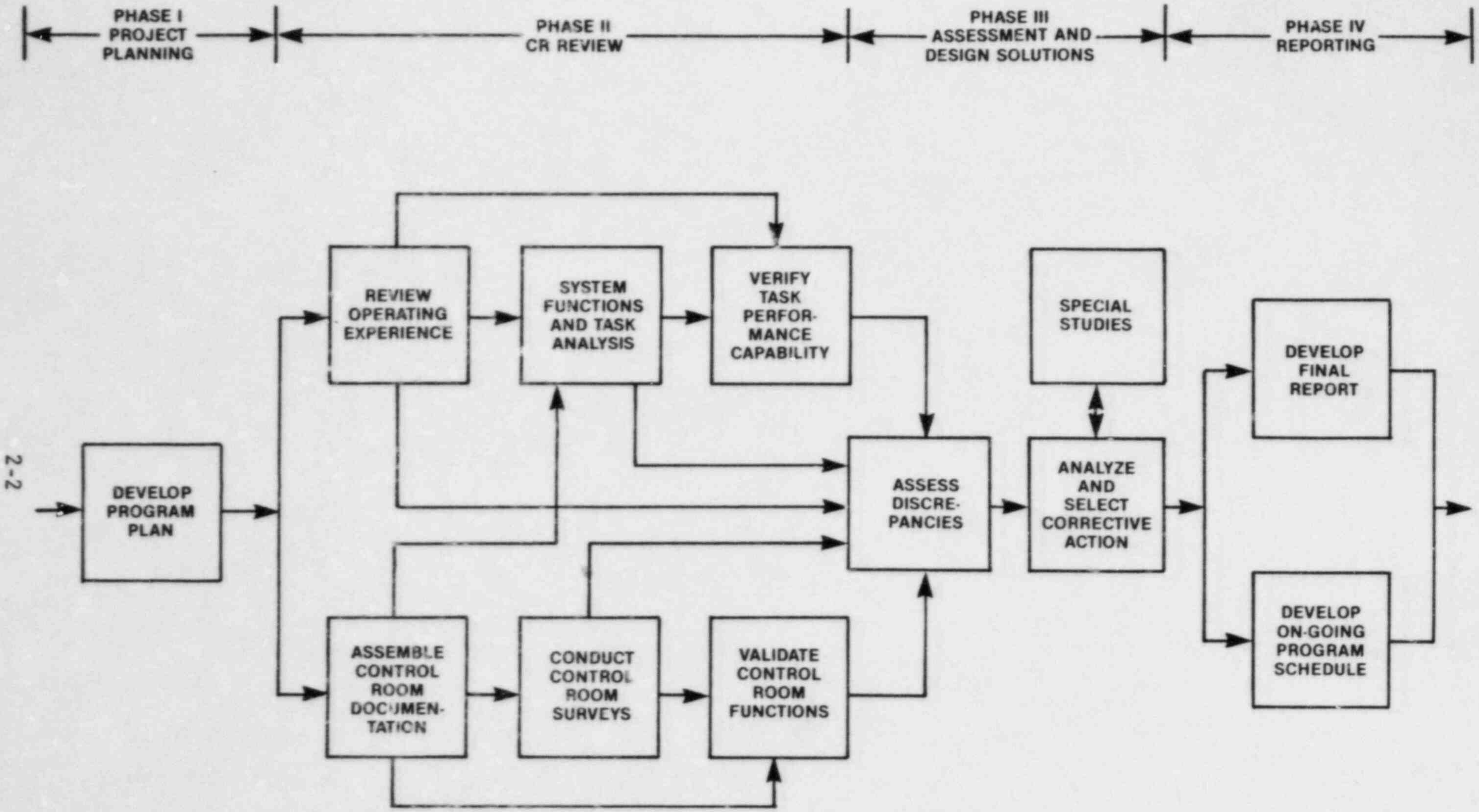


FIGURE 2-1
THE FOUR PHASES AND THE TASK FLOW RELATIONSHIP OF THE CR REVIEW

- o Method of identification and selection of enhancement and design solutions
- o Review results of Human Engineering Discrepancies, Human Engineering Discrepancy Assessment, and the selected enhancement and design solutions will be organized into the following groups:
  - survey findings (annunciator, communications, etc.)
  - task analysis findings (panel/workspace) and verification of human factors engineering suitability and validation of functions findings (control room traffic, workload distribution, and man/machine functional allocations)
- o Improvements to be made
  - enhancements/justification/extent of correction
  - design alternative/justification/extent of correction
- o Scope and scheduling of additional human engineering activities.

2.2 Phase 1 — Program Planning

The initial phase in this review involved preparation of a Detailed Control Room Design Review (DCRDR) Program Plan. The Program Plan was based on guidance contained in NUREGs-0700, -0801, and -0737 Supplement 1 (paragraph 5.2.a). The Program Plan addressed the following topics:

1. Review plan
2. Management and staffing
3. Documentation and document control
4. Review procedures
5. Assessment and implementation
6. Reporting.

The organization and scheduling reflected in the Program Plan were selected to coincide with other Toledo Edison ERC initiatives (e.g., RG1.97, EOP upgrade, SPDS implementation, etc.). Overall integration and coordination of review activities was directed by Mr. Jacque Lingenfelter, Project Administrator. The DCRDR Program Plan was submitted to the NRC for review and comment on 15 June 1983. Unless otherwise indicated, the review process as described in this summary report follows the approach presented in the Program Plan.

2.3 Review Procedures

This section presents, in general terms, the review procedures employed. Detailed descriptions of the procedures employed and results of each activity are presented in sections 3.0 - 5.0 .

2.3.1 Phase 2 — Control Room Review

The Control Room Review phase was subdivided into five subtasks as follows:

- o Review of Operating Experience
- o Assemble Control Room Documentation
- o Control Room Surveys
- o Review of System Functions and Task Analysis
- o Verify Task Performance Capability and Validation of Control Room Functions.

2.3.1.1 Review of Operating Experience — This task was composed of two subtasks: 1) conduct of operator interviews, and 2) review of plant operational experience through Licensee Event Reports, technical specification modifications, etc. This review task was conducted in accordance with the guidelines of NUREG-0700.

2.3.1.2 Assemble Control Room Documentation — In this task, a control room data base was established to support subsequent evaluation. A library was established with control room related documentation (technical specifications, drawings, etc.), control room components were photo-documented, and a full-scale three-dimensional mockup was constructed. The library and photo-documentation were centrally located to support the effort. In addition to the library and photographic documentation; a control room inventory of components was developed, identifying for each component, its location, system relationships, functions, and characteristics.

2.3.1.3 Conduct Control Room Surveys — Much of the detailed assessment of the control room was conducted through checklist surveys. Surveys required the collection of data using preconstructed checklists and interview forms, and the taking of direct measurements of control room parameters such as noise levels, light levels, etc. The survey criteria are presented in the appropriate survey sections (4.1 - 4.14). For each survey, a draft report (summarizing Human Engineering Discrepancies) was prepared for subsequent inclusion into the present final report. The surveys conducted were:

- o Workspace — checklist evaluation of various control room characteristics, such as layout and arrangement of CR furnishings, CR accessibility, etc.
- o Anthropometrics — analysis of reach and visual access to control room components given physical configuration of boards, panels, layout, etc. The data were subsequently compared to checklist item requirements.
- o Illumination — measurements were taken under various conditions (e.g., normal and emergency lighting) and compared to individual NUREG-0700 items.

- Noise — direct measurements of noise levels were taken and compared to individual checklists items.
- Heating, ventilation, and air conditioning (HVAC) — evaluation by direct measurement of HVAC parameters and comparison to NUREG-0700 criteria.
- Emergency Equipment — data were collected by walk-throughs, use of emergency garments, and checklist application.
- Maintainability — checklist and questionnaire data concerning operator-maintained components (trend recorders, bulbs, etc.).
- Communications — checklist evaluation of communications systems; speech intelligibility analysis of communications modes.
- Annunciators — checklist evaluation of annunciator systems; direct measurement of annunciator fonts, signal intensities, etc.
- Controls — checklist evaluation of controls.
- Displays — checklist evaluation of displays.
- Labels and location aids — checklist evaluation of labels and location aids.
- Design Conventions — evaluations by survey for the conventions listed below. The data were subsequently compared to NUREG-0700 guidelines.
  - coding methods (color, shape, pattern, etc.)
  - standardization of abbreviations and acronyms
  - consistency of control use
  - consistency of display movement or indication
- Computers — checklist evaluation of computer systems.

2.3.1.4 Review of System Functions and Task Analysis (SFTA) — System functions and tasks were identified and evaluated in this task. A 4-step procedure was employed:

- Identification of systems and subsystems by review of plant documentation and NSSS operating guidelines, and discussions with plant operations staff
- Identification of event sequences to undergo Task Analysis. These were identified using:
  - NUREGs-0737, -0660, and -0700
  - results of Operating Experience Review
  - B&W Abnormal Transient Operating Guidelines (ATOGs)
- Identification of system/subsystem functions through document review and operator interviews
- Identification and analysis of control room operational tasks.

Task Analysis data served as an input to the verification of task performance capability and validation of control room functions (see paragraph 2.3.1.5). The results/products of this task were:

- o Response Selection Diagrams
- o Task analysis of operating sequences
- o Task analysis of event sequences
- o Spatial-Operational Sequence Diagrams of task sequences
- o Traffic Pattern Diagrams.

2.3.1.5 Verification of Task Performance Capability and Validation of CR Functions (V&V) — This evaluation task involved three subtasks: 1) verification of instrument/ control availability, 2) verification of human engineering suitability, and 3) validation of CR functions. The first, verification of availability, was conducted using the Task Analysis and Control Room Inventory. In general, tasks associated with control room functions were examined in terms of appropriate instrumentation in the control room (i.e., task equipment demands vs. actual equipment present in the control room). When specified information or control requirements were not met, HED reports were prepared, including a description of the problem and an estimate of the potential effect on operator performance.

Estimations of nonprocedurally-bound operations (e.g., boration, etc.) were generated via operator interviews conducted during the V&V process. Also task sequences required in selected event sequences were estimated as to frequency of occurrence in the event sequences. Comparing both frequency and requirements data to the inventory, identification was made of: 1) the absence (in the control room) of task-required information or control, 2) the estimated frequency with which the information or control is required, and 3) the conditions (events, procedures, etc.) under which the information or control is required.

The second subtask, verification of human engineering suitability, involved using Spatial-Operational Sequence Diagrams, Traffic Pattern Diagrams, identified functional groups, and checklists to evaluate human engineering suitability in terms of sequence of component use, control/display proximity, and so forth. NUREG-0700 guidelines served as the principal source document for evaluation criteria.

The final subtask, validation of CR functions, involved analysis of workload and distribution of workload for operators performing specific task and event sequences. Also overall control room traffic was analyzed. Where potential problems in operator movement or workload were identified, walk-throughs were conducted at the Davis-Besse mockup.

2.4 Documentation and Document Control

Three types of documentation were addressed: 1) reference documentation, 2) process and Human Engineering Discrepancy documentation, and 3) Detailed Control Room Design Review output findings and reports.

2.4.1 Reference Documentation

A program library was established with reference documents to support the Detailed Control Room Design Review tasks. It contains:

- o Licensee Event Reports
- o Transient Assessment Reports
- o Final Safety Analysis Report
- o Technical specifications and system descriptions
- o Piping and Instrumentation Diagrams
- o Floor plans
- o Instrument lists
- o Panel drawings and photographs
- o Software descriptions
- o NSSS operating guidelines (ATOGs)
- o Upgraded emergency operating procedures
- o Samples of computer printouts
- o Various Nuclear Regulatory Commission and industry documents bearing on control room design (i.e., NUREGs-0700 and -0660, IEEE specifications and standards, human factors engineering texts, etc.).

As required, this documentation was referenced to support specific tasks within the control room evaluations.

2.4.2 Process Documentation

Data collection and reduction methods were documented for reporting purposes. The general flow of information management is presented in Figure 2-2. Task plans served as the basic process documentation. All data collected during the review were maintained in individual task folders in the central project files at Essex.

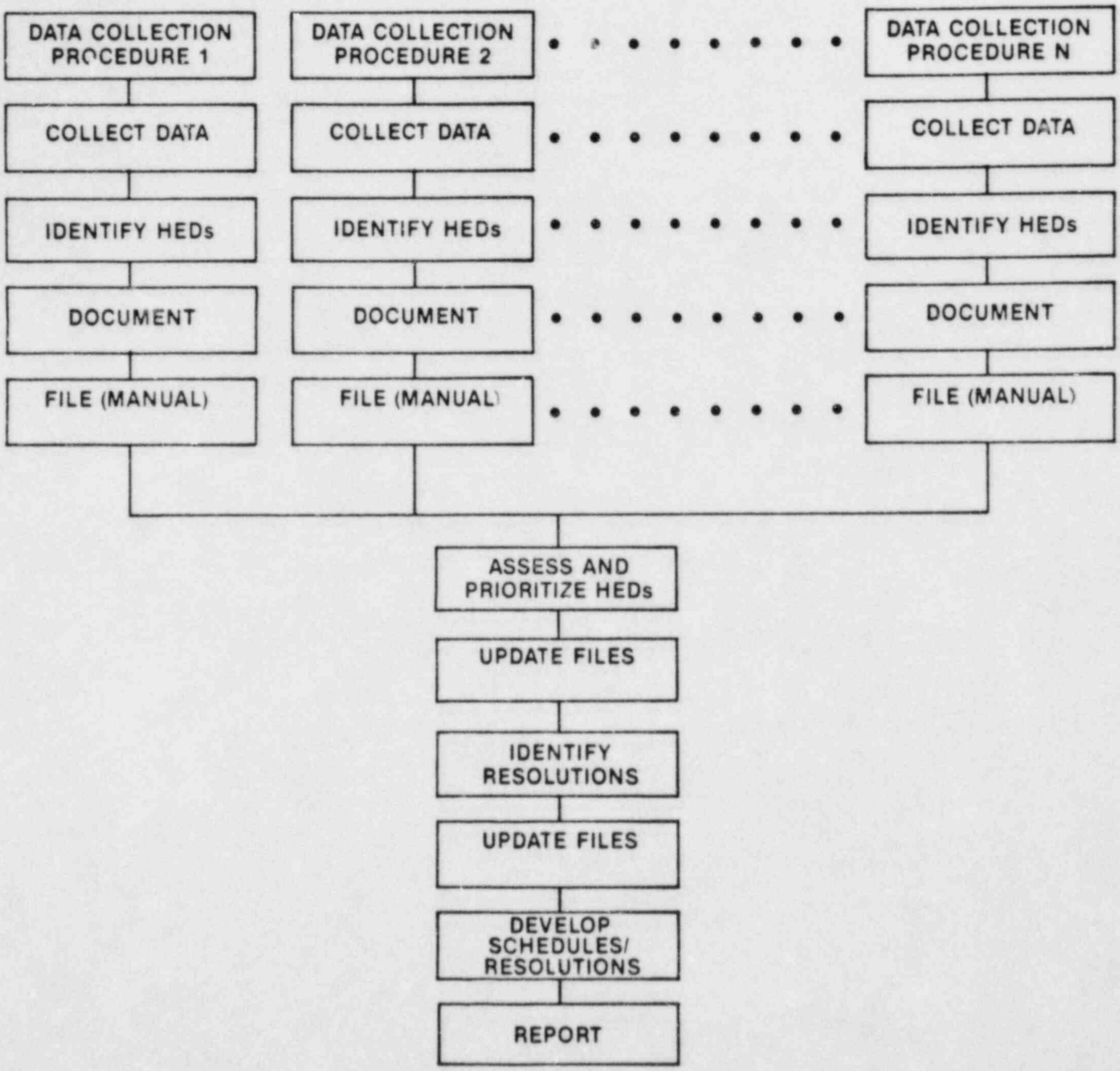


FIGURE 2-2 INFORMATION MANAGEMENT PROCESS

2.4.3 Guideline Human Engineering Discrepancy Documentation

Data files for each Human Engineering Discrepancy were generated. For each task requiring a report, file space was reserved for that report. The following information was recorded for each Human Engineering Discrepancy (HED):

- NUREG-0700 guideline number
- Human engineering discrepancy problem description
- Human engineering discrepancy assessment
- Human Engineering Discrepancy locations (components which are discrepant from the NUREG-0700 guidelines)
- Action to be taken on the Human Engineering Discrepancy.

Figure 2-3 presents the Human Engineering Discrepancy form used to document and report findings.

2.5 Phase 3 — Assessment and Disposition of HEDs

The final phase in the review process was the assessment and disposition of human engineering discrepancies. This activity was conducted in two parts. First, the HED was assessed for its potential to induce operator errors by considering the potential impact on human performance. Second, the effect of the error on plant safety was estimated by determining which systems and/or plant functions would be affected. Once this assessment was completed, the HED disposition was determined. Disposition included enhancements, design changes, and/or more detailed studies to determine specific design solutions. A detailed description of the HED assessment and disposition process is presented in Section 6.0 of this report.

FIGURE 2-3
HED PRIORITY

HUMAN ENGINEERING DISCREPANCY (HED) REPORT

____
PLANT/UNIT

ORIGINATOR: ____________________ HED NO.: ______________

VALIDATED BY: ____________________ DATE: ______________

a) HED TITLE: ____

____

b) ITEMS INVOLVED:

c) PROBLEM DESCRIPTION AND 0700 PARA. NUMBER:

d) DATA COLLECTION DESCRIPTION AND CODE NUMBER:

e) SPECIFIC HUMAN ERROR(s):

FIGURE 2-3 (cont'd)
HED PRIORITY

HED REPORT (CONTINUED)

______________________ HED NO.: __________
PLANT/UNIT

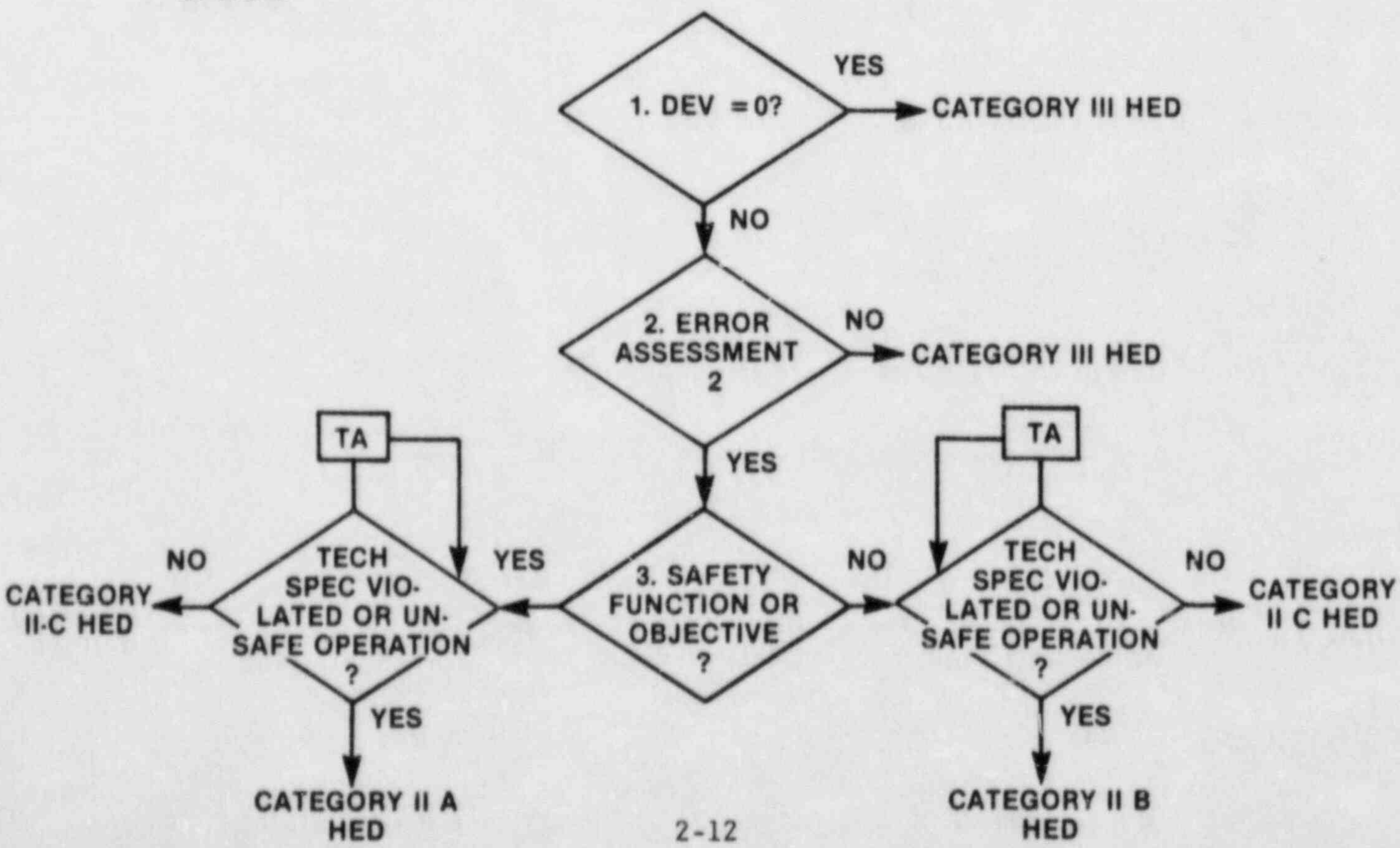
f) SUGGESTED BACKFIT:

g) REVIEW AND DISPOSITION:

FIGURE 2-3 (cont'd)
HED PRIORITY

HED #	

	N/A	SOME				COMPLETE
1. EXTENT OF DEVIATION FROM 0700 GUIDELINES		1	2	3	4	5
		LOW				HIGH
2. ERROR ASSESSMENT		1	2	3	4	5
3. SAFETY FUNCTION ?	YES					NO
4. NON SAFETY RELATED, REQUIRED TO MITIGATE CONSEQUENCES OF AN ACCIDENT	YES					NO
5. CONSEQUENCES OF ERROR OCCURENCE						
A. UNSAFE OPERATION	YES					NO
B. VIOLATION OF TECH. SPECS.	YES					NO



3.0 OPERATING EXPERIENCE REVIEW

The operator experience review consisted of two tasks: 1) conduct of operator interviews, and 2) review of plant operating experience. The methodology and result of these tasks are described in the following sections.

3.1 Operator Interviews

This section summarizes the results of operator interviews conducted at the Davis-Besse nuclear power plant during the period 20-24 June 1983. The interviews were conducted in accordance with NUREG-0700 as part of a Detailed Control Room Design Review (DCRDR) performed at Davis-Besse. The objective of the interviews was to solicit comments and observations from control room operating personnel concerning selected aspects of the design and operation of the Davis-Besse control room. The methodology and results of the interviews are described in the following sections.

3.1.1 Methodology

Operator interviews are conducted as part of the operating experience review for a DCRDR to identify and record any human engineering discrepancies (HEDs) that have been encountered during the operation of the plant. NUREG-0700 recommends that a range of operations personnel be interviewed, including operations managers, shift supervisors, shift technical advisors, senior reactor operators, reactor operators, and auxiliary operators.

The approach recommended by NUREG-0700 follows the general format of the critical incident technique in which the respondent is asked to describe specific incidents that demonstrate positive or negative aspects of the design and/or operation of the control room. This approach allows the interviewer to focus on critical success, failure and near-miss situations encountered in actual plant operation. These situations are then analyzed, from a human engineering perspective, to determine any causal or contributing factors related to the design and/or operation of the control room.

In the present study, the operator interviews were part of an integrated DCRDR process that employs four separate data collection techniques: observation, measurement, document review and operator interviews. Prior to initiation of the DCRDR, each guideline in Chapter 6 of NUREG-0700 was systematically reviewed to determine the most appropriate data collection technique(s). Those guidelines selected for inclusion in the operator interview were translated into the appropriate format and entered into the questionnaire.

Questionnaires were administered to 13 operations personnel from three of the six shifts at Davis-Besse. Interviews were conducted on an individual basis to preclude consensual bias and to maximize the interaction between interviewer and respondent. The interviews were conducted in an area adjacent to the control room in order that the respondent could have ready access to the control room to facilitate recall and to point out specific components involved in critical incidents.

Eight questionnaires were administered during the present study. These questionnaires focused on the following areas:

(1) Controls
(2) Displays
(3) Verification of task performance
(4) Labels and location aids
(5) Annunciators
(6) Ambient noise
(7) Maintainability
(8) Ambient illumination.

Example questionnaires for each of these areas are contained in Appendix A.

The results of the operator interviews are summarized in the following section.

3.1.2 Results

3.1.2.1 Operator Demography — A summary of the background information for the 12 operators/shift supervisors and one shift technical advisor is presented in Table 3-1. As indicated, the mean years of operational experience at Davis-Besse is 2.8 years. Four of the operators have experience from other plants and five were in the U.S. Navy Nuclear Program.

3.1.2.2 Interview Results — The responses to each of the questionnaires are presented in Appendix A. Each response was determined to be either negative (indicated by a -), positive (indicated by a +), or nonapplicable (NA). Questions pertaining to color coding were included in the conventions survey rather than the operator interviews.

Each negative response represents a potential problem area and was documented as a Potential Human Engineering Discrepancy (PHED) on HED forms (see Figure 2-3). These PHEDs underwent a review/verification process to determine the specific nature

Table 3-1

OPERATOR AND SUPERVISOR BACKGROUND DATA

Operator Number	Position	Davis-Besse Expr.	Other Plant Expr.	College Number of Yrs.	USN Nuclear Program	Other Military Expr.	
1	Shift Supervisor	6 yrs	0	2	6 yrs	--	
2	Senior Reactor Operator/ Assist. Shift Supervisor	3 yrs	0	2	0	--	
3	Shift Supervisor	6.5 yrs	0	0	0	*2 yrs	*Army
4	Senior Reactor Operator/ Assist. Shift Supervisor	2.2 yrs	0	0	6 yrs	--	
5	Reactor Operator	5 months	5 yrs	2	0	--	
6	Shift Technical Advisor (Supervisor)	1.5 yrs	0	4*	0	--	*BSME
7	Reactor Operator	4 months	3 yrs	2	0	--	
8	Reactor Operator	6 yrs	2.5*	2	0	--	*Fossil Plant
9	Senior Reactor Operator/ Assist. Shift Supervisor	3 yrs	0	2	0	--	
10	Reactor Operator	1.5 yrs	0	0	6 yrs	--	
11	Reactor Operator	6 months	0	0	6 yrs	--	
12	Senior Reactor Operator/ Assist. Shift Supervisor	4 yrs	0	1	6 yrs	--	
13	Reactor Operator	2 yrs	5 yrs	0	0	--	
	Summary	MEAN= 2.83 yrs	MEAN= 1.19 yrs	MEAN= .76 yrs	MEAN= 2.30 yrs		

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and extent of the problem before being considered an HED. Once this was determined, it was subjected to the formal HED review process as described in Section 6.0.

The preliminary results of the interviews revealed 117 PHEDs out of a total of 202 questions:

QUESTIONNAIRE	# OF QUESTIONS	# PHEDs
1. Controls	44	23
2. Displays	30	20
3. Verification of Task Performance	27	15
4. Labels and Location Aids	19	8
5. Annunciators	46	29
6. Ambient Noise	7	5
7. Maintainability	23	12
8. Illumination	6	5
	202	117

Each of the above areas is discussed in the following paragraphs.

Controls Questionnaire/Interviews

a. Three controls were reported to be positioned too close to adjacent controls, resulting in potential for accidental activation of the adjacent controls.

b. Three systems were reported to contain controls that require strict sequential activation; however, there are no interlocks or similar precautions to prevent out-of-sequence operation.

c. Ten controls on the control boards were reportedly not used by the operators.

d. Two controls on the control boards were reported as being duplicated unnecessarily.

e. Controls are not recognizable in terms of function and switch types are not consistent across the control boards.

f. Three controls were reported as being controls that can be positioned between detented positions.

g. Six controls were reported as being difficult to adjust to the necessary level of precision.

h. Pushbuttons that control valves provide inadequate feedback concerning valve position and/or status. In some cases, the associated indicator lights go out while the valve is travelling or the light doesn't change until valve stops moving. This makes it difficult to determine if the valve is operating properly or has malfunctioned.

Display Questionnaire/Interviews

a. Three sets of lights were reported to be too dim to be easily read under ambient conditions.

b. Fifteen lights or sets of lights were reported as indicating system/equipment status when the light is off.

c. Three sets of indicator lights are reportedly used as alert, annunciator, or alarm signals.

d. Fifteen meters were reported as having scales that do not span the expected range of operational parameters.

e. Five meters were reported having scales that are too wide for maximum displayed values.

f. All meters were reported as having pointers that do not go off scale when the meter fails.

g. Many meters were reported as having scales that are difficult to read because of poor contrast between pointer and background.

h. All recorders were reported as being difficult to read without opening the recorder window.

i. Five recorders were reported as having a tendency to mechanically or electrically "hang up."

Verification of Task Performance Questionnaire/Interview

a. Six instruments were reported as not being clearly labelled to indicate whether the displayed value is actual or demand status.

b. Eight displays were reported as requiring some form of mental conversion in order to effectively use the information.

c. Two sets of instruments which must be compared to other displays of the same parameter do not have compatible scales.

Labels and Location Aids Questionnaire/Interview

a. Many instruments were reported as not being clearly labelled.

b. Labels are not routinely cleaned as part of the maintenance procedure.

c. Mimic lines on the electrical distribution panel are difficult to distinguish quickly.

Annunciator System Questionnaire/Interview

a. Annunciator system does not contain a first out panel.

b. Annunciator system auditory signals are not priority coded by pulse, frequency change or intensity. Also, different frequencies are not provided for different signals.

c. Annunciator system does not contain separate auditory signals at each work station.

d. Three alarms were reported to startle or irritate operators.

e. An alarm cannot be acknowledged from more than one response control area.

f. Some annunciator tiles are used for status and are always illuminated.

g. Annunciator tiles that are on for extended periods during normal operations are not distinctively coded for positive recognition.

h. Operators reported that they are not immediately aware if an annunciator tile is out of service.

i. Five annunciator alarms were reported as nuisance alarms.

j. Five alarms require operators to obtain additional information from a source outside of the control room area.

k. Many annunciator tiles contain dual messages such as HIGH-LOW.

l. Multi-input alarms do not have a reflash capability that reflashes the tile after an auditory alert even if the first alarm has not cleared.

m. All multi-input alarms are not provided with an alarm printout.

n. The alarm printer is reported to sometimes lose or skip information.

Ambient Noise Questionnaire/Interview

a. Operators reported that the amplitude of four auditory signals interfere with other signals or voice communications.

b. Ram Tech Computer has an auditory signal the meaning of which is unclear.

c. Two alarm signals were reported to have similar sounds, but different meanings.

d. Three auditory signals were reported to be excessively loud, causing discomfort.

Maintainability Questionnaire/Interview

a. Recorder supplies and fuses are not stored in the control room.

b. Operators reported that there is not adequate storage space available in the control room.

c. Bulbs and recorder paper are not clearly marked to indicate type.

d. Records are not kept on the status of expendables and spare parts.

e. Annunciator tiles are not keyed to prevent interchanging of annunciator tiles.

f. Operators reported that they have been shocked while replacing bulbs.

g. Lamp test, dual bulbs, or dual filament bulbs are not provided for most indicator lights on the control boards.

h. Legend light/pushbutton covers are not keyed to prevent interchanging of covers.

Illumination Questionnaire/Interview

a. Operators reported that there are noticeable differences in the illumination levels throughout the control room.

b. Shadows were reported to interfere with reading recorders.

c. Glare was reported to interfere with reading displays.

PHEDs were reviewed by senior project personnel and evaluated during survey, task analysis, and V&V activities to determine the nature and extent of the deviations. In cases where PHEDs were judged to be invalid, they were deleted; however, the original PHED, including justification for its deletion, was maintained in the central project file. HEDs are summarized in Appendix C.

3.2 Documentation Review

This section summarizes the results of the documentation review performed to identify conditions in the Davis-Besse Control Room that may cause human performance problems. This review consisted of three elements as follows:

1. Review of Davis-Besse Reactor Trip and/or Transient Assessment Reports with Potential HED Implications.
2. Review of Davis-Besse LERs Attributed to Personnel Error with Potential HED Implications
3. Review of Industry-Wide LERs Associated with Human Error with Potential Generic HED Implications.

The methodology and results of these reviews are described briefly in the following paragraphs.

3.2.1 Methodology

The list of Davis-Besse Reactor Trip and Transient Assessment Reports was reviewed and those which involved potential HED implications were selected for further review. These reports were then evaluated to determine the events leading to the problem, the nature of the problem, and to identify potential HEDs associated with the problem. Similarly, the list of Davis-Besse LERs was reviewed and those attributed to personnel error with potential HED implications were selected for further review. These LERs were also evaluated to detemrine the events leading to the problems, the nature of the Problems, and to identify potential HEDs associated with the LER.

Beyond the limits of Davis-Besse specific documents, a computer assisted keyword search was made on the NSIC data base of all LERs for a listing of those LERs with possible HEDs of a generic nature that may also apply to Davis-Besse. These LERs were also evaluated to determine the events leading to the problem, the nature of the problem and to identify potential HEDs asscociated with the LER.

3.2.2 Results

Table 3-2 provides a summary of the documentation review results. Each Davis-Besse reactor Trip and/or transient assessment report, Davis-Besse LER or industry-wide LER with potential HED implications is listed along with the associated potential HED. Each potential HED generated during this task was further examined during other portions of the CRDR and was incorporated with an HED from the other tasks. These final HEDs addressing the concerns raised during the documentation review are provided in the final column of Table 3-2.

TABLE 3-2

SUMMARY OF DOCUMENTATION REVIEW

Reactor/Transient Assessment Report	Davis Besse LER	Industry Wide LER	Potential HED	Related HED(s)
Reactor Trip of 9/2/77			Automatic operation of startup feed valves and MFP when they should be in the manual mode	HED 9.2-73, 76 & 96. HED 9.2-28
Reactor Trip of 4/29/78			-Manual control of MFP speed -Control of MFW valve oscillating from flow control to level control -FW elements in manual were decreased too rapidly	HEDs 9.2-42 & 9.2-49
FW Transient of 11/16/80			-Erroneous main feedwater signal -Insufficient design to prevent SG overfill	HED 9.2-18
Reactor Trip of 6/24/81			-T-Sat/P-Sat meters provided misleading information -NNI-X power supply improperly labeld -Annunciator Error	HED 9.2-34
Reactor Trip of 10/22/81			-Spurious SFRCS Trip -TBV Logic	HEDs 9.2-18 & 9.2-32
Reactor Trip of 4/10/83			-Operator training - high xenon startup	Increase training
	LER-NP-32-77-6		-Insufficient administrative controls on DH valves	HED 4.1-7
	LER-NP-33-77-30		-SG overfill	SFRCS Redesign in process
	LER-NP-33-77-57		-Insufficient administrative controls on DH valves	HED 4.1-7

TABLE 3-2

SUMMARY OF DOCUMENTATION REVIEW

Reactor/Transient Assessment Report	Davis Besse LER	Industry Wide LER	Potential HED	Related HED(s)
	LER-NP-33-77-96		-Diesel generator overspeed trip	
	LER-NP-33-78-72		-Accidental actuation of critical controls	HED 4.1-1, 4.1-25
	LER-NP-33-80-28		-Accidental actuation of critical controls	HED 4.1-1, 4.1-25
		LER 82-011 San Onofre 2	-Preventative maintenance practices/notifications	Administrative controls
		LER 82-017 Calvert Cliffs 1	-Inadvertent actuation of critical controls	HED 4.1-1, 4.1-25
		LER 82-100 San Onofre 2	-Interlocks to prevent inadvertent operation	HED 4.1-7
		LER 81-151 McGuire 1	-Control of AFW from Aux. shutdown panel	
		LER 82-002 Sequoyah 2	-Latchtype permit controls that do not have CR indication	
		LER 83-050	-Instrumentation on remote/alternate shutdown out of service without indication in or knowledge of control room	
		LER 82-040 Susquehanna 1	-Accidental actuation of critical controls	HED 4.1-1, 4.1-25
		LER 82-046 LaSalle 1	-Chart recorders, paper replacement	HED 1.7-7, 5.1-14

TABLE 3-2

SUMMARY OF DOCUMENTATION REVIEW

Reactor/Transient Assessment Report	Davis Besse LER	Industry Wide LER	Potential HED	Related HED(s)
		LER 82-049 Palisades	-Power failure indication on buses	
		LER 81-021 D.C. Cook 1	-Communication lost between refueling crew in containment and control room	HED 2.1-3
		LER 80-018 Robinson 2	-All controls necessary for important emergency actions like isolation should have control points in the CR	
		LER 82-064 Duane Arnold	-Thermostat settings	

4.0 CONTROL ROOM SURVEY

The methodology used to conduct the CR surveys at Davis-Besse incorporated a mix of traditional procedures and methods tailored to the specific requirements of the plant. The four basic methods employed within each survey were measurements, observations, interview/questionnaires, and documentation reviews. Within the summary tables, these methods are designated by M, O, I, and D, respectively. Within each of these methods, specific procedures were used to ensure a comprehensive data collection, data reduction, and analysis process. The procedures were organized into a set of standardized task plans.

The survey process was structured into a number of separate tasks, each task involving a specific set of related control room design features. For example, environmental factors were organized into an illumination survey, noise survey, an HVAC survey, and a workspace survey. This structural approach, coupled with the standardized task plans, allowed for maximum flexibility during data collection, data reduction, and analysis, and resulted in a standard, well-organized self-documenting process.

All task plans followed the general format of:

1) Introduction (including the objectives)
2) Review Team Selection and Responsibilities
3) Criteria (from NUREG-0700, Section 6.0)
4) Procedures
5) Equipment and Facility Requirements
6) Inputs and Data Forms
7) Outputs and Results
8) Figures and Tables
9) Procedure Exceptions
10) Appendices (as required).

In addition to this general format, the control room survey task plans incorporated a standardized set of appendices that ensured a consistent well-documented process for data collection, analyses, audits, and follow-on backfitting procedures. The appendix structure employed was:

Appendix A (Criteria) - This is a compendium of all 0700, Section 6.0 criteria in 0700 paragraph number order that is relevant to that task plan. It was used to summarize the final results.

Appendix B (Data Forms) — This appendix is further divided into the following:

B1 Measurements Data -
- B1.1 Linear Measurements (scalar, force, torque, dimensional, air volume, temperature, humidity)
- B1.2 Sound Measurements (noise auditory signals, communications systems auditory response characteristics)
- B1.3 Light Measurements (illumination levels, luminance characteristics, contrast ratios)
- B1.4 through B1.n Others (as required)

B2 Interviews and Questionnaires -
- B2.1 Operations
- B2.2 Engineering
- B2.3 Instrumentation and Calibration
- B2.4 Management and Administration
- B2.5 through B2.n Others (as required)

B3 Observation Checklists

B4 Documentation Review Checklists

B5 Analysis Aids for B1 - Measurements
- B5.1 Analysis Aids for B1.1
- B5.2 Analysis Aids for B1.2
- B5.3 Analysis Aids for B1.3
- B5.4 through B5.n Analysis Aids for B1.4 through B1.n (as required)

B6 Analysis Aids for B2 - Interviews/Questionnaires

B7 Analysis Aids for B3 - Observation Checklists

B8 Analysis Aids for B4 - Documentation Review Checklists

B9 Additional forms, as required.

Prior to conducting the surveys, Appendices B2 (Interviews and Questionnaires) from the various task plans were assembled and used to conduct operator interviews (see Section 3.1 of this report). The results of the interviews were used to direct the focus of the survey effort. Details of the methods and findings of the CR surveys are presented in the following sections.

4.1 Workspace Survey

This section documents the results of the workspace survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.1.1 Objectives

The objectives of the workspace survey were to:

a. Assess the degree to which the workspace layout in the control room conforms to the criteria in NUREG-0700.

b. Identify and document any features of the workspace design that do not conform to the criteria in NUREG-0700.

4.1.2 Scope

The scope of the effort extends to the assessment of the workspace design in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- o Furniture and equipment layout
- o Document organization and storage
- o Supervisor access
- o Nonessential personnel access
- o Procedure availability at consoles
- o Desk dimensions
- o Chair design
- o Unit integration and interference
- o Personal storage
- o Ambience and comfort.

4.1.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.1.1.3a through g; 6.1.14a through e; 6.1.1.6a and b; 6.1.1.7; 6.1.2.6; 6.1.2.7a through d; 6.1.2.8a through g; 6.1.3.1a and b; 6.1.5.6a and b; and 6.1.5.7a through c.

The detailed definitions for each criterion are presented in Table 4-1.

4.1.4 Method

4.1.4.1 Data Collection

a. Data collected during the operator interviews were reviewed to identify any potential problems with CR workspace.

b. Data were collected through direct observation of the control room workspace using the checklist contained in the Workspace Task Plan. As necessary, operators on shift at the time of the survey were querried concerning the suitability of the control room workspace. Where data collected through direct observation were inconclusive, additional data were collected during the verification and validation process.

4.1.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the items involved, a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the workspace task plan were annotated to indicate compliance or noncompliance with the criteria.

4.1.5 Findings

The findings of the workspace survey are presented in Table 4-1 "Workspace Survey Findings and HEDs Generated." Overall, 56 criteria were applied to the workspace design in the Davis-Besse control room. Of these, nine (16%) were not applicable, 42 (75%) were in compliance, and five (9%) were not in compliance. A total of five HEDs were generated which document all of the five criteria which were not met. In general, those HEDs were related to viewing of controls and displays from the operators desk, storage of reference documents and procedures, the location of and communication with the shift supervisor's office.

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 1 of 10

GUIDELINE	METHOD	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.1.3 FURNITURE AND EQUIPMENT LAYOUT					
a. **VIEWING** — Desks and consoles placed in the primary operating area should permit operators at those desks and consoles full view of all control and display panels (including annunciator panels) in the primary operating area (see Exhibit 6.1-2).	O	NO	P.1.1-1	III	Reassessed in V&V
b. **COMMUNICATIONS** — Desk and console placement should facilitate voice communications from operators seated at those work stations to any point in the primary operating area.	O	YES			
c. **OPERATOR ACCESS**					
(1) Operator should be able to get to any work station without having to overcome obstacles such as tripping hazards, poorly positioned filing cabinets or storage racks, maintenance equipment, etc.	O	YES			
(2) Operators should be able to position themselves conveniently for performing task actions at any work station.	C	YES			
d. **CIRCULATION PATTERNS**					
(1) The control room arrangement should facilitate efficient unobstructed movement and communication.	O	YES			
(2) The control room arrangement should minimize interference between the members of the operational crew.	O	YES			

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 2 of 10

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.1.3 (Cont'd)					
e. OPERATOR MANEUVERING SPACE — Between the back (operator's position) of desk/consoles and any surface or fixed object behind the operator, adequate space should be allowed for the operator to get into and out of a chair freely or to turn in the chair to view the equipment behind.	O	YES			
(1) A minimum separation of 36 inches from the back of any desk to any opposing surface is suggested as the minimum (see Exhibit 6.1-3). A greater separation is preferable.	O	YES			
(2) Lateral space for a seated operator should be no less than 30 inches (see Exhibit 6.1-3). Greater latitude is preferable.	O	YES			
f. EQUIPMENT-TO-OPPOSING-SURFACE DISTANCE — Enough space should be allowed so that personnel can perform all required tasks. The space should accommodate kneeling and bending, simultaneous work by more than one operator, and simultaneous performance of operational and maintenance tasks as may be required. Recommended minimum separations are illustrated in Exhibit 6.1-4.					
(1) A minimum separation of 50 inches is recommended between a single row of equipment/panel and a wall or other opposing surface.	O	YES			
(2) A minimum separation of 50 inches is also recommended between two rows of facing equipment if both rows are worked by a single operator.	N/A	N/A			

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 3 of 10

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.1.3f. (Cont'd)					
(3) A minimum separation of 8 feet is recommended between opposing rows of equipment where more than one person must work simultaneously on operational or maintenance tasks and kneeling, bending, or use of test equipment may be necessary.	N/A	N/A			
g. OPENINGS — Panels should be laid out and maintained, and equipment enclosures designed, so that there are no unguarded openings through which unwanted objects can be introduced.	N/A	N/A			
6.1.1.4 DOCUMENT ORGANIZATION AND STORAGE					
a. ACCESSIBILITY					
(1) All procedures and other documents that may be needed for ready reference should be kept in the control room.	O	YES			
(2) Reference douments should be stored where they are easy to locate and extract for use. They should not be locked up, stored in places too low or too high for large and small personnel to access easily, in cramped spaces, or where poor illumination exists.	O	NO	P.1-2	III	
b. LOCATION AIDS					
(1) Clearly visible title labels should be provided to identify specific documents.	O	YES			
(2) Labels should distinguish documents as much as possible.	O	YES			

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 4 of 10

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.1.4b. (Cont'd)					
(3) Putting many volumes in one location creates a search problem, especially if titles are similar. One means of reducing search time would be to put operational documentation in one location and other documentation in a secondary location.	O	NO	P.1.1-3	III	
c. CONVENIENCE OF USE					
(1) Documents should not be fixed in racks; it should be possible to remove documents for use.	O	YES			
(2) Documents should be bound so that they can be opened fully and will remain open at the desired place without holding.	O	YES			
d. **PROTECTION** — Documents should be protected from wear so that they do not become dog-eared, dirty, loose, torn, and difficult to read.	O	YES			
e. **DEDICATED SETS OF PROCEDURES** — Sets of procedures should be separately stored for each unit in a multiunit control room.	N/A	N/A			
6.1.1.6 SUPERVISOR ACCESS					
a. ACCESS — The shift supervisor's office should be located so as to permit prompt physical access to the control room under all conditions, including control room isolation. The preferred location is within the control room isolation boundary, with placement to permit good visual and voice contact with the primary operational area.	O	NO	P.1.1-4	III	

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 5 of 10

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.1.6 (Cont'd)					
b. **COMMUNICATIONS** — When the shift supervisor's office is not within the control room boundary, dedicated communications links between the primary operating area and the shift supervisor's office should be provided. (See Guideline 6.2.1.7)	O	NO	P.1.1-5	III	
6.1.1.7 NONESSENTIAL PERSONNEL ACCESS Provision should be made to limit the access and movement of nonessential but authorized personnel to prescribed areas within the control room.	O	YES			
6.1.2.6 USE OF PROCEDURES AND OTHER REFERENCE MATERIALS AT CONSOLES Provision should be made so that the procedures manuals and other reference materials can be consulted easily while task sequences are performed at the consoles. Exhibit 6.1-15 shows the poor practice of laying manuals down on the benchboard when no convenient place has been provided for them. Exhibit 6.1-16 shows a good solution adopted by several plants: a rolling bookcase is provided for storing and using procedures manuals.	O	YES			
6.1.2.7 DESK DIMENSIONS					
a. **WORKING SPACE** — Desks should provide enough clear working space for all materials required for task performance.	N/A	YES			
b. **CHAIR POSITIONS** — The desk should allow for different chair positions as required, with adequate knee space.	O	YES			

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 6 of 10

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.7 (Cont'd)					
c. OPERATOR COMFORT — The relationships of working surface height and area, knee room, and chair height should allow operators to work comfortably. Exhibit 6.1-17 illustrates an uncomfortable situation created by desk height and chair design.	O	YES			
d. DIMENSIONS — The following desk dimensions are recommended and shown in Exhibit 6.1-18:					
(1) For seated work only, 26 to 31 inches above the floor (29 inches is a standard height).	O	YES			
(2) For sit-stand desks, 36 to 38 inches above the floor.	O	N/A			
(3) Work surface area depth: 16 inches minimum.	O	YES			
(4) Work surface area width: 24 inches minimum if tasks involve reading and writing only; 30 inches minimum if other kinds of tasks are required.	O	YES			
(5) Knee room height: A distance of approximately 25 inches from the floor to the under-surface of the desk top should provide adequate clearance for 5th to 95th percentile male and female adults at sit-down-only stations.	O	YES			
(6) Knee room depth: 18 inches minimum.	O	YES			
(7) Knee room width: 20 inches minimum (greater width preferred).	O	YES			

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 7 of 10

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.8 CHAIRS					
a. **MOBILITY** — Chairs should pivot so that operators can readily adjust position. Mobile bases (casters) are recommended for chairs at sit-only stations.	O	YES			
b. **BACKRESTS** — Chairs should support at least the lower back curvature (lumbrosacral region). The recommended angle between the back and the seat is about 100° for office tasks (such as keyboard tasks). A greater angle is preferred for reading and resting.	O	YES			
c. **ARMRESTS** — Where personnel may remain seated for relatively long periods, chairs with armrests are preferred. Adjustable or retractable armrests may be necessary to allow the elbows to rest in a natural position and for compatibility with a particular desk/console.	O	YES			
d. **CUSHIONING** — Seat and backrest should be cushioned with at least 1 inch of compressible material, enough so that some resilience remains when the chair is occupied.	O	YES			
e. **SEAT AREA** — The thighs and the backs of the knees should not be compressed so as to cause fatigue and circulation problems. The seat should be at least 17 inches wide. Seat depth should be 15-17 inches (see Exhibit 6.1-19).	O	YES			
f. **SEAT ADJUSTABILITY** — For chairs at sit-down stations, seat height should generally be adjustable from 15 to 18 inches (Exhibit 6.1-19). For chairs at sit-stand stations, seat height should be adjustable from 26 to 32 inches (Exhibit 6.1-20).	O	YES			

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 8 of 10

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.8 (Cont'd)					
g. **FOOTRESTS** — An adjustable footrest or heel catch should be provided to support the feet at a level no more than 18 inches below the seat surface. If a footrest is part of the chair, a circular design is recommended, diameter 18 inches. The footrest might be provided on the console base.	N/A	N/A			
6.1.3.1 UNIT INTEGRATION AND INTERFERENCE					
a. **EQUIPMENT ARRANGEMENT** — Equipment should be arranged with movement and communication patterns in mind, so that unit operations do not interfere with each other.	O	YES			
b. **SENIOR OPERATOR STATION** — Senior operators who supervise and assist operations of more than one unit need to be stationed so that they can communicate effectively with operators in each unit and have an unobstructed visual path to the control boards of each unit.	N/A	N/A			
6.1.5.6 PERSONAL STORAGE					
a. **STORAGE LOCATIONS** — There should be a suitable, out-of-the-way but secure place in which control room personnel may keep their coats and other personal belongings.	O	YES			
b. **STORAGE SUITABILITY** — If lockers are provided, they should be large enough to hold the items that can reasonably be expected to go into them.	N/A	N/A			
6.1.5.7 AMBIENCE AND COMFORT					
An effort should be made to create a pleasant and comfortable work setting in view of the long hours and confining aspects of the control room operator's job.					

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED Page 9 of 10

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.5.7 (Cont'd)					
a. DECOR — Features to be considered include:					
(1) Color coordination.	O	YES			
(2) Use of color and lighting to create a cheerful atmosphere (without introducing glare and brightness to a degree that causes eye fatigue of an overly intense atmosphere).	O	YES			
(3) Visual relief from arrays of instrumentation.	O	YES			
(4) Comfortable seating.	O	YES			
(5) Carpeting to lessen the fatigue of standing and walking.	O	YES			
b. RESTROOM AND EATING FACILITIES					
(1) A restroom and kitchen or eating area should be provided within (preferably) or near the control room isolation boundary.	O	YES			
(2) Since formal breaks are not scheduled in most control rooms, it is important that personnel have access to these facilities without delay. It is preferable that they be used only by control room personnel.	O	YES			
(3) Provision should be made for communication if facilities are out of voice contact, so that an operator taking a break can be contacted as necessary by personnel in the control room. (See Guideline 6.2.1.7.)	N/A	N/A			

TABLE 4-1
WORKSPACE SURVEY FINDINGS & HEDs GENERATED **Page 10 of 10.**

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.5.7 (Cont'd)					
c. **REST AREA/LOUNGE** — Consideration should be given to providing a rest area (possibly in conjunction with the eating area) conducive to relaxation and revitalization, especially where shifts are long.	O	YES			

4.2 Anthropometric Survey

This section documents the results of the anthropometrics survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.2.1 Objectives

The objectives of the anthropometrics survey were to:

a. Assess the degree to which all stand-up and sit-stand work stations in the control room conform to the criteria in NUREG-0700.

b. Identify and document any features of the work stations that do not conform to the criteria in NUREG-0700.

4.2.2 Scope

The scope of the effort extends to the assessment of the work station design in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The anthropometrics topics evaluated include:

- o Stand-up console dimensions
- o Sit-stand console dimensions
- o Vertical panels
- o Operator-display relationships.

4.2.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.1.2.2a through g; 6.1.2.3a through h; 6.1.2.4a through c; 6.1.2.5a and b; and 6.7.2.3a through f.

The detailed definitions for each criterion are presented in Table 4-2.

4.2.4 Method

4.2.4.1 Data Collection

a. Data collected during operator interviews were reviewed to identify any potential problem areas in the anthropometric characteristics of the control room.

b. Data were collected using the checklists contained in the Anthropometrics Task Plan.

c. Reach and visual envelopes recommended in NUREG-0700 were demarcated on the control boards and visual observations were made of the relative locations of controls and displays. Controls and displays falling outside the recommended envelopes were noted and their engineering numbers recorded.

d. Where it was necessary to consider the operational characteristics of the component (e.g., Guideline 6.1.2.5.a(1)), Davis-Besse operating procedures were reviewed and/or operations personnel were consulted.

4.2.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the displays or controls involved, a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the anthropometrics task plan were annotated to indicate compliance or noncompliance with the criteria.

d. Due to the fact that several anthropometric guidelines are related to the operational context of the component, a number of HEDs generated during this survey were referred to the verification and validation activity for clarification. These HEDs are annotated in the Remarks column of Table 4-2.

4.2.5 Findings

The findings of the anthropometrics survey are presented in Table 4-2 "Anthropometry Survey Findings and HEDs Generated." Overall, 44 criteria were applied to the displays in the Davis-Besse control room. Of these, 14 (31%) were not applicable, 23 (52%) were in compliance, and seven (15%) were not in compliance. A total of eight HEDs were generated which document all of the seven criteria which were not met. In general, those HEDs address controls and displays that are located too high or too low on the vertical panels and controls that are not located more than three inches away from the edge of the bench board.

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDs GENERATED Page 1 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.2 STAND-UP CONSOLE DIMENSIONS					
a. **CONSOLE HEIGHT TO SEE OVER —** When it is necessary for a standing operator to see over th top, console height (with or without annunciator panels) should not exceed 58 inches.	M	YES			
b. **CONTROL HEIGHT —** (Exhibits 6.1-5 and 6.1-6)					
(1) The highest control on a stand-up console should be within the highest reach of the 5th percen tile female without stretching or using a stool, ladder, etc.	M	NO	P.1.2.3	III	Assessed for critical controls in V&V.
(2) The lowest controls on a stand-up console should be within the lowest reach of the 95th percen tile male without bending or stooping.	M	NO	P.1.2.2	III	Assessed for critical controls in V&V.
c. **BENCHBOARD SLOPE —** The bench-board slope, in conjunction with its depth, should result in all controls being within the reach radius of the 5th per-centile female, as illustrated in Exhibit 6.1-6.	M	YES			
d. **CONTROL DISTANCE FROM THE FRONT EDGE OF THE CONSOLE**					
(1) Controls should be set back a minimum of 3 inches from the front edge to protect against accidental activation.	M	NO	P.1.2.1	III	Assessed for critical controls in V&V.
(2) No control should be more than 25 inches from the front edge of the console. This accommodates the maximum reach of the 5th per-centile female adult as illustrated in Exhibit 6.1-6.	M	YES			

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDs GENERATED Page 2 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.2 (Cont'd)					
e. **DISPLAY POSITIONING** — (Exhibit 6.1-7)					
(1) **DISPLAY HEIGHT AND ORIENTATION**					
(a) All displays, including annunciator tiles, should be mounted so that they are within the upper limit of the visual field (75° above the horizontal line of sight) of the 5th percentile female.	M	YES			
(b) In addition, all displays and annunciators should be mounted so that the angle from the line of sight to the face plane is 45° or greater. The 5th percentile female determines the upper limit. The 95th percentile male determines the lower limit.	M	YES			
(2) **HORIZONTAL DISPLACEMENT** — The oblique angle from the line of sight to a display located to either side of the working position from which the display must be read should be at least 45°. This includes annunciator tiles, which should be readable from the acknowledge button. (See Exhibit 6.1-8.)	M	YES			
f. **LATERAL SPREAD OF CONTROLS AND DISPLAYS** — The operator should be able to perform task sequences at a given work station with minimum respositioning. The amount of operator movement required depends on the arrangement of controls and displays, not simply on the lateral dimensions of the segments of the control board. The maximum lateral spread of controls and displays at a single-operator work station should not exceed 72 inches.	M	YES			Assessed in Verification and Validation

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDs GENERATED Page 3 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.2 (Cont'd)					
g. FOOT ROOM — Enough foot room is needed to allow the operator to get close to the board without leaning. A clearance of 4 inches vertically and 4 inches horizontally is recommended.	M	YES			
6.1.2.3 SIT-DOWN CONSOLE DIMENSIONS					
a. CONSOLE HEIGHT TO SEE OVER					
(1) If the seated operator must see over the console, the console height should be no more than approximately 27 inches above the seat to accommodate the 5th percentile adult female. Assuming seat height adjusted to 18 inches, maximum console height should therefore be 45 inches above the floor.	N/A	N/A			
(2) See-over console heights above 45 inches may be acceptable, for example, where the seated operator need only montior (not read) status lights and annunciators beyond the console, if they are at a suitable distance and height.	N/A	N/A			
b. CONTROL HEIGHT — All controls on a sit-down console should be within the reach radius of the 5th percentile female. Measurements should be made using seated shoulder height with the shoulder in line with the leading edge of the benchboard. This is illustrated in Exhibit 6.1-9.	N/A	N/A			
c. BENCHBOARD SLOPE — The benchboard slope, in conjunction with its depth, should be such that all controls are within the functional reach radius of the 5th percentile female (as illustrated in Exhibit 6.1-9) and all displays and markings can be read.	N/A	N/A			

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDs GENERATED Page 4 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.3 (Cont'd)					
d. CONTROL DISTANCE FROM THE FRONT EDGE OF THE CONSOLE					
(1) Controls should be set back a minimum of 3 inches from the front edge to protect against accidental activation.	N/A	N/A			
(2) Other controls may be mounted as far back as 25 inches from the console edge. This distance accommodates the extended functional reach of the 5th percentile as defined.	N/A	N/A			
e. DISPLAY POSITIONING					
(1) All displays, including annunciator tiles, should be mounted so that they are within the upper limit of the visual field — 75° above the horizontal line of sight — of the 5th percentile female (see Exhibit 6.1-10).	N/A	N/A			
(2) In addition, all displays should be mounted so that the angle from the line of sight to the display face plane is 45° or greater (see Exhibit 6.1-10). The 5th percentile female determines the upper limit. (Practically, there is no lower limit for a plausible sit-down console design.)	N/A	N/A			
f. LATERAL SPREAD OF CONTROLS AND DISPLAYS — (Exhibit 6.1-11)					
(1) For control and monitoring actions that must occur in sequence, all necessary controls and displays should be within the maximum extended reach and the viewing range of the seated operator from a single reference point.	N/A	N/A			

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDS GENERATED Page 5 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.3f (Cont'd)					
(2) For the situation described in item 1, above, and sustained or precise control action, the operator should be able to reach the controls without having to bend/stretch significantly.	N/A	N/A			
g. LEG AND FOOT ROOM — Sufficient leg and foot room should be provided to enable seated operators to avoid awkward and uncomfortable positions. Exhibit 6.1-12 shows the dimensions involved and gives minimums and ranges necessary to accommodate the 5th to 95th percentiles (as defined in Exhibit 6.1-5).	N/A	N/A			
h. WRITING SPACE ON CONSOLES -- Writing space may be needed by operators working at consoles.					
(1) An area at least 16 inches deep and 24 inches wide is recommended where these dimensions in the total configuration would fit operator reach capabilities. Less space may be adequate considering the frequency and duration of writing requirements at control room consoles.	N/A	N/A			
(2) If writing space is provided on the console itself, it should not interfere with viewing and manipulation of controls and displays.	N/A	N/A			
(3) If writing is necessary but space on the console is not available, other arrangements such as a nearby desk or table should be provided.	N/A	N/A			

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDs GENERATED Page 6 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.2.4 SIT-STAND WORK STATIONS					
a. **CONTROL AND DISPLAY POSITIONING** — The height and lateral limits for controls and displays should conform to the guidelines given for stand-up consoles (Guideline 6.1.2.2).	O	YES			
b. **CHAIR HEIGHT** — The operator should be provided with a high chair so that the seated eye height is approximately the same as standing eye height.	O	YES			
c. **KNEE ROOM** — Knee room and comfortable foot support should be provided.	O	YES			
6.1.2.5 VERTICAL PANELS					
a. **CONTROL HEIGHT**					
(1) Controls should be placed in an area between 34 inches and 70 inches above the floor.	M	NO	P.1.2-2 P.1.2-3	III III	Assessed for critical controls in V&V.
(2) Controls requiring precise or frequent operation and emergency controls should be placed in an area between 34 inches and 53 inches above the floor.	D	NO	P.1.2-6		Assessed in V&V - Deleted.
b. **DISPLAY HEIGHT**					
(1) Displays should be placed in an area between 41 inches and 70 inches above the floor.	M	NO	P.1.2-4 P.1.2-5	III III	Assessed for critical displays in V&V.
(2) Displays that must be read frequently or precisely should be placed in an area between 50 inches and 65 inches above the floor.	D	NO	P.1.2-8 P.1.2-7		Assessed for critical displays in V&V - Deleted.

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDs GENERATED Page 7 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2 CATHODE RAY TUBE (CRT) DISPLAYS					
6.7.2.3 OPERATOR-DISPLAY RELATIONSHIPS					
a. VIEWING DISTANCE — Viewing distance should be greater than 18 inches.	M	YES			
b. VIEWING ANGLE — The minimum angle between the operator's actual line-of-sight (LOS) as measured from the operator's normal work station, and the plane of the display screen should be 45° or greater in either the horizontal or vertical direction. See Exhibits 6.7-8 and 6.7-10.	M	YES			
c. SCREEN LOCATION, SEATED OPERATORS					
(1) CRT displays which require frequent or continuous monitoring, or which may display important (e.g., alarm) information, should be located within the following limits as measured from the normal operator work station (see Exhibit 6.7-9):	M D	YES			
(a) Horizontal limits — Not more than 35° to the left or right of the operator's straight-ahead LOS.	M	YES			
(b) Vertical limits — Not more than 20° above and 40° below the operator's horizontal LOS.	M	YES			
(2) CRT displays which do not require frequent or continuous monitoring, and which will not display important (e.g., alarm) information, should be located within the following limits.	M	YES			
(a) Horizontal limits — Not more than 95° to the left or right of the operator's straight-ahead LOS.					

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDs GENERATED Page 8 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.3c (Cont'd)					
(b) Vertical limits — Not more than 70° above and 90° below the operator's horizontal LOS.	M	YES			
d. SCREEN LOCATION, STANDING OPERATORS					
(1) CRT displays which require frequent or continuous monitoring, or which may display important (e.g., alarm) information, should be located within the following limits as measured from the normal operator work station:					
(a) Horizontal limits — Not more than 35° to the left or right of the operator's straight-ahead LOS.	M D	YES			
(b) Vertical limits — Not more than 35° above and 25° below the operator's horizontal LOS.	M D	YES			
(2) CRT displays which do not require frequent or continuous monitoring, and which will not display important (e.g., alarm) information, should be located within the following limits (as measured from normal operator work stations which permit full operator head and eye rotation):					
(a) Horizontal limits — Not more than 95° to the left or right of the operator's straight-ahead LOS.	M D	YES			
(b) Vertical limits — Not more than 85° above and 90° below the operator's horizontal LOS.	M D	YES			

TABLE 4-2
ANTHROPOMETRY SURVEY FINDINGS & HEDs GENERATED Page 9 of 9

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.3d (Cont'd)					
e. **MOUNTING IN CONSOLES** — When CRTs are permanently mounted in consoles, the console configuration, dimensions, and type of use (such as seated, sit-stand, or standing) affects the CRT/operator interface. Consoles in which CRTs are installed should conform to the guidelines of Section 6.1.2.	M	YES			
f. **VISIBILITY OF DATA** — All data and messages on the CRT screen should be within the unobstructed view of an operator at the normal work station.	O	YES			

4.3 Illumination Survey

This section documents the results of the illumination survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.3.1 Objectives

The objectives of the illumination survey were to:

a. Assess the degree to which the illumination levels under normal and emergency lighting in the control room conform to the criteria in NUREG-0700.

b. Identify and document any characteristics of control room illumination that do not conform to the criteria in NUREG-0700.

4.3.2 Scope

The scope of the effort extends to the assessment of the illumination characteristics in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The illumination topics evaluated include:

- o Illumination levels
- o Uniformity of illumination levels
- o Supplemental lighting
- o Task area luminance ratios
- o Shadowing
- o Glare
- o Reflectance
- o Color
- o Emergency lighting.

4.3.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraph 6.1.5.3a through h, and 6.1.5.4c.

The detailed definitions for each criterion are presented in Table 4-3.

4.3.4 Methods

4.3.4.1 Data Collection

a. Data collected during operator interviews were reviewed to identify CR areas having potential illumination problems.

b. Direct measurements of CR illumination were made using a Tektronix digital photometer (Model J16) with illuminance probe (Model J6511). All equipment had been recently calibrated by Leasametric, Inc.

c. Each control panel in the primary operating area, as well as the operators' desk, were subdivided into one-foot-square grids. An illumination reading was taken at the approximate center of each grid with the probe oriented toward the primary light source (i.e., overhead luminaire). Measurements were taken under both normal and emergency lighting. Extant illumination levels were recorded on data sheets depicting the location at which the measurement was taken. All deviations from NUREG-0700 guidelines were noted and recorded.

4.3.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the lighting source or affected components, a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the illumination task plan were annotated to indicate compliance or noncompliance with the criteria.

4.3.4 Findings

The findings of the illumination survey are presented in Table 4-3 "Illumination Survey Findings and HEDs Generated." Overall, 18 criteria were applied to the displays in the Davis-Besse control room. Of those criteria 10 (56%) were in compliance. Eight (44%) were not in compliance. A total of five HEDs were generated which document all of the eight criteria which were not met. In general, those HEDs address insufficient illumination levels in some areas, lack of uniformity in illumination levels, shadowing and glare in the control room, and inadequate illumination levels of the emergency lighting.

TABLE 4-3
ILLUMINATION SURVEY FINDINGS & HEDs GENERATED Page 1 of 2

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.5.3 ILLUMINATION					
a. LEVELS — (from Exhibit 6.1-22) Numbers are the min-recommended-max in ftC.					
(1) Panels, primary 20-30-50	M	NO	P.1.5-6	IIC	
(2) Aux panels 20-30-50	M	YES			
(3) Scale indicators 20-30-50	M	YES			
(4) Seated operations 50-75-100	M	NO	P.1.5-6	IIC	
(5) Reading, handwriting 50-75-100	M	YES			
(6) Reading, print 20-30-50	M	YES			
(7) Writing 50-75-100	M	YES			
(8) Maintenance 20-30-50	M	YES			
(9) Emergency operations - as above for area/task.	M	YES			
b. UNIFORMITY — The level of illumination should not vary greatly over a given work station.	I	NO	P.1.5-1	III	
c. SUPPLEMENTAL LIGHT — Supplemental lighting should be provided for personnel performing specialized visual tasks in areas where fixed illumination is not adequate.	I	NO	P.1.5-6	IIC	
d. TASK AREA LUMINANCE RATIOS — To determine task lighting requirements, it is necessary to consider the levels of lighting which surround a task. Great disparities between task and background lighting can lead to adaptation problems. To ensure effective visual performance, the task area luminance ratios in Exhibit 6.1-23 should not be exceeded.	I	NO	P.1.5-6	III	

TABLE 4-3
ILLUMINATION SURVEY FINDINGS & HEDs GENERATED Page 2 of 2

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.5.3 (Cont'd)					
e. SHADOWING — To reduce operator fatigue and eyestrain, shadows should be avoided.					
(1) Ambient illumination should be provided via indirect or diffuse lighting.	O	YES			
(2) Labels, instructions, and other written information should not be in shadowed positions.	I	NO	P.1.5-4	III	Re-evaluate after illumination has been ungraded.
f. GLARE — Glare should not interfere with the readability of displays, labels, or indicators.	I	NO	P.1.5-5	III	Re-evaluate after illumination has been ungraded.
g. REFLECTANCE — The amount of reflected light is affected by illuminated surface colors. Reflectance should conform to the recommendations shown in Exhibit 6.1-24. (See also Exhibit 6.1-25.)	M	YES			
h. COLOR — Surface colors should be recognizable under both normal and emergency lighting conditions.	I	YES			
6.1.5.4 EMERGENCY LIGHTING					
c. LIGHTING LEVELS — The control room emergency illumination system should be designed to provide a minimum illumination level of 10 footcandles at all work stations in the primary operating area.	M	NO	P.1.5-7	IIC	

4.4 Ambient Noise Survey

This section documents the results of the ambient noise survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.4.1 Objectives

The objectives of the ambient noise survey were to:

a. Assess the degree to which the ambient noise in the control room conforms to the criteria in NUREG-0700.

b. Identify and document any features of the ambient noise in the control room that do not conform to the criteria in NUREG-0700.

4.4.2 Scope

The scope of the survey extends to the assessment of the ambient noise in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- o Auditory environment
- o Background noise
- o Noise distractions
- o Reverberation time and sound absorption
- o Auditory signals
- o Signal intensity.

4.4.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.1.5.5a through e; 6.2.2.1c; 6.2.2.2b and c; and 6.2.2.6b and c.

The detailed definitions for each criterion are presented in Table 4-4B.

4.4.4 Method

4.4.4.1 Procedure Preparation and Conduct — The procedure employed in the conduct of this task was as follows:

a. The results of the operator interviews were reviewed to identify any potential problems with ambient noise levels in the CR.

b. Data were collected using methods and procedures consisting of observations, measurements, interviews and questionnaires.

c. The operator questionnaire was administered to 13 of the licensed reactor operators for the plant.

d. Noise data were collected on two separate occasions, once during July, 1983, and again during October, 1983. All measurements were made using a Gerard Model 1562 noise meter and probe calibrated prior to data collections. Noise was measured in dB on the A-scale for weighted averages and the following octaves (in Hz):

   o 31.5

   o 63

   o 125

   o 250

   o 500

   o 1000

   o 2000

   o 4000

   o 8000

   o 16000

   Figure 4-1 indicates the control room locations where noise measurements were taken. During both surveys, the reactor was at power and 12 - 14 people (including the data collectors) were in the control room. Both surveys were taken during the day shift.

4.4.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the noise source involved, a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the ambient noise task plan were annotated to indicate compliance or noncompliance with the criteria.

4.4.5 Findings

Table 4-4A presents the ambient noise data measured and documented during data collection. The upper left entry in each data location represent noise measurements

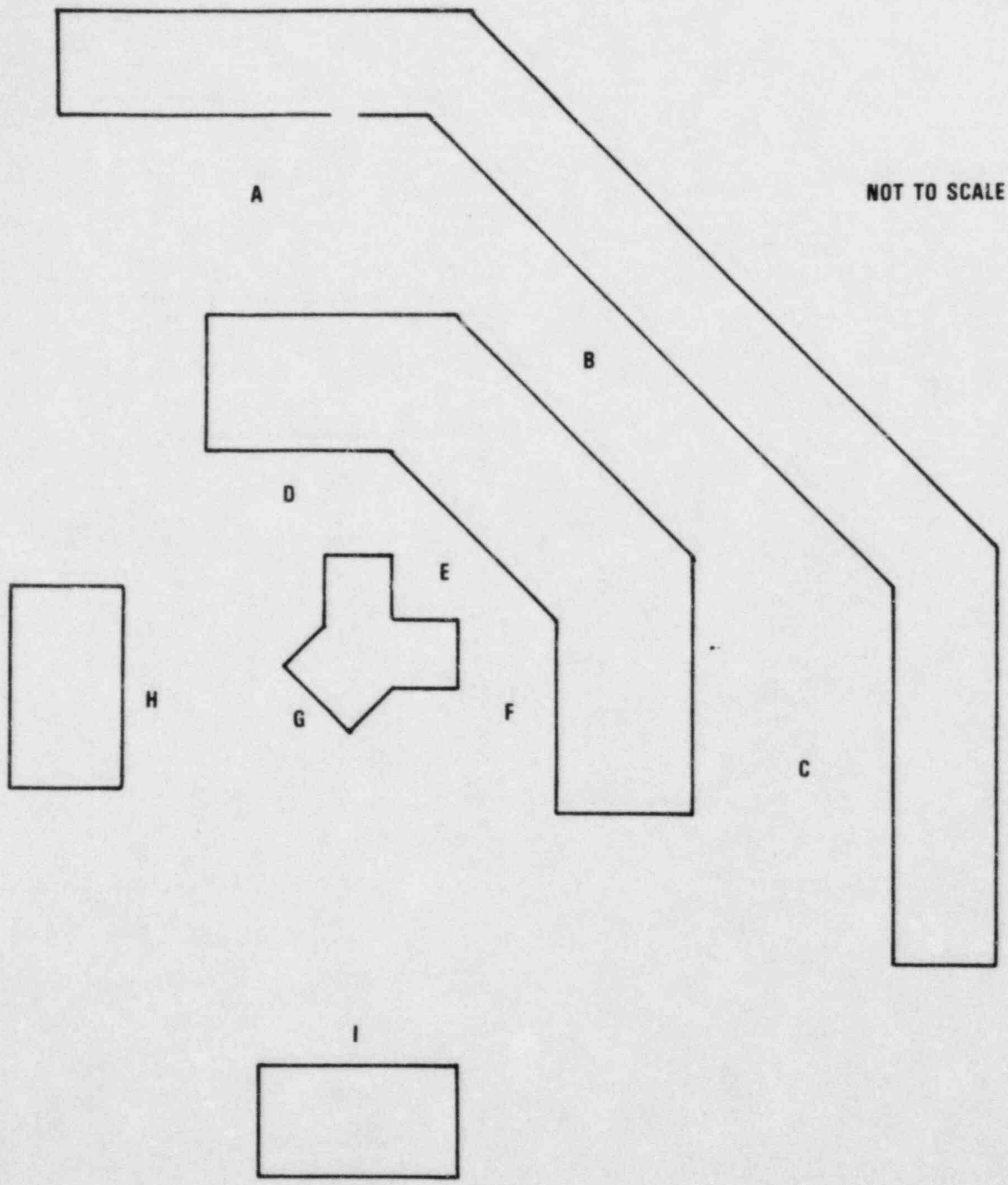

FIGURE 4-1
CONTROL ROOM NOISE SURVEY MICROPHONE LOCATIONS

LOCATION

	A	B	C	D	E*	F	G	H*	I'	OTHER*
WTG	58 / 62	60 / 62	60 / 62	60 / 64	/ 63	59 / 64	62 /	/ 64	61 /	/ 66
31.5	66 / 65	70 / 69	72 / 69	64 / 62	/ 65	63 / 67	63 /	/ 65	66 /	/ 62
63	64 / 63	63 / 63	65 / 63	66 / 62	/ 63	63 / 63	63 /	/ 63	63 /	/ 60
125	62 / 60	60 / 59	64 / 60	64 / 59	/ 59	63 / 60	65 /	/ 59	63 /	/ 57
250	60 / 56	58 / 56	60 / 55	62 / 58	/ 58	58 / 56	60 /	/ 56	60 /	/ 55
500	58 / 62	59 / 55	59 / 56	57 / 63	/ 62	58 / 58	60 /	/ 57	59 /	/ 59
1000	52 / 56	55 / 56	54 / 56	55 / 57	/ 56	52 / 56	55 /	/ 56	55 /	/ 55
2000	49 / 57	52 / 56	50 / 55	50 / 58	/ 56	49 / 55	52 /	/ 58	51 /	/ 56
4000	45 / 53	48 / 53	47 / 54	48 / 55	/ 53	46 / 53	46 /	/ 54	49 /	/ 54
8000	38 / 43	42 / 44	41 / 44	42 / 47	/ 44	39 / 43	42 /	/ 45	40 /	/ 48
1600	41 / 51	47 / 53	49 / 53	49 / 54	/ 53	43 / 44	49 /	/ 47	42 /	/ 52

* NOISE DATA NOT COLLECTED AT THIS LOCATION DURING FIRST SURVEY SESSION

' NOISE DATA NOT COLLECTED OF THIS LOCATION DURING SECOND SURVEY

TABLE 4-4 A
SOUND SURVEY RECORD (dB (A))

noted during the first survey. The information in the lower right represents noise data collected during the second survey session. All data are expressed as dB(A).

A series of peak noises was measured, source identified, and documented. Noise levels and their sources were as follows:

dB (A-weighted)	Source
73	page
79	printer & door slam
81	printer & door slam
74	file drawer closed
84	page & printer
84	page
78	laughter/conversation
77	page & printer
72	page

The findings of the ambient noise survey are presented in Table 4-4B "Ambient Noise Survey Findings and HEDs Generated." Overall, 11 criteria were applied to the ambient noise in the Davis-Besse control room. Of those criteria, seven (63%) were in compliance. Four (36%) were not in compliance. A total of four HEDs were generated which document all of the four criteria which were not met. In general, those HEDs address background noise levels, auditory signals that are too loud and auditory signals that sound similar.

TABLE 4-4B
AMBIENT NOISE SURVEY FINDINGS & HEDs GENERATED Page 1 of 2

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.5.5 AUDITORY ENVIRONMENT — The acoustic design of the control room should ensure that verbal communications between operators are not impaired; auditory signals are readily detected; and auditory distraction, irritation, and fatigue of operators are minimized.					
a. **BACKGROUND NOISE** — Background noise should not impair verbal communication between any two points in the primary operating area. Verbal communications between these points should be intelligible using normal or slightly raised voice levels.	I	YES			
b. **LIMIT** — Background noise levels should not exceed 65 dB(A).	M	YES			
c. **FURTHER REDUCTIONS** — Further reductions in background noise may be required where communications between the primary operating area and other control room locations are necessary and voice transmission systems are not provided.	I	NO	P.1.6-1	---	Pending - reanalysis required
d. **NOISE DISTRACTIONS** — Noise distractions generated either inside or outside the control room should be minimized.	O	YES			
e. **REVERBERATION TIME AND SOUND ABSORPTION** — The acoustical treatment of the control room should limit reverberation time to one second or less.	O	YES			
6.2.2.1 USE OF AUDITORY SIGNALS					
c. **SELECTION**					
(1) Auditory signals should be selected to avoid confusion with ambient control room noises.	I	YES			
(2) Auditory signals should be selected to avoid interference with other auditory sources, including verbal communication.	I	NO	P.1.6-2	IIC	

TABLE 4-4B
AMBIENT NOISE SURVEY FINDINGS & HEDs GENERATED Page 2 of 2

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.2.2 SIGNAL MEANING					
b. Similar auditory signals must not be contradictory in meaning with one another.	I	YES			
c. Auditory signals intended to alert the operator to a malfucntion or failure must be different from routine signals such as bells, buzzers, and normal operating noises.	I	NO	P.1.6-4	IIC	Assess in Annunc. Study.
6.2.2.6 SIGNAL INTENSITY					
b. COMFORT — Auditory signal intensity should not cause discomfort or 'ringing' in the ears.	I	NO	P.3.1.9	IC	
c. MAXIMUM INTENSITY — Auditory signal intensities should not exceed 90 dB(A), except for evacuation signals, which may be up to 115 dB(A).	M	YES			

4.5 Heating, Ventilation, and Air Conditioning Survey

This section documents the results of the heating, ventilation, and air conditioning (HVAC) survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.5.1 Objectives

The objectives of the HVAC survey were to:

a. Assess the degree to which the HVAC in the control room conform to the criteria in NUREG-0700.

b. Identify and document any features of the HVAC that do not conform to the criteria in NUREG-0700.

4.5.2 Scope

The scope of the effort extends to the assessment of the HVAC in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- o Temperature and humidity
- o Ventilation.

4.5.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.1.5.1a and b and 6.1.5.2a and b.

The detailed definitions for each criterion are presented in Table 4-5.

4.5.4 Method

4.5.4.1 Data Collection

a. All required data forms, plant documentation, engineering drawings, equipment, and materials were made available prior to conduct of this task. Permission was obtained for all required access to the control room.

b. Data were collected using methods and procedures consisting of observations, measurements, and document reviews.

c. Plant documentation was reviewed to verify the items listed in the Document Review Checklist in the HVAC task plan. The required plant documents included:

   HVAC system specifications
   Plant temperature and humidity
   Historical data.

4.5.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the system involved, a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the HVAC task plan were annotated to indicate compliance or noncompliance with the criteria.

4.5.5 Findings

The findings of the HVAC survey are presented in Table 4-5 "HVAC Survey Findings and HEDs Generated." Overall, four criteria were applied to the HVAC systems in the Davis-Besse control room. All criteria was in compliance and no HEDs were generated.

TABLE 4-5
HVAC SURVEY FINDINGS & HEDs GENERATED Page 1 of 1

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.5.1 TEMPERATURE AND HUMIDITY					
a. **COMFORT ZONE** — The climate control system should be capable of maintaining temperature and humidity within the shaded area comfort zone shown in Figure 8-1.	M	YES			
b. **TEMPERATURE DIFFERENTIAL** — Air temperature at floor level and at head level should not differ by more than 10°F.	D	YES			
6.1.5.2 VENTILATION					
a. **AIR QUANTITY** — The ventilation system should be capable of introducing outdoor air into the control room at a rate of at at least 15 cubic feet per minute (cfm) per occupant.	D	YES			
b. **AIR VELOCITY** — Air velocities in the primary operating area should not exceed 45 feet per minute (fpm) measured at operator head level and should not produce a noticeable draught.	D	YES			

WHAT ABOUT THE TERRIBLE "DUST" PROBLEM IN THE CONTROL ROOM DUE TO THE INADEQUATE ROUGHING FILTERS ?

4.6 Emergency Equipment Survey

This section documents the results of the emergency equipment survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.6.1 Objectives

The objectives of the emergency equipment survey were to:

a. Assess the degree to which the emergency equipment in the control room conform to the criteria in NUREG-0700.

b. Identify and document any features of the emergency equipment that do not conform to the criteria in NUREG-0700.

4.6.2 Scope

The scope of the effort extended to the assessment of the emergency equipment in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- o Operators' protective equipment
- o Fire, radiation, and rescue equipment
- o Emergency equipment storage
- o Emergency lighting
- o Emergency communications
- o Operator compatibility with emergency gear.

The emergency equipment survey did not address emergency equipment lighting and communications outside the control room environment.

4.6.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.1.4.1a through i, 6.1.4.2a through e, 6.1.4.3a and b, 6.1.5.4a and b, 6.2.1.8a through c(3), 6.4.1.1d.

The detailed definitions for each criterion are presented in Table 4-6.

4.6.4 Method

4.6.4.1 Data Collection

a. Data were collected using the checklists contained in the emergency equipment task plan.

b. The emergency equipment evaluated was limited to equipment stored in immediate proximity to the primary operating area; specifically, breathing apparatus and air packs. No protective clothing was available in the CR at the time of this survey (see HED #1.3-1).

c. CR operators experienced in the use of the emergency equipment were observed donning and doffing the equipment. The operators were instructed to describe any problems encountered while using the equipment. Comments were noted and recorded.

4.6.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the equipment involved (e.g., protective clothing), a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the emergency equipment task plan were annotated to indicate compliance or noncompliance with the criteria.

4.6.5 Findings

The findings of the emergency equipment survey are presented in Table 4-6 "Emergency Equipment Survey Findings and HEDs Generated." Overall, 25 criteria were applied to the emergency equipment in the Davis-Besse control room. Of these, 3 (12%) were not applicable, 20 (80%) were in compliance, and two (8%) were not in compliance. One HED was generated which documents the two criteria which were not met. In general, the HED addresses the lack of protective clothing in the control room.

TABLE 6-6
EMERGENCY EQUIPMENT SURVEY FINDINGS & HEDs GENERATED Page 1 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.4.1 OPERATOR PROTECTIVE EQUIPMENT					
a. **TYPES OF EQUIPMENT** — Protective equipment should include protective clothing and breathing apparatus.	O	NO	P.1.3-1	III	
b. **ANTHROPOMETRY** — Protective clothing and breathing equipment should be compatible with operator body sizes and tasks to provide adequate tactile sensitivity and ability to see, reach, move, communicate, and hear.	O	YES			
c. **PERIODIC CHECKS** — Operator protective equipment should be periodically checked to determine if it is in good condition.	D	YES			
d. **QUANTITY** — There should be protective equipment available in sufficient quantities and sizes for the required number of operators.	O	YES			
e. **MARKING** — Protective clothing sizes should be clearly identifiable.	O	YES			
f. **EXPENDABLES** — There should be an adequate supply of personal protection equipment expendables, such as filters.	N/A	N/A			
g. **ACCESSIBILITY** — All protective equipment should be easily and readily accessible.	O	NO	P.1.3-1	III	
h. **TRAINING** — Operators should be well practiced in donning protective equipment.	D	YES			
i. **PROCEDURES** — Instructions for donning, doffing, and controlling personal protective equipment should be provided.	D	YES			

TABLE 4-6
EMERGENCY EQUIPMENT SURVEY FINDINGS & HEDs GENERATED Page 2 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.4.2 FIRE, RADIATION, AND RESCUE EQUIPMENT					
a. **PERIODIC CHECKS** — All equipment should be periodically checked to determine if it is in good condition.	D	YES			
b. **ACCESSIBILITY** — All equipment should be easily and readily accessible.	O	YES			
c. **TRAINING** — Operators should be trained in the use of all emergency equipment.	D	YES			
d. **PROCEDURES** — There should be a written, administratively approved procedure for each type of emergency or combination of emergencies.	D	YES			
e. **AUTOMATIC WARNING SYSTEM** — There should be an automatic fire warning system for control room fires.	O	YES			
6.1.4.3 EMERGENCY EQUIPMENT STORAGE					
a. **PROPER STORAGE** — Provision should be made for the orderly storage, in the control room, of emergency equipment that is needed by control room personnel.	O	YES			
b. **ACCESS** — The storage location(s) may be away from the primary operating area but should be accessible, clearly marked, and known to all personnel.	O	YES			
6.1.5.4 EMERGENCY LIGHTING					
a. **AUTOMATIC ACTION** — A control room emergency lighting system should be automatically activated and immediately available upon failure of the normal control room lighting system. This system should be independent of any other plant lighting system that is available in the control room	O	YES			

TABLE 4-6
EMERGENCY EQUIPMENT SURVEY FINDINGS & HEDs GENERATED Page 3 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.5.4 EMERGENCY LIGHTING (cont'd)					
b. **OPERABILITY** — Failure of the normal control room lighting system should not degrade operability of the emergency lighting system.	O	YES			
6.2.1.8 EMERGENCY COMMUNICATIONS					
a. **BACKUP EQUIPMENT** — Provisions should be made to assure complete internal and external communications capabilities during emergencies	O	YES			
b. **EQUIPMENT USABILITY** — Communications equipment should be usable by personnel wearing protective gear without impediment to their tasks.	O	YES			
c. **VOICE COMMUNICATIONS WITH MASKS**					
(1) Emergency face masks should be equipped with diaphragms that are specially designed to transmit speech.	N/A	N/A			
(2) The diaphragms should be able to separate voice from exhaust valve action.	N/A	N/A			
(3) If not equipped with diaphragms, masks should be equipped with electronic speech systems which pick up the voice with an internal microphone and transmit it to a loudspeaker attached outside the mask.	O	YES			
6.4.1.1 GENERAL PRINCIPLES					
d. **COMPATIBILITY WITH EMERGENCY GEAR** — If used while wearing protective equipment (e.g., oxygen masks, protective gloves), controls should be:	O	YES			
(1) Easy to identify.					
(2) Easy to activate.					

4.7 Maintainability Survey

This section documents the results of the maintainability survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.7.1 Objectives

The objectives of the maintainability survey were to:

a. Assess the degree to which components with integral lighting are operator maintainable as defined in NUREG-0700.

b. Assess the degree to which display failures are recognizable by the operator as defined in NUREG-0700.

c. Assess to what degree spare parts, operating expendables and special tools are available and adequate for use by the operator during operator maintenance activities as defined in NUREG-0700.

b. To identify and document any features in the control room operator maintainability design that do not conform to the criteria defined in NUREG-700.

4.7.2 Scope

The scope of the effort extends to the assessment of control room design features defined as maintenance performed by the operators in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The maintainability topics evaluated include:

- o Spare parts
- o Operating expendables
- o Tools
- o General requirements for voice communications systems
- o Lamp replacement of annunciator panels
- o Provisions for lamp failure on legend and nonlegend indicator lights
- o Characteristics and problems of indicator lights
- o General characteristics of graphic recorders.

The Maintainability Survey did not address the general control room or plant design for maintainability.

4.7.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.1.1.5a through f, 6.2.1.1b, 6.3.31c(1) through (3), 6.4.3.3c(1) through (4), 6.5.3.1a(1) through (3) and c(2), 6.5.4.1e and f.

The detailed definitions for each criterion are presented in Table 4-7.

4.7.4 Method

4.7.4.1 Data Collection

a. Data were collected using the checklist contained in the Maintainability Task Plan.

b. Since operating experience was required to assess compliance with the various maintainability guidelines, the necessary data were collected through interviews of CR operators.

c. All discrepancies were noted and recorded.

4.7.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the equipment involved (e.g., bulbs, chart paper, inking pens, etc.), a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the maintainability task plan were annotated to indicate compliance or noncompliance with the criteria.

4.7.5 Findings

The findings of the maintainability survey are presented in Table 4-7 "Maintainability Survey Findings and HEDs Generated." Overall, 20 criteria were applied in the maintainability survey in the Davis-Besse control room. Of those criteria 3 (15%) were in compliance. Seventeen (85%) were not in compliance. A total of 12 HEDs were generated which document all of the 17 criteria which were not met. In general, those HEDs address the lack of expendables or spare parts in the control room, lamp test, and lamp replacement.

TABLE 4-7
MAINTAINABILITY SURVEY FINDINGS & HEDs GENERATED Page 1 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.1.5 SPARE PARTS, OPERATING EXPENDABLES, AND TOOLS					
a. **SUPPLY** — There should be an adequate supply of expendables and spare parts: fuses, bulbs, ink and inking pens, recorder charts, printer paper, etc	I	NO	P.1.7-1	IC	
b. **ACCESSIBILITY** — Expendables and spare parts should be readily accessible.	I	NO	P.1.7-1	IC	
c. **TOOLS** — All necessary or special replacement tools needed to install expendables and spare parts should be available.	I	YES			
d. **STORAGE SPACE** — There should be adequate storage space for expendables and spare parts.	I	NO	P.1.1-2	III	
e. **CODING** — When different types, sizes, or styles of expendables and spare parts are required, they should be clearly and distinctively marked to avoid misapplication.	I	NO	P.1.7-5	IC	
f. **INVENTORY** — Records should be kept as to the status of expendables and spare parts.	I	NO	P.1.7-6	IC	
6.2.1.1 GENERAL REQUIREMENTS FOR VOICE COMMUNICATIONS SYSTEMS					
b. **PERIODIC MAINTENANCE TESTS** — These should be performed on all communication systems to ensure that the system is normally operative and effective under changes in ambient noise levels that may have occurred since the last check.	I	YES			

TABLE 4-7
MAINTAINABILITY SURVEY FINDINGS & HEDs GENERATED Page 2 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.3.1 VISUAL ANNUNCIATOR PANELS					
c. LAMP REPLACEMENT					
(1) If a lamp replacement requires legend tile removal, there should be a way to ensure that the tile is replaced in the correct location.	I	NO	P.1.7-8	III	Address in Annunciator Study.
(2) Lamp replacement should not subject the operator to a shock hazard.	I	NO	P.1.7-9	IC	
(3) Operator aids should be provided if needed for lamp replacement.	I	NO	P.1.7-3	--	Delete - Tool is available
6.4.3.3 LEGEND PUSHBUTTONS					
c. PROVISION FOR LAMP FAILURE					
(1) A lamp test or dual lamp/dual filament capability should be provided.	I	NO	P.1.7-10	IA	Address in Special Study
(2) Lamps within the pushbutton should be replaceable from the front of the panel.	I	YES			
(3) Legend pushbuttons should not short out during lamp replacement or be susceptible to inadvertent activation during the process of lamp removal or replacement.	I	NO	P.1.7-11	IA	
(4) Legend covers should be keyed to prevent the possibility of interchanging the covers.	I	NO	P.1.7-12	III	
6.5.3.1 CHARACTERISTICS AND PROBLEMS OF LIGHT INDICATORS					
a. PRECAUTIONS TO ASSURE AVAILABILITY					
(1) Dual-bulb or dual-filament light assemblies should be used.	I	NO	P.1.7-10	IC	Address in Special Study

TABLE 4-7
MAINTAINABILITY SURVEY FINDINGS & HEDs GENERATED Page 3 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.3.1 CHARACTERISTICS AND PROBLEMS OF LIGHT INDICATORS (Cont'd)					
a. **PRECAUTIONS TO ASSURE AVAILABILITY (Cont'd)**					
(2) Bulb-test capability should be provided.	I	NO	P.1.7-10	IA	Address in Special Study
(3) Design should encourage immediate replacement of burned-out bulbs by providing for rapid and convenient bulb replacement with power on and without hazard to personnel or equipment.	I	NO	P.1.7-11	IA	
c. **PRECAUTIONS TO AVOID MISINTERPRETATION**					
(2) Provisions (design or procedural) should be made to prevent interchanging indicator lenses.	I	NO	P.1.7-1?	III	
6.5.4.1 GENERAL CHARACTERISTICS OF GRAPHIC RECORDERS					
e. **AVAILABILITY OF EXPENDABLES** — Paper, ink, and other operator-maintained expendables should be provided and accessible in the control room.	I	NO	P.1.7-1	IC	
f. **EASE OF ROUTINE REPLENISHMENT** — Recorder design should permit quick and easy replenishment of paper and ink.	I	NO	P.1.7-7	IC	

4.8 Communications Survey

This section documents the results of the communications survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.8.1 Objectives

The objectives of the communications survey were to:

a. Assess the degree to which the communication systems in the control room conform to the criteria in NUREG-0700.

b. Identify and document any features of the communication systems that do not conform to the criteria in NUREG-0700.

4.8.2 Scope

The scope of the effort extends to the assessment of the communications survey design in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- o Requirements for voice communications
- o Conventional-powered telephone systems
- o Walkie-talkie transceivers
- o Announcing systems
- o Intercom system
- o Emergency communications
- o Auditory signals
- o Signal meanings
- o Auditory coding techniques
- o Signal intensity
- o Reliability of auditory alarms.

Criteria pertaining to auditory signals are also assessed under the noise survey and the annunciator survey.

4.8.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.1.3.1b; 6.2.1.1c(1) and (2); 6.2.1.2a through e; 6.1.1.3a through e;

6.2.1.4a through e; 6.2.1.5a through c; 6.2.1.6a through f; 6.2.1.7a and b; 6.2.1.8a through c; 6.2.2.1a through c; 6.2.2.2a through c; 6.2.2.3a through e; 6.2.24a and b; 6.2.2.4a and b; 6.2.2.5a and b; 6.2.2.6a through c; 6.2.2.7a through c.

The detailed definitions for each criterion are presented in Table 4-8.

4.8.4 Method

4.8.4.1 Data Collection

a. The results of the operator interviews were reviewed to identify any potential problem areas in the design and/or operation of the various Davis-Besse communications systems.

b. Data were collected using the checklists contained in the communications Task Plan. Data were collected primarily through direct observation of the performance characteristics (e.g., intelligibility) of the various communications. As necessary, system documents (e.g., technical specifications for public address system) were reviewed to augment or corroborate observations.

4.8.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the system involved (e.g., Gai-Tronics system, telephone system, meters, chart recorders, etc.), a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the communications task plan were annotated to indicate compliance or noncompliance with the criteria.

4.8.5 Findings

The findings of the communications survey are presented in Table 4-8 "Communications Survey Findings and HEDs Generated." Overall, 86 criteria were applied to the communications systems in the Davis-Besse control room. Of these, 29 (33%) were not applicable 48 (55%) were in compliance and nine (10%) were not in compliance. A total of 5 HEDs were generated which document all of the 9 criteria which were not met. In general, those HEDs address telephone cords in traffic path and annunciator alarm not directional.

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 1 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.3.1 UNIT INTEGRATION AND INTERFERENCE					
b. **SENIOR OPERATOR STATION** — Senior operators who supervise and assist operations of more than one unit need to be stationed so that they can communicate effectively with operators in each unit and have an unobstructed visual path to the control boards of each unit.	N/A	N/A			
6.2.1.1 GENERAL REQUIREMENTS FOR VOICE COMMUNICATION SYSTEMS					
c. **EMERGENCY MESSAGES**					
(1) OUTGOING — Priority procedures should be established for the transmission of emergency messages from the control room by any of the communication systems.	O	YES			
(2) INCOMING — Procedures should be established for handling communications during an emergency and these procedures must be known by all operators.	O	YES			
6.2.1.2 CONVENTIONAL-POWERED TELEPHONE SYSTEMS					
a. **FREQUENCY RESPONSE** — The powered telephone system must provide good frequency response in that portion of the auditory spectrum most essential for intelligibility. Standard telephone bandpass is acceptable (200-3300 Hz).	I	YES			
b. **HANDSETS** — Design should incorporate the following features:	O	YES			
(1) Size and shape should be compatible with operator's hand size and mouth-ear distance (standard telephone dimensions acceptable).					

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 2 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.2 b.(Cont'd)					
(2) Should maintain firm ear contact by receiver while transmitter is positioned to receive voice waves directly from mouth.	O	YES			
(3) Cords should be of nonkink or self-retracting type.	O	YES			
(4) Cords should be of sufficient length to permit reasonable operator mobility.	O	YES			
(5) Cords should be positioned so as to avoid entangling critical controls or endangering passing traffic.	O	NO	P.2.1-2	III	Review and replace cords as necessary.
(6) Vertically mounted handset cradles should be designed and located to prevent the handset from being knocked out of the cradle by passing traffic.	O	NO	P.2.1-3	III	
(7) Where multiple telephone instruments are located close together (e.g., on a single desk) they should be coded to indicate circuit or function.	O	YES			
(8) If a press-to-talk button is used, the button should be convenient to both left and right hand operation.	O	YES			
c. SWITCHING MECHANISM —					
(1) Switching should be designed and/or programmed to minimize delay in making desired connections under both normal and emergency conditions.	O	YES			
(2) Switching should be programmed to give the control room automatic priority of access to the switching system.	O	YES			
d. TELEPHONE RINGING — Loudness of ringing should be adjustable at the individual telephone instrument.	O	NO	P.2.1-4	III	No action required.

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 3 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.2 (Cont'd)					
e. ANNOUNCING USE — When transmitters, within the powered telephone system, are used as the microphone input to the announcing system, the transmitter should be compatible with the rest of the announcing system.	N/A	N/A			
6.2.1.3 SOUND-POWERED TELEPHONE SYSTEMS					
a. SOUND QUALITY — Within engineering constraints imposed by sound-powering, the system should provide:					
(1) Good frequency response in the band from 200 to 3300 Hz (standard telephone quality).	N/A	N/A			
(2) In-phase feedback to the user.	N/A	N/A			
b. HEADSETS — Headsets should reflect the following design requirements:					
(1) Earphone cushioning to provide comfort for extended periods of wear. Earphones should cover the outer ear but without causing uncomfortable pressure.	N/A	N/A			
(2) Supporting structure for earpieces should not impose discomforts of weight, concentrated pressures, or metal contact with the skin.	N/A	N/A			
(3) The earpiece should be held firmly in place, yet be easy to remove.	N/A	N/A			
(4) Ideally, headsets should provide hands-free operation. This may have to be compromised, however, to accommodate a push-to-talk switch in anticipation of possible use in areas of high ambient noise.	N/A	N/A			

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 4 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.3b (Cont'd)					
(5) Biaural headsets should be available for use by control room personnel when they are required to leave the control room for plant areas with high ambient noise levels and communicate with the control room from these areas using sound-powered communication equipment.	N/A	N/A			
(6) A well-marked and accessible place should be provided for headset stowage.	N/A	N/A			
c. RINGING —					
(1) Need for ringing must be determined for the individual plant depending on the sound-powered phone procedures.	N/A	N/A			
(2) If ringing is not installed, then the user should be provided capability for directly switching the sound-powered transmitter to the paging system so that a desired party can be called to the line.	N/A	N/A			
d. JACK PROVISIONS —					
(1) Plug-in jacks for the sound-powered system should be provided within the control room.	N/A	N/A			
(2) Jacks should be located close to the work stations to prevent need for unduly long cords.	N/A	N/A			
(3) Jacks should not accommodate plugs of the conventionally powered phone system, in order to avoid wrong instrument-system connections.	N/A	N/A			
e. SWITCHING —					
(1) The requirements for switching must be assessed for the individual plant depending on procedures for use of sound-powered phones.	N/A	N/A			

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 5 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.3 e. (Con't)					
(2) Patch panels, when used, should be conspicuously marked and located in reasonably accessible places. These requirements are particularly critical in back-panel areas.	N/A	N/A			
(3) A complete set of cords should be provided at each panel if cord-type patching is used.	N/A	N/A			
6.2.1.4 WALKIE-TALKIE TRANSCEIVERS					
a. **SOUND QUALITY** — Within the engineering constraints imposed by radio frequency spectrum availability and by design for easy portability, walkie-talkies should realize the same quality desired throughout all of the communications systems, namely:					
(1) Good frequency response, preferably to telephone standards of 200 to 3300 Hz.	O	YES			
(2) Sufficient dynamic range and gain to handle instantaneous pressures found in speech and develop necessary signal level at the headphone or loudspeaker.	O	YES			
b. **AREA COVERAGE** —					
(1) Modulation and a radio frequency should be chosen, as FCC regulations permit, to provide broad-area walkie-talkie communication to the control room. One consideration for frequency selection should be radio-wave penetration of metal or reinforced concrete barriers, which at certain frequencies would tend to attenuate or bounce the signal.	O	YES			

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 6 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.4b (Cont'd)					
(2) Use of walkie-talkies should be prohibited in areas close to low-level analog or digital equipment unless EMI noise susceptibility tests have been conducted that demonstrate that equipment is not affected by the frequency bands used.	O	YES			
c. PACKAGING —					
(1) To the extent permitted by design for effective electrical/RF function, walkie-talkies should be small, light, and easy to carry.	O	YES			
(2) Their use should leave one hand, and preferably both, available most of the time for other tasks.	O	YES			
(3) The microphone should be integrated into the transceiver package.	O	YES			
d. PARTY IDENTIFICATION — When there are more than two parties on a channel operating at separate locations, procedures must provide for unambiguous identification of the speaker.	O	YES			
e. BATTERY REPLENISHMENT —					
(1) A supply of fresh replacement batteries should be stowed in an accessible, well-marked space.	N/A	N/A			
(2) The stock should be kept large enough to support long periods of continuous operation in case of emergency.	N/A	N/A			

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 7 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.5 FIXED-BASE UHF TRANSCEIVERS					
a. **SIGNAL QUALITY** — Unlike walkie-talkies, fixed-base UHF transceivers are not constrained by being designed for portability. Therefore, they should readily achieve good voice intelligibility, provided by adequate frequency response at least within telephone standards of 200 to 3300 Hz. They should exhibit sufficient dynamic range to handle instantaneous pressures found in speech and develop sufficient gain to develop the necessary signal level at the loudspeaker.	N/A	N/A			
b. **GAIN** — Gain should be adjustable, but the gain control should be limited so that even at its lowest setting an audible signal is still presented.	N/A	N/A			
c. **PROCEDURES** — Procedures should be established (and conspicuously posted) for use of the system.	O	YES			
6.2.1.6 ANNOUNCING SYSTEMS					
a. **INTELLIGIBILITY AND COVERAGE** —					
(1) Intelligibility requires the integration of carefully selected components (microphones, amplifiers, and loudspeakers) into an overall system providing good frequency response in the audio band which is critical for intelligibility. At a minimum, telephone quality is required (200 to 3300 Hz); higher intelligibility is achieved by a band of 200 to 6100 Hz.	I D	YES			
(2) Coverage depends on loudspeaker location. Adequate coverage requires that speakers should be placed so that they are available in all necessary areas and that there are no "dead spots" within any area.	O	YES			

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 8 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.6 (Cont'd)					
b. MICROPHONE CHARACTERISTICS —					
(1) Frequency response should be compatible with that of the rest of the system.	O	YES			
(2) If the powered telephone system is used to provide microphone input to the announcing system, the telephone system should contain transmitters of quality compatible with that of the announcing system.	N/A	N/A			
(3) Microphones should have high sensitivity to speech signals.	O	YES			
(4) Dynamic range should permit 50 dB variations in signal input.	O	YES			
(5) Microphone input should be provided within the control room.	O	YES			
c. LOUDSPEAKER LOCATION					
(1) Speakers should be provided in the control room and other areas where control room personnel operations might be (e.g., restrooms, eating areas, locker rooms, etc.).	O	YES			
(2) Speakers should be placed to yield an intelligible level of signal throughout the area.	O	YES			
d. SPEECH CLARITY — Since proper speech over an announcing system differs from normal conversation, operators should be familiarized with the proper way to speak on the announcing system.	O	YES			
e. LOUDSPEAKER VOLUME —					
(1) Speaker volume should be adjusted to ensure that speaker communications will not prevent detection of auditory alarms.	O	YES			

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 9 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.6e (Cont'd)					
(2) Audio gain controls (if provided) should be limited to preclude reducing volume below an audible level.	O	YES			
f. PRIORITY — Control room inputs to the plant announcing system should have priority over any other input. The control room input should be capable of interrupting an announcement in progress, or of bypassing queued announcements.	O	YES			
6.2.1.7 POINT-TO-POINT INTERCOM SYSTEMS					
a. INTELLIGIBILITY — At a minimum, the intercom system should provide transmission of the voice spectrum to telephone standards (200 to 3300 Hz).	I	YES			
b. GAIN ADJUSTMENT — Gain should be adjustable at each intercom unit, but adjustability should be limited to preclude reducing volume below an audible level.	O	YES			
6.2.1.8 EMERGENCY COMMUNICATIONS					
a. BACKUP EQUIPMENT — Provisions should be made to assure complete internal and external communications capabilities during emergencies.	O	YES			
b. EQUIPMENT USABILITY — Communications equipment should be usable by personnel wearing protective gear without impediment to their tasks.	O	YES			
c. VOICE COMMUNICATIONS WITH MASKS					
(1) Emergency face masks should be equipped with diaphragms that are specially designed to transmit speech.	N/A	N/A			

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 10 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.1.8c (Cont'd)					
(2) The diaphragms should be able to separate voice from exhaust valve action.	N/A	N/A			
(3) If not equipped with diaphragms, masks should be equipped with electronic speech systems which pick up the voice with an internal microphone and transmit it to a loudspeaker attached outside the mask.	O	YES			
6.2.2.1 USE OF AUDITORY SIGNALS					
a. DEDICATED USE — Systems used to transmit nonverbal auditory signals should be used only for that purpose.	N/A	N/A			
b. LOCALIZATION — Auditory signals should provide localization cues that direct operators to those control room work stations where operator attention is required.	O	NO	P.2.1-9	III	
c. SELECTION —					
(1) Auditory signals should be selected to avoid confusion with ambient control room noises.	O	NO	P.1.6-2	IIC	
(2) Auditory signals should be selected to avoid interference with other auditory sources, including verbal communication.	O	YES			
6.2.2.2 SIGNAL MEANING					
a. The meaning of each auditory signal should be clear and unambiguous.	O	YES			
b. Similar auditory signals must not be contradictory in meaning with one another.	O	YES			
c. Auditory signals intended to alert the operator to a malfunction or failure must be different from routine signals such as bells, buzzers, and normal operating noises.	O	YES			

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 11 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.2.3 AUDITORY CODING TECHNIQUES					
a. **DISTINCTIVE CODING** — Coding methods should be distinct and unambiguous, and should not conflict with other auditory signals.	O	YES			
b. **PULSE CODING** — Auditory signals may be pulse coded by repetition rate, but the number of codes should be limited (2 or 3). Repetition rates should be sufficiently separated to ensure operator discrimination.	N/A	N/A			
c. **FREQUENCY CHANGE CODING** — If modulation of the frequency (Hz) of a signal denotes information, center frequencies should be between 500 and 1000 Hz.	N/A	N/A			
d. **DISCRETE-FREQUENCY CODING** — Discrete-frequency codes may be used for audible signal coding. Frequencies should be broad band (±100 Hz) and widely spaced within the 200-5000 Hz range. No more than 5 separate frequencies should be used.	N/A	N/A			
e. **CODING BY INTENSITY** — Coding by intensity is not recommended.	O	YES			
6.2.2.4 PROPAGATION OF SIGNALS					
a. **DIRECTION OF SOUND** — Sound sources (speakers, buzzers, etc.) should direct sound toward the center of the primary operating area.	O	NO	P.2.1-12	III	
b. **AUDIBILITY** — Auditory alert and warning signals should be audible in all parts of the control room.	O	NO	P.1.6-2	IIC	
6.2.2.5 FREQUENCY					
a. **RANGE** — Auditory signal frequencies should be between 200 and 500 Hz. The optimum frequency range is between 500 and 3000 Hz.	O	YES			Compliance assessed in Noise Survey

TABLE 4-8
COMMUNICATIONS SURVEY FINDINGS & HEDs GENERATED Page 12 of 12

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.2.2.5 (Cont'd					
b. **BANDWIDTH** — Wide-band auditory signals of approximately 200 Hz should be used.	O	YES			
6.2.2.6 SIGNAL INTENSITY					
a. **GENERAL** — In general, a system capability to develop a signal-to-noise ratio of 20 dB in at least one octave band between 200 an 5000 Hz should be adequate for all control rooms and environments. This signal-to-noise ratio capability should apply throughout the primary operating area. However, a 20 dB differential may not be necessary for all signals and all environments. A normal value of 10 dB(A) above average ambient noise is generally adequate (See Guideline 6.3.2.1.)	O	YES			
b. **COMFORT** — Auditory signal intensity should not cause discomfort or "ringing" in the ears.	O	NO	P.3.1-9	IC	Assessed in Annunciator Survey.
c. **MAXIMUM INTENSITY** — Auditory signal intensities should not exceed 90 dB(A), except for evacuation signals, which may be up to 115 dB(A).	M	YES			Assessed in Noise Survey.
6.2.2.7 RELIABILITY					
a. **FAILURE OF ALARM CIRCUITRY** — Failure of auditory signal circuitry should not adversely affect plant equipment.	O	YES			
b. **FALSE ALARMS** — Auditory alarm systems should be designed so that false alarms are avoided.	O	NO	P.3.1-21	IIC	
c. **SYSTEM TEST** — Auditory signal system test capabilities should be provided.	O	YES			

4.9 Annunciator Survey

This section documents the results of the annunciator survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.9.1 Objectives

The objectives of the annunciator survey were to:

a. Assess the degree to which the annunciator system in the control room conforms to the criteria in NUREG-0700.

b. Identify and document any features of the annunciator system that do not conform to the criteria in NUREG-0700.

4.9.2 Scope

The scope of the effort extends to the assessment of the annunciator system design in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- o General system design
- o Alarm parameter selection
- o First out annunciators
- o Prioritization
- o Cleared alarms
- o Signal detection
- o Auditory coding
- o Visual annunciator panels
- o Visual alarm recognition and identification
- o Arrangement of alarm tiles
- o Tile legends
- o Tile readability
- o Annunciator controls
- o Annunciator response procedures.

4.9.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.3.1.1; 6.3.1.2a through d(2); 6.3.1.3a through d; 6.3.1.4a and b; 6.3.1.5a through b(3); 6.3.2.1a through f; 6.3.3.1a through b(2); 6.3.2.2a and b; 6.3.3.1a through c(3);

6.3.3.2a through f(2); 6.3.3.3a through f; 6.3.3.4a through d; 6.3.3.5a through d(6); 6.3.4.1a through d(2); 6.3.4.2a through c; 6.3.4.3a and b; 6.5.1.6a through c(2) and e(1) through 3(3); and 6.6.6.2a, b, and c.

The detailed definitions for each criterion are presented in Table 4-9.

4.9.4 Method

4.9.4.1 Data Collection

a. Data collected during the operator interviews were reviewed to identify any potential problems in the design or operation of the annunciator system.

b. Data were collected using the checklists contained in the annunciator task plan.

c. Data were collected primarily through measurement and direct observation of the annunciator system in the CR. As necessary, system documentation (e.g., P&IDs, electrical drawings, annunciator response procedures) were reviewed to augment and corroborate observations and interviews.

4.9.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the components or system involved, a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the annunciator task plan were annotated to indicate compliance or noncompliance with the criteria.

4.9.5 Findings

The findings of the annunciator survey are presented in Table 4-9 "Annunciator Survey Findings and HEDs Generated." Overall, 98 criteria were applied to the annunciator system in the Davis-Besse control room. Of these, 25 (26%) were not applicable, 38 (39%) were in compliance and thirty-five (36%) were not in compliance. A total of 30 HEDs were generated which document all of the 35 criteria which were not met. In general, those HEDs address auditory signals, annunciator controls, distinctive coding of annunciator tiles, nuisance alarms, alarm messages, multi-input alarms, annunciator response procedures, and annunciator tile grouping and prioritization.

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 1 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.1.1 GENERAL SYSTEM DESIGN					
Annunciator warning systems are the primary control room interface to immediately alert the operator to out-of-tolerance changes in plant condition. Annunciator warning systems consist of three major subsystems: (a) an auditory alert subsystem, (b) a visual alarm subystem, and (c) an operator response subsystem (see Exhibit 6.3-1). Together, these three subsystems should be designed to provide a preferred operational sequence for annunciator warnings as indicated in Exhibit 6.3.2	D	YES			
6.3.1.2 ALARM PARAMETER SELECTION					
a. SET POINTS — The limits or set points for initiating the annunciator warning system should be established to meet the following goals:					
(1) Alarms should not occur so frequently as to be considered a nuisance by the operators.	I	NO	P.3.1-21	IIC	Assess in Annunc. Study.
(2) However, set points should be established to give operators adequate time to respond to the warning condition before a serious problem develops.	I	YES			
b. GENERAL ALARMS —					
(1) Alarms that require the control room operator to direct an auxiliary operator to a given plant location for specific information should be avoided.	I	NO	P.3.1-24	IIC	Assess in Annunc. Study.
(2) If general alarms must be used, they should only be used for conditions that allow adequate time for auxiliary operator action and subsequent control room operator action.	I	YES			

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 2 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.1.2 (Cont'd)					
c. MULTICHANNEL OR SHARED ALARMS —					
(1) Annunciators with inputs from more than one plant parameter set point should be avoided. Multi-input alarms that summarize single-input annunciators elsewhere in the control room are an exception.	D	NO	P.3.1-37	IIA	Asses in Annunc. Study.
(2) Where multi-input annunciators must be used, an alarm printout capability should be provided. The specifics of the alarm should be printed on an alarm typer with sufficient speed and buffer storage to capture all alarm data.	I	NO	P.3.1-28	IIC	Assess in Annunc. Study.
			P.3.1-29	IIC	Being addressed in computer design program.
(3) A reflash capability should be provided to allow subsequent alarms to activate the auditory alert mechanism and reflash the visual tile even though the first alarm may not have been cleared.	I	NO	P.3.1-27	IIC	Assess in Annunc. Study.
d. MULTI-UNIT ALARMS —					
(1) Alarms for any shared plant systems should be duplicated in all control rooms.	N/A	N/A			
(2) When an item of shared equipment is being operated from one control room a status display or signal should be provided in all other control rooms which could potentially control this equipment.	N/A	N/A			
6.3.1.3 FIRST OUT ANNUNCIATORS					
a. REACTOR SYSTEM —					
(1) A separate first out panel should be provided for the reactor system.	O	NO	P.3.1-30	IIC	Assess in Annunc. Study.

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 3 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.1.3a (Cont'd)					
(2) The first out panel should consist of separate annunciator tiles for each of the automatic reactor trip functions.	I	YES			
(3) In the event of a reactor trip, the tile associated with the event should illuminate, and no other.	I	NO	P.3.1-30	IIC	
b. TURBINE-GENERATOR SYSTEM — A separate first out panel, similar in function to the reactor system panel, is recommended.	O	NO	P.3.1-31	III	
c. POSITION — First out panels should be located directly above the main control work station for the system.	N/A	N/A			
d. APPLICATION — First out annunciators should conform to the general auditory, visual, and operator response guidelines of this section.	N/A	N/A			
6.3.1.4 PRIORITIZATION					
A. LEVELS OF PRIORITY —					
(1) Prioritization should be accomplished using a relatively small (2-4) number of priority levels.	O	YES			
(2) Prioritization should be based on a continuum of importance, severity, or need for operator action in one or more dimensions, e.g., likelihood of reactor trip, release of radiation. Exhibit 6.3-3 provides an example of prioritization based on three levels of prioritization..	O	NO	P.3.1-39	IIC	Assess in Annunc. Study.

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 4 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.1.4 (Cont'd)					
b. PRIORITY CODING —					
(1) Some method for coding the visual signals for the various priority levels should be employed. Acceptable methods for priority coding include color, position, shape, or symbolic coding.	I	NO	P.3.1-39	IIC	Assess in annunc. study
(2) Auditory signal coding for priority level is also appropriate. See Guideline 6.2.2.3 for recommended coding techniques.	I	NO	P.3.1-39	IIC	
6.3.1.5 CLEARED ALARMS					
a. AUDITORY SIGNAL — Cleared alarms should have a dedicated, distinctive audible signal which should be of finite duration.	O	NO	P.3.1-41	IIC	
b. VISUAL SIGNAL — The individual tile should have one of the following:	O	YES			
(1) A special flash rate (twice or one-half the normal flash rate is preferred, to allow discrimination), or					
(2) Reduced brightness, or	N/A	N/A			
(3) A special color, consistent with the overall control room color coding scheme, produced by a differently colored bulb behind the tile.					
6.3.2.1 SIGNAL DETECTION					
a. INTENSITY — The signal should be such that operators can reliably discern the signal above the ambient control room noise. A nominal value of 10 dB(A) above average ambient noise is generally adequate.	M	YES			

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 5 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.2.1 (Cont'd)					
b. **CONTROL** — Signal intensity, if adjustable, should be controlled by administrative procedure.	D	YES			
c. **LIMITS** — The signal should capture the operator's attention but should not cause irritation or a startled reaction.	I	NO	P.3.1-9	IC	
d. **DETECTION** — Each auditory signal should be adjusted to result in approximately equal detection levels at normal operator work stations in the primary operating area.	I	NO	P.3.1-10	IC	
e. **RESET** — The annunciator auditory alert mechanism should automatically reset when it has been silenced.	N/A	N/A			
f. **IDENTIFICATION** — The operator should be able to identify the work station or the system where the auditory alert signal originated. Separate auditory signals at each work station within the primary operating area are recommended.	I	NO	P.3.1-6	III	
6.3.2.2 AUDITORY CODING					
a. **LOCALIZATION**					
(1) Auditory coding techniques should be used when the operator work station associated with the alarm is not in the primary operating area.	I	N/A			
(2) Coded signals from a single audio source should not be used to identify individual work stations within the primary operating area.	I	N/A			
b. **PRIORITIZATION** — Coding may be used to indicate alarm priority. (See Guideline 6.3.1.4.)	I	NO	P.2.1-9	III	

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 6 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.3.1 VISUAL ANNUNCIATOR PANELS					
a. **LOCATION** — Visual alarm panels should be located above the related controls and displays which are required for corrective or diagnostic action in response to the alarm. (See Exhibit 6.3-4.)	I	NO	P.3.1-23	IIC	Assess in Annunc. Study.
b. **LABELING**—					
(1) Each panel should be identified by a label above the panel.	I	YES			
(2) Panel identification label height should be consistent with a subtended visual angle of a least 15 minutes when viewed from a central position within the primary operating area.	I	YES			
6.3.3.2 VISUAL ALARM RECOG AND IDENT					
a. **FLASHING** — The specific tile(s) on an annunciator panel should use flashing illumination to indicate an alarm condition.	O	YES			
b. **FLASH RATE** — Flash rates should be from three to five flashes per second with approximately equal on and off times.	O	YES			
c. **FLASHER FAILURE** — In case of flasher failure of an alarmed tile, the tile light should illuminate and burn steadily.	I	NO	P.3.1-20		Pending - Eng. study.
d. **CONTRAST DETECTABILITY** — There should be high enough contrast between alarming and steady-on tiles, and between illuminated and nonilluminated tiles, so that operators in a normally illuminated control room have no problem discriminating alarming, steady-on, and steady-off visual tiles.	O	YES			

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HED's GENERATED Page 7 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.3.2 (Cont'd)					
e. "DARK" ANNUNCIATOR PANELS — A "dark" annunciator panel concept should be used. This means that under normal operating conditions no annunciators would be illuminated; all of the visual tiles of the annunciator panels would be "dark."	O	NO	P.3.. 17	IIC	Assess in Annunc. Study.
f. EXTENDED DURATION ILLUMINATION — If an annunciator tile must be "ON" for an extended period during normal operations (e.g., during equipment repair or replacement), it should be:	D	NO	P.3.1-18	IIC	Assess in Annunc. Study.
(1) Distinctively coded for positive recognition during this period, and					
(2) Controlled by administravie procedures.	N/A	N/A			
6.3.3.3 ARRANGEMENT OF VISUAL ALARM TILES					
a. MATRIX ORGANIZATION — Visual alarms should be organized as a matrix of visual alarm tiles within each annunciator panel.	O	YES			
b. FUNCTIONAL GROUPING — Visual alarm tiles should be grouped by function or system within each annunciator panel. For example area radiation alarms should be grouped on one panel, not spread throughout the control room.	D	NO	P.3.1-38	IIC	Assess in Annunc. Study.
c. LABELING OR AXES —					
(1) The vertical and horizontal axes of annunciator panels should be labeled with alphanumerics for ready coordinate designation of a particular visual tile.	O	NO	P.3.1-35	III	

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 8 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.3.3c (Cont'd)					
(2) Coordinate designation is preferred on the left and top sides of the annunciator panel.	O	NO	P.3.1-34	III	Assess in Annunc. Study.
(3) Letter height for coordinate designation should be consistent with a subtended visual angle of at least 15 minutes as viewed from a central position within the primary operating area.	O	YES			
d. PATTERN RECOGNITION —					
(1) The number of alarm tiles and the matrix density should be kept low (a maximum of 50 tiles per matrix is suggested).	O	NO	P.3.1-33	III	Assess in Annunc. Study.
(2) Tiles within an annunciator panel matrix should be grouped by sub system, function, or other logical organization.	D	NO	P.3.1-38	IIC	Assess in Annunc. Study.
e. OUT-OF-SERVICE ALARMS — Cues for prompt recognition of an out-of-service annunciator should be designed into the system.	I	NO	P.3.1-19	III	
f. BLANK TILES — Blank or unused annunciator tiles should not be illuminated (except during annunciator testing)	O	YES			
6.3.3.4 VISUAL TILE LEGENDS					
a. UNAMBIGUOUS — Annunciator visual tile legends should be specific and unambiguous. Wording should be in concise, short messages.	O	NO	P.3.1-40	IIC	Assess in Annunc. Study.
b. SINGULARITY — Alarms which refer the operator to another, more detailed annunciator panel located outside the primary operating area should be minimized.	I	NO	P.3.1-25	III	Assess in Annunc. Study.

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 9 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.3.4 (Cont'd)					
c. **SPECIFICITY** — Tile legends should address specific conditions; for example, do not use one alarm for HIGH-LOW, TEMPERATURE-PRESSURE.	I	NO	P.3.1-26	IIC	Assess in Annunc. Study.
6.3.3.5 VISUAL TILE READABILITY					
a. **DISTANCE** — The operator should be able to read all the annunciator tiles from the position at the work station where the annunciator acknowledge control is located.					
(1) Letter height should subtend a minimum visual angle of 15 minutes, or .004 x viewing distance. The preferred visual angle is 20 minutes, or .006 x viewing distance.	O	YES			
(2) Letter height should be identical for all tiles, based on the maximum viewing distance. Separate calculations should be made for stand-up and sit-down work stations.	M	YES			
b. **TYPE STYLE** — The size and style of lettering should meet the following:					
(1) Type styles should be simple.	O	YES			
(2) Type styles should be consistent on all visual tiles.	O	NO	P.3.1-32	III	Address in Labeling Study.
(3) Only upper-case type should be used on visual tiles.	O	YES			
c. **LEGEND CONTRAST** — Legends should provide high contrast with the tile background.					
(1) Legends should be engraved.	O	YES			
(2) Legends should be dark lettering on a light background.	O	YES			

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 10 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.3.5 (Cont'd)					
d. LETTER DIMENSIONS AND SPACING —					
(1) Stroke-width-to-character-height ratio should be between 1:6 and 1:8.	M	YES			
(2) Letter width-to-height ratio should be between 1:1 and 3:5.	M	YES			
(3) Numeral width-to-height ratio should be 3:5.	M	YES			
(4) Minimum space between characters should be one stroke width.	M	YES			
(5) Minimum space between words should be the width of one character.	M	YES			
(6) Minimum space between lines should be one-half the character height.	M	YES			
6.3.4.1 CONTROLS (See Exhibit 6.3-5.)					
a. SILENCE —					
(1) Each set of operator response controls should include a silence control.	O	NO	P.3.1-11	IIA	
(2) It should be possible to silence an auditory alert signal from any set of annunciator response controls in the primary operting area.	N/A	N/A			
b. ACKNOWLEDGE					
(1) A control should be provided to terminate the flashing of a visual tile and have it continue at steady illumination until the alarm is cleared.	I	YES			

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 11 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.4.1 (Cont'd)					
(2) Acknowledgement should be possible only at the work station where the alarm originated.	I	N/A			
c. **RESET**					
(1) If an automatic cleared alarm feature is not provided, a control should be provided to reset the system after an alarm has cleared.	I	NO	P.3.1-13	IIC	Assess in Annunc. Study.
(2) The reset control should silence any audible signal indicating clearance and should extinguish tile illumination.	I	NO	P.3.1-14	IIC	Assess in Annunc. Study.
(3) The reset control should be effective only at the work station for the annunciator panel where the alarm initiated.	I	NO	P.3.1-15	III	Assess in Annunc. Study.
d. **TEST**					
(1) A control to test the auditory signal and flashing illumination of all tiles in a panel should be provided.	I	YES			
(2) Periodic testing of annunciators should be required and controlled by administrative procedure.	I	YES			
6.3.4.2 CONTROL SET DESIGN					
a. **POSITIONING OF REPETITIVE GROUPS** — Repetitive groups of annunciator controls should have the same arrangement and relative location at different work stations. This is to facilitate "blind" reaching.	N/A	N/A			
b. **CONTROL CODING** — Annunciator response controls should be coded for easy recognition using techniques such as:	O	YES			

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 12 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.4.2b. (Cont'd)					
(1) Color coding;	O	YES			
(2) color shading the group of annunciator controls;	O	YES			
(3) demarcating the group of annunciator controls; or	O	YES			
(4) shape coding, particularly the silence control. (See Exhibit 6.3-5, Example 2.)	N/A	N/A			
c. NONDEFEATABLE CONTROLS — Annunciator control designs should not allow the operator to defeat the control. For example, some pushbuttons used for annunciator silencing and acknowledgement can be held down by inserting a coin in the ring around the pushbutton. This undesirable design feature should be eliminated.	I	N/A			
6.3.4.3 ANNUNCIATOR RESPONSE PROCEDURES					
a. AVAILABILITY — Annunciator response procedures should be available in the control room.	I	YES			
b. INDEXING — Annunciator response procedures should be indexed by panel indentification and annunciator tile coordinates.	D	NO	P.3.1-36	IIC	
6.5.1.6 COLOR CODING					
a. REDUNDANCY — In all applications of color coding, color should provide redundant information. That is, the pertinent information should be available from some other cue in addition to color.	N/A	N/A			See Conventions Survey Report

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 13 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6 (Cont'd)					
b. NUMBER OF COLORS —					
(1) The number of colors used for coding should be kept to the minimum needed for providing sufficient information.	N/A	N/A			See Conventions Survey Report
(2) The number of colors used for coding should not exceed 11.	N/A	N/A			See Conventions Survey Report
c. MEANING OF COLORS —					
(1) The meaning attached to a particular color should be narrowly defined.	N/A	N/A			See Conventions Survey Report
(2) Red, green, and amber (yellow) should be reserved for the following uses: Red: unsafe, danger, immediate operator action required, or an indication that a critical parameter is out of tolarance. Green: safe, no operator action required, or an indication that a parameter is within tolerance. Amber (yellow): hazard (potentially unsafe), caution, attention required, or an indication that a marginal value or parameter exists	N/A	N/A			See Conventions Survey Report
d. PRINCIPLES OF COLOR SELECTION					
(1) The primary principle which should be applied in selecting colors for coding purposes which do not have the immediate safety implications of red, green, and amber is to ensure that each color is recognized as different from any other. Exhibit 6.5-7 lists 22 colors of maximum contrast. Each successive color has been selected so that it will contrast maximally with the color just preceding it and satisfactorily	N/A	N/A			See Conventions Survey Report

TABLE 4-9
ANNUNCIATOR SURVEY FINDINGS & HEDs GENERATED Page 14 of 14

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6d(1) (Cont'd)					
with earlier colors in the list. The first 9 colors have been selected so as to yield satisfactory contrast for red-green-deficient as well as color-normal observers. The remaining 13 colors are useful only for color-normal observers.					
(2) Colors selected for coding should contrast well with the background on which they appear.	O	YES			
(3) Ambient lighting in the area in which color coding is used will influence the apparent color of the coded element (especially for surface colors). Each color selected for coding should be evaluated under all illumination conditions under which it is used.	O	YES			
6.6.6.2 DEMARCATION					
a. USE — Lines of demarcation can be used to:					
(1) Enclose functionally related displays.	N/A	N/A			
(2) Enclose functionally related controls	N/A	N/A			
(3) Group related controls and displays.	N/A	N/A			
b. CONTRAST — Lines of demarcation should be visually distinctive from the panel background.	N/A	N/A			
c. PERMANENCE — Lines of demarcation should be permanently attached.	N/A	N/A			

4.10 Controls Survey

This section documents the results of the controls survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.10.1 Objectives

The objectives of the controls survey were to:

a. Assess the degree to which all controls in the control room conform to the criteria in NUREG-0700.

b. Identify and document any features of the controls that do not conform to the criteria in NUREG-0700.

4.10.2 Scope

The scope of the effort extends to the assessment of the control design in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The control topics evaluated include:

- o General principles of control design
- o Prevention of accidental activation
- o Direction of movement
- o Coding of controls
- o Pushbutton design
- o Round pushbuttons
- o Legend pushbuttons
- o Rotary selector controls
- o J-Handle controls
- o Continuous adjustment rotary controls
- o Thumbwheels
- o Slide switches
- o Toggle switches
- o Separation of controls.

Several NUREG-0700 guidelines appropriate to controls were addressed as part of task analysis and task verification and validation activities. These have, therefore, been incorporated into the verification and validation evaluation reports.

4.10.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.4.1.1a(1) through c(2) and e(1) through e(3); 6.4.1.2a through g; 6.4.2.1; 6.4.2.2c(1) through c(4), e and f(1) through f(3); 6.4.3.1b and c; 6.4.3.2a(1) through d; 6.4.3.3.b(1), (2), (4), (5) and d(1) through e(5); 6.4.4.1a; 6.4.4.2a(1) through b; 6.4.43a through g(3); 6.4.4.4a through e(5); 6.4.4.5a through f; 6.4.5.1a through d(2)(e); 6.4.5.2a through b(2); 6.4.5.3a through c(6); 6.4.5a(1) through e(4); 6.5.1.6a through c(2) and d(3) through e(3); and 6.8.3.1a through c.

The detailed definitions for each criterion are presentedin Table 4-10.

4.10.4 Method

4.10.4.1 Data Collection

a. Data collected during operator interviews were reviewed to identify potential problems in the design, location, or operation of CR controls.

b. Data were collected using the checklists contained in the Controls Task Plan. The majority of the data were collected through interviews with CR operators and direct observation of controls in the CR. As necessary, measurements were made of the physical characteristics (e.g., size, separation, displacement of the controls).

4.10.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the control or controls involved (e.g., rotary controls, pushbuttons, J-Handle controls, etc.), a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the controls task plan were annotated to indicate compliance or noncompliance with the criteria.

4.10.5 Findings

The findings of the controls survey are presented in Table 4-10 "Controls Survey Findings and HEDs Generated." Overall, 142 criteria were applied to the controls in the Davis-Besse control room. Of these, 35 (25%) were not applicable, 79 (56%) were in compliance, and 28 (20%) were not in compliance. A total of 23 HEDs were generated which document all of the 28 criteria which were not met. In general, those HEDs address accidental activation of controls, inconsistent direction of movement, pushbutton resistance, and control separation.

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 1 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.1.1 GENERAL PRINCIPLES					
a. ADEQUACY —					
(1) It should provide a sufficient range of control.	I	YES			
(2) It should be easily adjusted with the required level of precision.	I	NO	P.4.1-19	IIC	
b. ECONOMY —					
(1) There should be a good reason to require a control for the function concerned.	I	NO	P.4.1-9	IIC	
(2) Duplication of controls should not occur, except for a specific reason.	I	YES			
(3) The precision and range of a control should not greatly exceed the need.	I	NO	P.4.1-18	III	
(4) Selected controls should be economic of space.	O	YES			
c. HUMAN SUITABILITY —					
(1) Each control should be recognizable in terms of its function.	I	NO	P.4.1-11	III	
(2) Each control should be of the type normally anticipated for the operation concerned. This means conforming to operator expectations, matching to other controls for the same function, and generally conforming to conventional practice.	I	NO	P.4.1-11	III	
e. DURABILITY —					
(1) Broken, chipped, or crumbled control surfaces should not ordinarily occur.	O	YES			

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 2 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.1.1e. (Cont'd)					
(2) Control knobs or handles should not rotate, slip, or move loosely on their shafts.	I	YES			
(3) No internal wear or breakage should occur which alters the "feel" or other sensory feedback of a control. Controls should not develop internal looseness, binding, or backlash.	I	YES			
6.4.1.2 PREVENTION OF ACCIDENTAL ACTIVATION					
a. PROPER LOCATION — Controls should be located and oriented so that the operator is not likely to strike or move them accidentally in any sequence of control movements.	I	NO	P.4.1-4	IA	Controls Study
b. FIXED PROTECTIVE STRUCTURES —					
(1) Controls may be recessed, shielded, or otherwise surrounded by physical barriers. (See Exhibit 6.4-1)	O	NO	P.4.1-25 P.4.1-31	IIC IIC	
(2) The control should be entirely contained within the envelope described by the recess or barrier.	O	YES			
c. MOVABLE COVERS OR GUARDS —					
(1) Controls may be covered or guarded with movable (e.g., hinged) barriers. (See Exhibit 6.4-2)	O	YES			
(2) Safety or lock wires should not be used.	O	YES			
(3) When the guard is in the open position, it should not interfere with the operation of the guarded control or other adjacent controls.	I	NO	P.4.1-2	III	

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 3 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.1.2 (Cont'd)					
d. INTERLOCKING CONTROLS — Controls may be provided with interlocks so that:					
(1) Extra movement is required (e.g., a side movement out of a detent position or a pull-to-engage clutch).	I	NO	P.4.1-6	IIC	Additional analysis required.
(2) Prior operation of a related or locking control is required.	I	NO	P.4.1-6	IIC	Additional analysis required.
e. RESISTANCE TO MOVEMENT — Controls should be provided with resistance (e.g., friction or spring-loading), so that distinct or sustained effort is required for activation.	I	NO	P.4.1-13	IIC	
f. SEQUENTIAL ACTIVATION — When a strict sequential activation is necessary, controls should be provided with locks to prevent the controls from passing through a position. Further movement should require a new control action.	I	NO	P.4.1-7	IIC	
g. CHOICE OF ACTION — Rotary action controls should be used in situations where linear or pushbutton controls would be subject to inadvertent activation, and fixed protective structures are impractical or inappropriate.	I	YES			
6.4.2.1 DIRECTION OF MOVEMENT					
To minimize operator error, control movements should conform to the following population stereotypes (for U.S. population only):					
a. ON, START, RUN, OR OPEN — Up, right, forward, clockwise, or pull.	O	NO	P.4.1-28	III	
b. OFF, STOP, CLOSE — Down, left, backward, counterclockwise, or push.	O	NO	P.4.1-29 P.4.1-30	III III	

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED   Page 4 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.2.1 (Cont'd)					
c. RIGHT (AS A FUNCTION) — Clockwise or right.	O	YES			
d. LEFT (AS A FUNCTION) — Counter-clockwise or left.	O	YES			
e. RAISE — Up.	O	YES			
f. LOWER — Down.					
g. INCREASE — Forward, up, right, or clockwise.	O	YES			
h. DECREASE — Backward, down, left, or counterclockwise.	O	YES			
6.4.2.2 CODING OF CONTROLS					
c. SIZE CODING					
(1) No more than three different sizes of controls should be used for discrimination by absolute size.	I	NO	P.4.1-11	IIC	
(2) Controls used for performing the same function on different items of equipment should be the same size.	O	YES			
(3) When knob diameter is used as a coding parameter, differences between diameters should be at least 0.5 inch.	I	NO	P.4.1-11	IIC	
(4) When knob thickness is a coding parameter, differences between thicknesses should be at least 0.4 inch.	I	NO	P.4.1-11	IIC	

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 5 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.2.2 (Cont'd)					
e. **ROTATING KNOB SHAPE OPTIONS** — Rotating knob controls for different types of control actions should be distinguishable by sight and touch and not easily confused with each other. Exhibits 6.4-4 through 6.4-6 give examples of 15 suitable knob designs developed for three major classes of knobs, each class intended for a different purpose: multiple rotation, fractional rotation, and detent positioning.	O	YES			
f. **COLOR CODING**					
(1) Color coding should follow the recommendations of Guideline 6.5.1.6.	N/A	N/A			See Conventions Survey Report
(3) The color of the control should contrast with the panel background. (See Guideline 6.1.5.6.e)	O	YES			
6.4.3.1 PUSHBUTTON DESIGN PRINCIPLES					
b. **INDICATION OF ACTIVATION** — To ensure that the operator knows that a pushbutton has been pressed far enough for activation, a positive indication should be provided in the form of a snap feel, an audible click, or an integral light.	I	NO	P.4.1-20	IC	
c. **PUSHBUTTON SURFACE** — For best operation, the surface of a pushbutton should offer slip resistance, or be concave.	O	YES			

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 6 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.3.2 ROUND PUSHBUTTONS (See Exhibit 6.4-7)					
a. Diameter (D), for fingertip operation (inches)					
(1) Unguarded and nonrecessed push buttons Minimum 0.385	M	YES			
(2) Guarded or recessed pushbuttons Minimum 0.75	M	YES			
b. Diameter (D), for thumb or heel of hand operation (inches) Minimum 0.75	M	YES			
c. Displacement (A), for thumb or finger operation (inches) Minimum 0.125	M	YES			
d. Resistance (R), for fingertip operation (ounces) Minimum 10 Maximum 40	M	NO	P.4.1-27	III	
6.4.3.3 LEGEND PUSHBUTTONS					
b. LEGEND					
(1) The legend should be readable under ambient light conditions, with or without internal illumination.	O	YES			
(2) The illuminated condition should be clearly recognizable under the highest predicted ambient light condition and should be at least 10% brighter than the surrounding panel.	O	YES			
(3) Legend lettering and contrast should conform to recommendations for legend lights (Guideline 6.5.3.3).	N/A	N/A			See Displays Survey Report

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 7 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.3.3b. (Cont'd)					
(4) The legend message should be specific, unambiguous, end concise.	O	NO	P.4.1-26	IIC	
(5) The legend message should contain no more than three lines of lettering.	O	YES			
d. BARRIERS					
(1) Barriers should be used when legend pushbuttons are contiguous.	O	YES			
(2) Barriers should have rounded edges	O	YES			
e. LEGEND PUSHBUTTON DIMENSIONS — For maximum effectiveness of legend pushbutton controls, the following dimensions should be used (see Exhibit 6.4.8):					
(1) Size (S) (inches) Minimum 0.75 Maximum 1.5	M	YES			
(2) Displacement (A) (inches) Minimum 0 (touch plate) Minimum 0.125 (all others) Maximum 0.250	M	YES			
(3) Barrier width (B_w) (inches) Minimum 0.125	M	YES			
(4) Barrier depth (B_d) (inches) Minimum 0.183 Maximum 0.250	M	YES			
(5) Resistance (ounces) Minimum 10 (except touch plate) Maximum 40	M	NO	P.4.1-27	III	

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 8 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.4.1 ROTARY CONTROL DESIGN PRINCIPLES					
a. **DIRECTION OF ACTIVATION** — Rotary control settings should increase in value with a clockwise rotation.	O	YES			
6.4.4.2 J-HANDLES					
a. **HIGH-TORQUE DESIGNS** — J-handles should conform to dimensions as follows (see Exhibit 6.4-9):					
(1) Length (L) (inches) Minimum 3.75 Optimum 4.0	M	YES			
(2) Clearance (C) (inches) Minimum 1.0 Optimum 2.0	M	YES			
b. **LOW-TORQUE DESIGNS** — For certain purposes, smaller scale J-handles may be used. In such cases the handle proportion usually has a flattened or flared tip for finger placement, and the clearance between handle and panel surface can be less.	I	YES			
6.4.4.3 KEY-OPERATED CONTROLS					
a. **USE** — Key-operated controls should be used when system requirements dictate that the function being controlled should be secured against activation by unauthorized personnel. If key-oerated controls cannot be justified in terms of security, they are probably not necessary and should ot be used. Key-operated switches should not be used solely as a means of shape coding.	N/A	N/A			No key switches used
b. **TEETH: SINGLE ROW** — Keys with a single row of teeth should be inserted into the lock with the teeth pointing up or forward.	N/A	N/A			No key switches used

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 9 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.4.3 (Cont'd)					
c. TEETH: DOUBLE ROW — If keys have teeth on both edges, they should fit the lock with either side up or forward.	N/A	N/A			No key switches used
d. ON-OFF ORIENTATION — Locks should be oriented so that the switch is OFF (or SAFE) when the key is in the vertical position.	N/A	N/A			No key switches used
e. KEY REMOVAL — Operators should not normally be able to remove the key from the lock unless the switch is turned to the OFF or SAFE position.	N/A	N/A			No key switches used
f. LABELING — Control positions should be labeled.	N/A	N/A			No key switches used
g. KEY-OPERATED CONTROL DIMENSIONS — The following dimensions should be used for key-operated controls (see Exhibit 6.4-10).					
(1) Displacement (A) (degrees) Minimum 80° Maximum 90°	N/A	N/A			No key switches used
(2) Height (H) (inches) Minimum 0.5 Maximum 3.0	N/A	N/A			No key switches used
(3) Resistance (inch/pounds) Minimum 1.0 Maximum 6.0	N/A	N/A			No key switches used
6.4.4.4 CONTINUOUS ADJUSTMENT ROTARY CONTROLS — To ensure precise control along a continuous variable, continuous adjustment rotary controls are appropriate.	O	YES			
a. KNOBS — Knobs for continuous adjustment controls should be round in shape, with knurled or serrated edges.	O	YES			

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 10 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.4.3 (Cont'd)					
b. POSITION INDICATION — When an indication of position is desirable, the pointer configurations shown in Exhibit 6.4-11 may be used. Where more accuracy is required, a line should be engraved (and filled with contrasting pigment) both on top and down the side of the pointer, as shown on the knob at the bottom of the exhibit.	O	YES			
c. DIMENSIONS					
(1) Fingertip grasp knobs should conform to the following dimensions:					
(a) Height (inches) Minimum 0.5 Maximum 1.0	M	YES			
(b) Diameter (inches) Minimum 0.375 Maximum 4.0	M	YES			
(2) Thumb and forefinger encircled knobs should conform to the following dimensions: Diameter (inches) Minimum 1.0 Maximum 3.0	M	YES			
d. TORQUE — Knob torque should be within the range of 4.5 to 6.0 inch/ounces.	M	YES			
e. CONTINUOUS ADJUSTMENT ROTARY CONTROLS WITH KNOB SKIRTS — If knob skirts are used, such controls should conform to approximately the following dimensions. See Exhibit 6.4-12.					
(1) Skirt diameter (D_S): 2.0 inches.	M	YES			
(2) Skirt height (H_S): 0.25 inch.	M	YES			

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 11 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.4.4e. (Cont'd)					
(3) Finger stop diameter (D_F): 1.25 inches.	M	YES			
(4) Finger stop height (H_F) plus rotary knob height (H_K): total 0.75 inch.	M	YES			
(5) Knob diameter (D_K): 0.75 inch.	M	YES			
6.4.4.5 ROTARY SELECTOR CONTROLS					
a. SELECTION — Rotary selector controls should be used when three or more detented positions are required, and may be used for two-detented position operation.	I	NO	P.4.1-14	IIC	
b. POSITIONING					
(1) To ensure proper positioning of a discrete rotary control, detents should be provided at each control position.	I	YES			
(2) It should not be possible to position a control between detented positions.	I	NO	P.4.1-15	IIC	
(3) A maximum of 24 positions should be used on a rotary selector control.	O	YES			
(4) To minimize the possibility of placing a rotary selector control in an unused position, stops should be provided at the limits of the control range.	I	YES			
c. READABILITY — To maximize read ability, rotary controls should have a moving pointer and fixed position settings.	O	YES			

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 12 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.4.5 (Cont'd)					
d. POSITION INDICATION					
(1) Position indication should be provided. Desirable alternatives are:					
(a) Illuminated indicator lights,	O	YES			
(b) A line engraved both on the top of the knob and down the side, or	O	YES			
(c) A pointer shape.	O	YES			
(2) It should not be possible to confuse the position of the knob in reference to position markers on the panel. To minimize the problem of parallax, pointers on knobs should be mounted close to the settings to which they point.	O	YES			
e. DIMENSIONS — Recommended dimensions for rotary selector switches are as follows (see Exhibit 6.4-13):					
(1) Length (L) (inches) Minimum 1.0	M	YES			
(2) Width (W) (inches) Maximum 1.0	M	YES			
(3) Diameter (D) (inches) Minimum 1.0	M	YES			
(4) Depth (H) (inches) Minimum 0.625	M	YES			
(5) Resistance (inch/pounds) Minimum 1.0 Maximum 6.0	M	YES			

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CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 13 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.4.5 (Cont'd)					
f. MOMENTARY CONTACT ROTARY SELECTOR CONTROLS — Knobs for spring-loaded momentary contact rotary selector controls should be large enough to be easily held against the spring torque, without fatigue, for as long as necessary to accomplish the control action.	I	NO	P.4.1-16	III	
6.4.5.1 THUMBWHEELS					
a. VISIBILITY — To minimize error, thumbwheel readouts should be visible from the thumbwheel operating position.	O	YES			
b. CODING — If the thumbwheel is used as an input device, the OFF, zero, or normal position should be coded to facilitate visual recognition of status.	O	YES			
c. CONTINUOUS ADJUSTMENT THUMB-WHEELS — The dimensions of thumbwheel controls which permit continuous adjustment (not stepped or detented) should be as follows:					
(1) At least 1 inch of the wheel should be exposed to permit easy manipulation.	M	YES			
(2) Resistance should be between 3 and 6 ounces.	M	YES			
(3) If the thumbwheel has an OFF position, a detent should be provided for feedback at that point.	N/A	N/A			

TABLE 4-10
CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 14 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.5.1 (Cont'd)					
d. DISCRETE SETTING (STEPPED) THUMBWHEELS					
(1) Thumbwheel controls which have discrete settings should be detented between positions. The control should snap into each position, and resist intermediate or uncertain settings.	I	N/A			
(2) Discrete thumbwheel controls should conform to the following specifications. (See Exhibit 6.4-14)					
(a) Diameter (D) (inches) Minimum 1.5 Maximum 2.5	M	YES			
(b) Trough distance (L) (inches) Minimum 0.45 Maximum 0.75	M	YES			
(c) Width (W) (inches) Minimum 0.1	M	YES			
(d) Depth (H) (inches) Minimum 0.125 Maximum 0.5	M	YES			
(e) Resistance (ounces) Minimum 6 Maximum 20	M	YES			
6.4.5.2 SLIDE SWITCHES					
a. SURFACE — The surface of slide switches should be serrated or knurled.	O	YES			
b. DIMENSIONS — Slide switches should conform to approximately the following dimensions. See Exhibit 6.4-15.					
(1) Thickness (T): 0.25 inch.	M	N/A			

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CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 15 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.5.2b (Cont'd)					
(2) Length (L): 1.0 inch.	M	N/A			
6.4.5.3 TOGGLE SWITCHES					
a. POSITIONING — To minimize the possibility of inadvertent activation or setting between control positions, toggle switches should have an elastic resistance that increases as the control is moved and drops as the switch snaps into position.	I	N/A			
b. FEEDBACK — Toggle switches should emit an audible click, or provide some other source of feedback on activation.	I	NO	P.4.1-24	IIC	
c. DIMENSIONS — To ensure the most effective use, toggle switches should conform to the following dimensions. See Exhibit 6.4-16.					
(1) Arm length (L), for use by one finger (inches) Minimum 0.5 Maximum 2.0	M	YES			
(2) Tip diameter (D) (inches) Minimum 0.125 Maximum 1.0	M	YES			
(3) Resistance (small switch) (ounces) Minimum 10 Maximum 16	M	YES			
(4) Resistance (large switch) (ounces) Minimum 10 Maximum 40	M	YES			
(5) Displacement (A), two position (degrees) Minimum 30 Maximum 120	M	YES			

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CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 16 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.5.3c (Cont'd)					
(6) Displacement (A), three position (degrees between settings) Minimum 18 Maximum 60 Optimum 25	M	YES			
6.4.5.4 ROCKER SWITCHES	N/A	N/A			No Rocker switches.
a. ORIENTATION — Rocker switches should ordinarily be oriented vertically.					
(1) Activation of the upper part should control the ON or INCREASE function.	N/A	N/A			No Rocker switches.
(2) Horizontal orientation should be used only when the location of the controlled function or equipment requires it.	N/A	N/A			No Rocker switches.
b. INDICATION OF ACTIVATION					
(1) Activation should be indicated by a snap feel, an audible click, or an integral light.	N/A	N/A			No Rocker switches.
(2) In the ON position, the top of the switch should be flush with the panel surface.	N/A	N/A			No Rocker switches.
c. RESISTANCE					
(1) Control resistance should gradually increase, then drop to zero when the control snaps into position.	N/A	N/A			No Rocker switches.
(2) This resistance should preclude the switch being placed between positions.	N/A	N/A			No Rocker switches.
d. INADVERTENT ACTIVATION — If it controls a critical function, the switch should be protected by channel guards or other means to prevent inadvertent activation.	I	NO	P.4.1-1	IIC	

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CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 17 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.5.A (Cont'd)					
e. ROCKER SWITCH DIMENSIONS — (see Exhibit 6.4-17):	N/A	N/A			No Rocker switches.
(1) Width (W) (inches) Minimum 0.75 Maximum 1.5					
(2) Resistance (ounces) Minimum 10 Maximum 40	N/A	N/A			No Rocker switches.
(3) Displacement, two-position switches (A) (degrees) Minimum 30 Maximum 120	N/A	N/A			No Rocker switches.
(4) Displacement, three-position switches (A) (degrees) Minimum 18 Maximum 60 Optimum 25	N/A	N/A			No Rocker switches.
6.5.1.6 COLOR CODING					
a. REDUNDANCY — In all applications of color coding, color should provide redundant information. That is, the pertinent information should be available from some other cue in addition to color.	N/A	N/A			See Conventions Survey Report
b. NUMBER OF COLORS (1) The number of colors used for coding should be kept to the minimum needed for providing sufficient information.	N/A	N/A			See Conventions Survey Report
(2) The number of colors used for coding should not exceed 11.	N/A	N/A			See Conventions Survey Report

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6 (Cont'd)					
c. MEANING OF COLORS					
(1) The meaning attached to a particular color should be narrowly defined.	N/A	N/A			See Conventions Survey Report
(2) Red, green, and amber (yellow) should be reserved for the following uses:	N/A	N/A			See Conventions Survey Report
Red: unsafe, danger, immediate operator action required, or an indication that a critical parameter is out of tolerance.	N/A	N/A			See Conventions Survey Report
Green: safe, no operator action required, or an indication that a parameter is within tolerance.					
Amber (yellow): hazard (potentially unsafe), caution, attention required, or an indication that a marginal value or parameter exists.					
e. PRINCIPLES OF COLOR SELECTION					
(1) The primary principle which should be applied in selecting colors for coding purposes which do not have the immediate safey implications of red, green, and amber is to ensure that each color is recognized as different from any other. Exhibit 6.5-7 lists 22 colors of maximum contrast. Each successive color has been selected so that it will contrast maximally with the color just preceding it and satisfactorily with earlier colors in the list. The first 9 colors have been selected so as to yield satisfactory contrast for red-green-deficient as well as color-normal	N/A	N/A			See Conventions Survey Report

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CONTROLS SURVEY FINDINGS & HEDs GENERATED Page 19 of 19

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6e(1) (Cont'd)					
observers. The remaining 13 colors are useful only for color-normal observers.					
(2) Colors selected for coding should contrast well with the background on which they appear.	O	YES			
(3) Ambient lighting in the area in which color coding is used will influence the apparent color of the coded element (especially for surface colors). Each color selected for coding should be evaluated under all illumination conditions under which it is used.	O	YES			
6.8.3.1 SEPARATION OF CONTROLS					
Recommended minimum control separation distances are shown in Exhibits 6.8-2 and 6.8-3. In most cases, control room operations will require greater separation. The function requirements that should be considered are:					
a. ACCESS — Control access should not be impeded by any position of an adjacent control.	I	NO	P.4.1-5	III	
b. INADVERTENT ACTUATION — Control actuation should not result in advertent actuation of an adjacent control.	I	NO	P.4.1-4	IIC	
c. SIMULTANEOUS ACTUATION — Simultaneously actuation of adjacent controls (where required) should be possible.	N/A	N/A			See Verification and Validation Survey Report

4.11 Displays Survey

This section documents the results of the displays survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.11.1 Objectives

The objectives of the displays survey were to:

a. Assess the degree to which all displays in the control room conform to the criteria in NUREG-0700.

b. Identify and document any features of the displays that do not conform to the criteria in NUREG-0700.

4.11.2 Scope

The scope of the effort extends to the assessment of the display design in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The display topics evaluated include:

- o Display failure
- o Usability of displayed values
- o Readability
- o Printing on the display face
- o Scale markings
- o Coding
- o Display movement
- o Scale pointers
- o Zone markings
- o Light indicators (legend and simple)
- o Legend design
- o Trend recorders.

CRT displays were evaluated as part of the computer survey. Several NUREG-0700 guidelines appropriate to displays are addressed as part of task analysis and task verification and validation activities. These guidelines have been incorporated into the verification and validation evaluation reports.

4.11.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.5.1.1f; 6.5.1.2d(1) through e; 6.5.1.3a through c(1) and d(1) through d(6); 6.5.1.4a(1) through f; 6.5.1.5a through c and e and f; 6.5.1.6a through c(2) and d(3) through e(3); 6.5.2.1a through c; 6.5.2.2a(1) through c; 6.5.2.3a through c; 6.5.2.4a through c(3); 6.5.2.5c; 6.5.3.1a(1) through c(1) and d; 6.5.3.2a(1), a(3), and b; 6.5.3.3a(1) through b(7); 6.5.4.1a through d and g through k; 6.5.4.2a(1) through b(4); 6.5.5.1a(1) through c(2); and 6.5.5.2a(1) through c.

The detailed definitions for each criterion are presented in Table 4-11.

4.11.4 Method

4.11.4.1 Data Collection

a. Data collected during the operator interviews were reviewed to identify potential problems with the design, location, or information content of the CR displays.

b. Data were collected using the checklists from the Displays Task Plan. Data were collected primarily through operator interviews and direct observation of displays in the CR. As necessary, measurements were made of the physical characteristics (e.g., characterize, height-to-width ratios, etc.) of CR displays. Where guidelines refer to consistency with operating procedures (e.g., 6.5.1.4.e), existing procedures were reviewed.

c. Data were recorded on the appropriate forms.

4.11.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the instrument or instruments involved (e.g., legend lights, meters, chart recorders, etc.), a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the displays task plan were annotated to indicate compliance or noncompliance with the criteria.

4.11.5 Findings

The findings of the displays survey are presented in Table 4-11 "Displays Survey Findings and HEDs Generated." A total of 105 criteria were applied to the displays in the

Davis-Besse control room. Of these, 22 (21%) were not applicable, 47 (45%) were in compliance, and 36 (34%) were not in compliance. A total of 33 HEDs were generated which document all of the 36 criteria which were not met. In general, those HEDs address display labeling, readability, adequacy of information presentation and methods of information presentation.

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED PAGE 1 OF 15

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.1 INFORMATION TO BE DISPLAYED					
f. **DISPLAY FAILURE** — When panel instruments, such as meters, fail or become inoperative, the failure should be apparent to the operator (e.g., through off-scale indication).	I	NO	P.5.1-7	IIB	
6.5.1.2 USABILITY OF DISLAYED VALUES					
d. **SCALE RANGE** — Scales should be selected to:					
(1) Span the expected range of operational parameters, or	I	NO	P.5.1-4	IIC	
(2) Employ appropriate scale ranging techniques, or	I	YES			
(3) Be supported by auxiliary wide-range instruments.	I	NO	P.5.1-6	IIA	
e. **SCALE SIZE** — Scale ranges may be expanded (or contracted) by multiplying or dividing indicated scale values by powers of ten. All such scales should be clearly marked as to whether the indicated values should be multiplied or divided, and the factor involved (e.g., 10, 100, 1000).	O	NO	P.5.1-24	III	
6.5.1.3 READABILITY					
a. **CHARACTER HEIGHT** — Character height should subtend a minimum visual angle of 15 minutes, or 0.004 x viewing distance. The preferred visual angle is 20 minutes, or 0.006 x viewing distances.	M	NO	P.5.1-36	III	
b. **TYPE STYLE** — Exhibits 6.5-1 and 6.5-2 present two recommended sets of characters, character size and style should meet the following:	O	NO	P.5.1-32	III	
(1) Type styles should be simple.	O	YES			
(2) Type styles should be consistent.	O	NO	P.5.1-35	III	

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED PAGE 2 OF 15

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.3b (Cont'd)					
(3) Only upper-case letters should be used.	O	YES			
c. CONTRAST — Highest contrast is provided by black and white.					
(1) Visual displays should normally contain black markings on a white background.	O	YES			
d. CHARACTER DIMENSIONS AND SPACING —					
(1) Stroke-width-to-character-height ratios should be between 1:6 and 1:8.	M	YES			
(2) Letter width-to-height ratios should be between 1:1 and 3:5.	M	YES			
(3) Numeral width-to-height ratios should be 3:5.	M	YES			
(4) Minimum space between characters should be one stroke width.	M	YES			
(5) Minimum space between words should be the width of one character.	M	YES			
(6) Minimum space between lines should be on-half the character height.	M	N/A			
6.5.1.4 PRINTING ON THE DISPLAY FACE					
a. PROVISION OF NEEDED MESSAGE — If any information is required to use the display, it must be provided close enough to the scale so that the scale and the message are clearly associated. The message may be communicated:					
(1) By printing on the display face.	O	NO	P.5.1-40	IIC	
(2) By an appropriate label adjacent to the display.	O	NO	P.5.1-40	IIC	

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.4 (Cont'd)					
b. AVOIDANCE OF EXTRANEOUS ITEMS — Categories of information not needed in using the display should be avoided (e.g., patent notices, manufacturer's trademark or address).	O	NO	P.5.1-26	IIC	
c. BREVITY — To avoid distraction and interference with the needed essential markings, messages should be written as briefly as clarity permits.	O	YES			
d. ABBREVIATIONS — Only standard and commonly accepted abbreviations should be used.	D	NO	P.5.1-39	III	
e. CONSISTENCY WITH PROCEDURES — The printed message should use the same terms as the procedures in display identification, parameter identification, and units displayed.	D	NO	P.5.1-37	III	
f. INDICATION OF TRANSFORMATIONS NEEDED — Where necessary to multiply or divide the displayed readings by powers of 10 to determine quantitative value, the operation required and result derived must be clearly indicated.	O	NO	P.5.1-24	III	
6.5.1.5 SCALE MARKINGS					
a. USE OF GRADUATIONS — Scales for quantitative reading should be provided with graduations consistent with the progression of their numerals.	O	YES			
(1) No more than 9 graduations should separate numerals.	O	NO	P.5.1-27	IIC	
(2) Major and minor graduations should be used if there are up to four graduations between numerals.	O	YES			
(3) Major, intermediate, and minor graduation should be used if there are five or more graduations between numerals.	O	YES			

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.5 (Cont'd)					
b. GRADUATION HEIGHT — Graduation heights as a function of viewing distance should be:	O	NO	P.5.1-25	III	
c. VALUES INDICATED BY UNIT GRADUATIONS — Successive values indicated by unit graduations should be one of those shown below or those values multiplied by some power of 10.	O	NO	P.5.1-28	IIC	
e. LINEAR VS LOGARITHMIC SCALES — Logarithmic scales should be avoided unless needed to display a large range of values.	I	YES			
f. MULTISCALE INDICATORS — Multi-scale indicators (i.e., single pointer, multiple scales) should be avoided unless they can be justified as of operational benefit, and precautions are taken to avoid operator confusion.	I	NO	P.5.1-9	IIA	
6.5.1.6 COLOR CODING					
a. REDUNDANCY — In all applications of color coding, color should provide redundant information. That is, the pertinent information should be available from some other cue in addition to color.	I	N/A			SEE CONVENTIONS SURVEY REPORT

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6 (Cont'd)					
b. NUMBER OF COLORS —					
(1) The number of colors used for coding should be kept to the minimum needed for providing sufficient information.	I	N/A			SEE CONVENTIONS SURVEY REPORT
(2) The number of colors used for coding should not exceed 11.	I	N/A			SEE CONVENTIONS SURVEY REPORT
c. MEANING OF COLORS					
(1) The meaning attached to a particular color should be narrowly defined.	I	N/A			SEE CONVENTIONS SURVEY REPORT
(2) Red, green, and amber (yellow) should be reserved for the following uses: Red: unsafe, danger, immediate operator action required, or an indication that a critical parameter is out of tolerance. Green: safe, no operator action required, or an indication that a parameter is within tolerance. Amber (yellow): hazard (potentially unsafe), caution, attention required, or an indication that a marginal value of parameter exists.	I	N/A			SEE CONVENTIONS SURVEY REPORT

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
e. PRINCIPLES OF COLOR SELECTION					
(1) The primary principle which should be applied in selecting colors for coding purposes which do not have the imemdiate safety implications of red, green, and amber is to ensure that each color is recognized as different from any other. Exhibit 6.5-7 lists 22 colors of maximum contrast. Each successive color has been selected so that it will contrast maximally with the color just preceding it and satisfactorily with earlier colors in the list. The first 9 colors have been selected so as to yield satisfactory contrast for red-green-deficient as well as color-normal observers. The remaining 13 colors are useful only for color-normal observers.	I	N/A			
(2) Colors selected for coding should contrast well with the background on which they appear.	O	YES			
(3) Ambient lighting in the area in which color coding is used will influence the apparent color of the coded element (especially for surface colors). Each color selected for coding should be evaluated under all illumination conditions under which it is used.	O	N/A			SEE CONVENTIONS SURVEY REPORT
6.5.2.1 DIRECTIONALITY OF MOVEMENT AND NUMBERING WITH FIXED-SCALE AND MOVING-POINTER METERS					
a. **CIRCULAR SCALES** — Scale values should increase with clockwise movement of the pointer as in Exhibit 6.5-8.	O	YES			
b. **VERTICAL STRAIGHT SCALES** — Scale values should increase with upward movement of the pointer as in Exhibit 6.5-9.	O	YES			

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
c. **HORIZONTAL STRAIGHT SCALES** — Scale values should increase with pointer movement to the right as in Exhbit 6.5-10.	O	YES			
6.5.2.2 POINTERS					
a. **POINTER TIP FORM** —					
(1) Pointer tips should be simple. Examples of preferred and non-preferred types are given in Exhibit 6.5-11.	O	NO	P.5.1-33	III	
(2) Pointer tips should be selected to minimize concealment of scale graduation marks or numerals. (See Exhibit 6.58.)	O	YES			
b. **POINTER POSITIONING RELATIVE TO SCALE** —					
(1) Pointer tip should extend to within about 1/16 inch of (but not overlap) the smallest graduation marks on the scale. (See Exhibits 6.5-8, -9,-10.)	M	YES			
(2) Pointers should be mounted to avoid parallax errors.	M	NO	P.5.1-29	IIA	
c. **POINTER VISIBILITY** — Pointer/background contrast and pointer size should be adequate to permit rapid recognition of pointer position.	I O	NO	P.5.1-10 P.5.1-33	IIC III	
6.5.2.3 ZONE MARKING (Exhibit 6.5-12)					
a. Zone markings should be conspicuous and distinctively different for different zones.	O	NO	P.5.1-30	III	
b. Zone marking should not interfere with reading of quantitative markings.	O	NO	P.5.1-31	III	
c. If color is used for coding, color should be related to meaning as given in Guideline 6.5.1.6.c.	O	N/A			SEE CONVENTIONS SURVEY REPORT

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.2.4 ORIENTATION OF MARKINGS ON FIXED-SCALE METERS					
a. **NUMERAL ORIENTATION** — Individual numerals on any type of fixed scale should be vertical (see Exhibit 6.5-13). This holds true for circular as well as linear scales.	O	YES			
b. **ZERO-POINT ORIENTATION** —					
(1) Where pointer movement is more than 360°, the zero point should be located at the 12 o'clock position.	O	N/A			
(2) Where positive and negative values are displayed around a zero or null position, the zero or null point should be located at the 12 o'clock position.	O	YES			
c. **END-POINT INDICATION ON PARTIAL-REVOLUTION SCALES** —					
(1) Where the scale covers less than a full rotation of the pointer, scale end-points should be indicated by a break in scale (see Exhibit 6.5-13).	O	YES			
(2) The break should be at least one numbered interval in length.	O	YES			
(3) The break should be oriented at the 6 o'clock position.	O	YES			
6.5.2.5 MOVING-SCALE METERS					
Moving-scale fixed-pointer meters are infrequently seen in nuclear power plant control rooms. They should be avoided in favor of the more effective fixed-scale moving-pointer types.	O	N/A			

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED PAGE 9 OF 15

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.3.1 CHARACTERISTICS AND PROBLEMS OF LIGHT INDICATORS					
b. **PRECAUTIONS TO ASSURE UNAMBIGUOUS SENSING BY OPERATORS** — Lights should not appear to be glowing when in fact they are off, or vice versa. To that end, ambient light sources should be selected, located, or controlled to avoid reflections or refractions. (See Guideline 6.1.5.3.)	I	NO	P.5.1-1	IIC	
c. **PRECAUTIONS TO AVOID MISINTERPRETATION** —					
(1) System/equipment status should be inferred by illuminated indicators, and never by the absence of illumination.	I	NO	P.5.1-2	IIA	
d. **USE AS ALERTING INDICATORS** — Alerting the operator to unfavorable status should be a function of the annunciator system and not assigned to light indicators.	I	NO	P.5.1-3	IIC	
6.5.3.2 DESIGN AND USE OF NONLEGEND LIGHT INDICATORS					
a. **IDENTIFICATION OF MEANING** —					
(1) Where meaning is not apparent, labeling must be provided close to the light indicator showing the message intended by its glowing.	O	NO	P.5.1-21	III	
(3) The color of the light should be clearly identifiable.	I	NO	P.5.1-34	III	
b. **LIGHT INTENSITY** — The illuminated indicator should be at least 10% greater in light intensity than the surrounding panel (as measured by a spot photometer).	O	YES			

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED PAGE 10 OF 15

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.3.3 DESIGN AND USE OF LEGEND LIGHT INDICATORS					
a. VISIBILITY FACTORS —					
(1) Light intensity of the illuminated indicators should be at least 10% greater than the surrounding panel (as measured by a spot photometer).	O	YES			
(2) Legends should be legible under ambient illumination with indicator lights off.	O	NO	P.5.1-22	III	
(3) Legend lettering should contrast well with background under both ambient and transilluminated lighting.	O	NO	P.5.1-23	IIC	
b. LEGEND DESIGN					
(1) General legend design should be consistent throughout the control room.	O	YES			
(2) Lettering should be simple, and should follow Guideline 6.5.1.3 for style and size.	M	YES			
(3) Symbolic legends should be clear and unambiguous as to their meaning.	O	N/A			
(4) Text should be short, concise, and unambiguous.	O	YES			
(5) Legend messages should contain no more than three lines of text.	O	YES			
(6) Nomenclature and abbreviations should be standard, and consistent with usage throughout the control room and in the procedures.	O	NO	P.5.1-38	III	
(7) Legends should be worded to tell the status indicated by glowing of the light.	O	YES			

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED PAGE 11 OF 15

GUIDELINE		METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.4.1 GENERAL CHARACTERISTICS OF GRAPHIC RECORDERS						
a.	**QUALITY OF EXPENDABLE MATERIALS** — Pens, inks, and paper should be of a quality to provide clear, distinct, and reliable marking. For example, ink should not clog pens or smudge on the paper.	I	YES			
b.	**SCALE COMPATIBILITY** — Scales printed on the recording paper should be the same as the scales shown on the recorder.	O	YES			
c.	**SCALE DESIGN** — Recorder scales should be numbered and marked according to the general principles of scale graduation (Guideline 6.5.1.5), with number style and dimensions according to Guidelines 6.5.1.3 and 6.5.1.4.	O O	NO NO	P.5.1-24 P.5.1-28	III IIC	
d.	**PAPER TAKEUP AND CUTOFF** — A takeup spool should be provided to receive completed recordings. On most instruments this is provided as an inherent part of the design. Also, means should be provided for tearing off completed records for storage.	I	YES			
g.	**USE** — As a general rule, recorders should be used to record trend information and material which may be needed for later reference.	I	NO	P.5.1-13	III	
h.	**PLACEMENT OF RECORDERS** — As devices which must be verified and attended by the operator, graphic recorders should in principle be located within the primary operating area rather than on back panels.	I	YES			
i.	**PAPER-SPEED ADJUSTABILITY** — Not only should high paper speed option be provided to run out records for detachment, but a selection of lower speeds should be available to permit adjustment of the time scale so that rate-of-change information can be indicated.	I	NO	P.5.1-14	III	

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.4.1 (Cont'd)					
j. **ANNOTATION** — It should be convenient to annotate recordings with date and time markings, with paper speed if varied from normal, with parameter identification, or with any other relevant information.	I	NO	P.5.1-15	III	
k. **VISIBILITY** — Recorder design should ensure that all data will be visible through the window of the recorder and not require open-door operation to expose it.	I	NO	P.5.1-16	IIC	
6.5.4.2 SPECIFIC RECORDER TYPES					
a. CONTINUOUS RECORDERS —					
(1) LABELING — Labels should identify the parameters recorded. With multiple-pen recorders, parameters should be listed in the order of the associated scales on the recorder.	O	YES			
(2) INK COLORS — Each pen should use a different colored ink to permit channel identification from line color. Colors selected should be distinctively different and should afford good contrast with the paper.	O	YES			
b. DISCRETE RECORDERS —					
(1) CHANNEL OVERLOAD — The recorder should not be loaded beyond its designed channel capacity because this adds complexity to the analysis and prolongs sampling cycle time.	I	NO	P.5.1-20	III	
(2) CHANNEL IDENTIFICATION ON INSTRUMENT — Discrete recorders should be equipped to display an easily viewed manner the channel being plotted. Viewing from odd and inconvenient angles should not be imposed.	O	NO	P.5.1-32	III	

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.4.2b (Cont'd)					
(3) CHANNEL IDENTIFICATION ON RECORDING — Number-printing mechanism should be designed and maintained to provide clear, sharp, and small numbering to avoid crowding of data and consequent analysis problems.	O	YES			
(4) CHANNEL SELECTION CAPABILITY — Provision should be made to select any single channel for immediate display without awaiting completion of a sampling cycle.	I	YES			
6.5.5.1 DRUM-TYPE COUNTERS					
a. NUMERICAL PRESENTATION FACTORS —					
(1) ORIENTATION — Multidigit numbers formed by several counter drums should be read horizontally from left to right (see Exhibit 6.5-14).	O	N/A			
(2) WIDTH-HEIGHT RATIO — To compensate for the distortion imposed by the curved surface of the drum, counter numerals should reflect a width-height ratio of 1:1, not 3:5 as recommended for numerals and other displays.	M	N/A			
(3) GROUPING OF NUMERALS — If more than four digits are required, they should be grouped and the groupings separated as appropriate by commas, by a decimal point, or by additional space (see Exhibit 6.5-15).	O	N/A			
(4) CONTRAST — The color of the numerals and of the background should be chosen to yield high contrast. Black numerals on white drum surface is recommended.	O	N/A			

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED PAGE 14 OF 15

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.5.1a (Cont'd)					
(5) DRUM FINISH — The surface of the drums and surrounding areas should have a matte finish to minimize glare.	O	N/A			
b. MOUNTING —					
(1) Drum-type counters are clearly readable only within a viewing angle that is more restrictive than for most displays. Accordingly, they should be mounted perpendicular to the operator's line of sight.	O	N/A			
(2) Counters should be mounted as close as possible to the panel surface to minimize shadows and maximize viewing angle.	O	N/A			
(3) The window should be sized to allow no more than one digit per drum to appear in the window at any one time.	O	N/A			
c. DRUM MOVEMENT —					
(1) Numbers should change by snap action rather than through continuous movement.	O	N/A			
(2) The counter drums should move upward with increasing values.	O	N/A			
6.5.5.2 ELECTRONIC COUNTERS					
a. NUMERICAL PRESENTATION FACTORS —					
(1) ORIENTATION — Multidigit counters should be oriented to read horizontally from left to right.	O	YES			

TABLE 4-11
DISPLAYS SURVEY FINDINGS & HEDS GENERATED PAGE 15 OF 15

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.5.2a (Cont'd)					
(2) CHARACTER STYLE — Simple character fonts should be used. Styles using variable stroke widths, slanted characters, etc., should be avoided.	O	YES			
(3) NUMERAL HEIGHT — Numerals should be of such a height as to subtend a visual angle of 15 minutes from the farthest anticipated viewing distance.	M	YES			
(4) WIDTH-TO-HEIGHT RATIO — Width-to-heigh ratio of numerals should be approximately 3:5.	M	YES			
(5) SPACING — Horizontal spacing between numerals should be between one-quarter and one-half the numeral width.	M	YES			
b. RATE OF CHANGE — Numerals should not follow each other faster than two per second when the operator is expected to read the numerals consecutively.	M	YES			
c. CONTRAST — Character-to-background contrast ratio should be between 15:1 minimum and 20:1 preferred.	M	YES			

4.12 Labels and Location Aids Survey

This section documents the results of the labels and location aids survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.12.1 Objectives

The objectives of the labels and location aids survey were to:

a. Assess the degree to which all labels and location aids in the control room conform to the criteria in NUREG-0700.

b. Identify and document any features of the labels and location aids that do not conform to the criteria in NUREG-0700.

4.12.2 Scope

The scope of the effort extends to the assessment of the labels and location aids in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- o Labeling of annunciator panels.
- o Color coding of labels
- o Need for labeling
- o Hierarchical labeling
- o Placement of labels
- o Mounting of labels
- o Spatial orientation of labels
- o Label visibility
- o Label content
- o Word selection
- o Consistency
- o Symbols
- o Control position labeling
- o Label readability
- o Temporary labels
- o Demarcation
- o Mimics.

4.12.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.3.3.3c(3); 6.5.1.6a through e; 6.6.1.1, 6.6.1.2a and b; 6.6.2.1a through f; 6.6.2.2a and b; 6.6.2.3a and b; 6.6.2.4a through d; 6.6.3.1a through e; 6.6.3.5; 6.6.3.6, 6.6.3.7a and b; 6.6.3.8a through c; 6.6.5.1a through h; 6.6.5.2a and b; 6.6.6.2a through c; 6.6.6.3; 6.6.6.4a and b; and 6.8.3.2d.

The detailed definitions for each criterion are presentedin Table 4-12.

4.12.4 Method

4.12.4.1 Data Collection

a. Data collected during operator interviews were reviewed to identify potential problem in the design, location, or content of CR labels and other location aids.

b. Data were collected using the checklists from the Labels and Location Aids Task Plan. Data were collected primarily through interviews with operators and direct observation of the CR labeling. As necessary, measurements were made of the physical characteristics (e.g., character size and separation, height-to-width ratios, etc.) of the CR labels. For those guidelines related to consistency with operating procedures (e.g., 6.6.3.3.c), operating procedures were reviewed.

c. Data were recorded on the appropriate data collection forms.

4.12.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the labels involved, a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the labels task plan were annotated to indicate compliance or noncompliance with the criteria.

4.12.5 Findings

The findings of the labels and location aids survey are presented in Table 4-12 "Labels Survey Findings and HEDs Generated." Overall, 113 criteria were applied to the labels and location aids in the Davis-Besse control room. Of these, 12 (10%) were not applicable, 61 (53%) were in compliance, and 40 (35%) were not in compliance. A total of 26 HEDs were generated which document all of the 40 criteria which were not met. In general, those HEDs address label content, temporary labels, lack of a hierarchical labeling scheme, nonstandard abbreviations, readability of labels, and lack of demarcation.

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 1 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.3.3 ARRANGEMENT OF VISUAL ALARM TILES					
c. LABELING OF AXES					
(1) The vertical and horizontal axes of annunciator panels should be labeled with alphanumerics for ready coordinate designation of a particular visual tile.	O	NO	P.3.1-35	III	
(2) Coordinate designation is preferred on the left and top sides of the annunciator panel.	O	NO	P.3.1-34	III	Assess in labeling study.
(3) Letter height for coordinate designation should be consistent with a subtended visual angle of at least 15 minutes as viewed from a central position within the primary operating area.	M	YES			
6.5.1.6 COLOR CODING					
a. REDUNDANCY — In all applications of color coding, color should provide redundant information. That is, the pertinent information should be available from some other cue in addition to color.	O	YES			
b. NUMBER OF COLORS					
(1) The number of colors used for coding should be kept to the minimum needed for providing sufficient information.	O	YES			
(2) The number of colors used for coding should not exceed 11.	O	YES			
c. MEANING OF COLORS					
(1) The meaning attached to a particular color should be narrowly defined.	O	YES			

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 2 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6c. (CONT'D)					
(2) Red, green, amber (yellow) should be reserved for the following uses:					
Red: unsafe, danger, immed iate operator action required, or an indication that a critical parameter is out of tolerance.	O	NO	P.8.1-2	III	Assess in labeling study.
Green: safe, no operator action required, or an indi cation that a parameter is within tolerance.	O	NO	P.8.1-3	III	Assess in labeling study.
Amber (yellow): hazard (potentially unsafe), caution, attention required, or an indi-cation that a marginal value or parameter exists.	O	NO	P.8.1-4	III	Assess in labeling study.
d. CONSISTENCY OF MEANING					
(3) The meaning of a particular color should remain the same both within and among the various systems to which it is applied.	N/A	N/A			Addressed in Conventions Survey
e. PRINCIPLES OF COLOR SELECTION					
(1) The primary principle which should be applied in selecting colors for coding purposes which do not have the immediate safety implications of red, green, and amber is to ensure that each color is recognized as different from any other. Exhibit 6.5-7 lists 22 colors of maximum contrast. Each successive color has been selected so that it will contrast maximally with the color just preceding it and satisfactorily with earlier colors in the list. The first 9 colors have been selected so as to yield saftisfactory contrast for red-green-deficient as well as color-normal observers. The remaining 13 colors are useful only for color-normal observers.					

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 3 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6e. (CONT'D)					
(2) Colors selected for coding should contrast well with the background on which they appear.	O	YES			
(3) Ambient lighting in the area in which color coding is used will influence the apparent color of the coded element (especially for surface colors). Each color selected for coding should be evaluated under all illumination conditions under which it is used.	O	YES			
6.6.1.1 NEED FOR LABELING					
Controls, displays, and other equipment items that must be located, identified, or manipulated should be appropriately and clearly labeled to permit rapid and accurate human performance.	I	NO	P.6.1-1	IIC	Assess in labeling study.
6.6.1.2 HIERARCHICAL SCHEME					
To reduce confusion, operator search time, and redundancy, a hierarchical labeling should be used. (See Exhibit 6.6-1.)	O	NO	P.6.1-10	IIC	Assess in labeling study.
a. **RANKING**					
(1) Major labels should be used to identify major systems or operator work stations.	O	YES			
(2) Subordinate labels should be used to identify subsystems or functional groups.	O	NO	P.6.1-11	IIC	Assess in labeling study.
(3) Component labels should be used to identify each discrete panel or console element.	O	YES			
(4) Labels should not repeat information contained in higher-level labels.	N/A	N/A			

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 4 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.1.2 (CONT'D)					
b. LETTER GRADATIONS — Labels should be graduated in letter size such that:					
(1) System/work station labels are about 25% larger than	M	YES			
(2) Subsystem/functional group labels which are about 25% larger than	M	NO	P.6.1-28	III	Assess in labeling study.
(3) Component labels which are about 25% larger than	M	YES			
(4) Control position identifiers.	M	YES			
6.6.2.1 PLACEMENT					
a. NORMAL PLACEMENT — Labels should be placed above the panel element(s) they describe.	O	NO	P.6.1-12	IIA	Assess in labeling study.
b. PANEL LABELING — The placement of labels on control panels should conform to the guidance shown in Exhibit 6.6-1.	O	NO	P.6.1-12	IIA	Assess in labeling study.
c. VISIBILITY ENHANCEMENT — Labels of elements located above eye level should be positioned to ensure label visibility.	O	NO	P.6.1-12	IIA	Assess in labeling study.
d. PROXIMITY — Labels should be placed close to the panel element. See Exhibit 6.6-2.	O	YES			
e. LABELS ON CONTROLS — Labels should not appear on the control itself when an adjustment or manipulation is required that causes the operator's hand to obscure the label for an extended time period.	D	YES			
f. ADJACENT LABELS --Adjacent labels should be separated by sufficient space so that they are not read as one continuous label. See Exhibits 6.6-3 and 6.6-4.	O	YES			
6.6.2.2 MOUNTING					
a. INTEGRITY— Label should be mounted in such a way as to preclude accidental removal.	O	YES			

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 5 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.2.2 (CONT'D)					
b. SURFACE — Labels should be mounted on a flat surface.	O	YES			
6.6.2.3 SPATIAL ORIENTATION					
a. HORIZONTAL ORIENTATION					
(1) Labels should be oriented horizontally so that they may be read quickly and easily from left to right.	O	YES			
(2) Although not normally recommended, vertical orientation may be used only where space is limited.	O	YES			
b. CURVED PATTERNS — Curved patterns of labeling should be avoided. See Exhibit 6.6-5.	O	YES			
6.6.2.4 VISIBILITY					
a. OTHER INFORMATION SOURCES — Labels should not cover any other information source. They should not detract from or obscure figures or scales which must be read by the operator.	O	NO	P.6.1-15	IIA	
b. CONCEALMENT — Labels should not be covered or obscured by other units in the equipment assembly.	O	NO	P.6.1-16	III	Assess in labeling study.
c. CONTROLS — Labels should be visible to the operator during control actuation.	I	YES			
d. CLEANING — Administrative procedures should be in place for the periodic cleaning of labels.	I	NO	P.6.1-2	III	Turn over to ops. admin.
6.6.3.1 KINDS OF INFORMATION					
a. PRIMARY FUNCTION — Labels should describe the function of equipment items.	I	NO	P.6.1-3	IIC	
b. SECONDARY FUNCTION — If needed for clarity, engineering characteristics or nomenclature may also be described.	O	YES			

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 6 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.3.2 WORD SELECTION					
a. INTENDED ACTION --The words employed in the label should express exactly what action is intended.	I	NO	P.6.1-4	IIC	Assess in labeling study.
b. CLARITY — Instructions should be clear.	I	YES			
c. DIRECT — Instructions should be direct.	I	YES			
d. MEANING — Words should be used that have a commonly accepted meaning for all intended users.	I	NO	P.6.1-5	III	Assess in labeling study.
e. TECHNICAL TERMS — Unusual technical terms should be avoided.	I	YES			
f. SPELLING — Words should be correctly spelled.	O	YES			
6.6.3.3 CONSISTENCY					
b. INTERNAL CONSISTENCY — Labels should be consistent within and across pieces of equipment in their use of words, acronyms, abbreviations, and part/system numbers. See Exhibit 6.6-6.	O	NO	P.6.1-17	III	Assess in labeling study.
c. CONSISTENCY WITH PROCEDURES — There should be no mismatch between nomenclature used in procedures and that printed on the labels.	D	NO	P.6.1-26	IIC	Assess in labeling study.
6.6.3.4 SYMBOLS					
a. MEANING — Abstract symbols should be used only if they have a commonly accepted meaning for all intended users (e.g., %).	I	YES			
b. DISTINGUISHABILITY — Symbols should be unique and distinguishable from each other.	I	YES			
c. STANDARD — A commonly accepted standard configuration should be used.	I	YES			
d. CONSISTENCY — Symbols should be consistently used within and across panels.	O	YES			

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED **Page 7 of 13**

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.3.4 (CONT'D)					
e. **ROMAN NUMERALS** — Use of Roman numerals should be avoided.	O	YES			
6.6.3.5 BREVITY					
Brevity should not be stressed if the results will be unfamiliar to operating personnel. Words on labels should be concise and still convey the intended meaning. See Exhibit 6.6-7.	I	NO	P.6.1-5	III	Assess in labeling study.
6.6.3.6 SIMILARITY					
Words and abbreviations of similar appearance should be avoided where an error in interpretation could result. When labels containing similar words, abbreviations, or acronyms are located in close proximity to each other, different words should be selected or means of coding should be used to reduce the probability of selecting the wrong control or reading the wrong display. See Exhibit 6.6-8.	O	YES			
6.6.3.7 FUNCTIONAL GROUPS					
a. **FUNCTIONAL RELATIONSHIP** — Labels should be used to identify functionally grouped controls or displays.	O	NO	P.6.1-11	IIC	Assess in labeling study.
b. **LOCATION** — Labels should be located above the functional groups they identify.	O	YES			
6.6.3.8 CONTROL POSTION LABELING					
a. **POSITION** All discrete functional control positons should be identified.	O	NO	P.6.1-32	III	Assess in labeling study.
b. **DIRECTION** — Direction of motion (increase, decrease) should be identified for continuous motion rotary controls.	O	YES			
c. **VISIBILITY** — Control position information should be visible to the operator during operation of the control.	I	YES			

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 8 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.3.9 ACCESS OPENING, DANGER, WARNING, AND SAFETY INSTRUCTION LABELING					
a. ACCESS OPENING LABELS — Each access opening used by control room operators should be labeled to identify the function of items accessible through it.	O	YES			
b. DANGER, WARNING, AND SAFETY INSTRUCTION LABELS — All danger, warning, and safety instruction labels should be in accordance with appropriate safety standards.	O	YES			
6.6.4.1 READABILITY					
a. CHARACTER HEIGHT					
(1) Character height should subtend a visual angle of 15 minutes as a minimum, or 0.004 x viewing distance. A visual angle of 20 minutes, or 0.006 x viewing distance, is preferred.	M	NO	P.6.1-20	III	Assess in labeling study.
(2) Letter height should be identical for all labels within the same hierarchical level, based on the maximum viewing distance.	M	NO	P.6.1-27	III	Assess in labeling study.
b. CONTRAST					
(1) To ensure adequate contrast and prevent loss of readability because of dirt, dark characters should be provided on a light background.	O	NO	P.6.1.18	III	Assess in labeling study.
(2) If color print is used for coding purposes, it should conform to the established color coding scheme for the control room. (See Guideline 6.5.1.6.) Colors should be chosen for maximum contrast against the label background. Exhibit 6.6-9 rates various color combinations in terms of relative legibility.	N/A	N/A			

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 9 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.4.2 STYLE (Exhibits 6.5-1 and 6.5-2)					
a. CHARACTER SELECTION					
(1) Labels should be prepared in capital letters.	O	YES			
(2) The design of letters and numerals should be simple and without flourishes or serifs.	O	YES			
b. CHARACTER WIDTH					
(1) Letter width-to-height ratio should be between 1:1 and 3:5.	M	YES			
(2) Numeral width-to-height ratio should be 3:5 except for the numeral "4" which should be one stroke width wider and the numeral "1" which should be one stroke in width.	M	YES			
c. STROKE WIDTH — Stroke width-to-character height ratio should be between 1:6 and 1:8.	M	NO	P.6.1-30	III	Assess in labeling study.
d. SPACING					
(1) The minimum space between characters should be one stroke width.	M	NO	P.6.1-31	III	Assess in labeling study.
(2) The minimum space between words should be one character width.	M	YES			
(3) The minimum space between lines should be one-half of the character height.	M	YES			
6.6.5.1 USE OF TEMPORARY LABELS					
a. NECESSITY — Temporary labels should be used only when necessary.	I	NO	P.6.1-7	III	Asssess in labeling study.
b. HUMAN FACTORS PRACTICES — Temporary labels should conform to good human engineering principles.	O	NO	P.6.1-19	III	Assess in labeling study.

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 10 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.5.1 (CONT'D)					
c. **VISIBILITY** — Temporary labels should not obscure prior permanent labels unless the old label is to be replaced.	O	NO	P.6.1-15	IIA	
d. **IDENTIFICATION** — Tag-out labels should clearly identify out-of-service components and equipment.	O	YES			
e. **MOUNTING** — Tag-outs should be securely affixed.	O	YES			
f. **OBSCURATION** — Tag-outs should not obscure the label associated with the nonoperable device.	O	NO	P.6.1-15	IIA	
g. **ACTIVATION** — Tag-outs should be designed to physically prevent actuation of a control.	I	YES			
h. **ADJACENT DEVICES** — Tag-outs should not obscure any adjacent devices or their associated labels.	O	NO	P.6.1-15	IIA	
6.6.5.2 CONTROL OF TEMPORARY LABELS					
a. **ADMINISTRATIVE PROCEDURES** — The use of temporary labels should be administratively controlled.	D	YES			
b. **REVIEW PROCEDURES** — A review procedure should be in place that will result in a determination of:	D	YES			
(1) when temporary labels are needed;					
(2) how they will be used;	D	YES			
(3) their content (given human engineering requirements);	D	YES			
(4) their installation;	D	YES			
(5) the impact of their use on other system equipment (e.g., annunciators, mimics);	D	YES			

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 11 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.5.2b. (CONT'D)					
(6) documentation requirements;	D	YES			
(7) retraining requirements;	D	YES			
(8) their periodic review: and	D	YES			
(9) their removal.	D	YES			
6.6.6.2 DEMARCATION (See Exhibit 6.8-1)					
a. USE — Lines of demarcation can be used to:					
(1) Enclose functionally related displays.	N/A	N/A			
(2) Enclose functionally related controls.	N/A	N/A			
(3) Group related controls and displays.	N/A	N/A			
b. CONTRAST — Lines of demarcation should be visually distinctive from the panel background.	N/A	N/A			
c. PERMANENCE — Lines of demarcation should be permanently attached.	N/A	N/A			
6.6.6.3 COLOR					
Color should be dedicated to specific functions or conditions throughout the control room in order for the code to elicit the expected operator response. The color coding scheme should be used consistently throughout the control room. Refer to Guideline 6.5.1.6 for specific recommendations on the use of color.	N/A	N/A			See Conventions Survey Report

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 12 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.6.4 USE OF MIMICS					
a. COLOR					
(1) Flow paths should be color coded. Colors should be selected in con formance with Guidelines 6.5.1.6.	O	NO	P.6.1-20	IIC	Assess in labeling study.
(2) The mimic colors should be dis-criminably different from each other.	I	NO	P.6.1-9	IIC	Assess in labeling study.
(3) There should be adequate contrast between the mimic colors and the panel.	O	YES			
(4) Mimic lines depicting flow of the same contents (e.g., steam, water, electricity) should be color coded the same throughout the control room.	O	NO	P.6.1-20	IIC	Assess in labeling study.
(5) No more than 4 mimic lines of the same color should run in parallel if the operator must quickly identify any one of the lines.	O	YES			
b. MIMIC LINES					
(1) Differential line widths may be used to code flow paths (e.g., significance, volume, level).	O	YES			
(2) Overlapping of mimic lines should be avoided.	O	YES			
(3) Flow directions should be clearly indicated by distinctive arrow-heads.	O	YES			
(4) All mimic origin points should be labeled or begin at labeled com ponents.	O	NO	P.6.1-23	III	Assess in labeling study.
(5) All mimic destination or terminal points should be labeled or end at labeled components.	O	NO	P.6.1-23	III	Assess in labeling study.
(6) Component representations on mimic lines should be identified.	O	NO	P.6.1-24	IIC	Assess in labeling study.

TABLE 4-12
LABELS SURVEY FINDINGS & HEDs GENERATED Page 13 of 13

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.8.3.4 (CONT'D)					
c. SYMBOLS					
(1) Graphic symbols should be readily understood and commonly used.	N/A	N/A			See Conventions Survey Report
(2) Symbols should be used consistently.	N/A	N/A			See Conventions Survey Report
6.8.3.2 STRINGS OR CLUSTERS OF SIMILAR COMPONENTS					
d. LARGE MATRICES					
(1) Large matrices of similar components should have the coordinate axes labeled for identification of any single component within the grid. The left and top sides of the matrix should be used for labeling (see Exhibit 6.8-6).	N/A	N/A			
(2) Large matrices should be subdivided by appropriate demarcation.	O	NO	P.6.1-25	IIC	

4.13 Conventions Survey

This section documents the results of the conventions survey conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.13.1 Objectives

The objectives of the conventions survey were to:

a. Identify the NUREG-0700 defined conventions that are applied in the Davis-Besse control room.

b. Determine if the applications of the identified conventions are consistent across the applicable design features.

c. Document any inconsistent or missing conventions in the control room.

4.13.2 Scope

The scope of the effort extends to the assessment of color, shape, and arrangement coding across design features in the main control room at Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- Coding of controls
- Color coding of controls and displays
- Label content consistency
- Enhancements of emergency controls.

Abbreviations and acronyms used within the control room were addressed in the labeling survey.

4.13.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.3.3.4d; 6.4.2.2a, b, f(1) and f(2); 6.5.1.6b(2), c(2), and d(1) through d(3); 6.5.3.2a(2); 6.6.3.3a; 6.6.6.4c(1) and c(2); and 6.8.1.3c and d.

The detailed definitions for each criterion are presented in Table 4-13.

4.13.4 Method

4.13.4.1 Data Collection

a. All required data forms, plant documentation, engineering drawings, equipment, and materials were made available prior to conduct of this task. Permission was obtained for all required access to the control room.

b. Data were collected using methods and procedures consisting of observations and document reviews.

c. Administrative procedures were reviewed to verify the items listed in the Document Review Checklist in the conventions task plan.

4.13.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the components involved (e.g., controls, meters, labels, etc.), a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the conventions task plan were annotated to indicate compliance or noncompliance with the criteria.

4.13.5 Findings

The findings of the conventions survey are presented in Table 4-13 "Conventions Survey Findings and HEDs Generated." Overall, 18 criteria were applied to the conventions in the Davis-Besse control room. Of these, eight (44%) were not applicable, one (5%) was in compliance, and nine (50%) were not in compliance. A total of six HEDs were generated which document all of the nine criteria which were not met. In general, those HEDs addressed inconsistent uses of color, no administrative control over the uses of abbreviations and no enhancement techniques used on emergency controls.

TABLE 4-13
CONVENTIONS SURVEY FINDINGS & HEDs GENERATED Page 1 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.3.4 VISUAL TILE LEGENDS					
d. **ABBREVIATIONS** — Abbreviations and acronyms should be consistent with those used elsewhere in the control room.	N/A	N/A			Addressed in Labels Survey
6.4.2.2 CODING OF CONTROLS (Exhibit 6.4-3)					
a. **CONSISTENCY** — The coding system should be uniform throughout the control room.	N/A	N/A			
b. **LOCATION CODING** — Controls should be located so as to be easily related to functions and functional groupings. Controls with similar functions should be in the same location from panel to panel. (See Guideline 6.8.2.3.)	N/A	N/A			
f. **COLOR CODING**					
(1) Color coding should follow the recommendations of Guideline 6.5.1.6.	O	NO	P.8.1-1	III	Assess in labeling study.
(2) When color coding is used to relate a control to its corresponding display, the same color should be used for both the control and the display.	N/A	N/A			
6.5.1.6 COLOR CODING					
b. **NUMBER OF COLORS**	O	YES			
(2) The number of colors used for coding shuld not exceed 11.					

TABLE 4-13
CONVENTIONS SURVEY FIN)INGS & HEDs GENERATED Page 2 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6 (CONT'D)					
c. MEANING OF COLORS					
(2) Red, green, and amber (yellow) should be reserved for the following uses:					
Red: unsafe, danger, immediate operator action required, or an indication that a critical parameter is out of tolerance.	O	NO	P.8.1-2	III	Assess in labeling study.
Green: safe, no operator action required, or an indication that a parameter is within tolerance.	O	NO	P.8.1-3	III	Assess in labeling study.
Amber (yellow): hazard (potentially unsafe), caution, attention required, or an indication that a marginal value or parameter exists.	O	NO	P.8.1-4	III	Assess in labeling study.
d. CONSISTENCY OF MEANING					
(1) The meaning assigned to particular colors should be consistent across all applications within the control room.	O	NO	P.8.1-1	III	Assess in labeling study.
(2) The meaning of a particular color should remain the same whether applied to panel surfaces or projected in signal lights or on CRTs.	O	NO	P.8.1-1	III	Assess in labeling study.
(3) The meaning of a particular color should remain the same both within and among the various systems to which it is applied.	N/A	N/A			
6.5.3.2 DESIGN AND USE OF NONLEGEND LIGHT INDICATORS					
a. IDENTIFICATION OF MEANING					
(2) The color of the light indicator when transilluminated should conform to the general code established for the control room. (See Guideline 6.5.1.6.)	O	NO	P.8.1-1	III	Assess in labeling study.

TABLE 4-13
CONVENTIONS SURVEY FINDINGS & HEDs GENERATED Page 3 of 3

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.6.3.3 LABEL CONTENT CONSISTENCY					
a. ADMINISTRATIVE CONTROL — A list of standard names, acronyms, abbrevia tions, and part/system numbers should be in place and administratively controlled.	D	NO	P.8.1-5	III	Assess in labeling study.
6.6.6.4 USE OF MIMICS					
c. SYMBOLS					
(1) Graphic symbols should be readily understood and commonly used.	N/A	N/A			
(2) Symbols should be used consistently.	N/A	N/A			
6.8.1.3 ENHANCING RECOGNITION AND IDENTIFICATION					
c. COLOR SHADING — Color shading may be used to enhance recognition of controls, displays, or functional groups. When color shading is used, colors should provide adequate contrast, and should be consistent with other color coding in the control room.	NA	N/A			
d. EMERGENCY CONTROLS — Distinctive enhancement techniques should be used for emergency controls.	O	NO	P.8.1-6	III	Assess in labeling study.

4.14 Computer System Survey

This section documents the results of the computer system conducted in the main control room at the Davis-Besse Nuclear Station. This review was conducted in accordance with the requirements of NUREG-0700, as specified in the Davis-Besse DCRDR Program Plan.

4.14.1 Objectives

The objectives of the computer system survey were to:

a. Assess the degree to which the computer system in the control room conforms to the criteria in NUREG-0700.

b. Identify and document any features of the computer system that do not conform to the criteria in NUREG-0700.

4.14.2 Scope

The scope of the effort extends to the assessment of the computer system design in the main control room at the Davis-Besse Nuclear Station using the applicable guidelines as stated in NUREG-0700. The topics evaluated include:

- o Software security
- o Operator/computer dialogue
- o Prompting and structuring
- o Keyboards
- o Computer function controls
- o Other control devices
- o Computer response time
- o Access aids
- o CRT display characteristics
- o Symbol and character size
- o Operator-display relationships
- o Data presentation format
- o Screen layout and structuring
- o Messages
- o Graphic coding and highlighting
- o Multiple-page considerations
- o Printer characteristics
- o Alarm messages
- o Graph and table requirements.

4.14.3 Criteria

The criteria applied in this survey, identified by NUREG-0700 paragraph number, are: paragraphs 6.5.1.6d(2), 6.7.1.1a through d, 6.7.1.2a through d, 6.7.1.3a through e, 6.7.1.4a through i, 6.7.1.5a through d, 6.7.1.6a through d, 6.7.1.7a and b, 6.7.1.8a and b, 6.7.2.1a through h, 6.7.2.2a through g, 6.7.2.3a through f, 6.7.2.4a through q, 6.7.2.5a through n, 6.7.2.6a through l, 6.7.2.7a through m, 6.7.2.8a through e, 6.7.3.1a through f, 6.7.3.2a through f, 6.7.3.3a through d.

The detailed definitions for each criterion are presented in Table 4-14.

4.14.4 Method

4.14.4.1 Data Collection

a. Data were collected using the checklists contained in the Computer System Task Plan. Data were collected primarily through direct observation of the computer system in the CR and examination of hard-copy printouts of display pages. As necessary, personnel from the Davis-Besse computer group were consulted to augment or clarify observations. Measurement of physical characteristics of the computer system (e.g., key displacement, character size and separation, etc.) were made. System documentation, including operating procedures and hardware specifications, were reviewed, as required.

b. All pertinent observations were recorded on the appropriate data forms.

4.14.4.2 Analysis — Data were analyzed according to the following procedure:

a. All deviations from the criteria were recorded on Human Engineering Discrepancy (HED) reports. Recorded information included the items involved, a description of the problem including the NUREG-0700 paragraph number of the criteria, and a recommended solution.

b. The data collection method was also recorded on the HED form. Where data from two or more sources were contradictory, resolution of the conflict was achieved through data review and discussions with cognizant plant personnel.

c. Upon completion of all analyses, the criteria of the computer system task plan were annotated to indicate compliance or noncompliance with the criteria.

4.14.5 Findings

The findings of the computer system survey are presented in Table 4-14 "Computer Survey Findings and HEDs Generated." Overall, 226 criteria were applied to the computer system in the Davis-Besse control room. Of these 27 (12%) were not applicable, 165 (73%) were in compliance, and 31 (14%) were not in compliance. A total of 16 HEDs were generated which document all of the 31 criteria which were not met. In general those HEDs address uses of colors as the CRT displays, computer procedures, character separation on CRT displays, blink rates, flicker on CRTs, display formats.

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 1 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.6 COLOR CODING					
d. **CONSISTENCY OF MEANING**					
(2) The meaning of a particular color should remain the same whether applied to panel surfaces or projected in signal lights or on CRTs.	O	NO	P.8.1-1	III	Assess in labeling study.
6.7.1.1 SOFTWARE SECURITY					
a. **AUTHORIZATION** — The system should include positive protection provisions to ensure that only properly authorized personnel can make changes (by entry, deletion, or alteration).	O	YES			
b. **SECURE STORAGE** — At least one copy of the current operating software should be stored in a secure remote location.	O	YES			
c. **EDITING** — When characters, words, or phrases are to be inserted, such items should first be collected and displayed on a buffer area of the screen, and then collectively inserted by one operator command.	O	YES			
d. **ACKNOWLEDGEMENT** — Before any operator requests are processed that would result in permanent changes to existing data, the computer system should require operator acknowledgement.	O	YES			
6.7.1.2 OPERATOR/COMPUTER DIALOGUE					
a. **LANGUAGE CHARACTERISTICS**					
(1) Dialogue should be based on the operator's point of view, not the programmer's.	O	YES			
(2) Dialogue should be logical.	O	YES			
(3) Dialogue should be used in a consistent manner.	O	YES			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 2 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.1.2a (Cont'd)					
(4) Dialogue should reflect the vocabulary and syntax of the expected user population.	O	YES			
(5) Input words (e.g., keywords) should approximate real words.	O	YES			
(6) Dialogue should require an explicit command in order to terminate an interaction.	O	YES			
b. ENTRY LENGTH — Individual input words which must be typed should not exceed 7 characters.	O	YES			
c. ABBREVIATIONS					
(1) Abbreviations should be used whenever possible to minimize operator input requirements.	O	YES			
(2) If the operator is using a synonym or abbreviation for a system command name, the computer system should use the same synonym or abbreviation when referring to that command in messages, prompts, etc., to the operator.	O	YES			
(3) The use of abbreviations or contractions for output text should be avoided.	O	YES			
d. ERROR AVOIDANCE — Operator inputs, responses, or actions which could significantly degrade computer system or plant performance should not be dependent on a single keystroke.	O	YES			
6.7.1.3 PROMPTING AND STRUCTURING					
a. OPERATOR REQUESTS — The computer system should contain prompting and structuring features by which an operator can request additional information.	O	YES			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 3 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.1.3a (Cont'd)					
b. CORRECTION OF DATA — The computer system should contain prompting and structuring features by which an operator can request corrected information when an error is detected.	O	YES			
c. MODE/FILE DISPLAY — The computer system should display the mode designation and the file(s) being processed.	O	YES			
d. SPECIFIC ERROR CORRECTION — The computer system should permit correction of individual errors without requiring re-entry of correctly entered data.	O	YES			
e. ENTRY FILE — The computer system should contain a sequential file of operator entries, available upon operator request.	O	YES			
6.7.1.4 DATA ENTRY — KEYBOARDS					
a. ALPHANUMERIC KEYBOARD ARRANGEMENT — Keyboards that combine alphabetic and numeric functions on a single keyboard should conform to the standard "QWERTY" arrangement. See Exhibit 6.7.-1.	O	YES			
b. NUMERIC KEYBOARD ARRANGEMENT — The configuration of a keyboard used to enter solely numeric data should be a 3x3+1 matrix, either "telephone" style or "calculator" style. see Exhibit 6.7-2.	O	YES			
c. USE OF MULTIPLE KEYBOARDS — If there is more than one computer system keyboard in a control room, the alphanumeric and/or numeric-only key configuration should be the same in all cases.	N/A	N/A			
d. KEY MEASUREMENTS — To maximize the effectiveness of keyboards, key dimensions and separation should be as illustrated (see Exhibit 6.7-3).	O	YES			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 4 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.1.4 (Cont'd)					
e. KEY DISPLACEMENT AND RESISTANCE — To provide positive key movement feedback to the operator, and to reduce inadvertent activation of keys,					
(1) Key displacement should be as shown in Exhibit 6.7-4.	M	YES			
(2) Key resistance should be as shown in Exhibit 6.7-4.	M	YES			
f. POSITIVE INDICATION — To provide positive key actuation feedback to the operator, a definite indication should be provided (e.g., snap, feel, audible click, release of resistance).	O	YES			
g. KEYBOARD SLOPE — Keyboards should have a slope between 15° and 25° from the horizontal (see Exhibit 6.7-5).	M	YES			
h. VISUAL FEEDBACK — Data being entered via keyboards should be displayed as it is keyed.	O	YES			
i. RELEVANT KEYS — The presence of nonrelevant keys, such as those that might be used by programmer personnel, adds to keyboard complexity and induces operator errors. Control room keyboards should contain only those keys which are used by operators.	O	YES			
6.7.1.5 COMPUTER FUNCTION CONTROLS					
a. CONTROL DESIGN — When dedicated controls are used for selection of computer or display functions or modes, the design of the controls should conform to the appropriate guidelines specified in Section 6.4, Controls.	O	YES			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 5 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.1.5 (Cont'd)					
b. LABELING AND NOMENCLATURE — Terms, nomenclature, and abbreviations used on function controls should be the same as or consistent with the terms, nomenclature, and abbreviations of the computer function which is selected or displayed.	O	YES			
c. MASTER CONTROL — When CRTs are subject to operation by centrally located master controls, a positive indication should be provided:	O	YES			
(1) At the master-control location to identify those displays under local or master control.	O	YES			
(2) At the individual CRT to indicate whether the display is under master or local control.					
d. FUNCTION CONTROLS					
(1) When dedicated controls are used to initiate/activate functions, the keys should be grouped together.	O	YES			
(2) Function controls should be easily distinguished from other types of keys on the computer console.	O	YES			
(3) Each function control should be clearly labeled to indicate its function to the operator.	O	YES			
(4) If multiple computer consoles exist in the control room, the design and layout of the function controls should be consistent for all consoles.	N/A	N/A			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 6 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.1.5d (Cont'd)					
(5) When function keys are included with an alphanumeric keyboard, the function keys should be physically separate. (Avoid multiple-mode keyboards which utilize the same keys for both alphanumerics and functions by using "shift" keys or mode selection controls.)	O	YES			
6.7.1.6 OTHER CONTROL DEVICES					
a. LOCATION — The control devices should be operable from the location where the operator is most likely to need to interact with the computer (e.g., keyboard, computer console, display screen).	O	YES			
b. SPEED — The control device should provide rapid positioning of cursors or selection of choices.					
c. ACCURACY — Device or method accuracy should be commensurate with the functions to be served.	O	YES			
d. DISPLACEMENT — Control design should allow the operator freedom of movement to perform other duties.	O	YES			
6.7.1.7 COMPUTER RESPONSE TIME TO OPERATOR QUERIES					
a. MAXIMIZE RESPONSE TIMES — The computer system should provide the correct response to each type of query within the recommended response times listed in Exhibit 6.7-6.	O	YES			
b. RESPONSE DELAY MESSAGES — When response time for any query exceeds 3 seconds, a delay message should be presented to maintain the operator's attention and to confirm normal computer operation. (See also Guideline 6.7.2.6.)	O	YES			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 7 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.1.8 ACCESS AIDS					
a. COMPUTER SYSTEM PROCEDURES					
(1) A compute set of computer system operating procedures and contingency procedures should be available in the control room.	D	NO	P.7.1-6	III	
(2) Procedures should be prepared from the point of view of the control room operator.	D	YES			
(3) Procedures should be in hardcopy form as a minimum.	D	YES			
(4) Operating procedures should describe:					
(a) The overall computer system.	D	YES			
(b) The computer system components with which the operator can interface.	D	YES			
(c) The specific procedures necessary to accomplish all of the operator-computer interface functions.	D	YES			
(5) Contingency procedures should describe:					
(a) Indications available to the operator which identify failure or malfunctioning of the computer system.	D	YES			
(b) Necessary actions to be performed by the operator if the computer fails or malfunctions.	D	YES			

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.1.8 (Cont'd)					
b. DATA POINT INDICES					
(1) The specific codes, or addresses, by which data displays can be called up by an operator should be cross-indexed by:					
(a) Alphanumeric or numeric code	D	YES			
(b) Program name	D	NO	P.7.1-12	III	
(c) System/subsystem identification	D	NO	P.7.1-12	III	
(d) Functional group identification.	D	NO	P.7.1-12	III	
(2) Cross-indices should be available in the control room in hardcopy form as a minimum.	D	NO	P.7.1-12	III	
6.7.2.1 CRT DISPLAY CHARACTERISTICS					
a. READABILITY — Alphanumeric and graphic characters should be easily readable by the operator under all control room lighting conditions.	O	YES			
b. REFLECTED GLARE — CRT screens should be installed to minimize or eliminate reflected glare at normal operator viewing angles.	O	YES			
c. SCREEN LUMINANCE					
(1) Ambient illumination should contribute no more than 25% to screen luminance through diffuse reflection and phosphor excitation.	O D	YES			
(2) When ambient illumination in the vicinity of the CRT is in the medium to high range (see Guideline 6.1.5.3), the CRT should use dark characters and symbols on a light background.	N/A	N/A			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 9 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.1c (Cont'd)					
(3) When the CRT uses dark characters on a light background, the screen background luminance should be 23 foot-Lamberts (ft-L) minimum and 46 ft-L preferred.	N/A	N/A			
(4) When the CRT uses light characters on a dark background, the character luminance should be 23 ft-L minimum and 46 ft-L preferred.	D	YES			
d. LUMINANCE CONTRAST					
(1) Contract between light characters and a dark screen background should be 15:1 minimum and 20:1 preferred.	D	YES			
(2) Contrast between dark characters and a light screen background should be 1:15 minimum and 1:20 preferred.	D	YES			
e. GEOMETRIC DISTORTION — The cumulative effects of all geometric distortion should not displace any point within the viewable area of the screen from its correct position by more than 5% of picture height.	O D M	YES			
f. RESOLUTION — Discrimination of fine detail is a function of the number of scan lines or addressable points ("resolution elements") per unit length.					
(1) CRTs for displaying simple alphanumeric text should have a minimum of 20 resolution elements per inch.	M	YES			
(2) CRTs for displaying complex symbols and graphic detail should have a minimum of 100 resolution elements per inch.	N/A	N/A			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 10 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.1f (Cont'd)					
(3) Complex symbols which must be distinguished from other complex shapes should have a minimum of 10 resolution elements for the longest dimension of the symbol.	M	YES			
(4) Alphanumeric characters should have a minimum of 10 resolution elements per character height.	M	YES			
g. REGENERATION RATE — The regeneration rate for a particular CRT display should be above the critical frequency at fusion so that the occurrence of disturbing flicker is not perceptible.	O	NO	P.7.1-11	III	
h. CRT DISPLAY CONTROLS					
(1) Parameters such as luminance (brightness), contrast, and color should be adjustable by the control room operator.	O	YES			
(2) Adjustment controls should conform to the appropriate guidelines in Section 6.4, Controls, and Section 6.9, Control-Display Integration.	O	YES			
6.7.2.2 SYMBOLS AND CHARACTERS					
a. SYMBOL SIZE — When a displayed symbol of complex shape is to be distinguished from another symbol shape that is also complex, the visual angle of the symbol should subtend not less than 20 minutes of arc at the required viewing distance.	M	NO	P.7.1-8	III	
b. ALPHANUMERIC CHARACTER SIZE					
(1) The height of alphanumeric characters should have a visual angle of not less than 12 minutes of arc at the required viewing distance.	M	YES			

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.2b (Cont'd)					
(2) Alphanumeric characters should be uppercase letters.					
c. CHARACTER WIDTH-TO-HEIGHT RATIO — The width-to-height ratio for alphanumerics should be between 3:5 and 1:1.	D	YES			
d. STROKE-WIDTH-TO-CHARACTER-HEIGHT RATIO — Stroke-width-to-character-height ratio should be between 1:5 and 1:10.	D	YES			
e. GRAPHICS — A graphic line will appear continuous if the separation between addressable points, or resolution elements, is less than one minute of arc. To provide the illusion of continuity, graphic lines should contain a minimum of 50 resolution elements per inch.	D	YES			
f. CHARACTER AND SYMBOL SEPARATION					
(1) Horizontal separation between characters or symbols should be between 10% and 65% of character or symbol height.	D	YES			
(2) Separation should be not less than 25% of character or symbol height when any of the following degraded conditions exists:	O	NO	P.7.1-7	III	
(a) When character or symbol width is less than 85% of height;	M	NO	P.7.1-7	III	
(b) When character or symbol luminance is less than 12 ft-L;	M	NO	P.7.1-7	III	
(c) When luminance contrast is less than 88%;	M	NO	P.7.1-7	III	
(d) When CRT screen location is greater than 35° to the left or right of the operator's straight-ahead line of sight;	M	NO	P.7.1-7	III	

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.2f(2) (Cont'd)					
(e) When the visual angle subtended by symbol height is less than 15 minutes of arc;	M	NO	P.7.1-7	III	
(f) When the visual angle subtended by character height is less than 12 minutes of arc.	M	NO	P.7.1-7	III	
g. **CHARACTER STYLE (FONT)**					
(1) Simple character fonts should be used, with no serifs, variable stroke widths, slanting, etc.	O	YES			
(2) When dot-matrix characters are used, 7x9 dot-matrix should be used in preference to 5x7 dot-matrix.	O	NO	P.7.1-2	III	
(3) Character styles such as Lincoln/Mitre or Leroy should be used.	O	YES			
6.7.2.3 OPERATOR-DISPLAY RELATIONSHIPS					
a. **VIEWING DISTANCE** — Viewing distance should be greater than 18 inches.	M	YES			
b. **VIEWING ANGLE** — The minimum angle between the operator's actual line-of-sight (LOS) as measured from the operator's normal work station, and the plane of the display screen should be 45° or greater in either the horizontal or vertical direction. See Exhibits 6.7-8 and 6.7-10.	M	YES			
c. **SCREEN LOCATION, SEATED OPERATORS**					
(1) CRT displays which require frequent or continuous monitoring, or which may display important (e.g., alarm) inf. mation, should be located within the following limits as measured from the normal operator work station (see Exhibit 6.7-9):	N/A	N/A			

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.7c (Cont'd)					
(a) Horizontal limits — Not more than 35° to the left or right of the operator's straight-ahead LOS.	N/A	N/A			
(b) Vertical limits — Not more than 20° above and 40° below the operator's horizontal LOS.	N/A	N/A			
(2) CRT displays which do not require frequent or continuous monitoring, and which will not display important (e.g., alarm) information, should be located within the following limits (as measured from normal operator work stations which permit full operator head and eye rotation). See Exhibit 6.7-10):					
(a) Horizontal limits — Not more than 95° to the left or right of the operator's straight-ahead LOS.	N/A	N/A			
(b) Vertical limits — Not more than 70° above and 90° below the operator's horizontal LOS.	N/A	N/A			
d. SCREEN LOCATION, STANDING OPERATORS					
(1) CRT displays which require frequent or continuous monitoring, or which may display important (e.g., alarm) information, should be located within the following limits as measured from the normal operator work station:					
(a) Horizontal limits — Not more than 35° to the left or right of the operator's straight-ahead LOS.	M	YES			
(b) Vertical limits — Not more than 35° above and 25° below the operator's horizontal LOS.	M	YES			

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.3d (Cont'd)					
(2) CRT displays which do not require frequent or continuous monitoring, and which will not display important (e.g., alarm) information, should be located within the following limits (as measured from normal operator work stations which permit full operator head and eye rotation):					
(a) Horizontal limits — Not more than 95° to the left or right of the operator's straight-ahead LOS.	M	YES			
(b) Vertical limits — Not more than 85° above and 90° below the operator's horizontal LOS.	M	YES			
e. **MOUNTING IN CONSOLES** — When CRTs are permanently mounted in consoles, the console configuration, dimensions, and type of use (such as seated, sit-stand, or standing) affects the CRT/operator interface. Consoles in which CRTs are installed should conform to the guidelines of Section 6.1.2.	M	YES			
f. **VISIBILITY OF DATA** — All data and messages on the CRT screen should be within the unobstructed view of an operator at the normal work station.	M	YES			
6.7.2.4 DATA PRESENTATION FORMAT					
a. **USABILITY OF DATA**					
(1) Data should be presented to the operator in a readily usable format.	O	NO	P.7.1-16	III	
(2) There should be no requirement for transposing, computing, interpolating, or mentally translating displayed data into other units or numerical bases.	O	YES			

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.4 (Cont'd)					
b. ILLUSTRATIONS — Illustrations should be used whenever possible to supplement or explain text.	O	YES			
c. CHARACTER GROUPING					
(1) When 5 or more digits and/or non-text alphanumerics are displayed, and no natural (i.e., population stereotyped) organization exists, characters should be grouped in blocks of 3 to 4 characters each.	O	NO	P.7.1-15	III	
(2) Groups should be separated by a minimum of 1 blank character space.	O	YES			
d. MAINTENANCE OF ORDERING — Elements in a data field should be displayed in logical order (e.g., chronological).	O	YES			
e. PRESENTATION OF IDENTICAL DATA					
(1) The manner of presentation of identical data should be based on the uses to which the data will be put by the operator.	O	YES			
(2) Within the limits of (1) above, identical data in different presentations should be displayed in a consistent, standardized manner.	O	YES			
f. MENU DESIGNATORS					
(1) Numbers should be used as designators when listing selectable items.	O	YES			
(2) Numerical designators should start with the number "1" (not zero).	O	YES			

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.4f (Cont'd)					
(3) If the use of numbers as designators would create confusion because of other numbers which make up the item to be designated, alphabetic characters should be used.	N/A	N/A			
(4) When used, alphabetic designators should start with the letter "A."	N/A	N/A			
g. LISTS					
(1) Lists should be vertically aligned and left-justified.	O	YES			
(2) Indentation should be used for subclassifications.	O	YES			
h. TABLES AND GRAPHS — Quantitative data which must be scanned and compared should be presented in either tabular or graphic form.	O	YES			
i. HYPHENATION — The use of hyphenation should be minimized.*	O	YES			
j. ALIGNMENT					
(1) When presented in tabular form, alphanumeric data should be left-justified.	O	YES			
(2) When presented in tabular form, numeric data should be right-justified with decimal points aligned.	O	YES			
k. PERIODS — Periods should be placed after item selection designators and at the end of a sentence.	O	YES			

TABLE 4-14
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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.4 (Cont'd)					
l. **STANDARDIZED FIELDS** — The following standardized fields should be used:					
(1) Telephone Number: (914)555-1212	O	YES			
(2) Time: HH:MM:SS, HH:MM, MM:SS:(.S)	O	YES			
(3) Date: MM:DD:YY.	O	YES			
m. **DATA GROUP LABELING**					
(1) Each individual data group or message should have a descriptive title.	O	NO	P.7.1-13	III	
(2) Labels should reflect some unique characteristic of the content of the data group or message.	O	YES			
n. **LABEL PLACEMENT** — Labels should be located in a consistent manner either above or to the left of the data group or message they describe.	O	YES			
o. **LABEL ORIENTATION** — Labels should be oriented horizontally.	O	YES			
p. **LABEL HIGHLIGHTING**					
(1) Labels should be highlighted or otherwise accentuated to facilitate operator scanning and recognition.	O	NO	P.7.1-14	III	
(2) The technique used to highlight labels should be easily distinguished from that used to highlight emergency or critical messages.	N/A	N/A			
q. **OPTION LABELS** — When presenting a list of operator options, the label should reflect the question or choices being posed to the operator.	O	NO	P.7.1-1	III	

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COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 18 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.5 SCREEN LAYOUT AND STRUCTURING					
a. ORGANIZATION OF DATA					
(1) Displayed data should be organized in a logical, consistent manner.					
(2) Displayed data should reflect some obvious and inherent quality of the data groups (e.g., hierarchical, sequential, or mimic relationships).	O	YES			
b. LOCATION OF DATA GROUPS — Physical location of specific data groups (e.g., alarms, menus) on the screen should be consistent.	O	YES			
c. DEMARCATION OF DATA SUBGROUPS — Organization and separation of information subgroups should be made apparent to the operator through the use of blank spaces, lines, or some other form of visible demarcation.	O	YES			
d. USE FREQUENCY RANKING — Lists of options should be organized according to the probability of selection for each item, with high probability items presented first.	O	YES			
e. ALPHANUMERIC RANKING — Non-option lists of equal-probability options should be presented in alphabetical or numerical order.	O	YES			
f. SEPARATION OF PARAGRAPHS — Paragraphs in continuous text should be separated by at least one blank line.	N/A	N/A			
g. SELECTION DESIGNATORS — Selection designators in menus should be separated from text descriptors by at least one blank space.	O	YES			

TABLE 4-14
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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.5 (Cont'd)					
h. PAGE DESIGNATION — When data are contained on multiple pages, each page should display both page number and total number of pages.	N/A	N/A			
i. CONTINUOUS NUMBERING — Items contained in a numbered list and described on "continue" pages should be numbered relative to the first number on the first page of the list.	N/A	N/A			
j. PLACEMENT OF INSTRUCTIONS — When directions to the operator accompany a list of options, such directions should precede presentation of the list.	N/A	N/A			
k. URGENT MESSAGES					
(1) Urgent messages requiring immediate operator response should be highlighted to attract the operator's attention.	O	YES			
(2) Urgent messages should always be displayed in the same location.	O	YES			
l. USE OF CURSOR — In systems in which selection is made by use of a cursor, formats should be organized to minimize positioning movements of the cursor.	N/A	N/A			
m. SCREEN LOADING — The amount of information-bearing activated screen area should not exceed 25% of the total screen area. This does not include demarcation lines used to separate groups of data.	O	YES			

TABLE 4-14
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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.5 (Cont'd)					
n. TREND PLOT SCALES — CRT displayed trend plot scales should be consistent with the intended functional use of the data. (For example, the monitoring of neutron flux at reactor trip may have a variable scale of 0% to 1% of the design value and a time scale resolution of seconds. However, post-trip monitoring may have a variable scale of 0% to 10% with a time scale resolution of minutes. Finally, operational log data of neutron flux may have a time scale resolution of hours.)	O	YES			
6.7.2.6 MESSAGES					
a. MESSAGES, GENERAL					
(1) Messages should be concise.	O	YES			
(2) Messages should provide the operator with the information necessary to complete a specific action or decision sequence.	O	YES			
b. MESSAGE CONTENT — Information contained in messages should be necessary, complete, and readily usable.	O	YES			
c. USE OF PROMPTS — Prompts should be displayed whenever the operator may need directions or guidance to initiate or complete an action or sequence of actions.	N/A	N/A			
d. CONTENT OF PROMPTS — Prompts should contain clear and specific cues and instructions which are relevant to the action to be taken.	N/A	N/A			
e. PROMPT INFORMATION SEQUENCE — Directions should be placed in the sequence to be used by the operator.	O	YES			

TABLE 4-14
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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.6 (Cont'd)					
f. USE OF ERROR MESSAGES — Whenever an operator error or invalid input is detected, an error message should be displayed.	O	YES			
g. ERROR CORRECTION GUIDANCE — Error messages should contain instructions to the operator regarding required corrective action.	O	NO	P.7.1-3	III	
h. ERROR CORRECTION EASE — Capability should be provided for operator correction of individual errors without affecting adjacent valid entries.	O	YES			
i. SYSTEM STATUS FEEDBACK MESSAGES — Feedback messages should be provided to the operator to indicate changes in the status of system functioning.	O	YES			
j. SELECTION FEEDBACK — When a displayed message or datum is selected as an option or input to the system, the subject item should be highlighted, or otherwise positively identified, to indicate acknowledgement by the system.	O	YES			
k. DELAY FEEDBACK — When system functioning requires the operator to stand by, such as when the computer is searching for requested data, periodic feedback should be provided to the operator to indicate normal system operation and the reason for the delay.	O	YES			
l. ACTIVITY COMPLETION FEEDBACK — When a process or sequence is completed by the system, positive indication should be presented to the operator concerning the outcome of the process and requirements for subsequent operator actions.	O	YES			

TABLE 4-14
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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.7 GRAPHIC CODING AND HIGHLIGHTING					
a. USE OF HIGHLIGHTING --Highlighting should be used to attract the operator's attention to any displayed data item or message which is important to decision-making or action requirements.	O	YES			
b. CONSISTENT APPROACH					
(1) Highlighting methods which have information value beyond their attention-getting quality should have the same meaning in all applications.	O	YES			
(2) Highlighting methods associated with emergency conditions should not also be used in association with normal conditions.	O	YES			
c. CONTRAST ENHANCEMENT — When contrast enhancement (i.e., increased illumination intensity level) is used for highlighting, not more than two (preferable) or three (maximum) brightness levels should be used in a single presentation.	N/A	N/A			
d. FLICKER OR BLINKING — Blinking of a symbol or message (e.g., ON-OFF or alternating high-low brightness) for purposes of highlighting should be reserved for emergency conditions or similar situations requiring immediate operator action.	O	YES			
e. BLINK RATES					
(1) When blinking is used for highlighting, a maximum of 2 blink rates should be used.	M	NO	P.7.1-9	III	
(2) When a single blank rate is used, the rate should approximate 2 to 3 "blinks" per second with a minimum of 50 msec "on" time between blinks.	M	NO	P.7.1-10	III	

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.7e (Cont'd)					
(3) When 2 blink rates are used, the fast blink should approximate 4 per second and the slow blink should approximate 1 per second.	M	NO	P.7.1-9	III	
(4) When 2 blink rates are used, the "on-off" ratio should approximate 50%.	M	NO	P.7.1-9	III	
(5) When 2 blink rates are used, the higher rate should apply to the most critical information.	M	NO	P.7.1-9	III	
f. INVERSE VIDEO — Image reversal (e.g., dark characters on a light background) should be used primarily for highlighting in dense data fields, such as a word or phrase in a paragraph of text, or a set of characters in a table of data.	O	YES			
g. USE OF GRAPHIC CODING — Graphic coding methods (e.g., symbols, boxes, underlines, colors) should be used to present standard qualitative information to the operator or to draw the operator's attention to a particular portion of the display.	O	YES			
h. GRAPHIC CODE CONSISTENCY — Graphic codes, used separately or in combination, should have the same meaning in all applications.	O	YES			
i. GEOMETRIC SHAPE CODING — When geometric shape (symbol) coding is used, the basic symbols should vary widely in shape.	O	YES			
j. NUMBER OF SYMBOLS					
(1) The number of basic symbols used for coding should be kept small.	O	YES			
(2) The upper limit under optimum display conditions should be 20.	O	YES			

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 24 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.7j (Cont'd)					
(3) The upper limit under adverse display conditions should be 6.	O	YES			
(4) When needed, other highlighting and graphic techniques (color, filled versus unfilled, and other "modifiers") should be used to display different states or qualities of a basic symbol.	O	YES			
k. USE OF COLOR — (Exhibit 6.7-11)					
(1) Colors used on the CRT to convey information should be consistent in use and meaning with all other color codes in the control room.	O	NO	P.7.1-4	III	
(2) Once colors are assigned a specific use or meaning, no other color should be used for the same purpose.	O	NO	P.7.1-5	III	
l. COLOR MEANINGS — When color is used, the meaning of the colors should, where applicable, equate with the commonly understood meaning of those colors. The following specific meanings for selected colors should apply when these colors are used in CRT displays:					
(1) Red — Unsafe condition, danger, immediate operator action required, or critical parameter value out of tolerance.	O	NO	P.8.1-2		Assessed as part of Conventions Survey
(2) Green — Safe condition, no operator action required, or parameter value is within tolerance.	O	NO	P.8.1-3		Assessed as part of Conventions Survey
(3) Yellow/Amber — Hazard, potentially unsafe, caution, attention required; marginal parameter value exists.	O	NO	P.8.1-4		Assessed as part of Conventions Survey

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.7 (Cont'd)					
m. **RED-GREEN COMBINATIONS**					
(1) Whenever possible, red and green colors should not be used in combination.	O	YES			
(2) Use of red symbols/characters on a green background should especially be avoided.	O	YES			
6.7.2.8 MULTIPLE-PAGE CONSIDERATIONS					
a. **OPERATOR MEMORY**					
(1) Page design and content planning should minimize requirements for operator memory.	O	YES			
(2) All data relevant to a specific operator entry should be displayed on a single page.	O	YES			
b. **AUDIT TRAIL** — When pages are organized in a hierarchical fashion, containing a number of different paths through the series, a visual audit trail of the choices should be available upon operator request.	O	YES			
c. **LOCATION REFERENCES**					
(1) When the operator is required to scroll or pan on a large logical frame, location references should be provided in the viewable portion of the frame. (For example, when scrolling a list, ony part of which is visible at any one time, the present and maximum location should be shown.)	N/A	N/A			
(2) Sectional coordinates should be used when large schematics must be panned or magnified.	N/A	N/A			

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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.2.8 (Cont'd)					
d. OPERATOR CONTROL — The operator should have some capability for controlling the amount, format, and complexity of information (e.g., core dumps, program outputs, error messages) being displayed by the system.	O	YES			
e. LOCATION CONSISTENCY — If the message is a variable option list, common elements should maintain their physical relationship to other recurring elements.	O	YES			
6.7.3.1 PRINTER CHARACTERISTICS					
a. PRINTER APPLICATIONS					
(1) Printers should be part of the process computer system and be located in the primary operating area.	O	YES			
(2) Control room printers should provide the capability to record alarm data, trend data, and plant status data.	O	YES			
b. DISPLAY COPIES					
(1) The system should, if possible, be designed to provide hardcopy of any page appearing on the CRT at the request of the operator.	O	YES			
(2) If the copy will be printed remote to the operator, a print confirmation or denial message should be displayed.	O	YES			
(3) Printer operation should not alter screen content.	O	YES			
c. FORM OF PRINTED INFORMATION — Printed information should be presented in a directly usable form with minimal requirements for decoding, transposing, and interpolating.	O	YES			

TABLE 4-14
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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.3.1 (Cont'd)					
d. PRINTER SPEED — Printers used for recording trend data, computer alarms, and critical status information should have a high-speed printing capability of at least 300 lines a minute to permit printer output to keep up with computer output.	O	YES			
e. PRINTER OPERATION — Paper, ribbons, and ink (if used) should be consistent with the following:					
(1) Hard-finish matte paper should be used to avoid smudged copy and glare.	O	YES			
(2) There should be a positive indication of the remaining supply of recording materials.	O	YES			
(3) Instructions for reloading paper, ribbon, ink, etc., should appear on an instruction plate attached to the printer.	O	YES			
(4) When the printer is down during reloading, data and information which would normally be printed must not be lost.	O	YES			
(5) A takeup device for printed materials should be provided which requires little or no operator attention and which has a capacity at lease equal to the feed supply.	O	YES			
f. PRINT COPY ACCESSIBILITY — The following features should be provided to enhance operator accessibility of printed material:					
(1) Provisions should be made so that the operator can always read the most recently printed line.	O	YES			

TABLE 4-14
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GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.3.1f (Cont'd)					
(2) Printed material should have an adequate contrast ratio to ensure easy operator reading.	O	YES			
(3) It should be possible to annotate the print copy while it is still in the machine.	O	YES			
(4) The recorded matter should not be obscured, masked, or otherwise hidden in a manner which prevents direct reading of the material.	O	YES			
6.7.3.2 ALARM MESSAGES					
a. ALARM RECORDS					
(1) A printer should be provided for recording alarm messages.	O	YES			
(2) All annunciator alarms should be recorded.	O	YES			
b. ALARM SEQUENCE — Alarm messages should be recorded in the sequence of their occurrence.	O	YES			
c. OPERATOR-REQUESTED PRINTOUT — Provisions should be included to provide, upon operator request, printouts by alarm group (e.g., system, subsystem, component).	O	YES			
d. ALARM IDENTIFICATION — Alarm messages should be readily distinguishable from other messages.	O	YES			
e. ALARM DISCRIMINATION — Alarm messages should provide rapid identification of the nature of the alarm.					
f. CONSISTENT TERMINOLOGY — Wording in alarm messages should:	O	YES			
(1) Clearly relate to the specific annunciator tile that is illuminated.					

TABLE 4-14
COMPUTER SURVEY FINDINGS & HEDs GENERATED Page 29 of 29

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.7.3.2f (Cont'd)					
(2) Contain at least that information (i.e., wording) presented in the illuminated annunciator tile.	O	YES			
(3) Provide additional specific data.	O	YES			
6.7.3.3 GRAPH AND TABLE REQUIREMENTS					
a. SHAPE OF FUNCTION — If the general shape of the function is important in making decisions, a graph should be used.	N/A	N/A			
b. INTERPOLATION — If interpolation is necessary, line graphs are preferable to bar graphs and tables.	N/A	N/A			
c. GRIDS					
(1) Graphs should be constructed so that numbered grids are bolder than unnumbered grids.	N/A	N/A			
(2) If 10-grid intervals are used, the fifth intermediate grid should be less bold than the numbered grid, but bolder than the unnumbered grids.	N/A	N/A			
d. TABLES					
(1) Tables should be simple, concise, and readable.	O	YES			
(2) When table columns are long, numbers should be separated into groups by providing a space between groups of five.	O	NO	P.7.1-15	III	
(3) When columns are not separated by vertical lines, the columns should be separated by at least 2 character widths.	O	YES			

5.0 SYSTEM FUNCTIONS REVIEW, TASK ANALYSIS AND VERIFICATION AND VALIDATION

5.1 System Functions Review

5.1.1 Objective

The objective of the system functions review was to identify those instruments and controls that the operator needs to respond to a spectrum of plant operations, with emphasis on abnormal and emergency conditions. The results of this review were used as input to the task analysis, verification of task performance capability, and validation of control room functions described in paragraph 5.2 below.

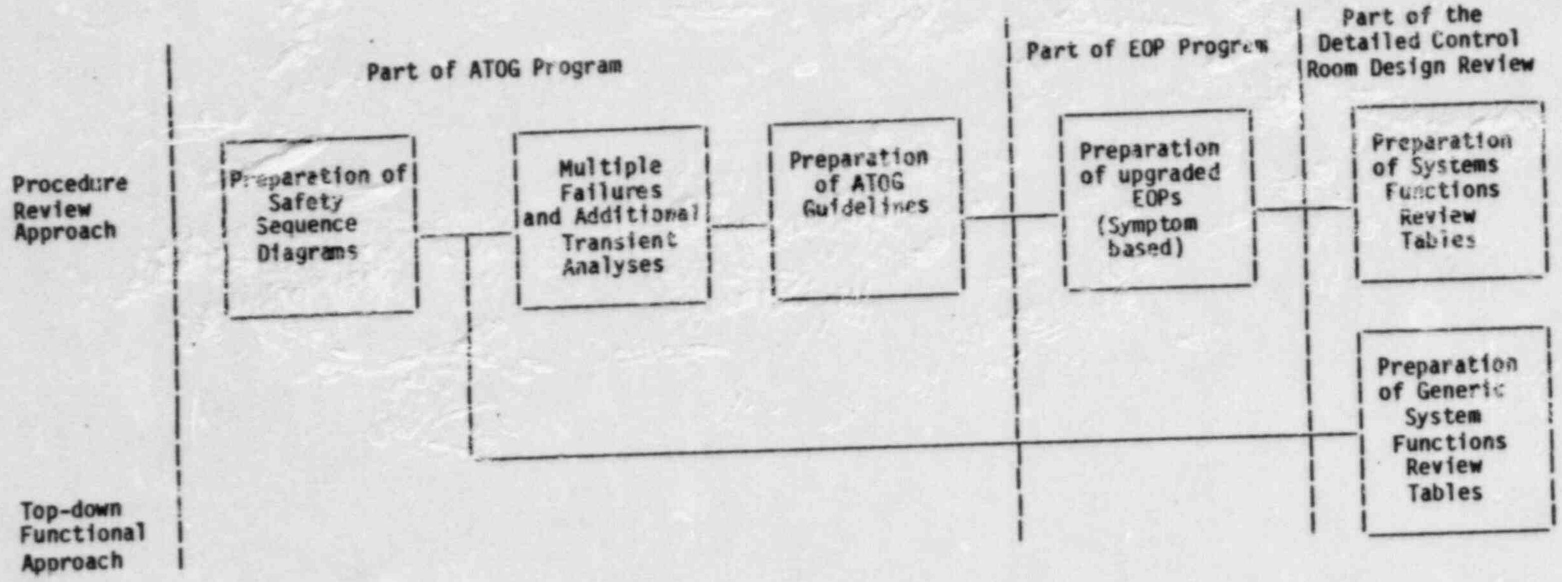
5.1.2 Approach

To accomplish this objective a two-pronged approach was utilized. The first element consisted of performing the system functions review (SFR) based on the symptom oriented emergency operating procedure. Each step of the procedure was reviewed to determine the instruments and controls required by the operators to perform that step. The actual Davis-Besse instruments and controls that would be used to perform these functions were then identified. In parallel with this effort, and SFR using a top-down functional approach was conducted, identifying the safety systems, system functions, operator actions and instrumentation and control requirements necessary to satisfy critical safety functions. The results of the two approaches were compared and differences resolved. This two-pronged approach permitted a detailed review of the allocation of functions between systems and human operators afforded by a procedure review and at the same time provided an independent assessment of the functions performed by systems and operators using the top-down functional approach. In addition, the two-pronged approach assured that the review would not result in a circular logic co-validation of the EOPs and the function and task analysis which is internally consistent, but that may not be operationally correct.

The following pragraphs give a more detailed description of the implementation of each approach and the background leading to the development of each approach. The information provided in these paragraphs is shown in a flow chart format in Figure 5-1.

SEQUENCE OF EVENTS LEADING TO THE SYSTEMS FUNCTION REVIEW TABLES

FIGURE 5-1



5.1.2.1 Procedure Based System Functions Review

Implementation — This approach consisted of reviewing each step of the symptom oriented emergency operting procedure, identifying the operator actions required for each step, the instrumentation and control requirements to execute the required operator action and the existing Davis-Besse instrumentation and controls available to perform these actions. The results of this review were documented on Systems Functions Review Tables (SFRTs). A sample SFRT is shown on Table 5-1. The "Plant/System Status" and "Operator Action Required" columns were taken directly from the procedure. The "Instrumentation and Control Requirements" columns were completed by the analyst based on his experience to identify these indicators and/or controls that the operator would need to execute the operator action requirement. The "Existing Davis-Besse Instrumentation and Controls" columns were completed using the Control Board mockups and the Control Room Inventory. Completion of these tables provided the basis for task analysis and verification of task performance capability. These tables facilitated the verification of the availability and human engineering suitability of required instrumentation and controls by providing the task specification requirements and the actual Davis-Besse instruments and controls including their locations on the same table.

Background — The Symptom Oriented Emergency Operating Procedure was prepared by Toledo Edison utilizing the Davis-Besse Abnormal Transient Operating Guidelines (ATOG).

The Davis-Besse ATOGs were generated as part of and overall program consisting of the following elements:

1. Identification of Event Sequences. A set of initiating events was selected which was representative of the complete set of initiating events analyzed in Chapter 15 of the FSAR in terms of exercising a complete range of system functions and operator actions. The set of initiating events selected were as follows:
   - o Small Break LOCA
   - o Small Steamline Break
   - o Loss of Normal Feedwater
   - o Excess Feedwater
   - o Loss of Offsite AC Power
   - o Steam Generator Tube Rupture.
2. Event Evaluation and Function Identification. Each event selected was evaluated and documented by preparing a functional flow diagram (referred to in the ATOG program as Safety Sequence Diagrams) for each sequence. These diagrams show the systems whose responses are necessary to providing the

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TABLE 5-1

SYSTEMS FUNCTIONS REVIEW TABLE

EVENT: SYMPTOMS*

Prepared by: ______ Date: ______
Checked by: ______ Date: ______
Approved by: ______ Date: ______

Reference Section in Upgraded EOPs	Plant/System Status	Operator Action Required	Instrumentation and Control Requirements (1): Indicators: Parameter	Range	Controls	Annunciator (2) Alarms/Lights	Existing DB Instrumentation and Controls: Indicators: Indicators (Location)	Range	Controls (Location)	Annunciator Alarms/Lights (Setpoint) (Location)
1.0										
1.1	Reactor Trip (also denotes a trip condition exists whether or not an automatic trip has occurred)									
1.1.1		Alarm: The following annunciator CRD Trip Confirm AND				CRD Trip Confirm				"CRD Trip Confirm" Q266
1.1.2		Plant Response: NI's indicate a rapid decrease in neutron flux level	Neutron Flux	10^{-6}-100% Full Power			Neutron Flux: Source Range 06-NI-NI-1 06-NI-NI-2	10^{-1}-10^{+6} CPS		
							Intermediate Range 07-NI-NI-3 07-NI-NI-4	10^{-11} - 10^{-4} amps		
							Power Range 07-NI-NI-5 07-NI-NI-6	0-120% FP		

* This procedure will be implemented anytime one of the six below listed conditions exist alone or in combination with the others and recognizes the fact the Safety Features Actuation System (SFAS) or Steam and Feedwater Rupture Control System (SFRCS) may trip with the plant initially in Mode 3 or less.

functions required to mitigate the consequences of the postulated event. The basic philosophy of the safety sequence analysis is to evaluate the plants ability to achieve and maintain critical safety functions (i.e., reactivity control, reactor heat removal, primary level control, etc.). This is demonstrated by establishing success paths consisting of a series of system functions which result in the achievement of a safety function.

In addition to showing all the systems involved in achieving a safety function, the safety sequence diagram shows input signals, logics, setpoints, output actions, parameters monitored, and operator functions required. The operator functions are further broken down into where the control of the function resides (e.g., control room, local or a combination). This analysis addressed not only the "prime" systems such as Reactor Protection, High Pressure Injection, Low Pressure Injection, Auxiliary Feedwater, etc., but also support systems such as electric power, component cooling water, service water, instrument air, etc.

3. Event Propogation and Additional Transient Analysis. The event sequences were then propogated beyond single failure to include multiple failure and operator errors. Additional transient analysis were performed to predict the plant response following the postulated additional failures and the resulting plant configurations.

4. Preparation of Davis-Besse ATOGs. Utilizing the diagrams and additional transient analyses discussed above, the Davis-Besse ATOGs were prepared. The objective was to produce a set of technical guidelines that could be turned over to the plant staff for conversion into a symptom based emergency operating procedure. The basic philosophy was instead of having the operators try to diagnose the precise event and then follow the EOP for that event, the operator would concern himself immediately following an event with maintaining certain critical safety function parameters within acceptable limits by monitoring these parameters and assuring the operation of appropriate systems.

5.1.2.2 Top-Down Functional System Functions Review

Implementation — This approach consisted of taking the Safety Sequence Diagrams discussed above and identifying the systems, system functions, major components, operator actions, and instrumentation and control requirements necessary to satisfy critical safety functions for each selected event sequence. A determination was then made as to the availability of Davis-Besse Instrumentation and controls to support these system functions. Finally each instrument and control identified, was located within the upgraded EOP to ascertain if any additional instrumentation was identified. The results of this review were documented on Generic Systems Functions Review Tables (GSFRTs). A sample is shown on Table 5-2.

Basis — This approach results in a systems functions review based upon the same analysis that had been used in developing the symptom based EOPs.

TABLE 5-2

GENERIC SYSTEMS FUNCTIONS REVIEW TABLE

Prepared by: ____________ Date: ______
Checked by: ____________ Date: ______
Approved by: ____________ Date: ______

Critical Safety Functions	Safety or Non-Safety Systems	System Function	Major Components	Required Instrumentation and Controls: Indicators	Required Instrumentation and Controls: Controls	Required Instrumentation and Controls: Alarms/Lights	D-8 Instru. & Controls (Y/N)	Applicable UEOP Section	Remarks/Comments
Trip Reactivity Control	Safety Systems								
	RPS	RPS modules trip			Reactor Trip Switch	Reactor Trip Confirm	Y	1.0, 2.0, 3.0, 4.0, 7.0, 8.0	
				RC Pump Status	RC Pump Switch		Y	5.0, 6.0, 8.0, 9.0, 11.0, 13.0	
				Power Imbalance Flow			Y		
				RCS Press		RCS Press	Y	7.0, 11.0, 13.0	
				Neutron Flux			Y	1.0	
	CRDCS	Deenergize UV coils, tripping associated breaker, removing power from CRDMs				CRD Trip Confirm	Y	1.0, 3.0	
	CRDM	Roller nuts disengage from lead screw							
	CRA	Gravity insertion of CRAs		Rod Position		Rod Position	Y	2.0, 3.0, 4.0	
				Neutron Flux			Y	1.0	
	Non-Safety System								
	ARTS	ARTS modules trip		SG-FW Diff. Press.				2.0	
						Turb. Trip Confirm	Y	4.0, 8.0	

5.2 Task Analysis and Task Verification and Validation

A task analysis was performed of the principal operator tasks performed by the Davis-Besse operators. The objectives of the task analysis were to: 1) identify the control room information and control requirements required to support operator allocated tasks, and 2) prepare for task verification and validation which would assess the suitability of the control room design in supporting task performance.

System Function and Task Analysis and V&V activities were conducted in four basic steps, as follows:

- o Identify/review tasks and task sequences
  - identify system functions
  - develop task lists and task identification
- o Analyze tasks
  - analyze tasks for each task sequence
  - develop Spatial-Operational Sequence Diagrams
- o Verify task performance capability/human engineering suitability
- o Validate control room functions.

Each of these steps is discussed in the following sections.

5.2.1 Identify/Review Functions and Tasks

The overall objective of the task analysis was to identify and organize plant systems, functions, and operator tasks to identify task requirements in terms of information/control requirements and to identify control room design requirements based on task requirements.

5.2.1.1 Identification of Functions and Tasks – Function and task identification was made by review of the System Function Review Table (SFRT). As previously discussed, SFRTs identified the functions, tasks, task sequences, and information and control requirements required to maintain plant safety given system failures, as specified in the ATOGs, and upgraded EOPs.

5.2.1.2 Develop Task Lists — The objectives of this subtask were: 1) to identify motor, perceptual, and information processing tasks associated with performance of system and subsystem functions, and 2) to identify/analyze task sequences, decision points, and task dependencies.

Through review of the system function review table, and, as required, EOPs, conditions which initiate operator tasks in relation to performing functions were identified (initiators include alarms, routine monitoring, administrative procedures, etc.). Also identified were the prerequisite conditions for the conduct of functions and the possible variations in the conduct of functions based on presence or absence of prerequisite conditions.

By reviewing the system function review table individual tasks and decision points involved in function performance were identified. Detailed descriptions of task actions were identified depicting:

- o Tasks
- o Task sequences
- o Decision points
- o Task dependencies
- o Task descriptions.

5.2.1.3 Task Identification — Task and task lists were identified for the following sequences:

- o Reactor and plant symptoms and diagnostics
- o Monitoring of automatic system functions
- o Immediate operator action in response to safety system actuation
- o Supplementary operator actions in responses to plant system failures
- o Monitoring and restoration of subcooling margin
- o Recovery of primary to secondary heat transfer
- o Monitoring and control of cooldown
- o Reactor shutdown and control given steam generator tube ruptures
- o Recovery from inadequate core cooling
- o Control of large loss of coolant accidents
- o Steam generator cooldown with saturated RCS
- o Make up/low pressure injection system cooldown
- o Steam generator cooldown with pressurizer solid.

5.2.2 Analyze Tasks

The basic objective of this activity was to use the data previously generated to analyze, in detail, operator-allocated tasks for each of the functional sequences selected for analysis. Subtasks are discussed below.

5.2.2.1 Analyze Tasks for Each Function -- The objectives of this subtask were to further analyze task requirements to determine information requirements, control requirements, communication requirements, constraints (time, etc.) on task performance, and to document task requirements in an accessible, usable format for each task and task sequence.

The SFRT and task lists were used as a basis to determine detailed task requirements. Detailed task descriptions were analyzed, and for each task the following information was assembled on the Task Data form (See Figure 5-2):

- o RSD — Response Selection Diagram, a flow diagram which identifies decisions, decision options, observations, and control actions.
- o Task elements — operational elements which comprise high level tasks
- o Task allocation — task allocation among operators personnel, including control room and auxiliary personnel
- o Task actions — parameter monitoring, observation (display reading, etc.), controlling/manipulating, decision-making, response selection, and communicating
- o Task object of action — the specific operator-system/function interaction, resolving to:
  - plant system (e.g., RCS)
  - plant component (e.g., RC pumps)
  - plant parameter (e.g., RC flow)
  - state (e.g., RC pump status, RCS flow, etc.)
- o Means of action — addressing CR designs currently employed to allow task requirements (task object of action). These included:
  - components (alarms, controls, displays, etc.)
  - component locators (panels)
  - ranges (of controls/displays)
  - types (alarms, controls, etc.)
- o Communications — indicating plant action and task conducted outside at the control room
- o Remarks — incidental remarks entered to clarify tasks, requirements, designs, etc.

The task action and object of action columns identify task requirements in terms of behaviors involved, information requirements and control requirements. The means of action and communications columns represent control room components in the inventory which are available to meet task requirements. Thus, on the task data form are both task requirements and, as applicable, the associated CR components. In all cases, task requirements were identified and analyzed prior to review and the control room inventory.

5.2.2.2 Develop Spatial-Operational Sequence Diagrams — The objective of this subtask was to present graphically sequential task accomplishment on line drawings of the board layouts.

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TASK DATA FORM

EVENT/SEQUENCE 5.0 Lack of Adequate Subcooling Margin

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FUNCTION 5.1 Inadequate Subcooling Margin

REFERENCES System function Review Table

TASK 5.1 Trip All RCPs

RSD	TASK ELEMENTS	ALLOCATION	ACTION (VERB)	OBJECT OF ACTION: PLANT SYSTEM	OBJECT OF ACTION: PLANT COMPONENT	OBJECT OF ACTION: PLANT PARAMETER	OBJECT OF ACTION: STATE	MEANS OF ACTION: CONTROL ROOM COMPONENT: Component	MEANS OF ACTION: CONTROL ROOM COMPONENT: Location	MEANS OF ACTION: CONTROL ROOM COMPONENT: Range	MEANS OF ACTION: TYPE	COMMUNICATIONS (OTHER PARTY, CONTENT)	REMARKS/SHEET ID
Start Yes exit ← 5.0 No	Determine if Subcooling Margin is Adequate		observe	RCS		Subcooling Temperature margin	Below limit	98-TDI-4451 98-TDI-4450	PAM PAM	1024°F Subcooled To 1024°F Superheat	D-DI D-DI		
5.1	Trip All RCP's		Positions	RCS	RC pumps		Trip	18-HIS-RCSB1 18-HIS-RCSB2 18-HIS-RCSA1 18-HIS-RCSA2	Reactor Coolant Panel C-18	Stop-Stop-Start Stop-Stop-Start Stop-Stop-Start Stop-Stop-Start	C-JS		
5.1.1			observes	RCS	RC pump	Amps	Zero'	18-II-RCSB1 18-II-RCSB2 18-II-RCSA1 18-II-RCSA2	Reactor Coolant Panel C-18	0-600 Amps	D-CM		
5.1.2 A			observes	Annunciators			on	Alarms associated with RCPs	F-780, 781 F-796, 816 F-836, 856 T-794, 814 T-834, 854		D-ANN		Additional Annunc. L-797, 819, 839, 854 A-780, 800, 839, 840 V-788, 808, 815, 854

FIGURE 5-2

5-10

415-1/0

Using Task data forms as input, human factors engineering analysts graphically represented task sequences on panel line drawings (i.e, Spatial-Operational Sequence Diagrams). The procedure for generating Spatial-Operational Sequence Diagrams is as follows:

- o Assemble line drawings of control board
- o Code components with locator codes on task analysis forms
- o Sequentially link control board instrumentation and displays based on Task Analysis/Response Selection Diagram data
- o Numerically identify links with task code numbers from task analysis data forms
- o Assemble and file Spatial-Operational Sequence Diagrams for subsequent analysis.

The outputs and results of this subtask were Spatial-Operational Sequence Diagrams for each system and subsystem function that identify:

- o Sequence of control/display use
- o Frequency of control/display use
- o Decision and task sequences
- o Existing CR components that support task performance.

The outputs and results of this subtask were verification or identification of: instrumentation and communications requirements for performance of tasks, and workload assessment. An example spatial OSD is presented in Figure 5-3.

5.2.3 Verify Task Performance Capability/Human Engineering Availability and Suitability

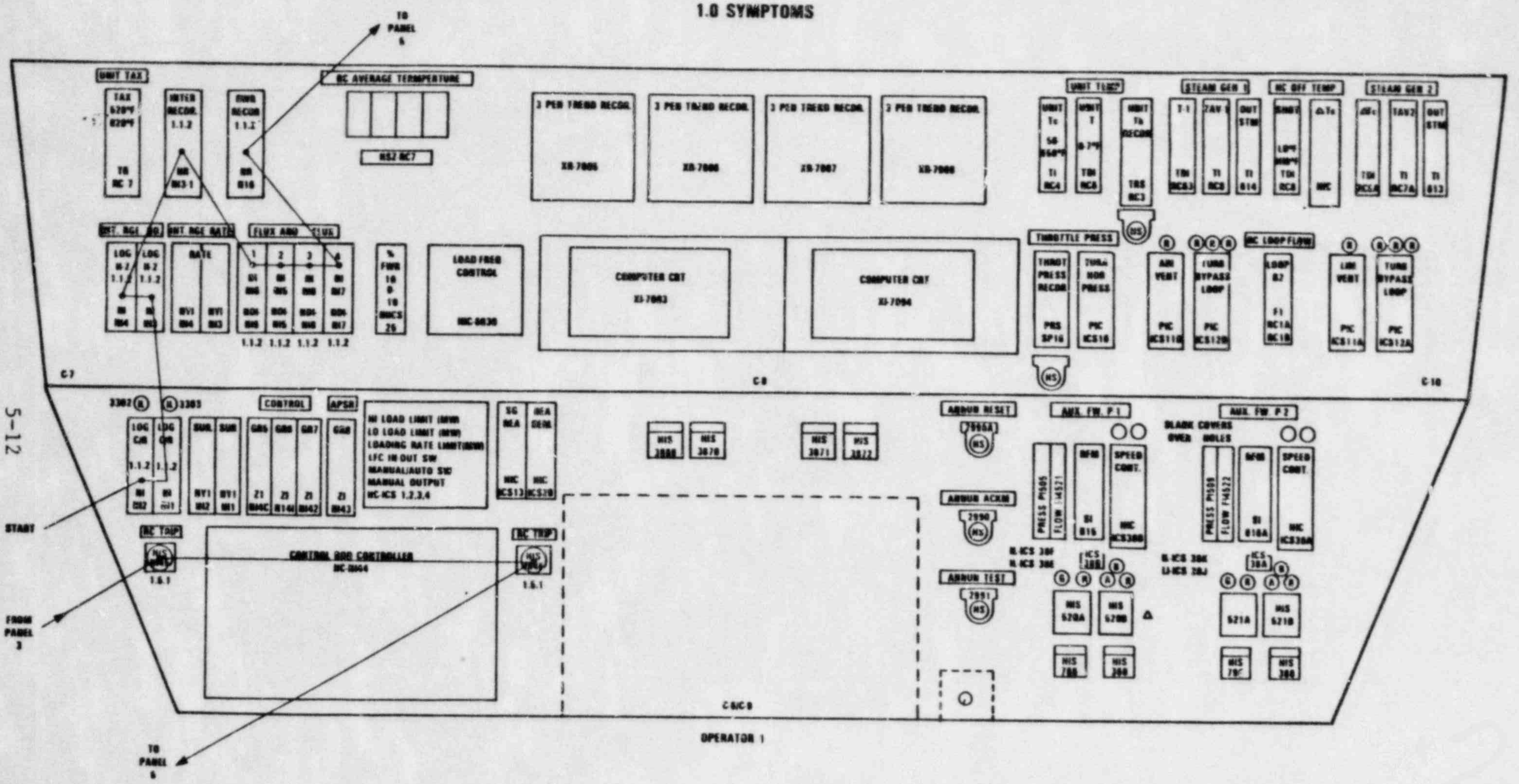
This task required further analysis and evaluation of operator-allocated tasks. Subtasks for this task are discussed below.

5.2.3.1 Perform Operator Traffic Analysis — The objective of this subtask was to develop operator traffic analyses for each task sequence analyzed. For each event sequence which underwent evaluation, event evolutions (courses) were identified and the plant status and operational status ensuing after an initiating event was analyzed.

The procedure for developing operator traffic analysis was as follows:

- o Identify the previously defined functions and tasks as operationally sequenced in the event
- o Identify branch points (e.g., diagnostic decisions, etc.)
- o Analyze operations and tasks to identify event progressions
- o Obtain control room floor plan drawings

1.0 SYMPTOMS



EXAMPLE SPATIAL OSD

FIGURE 5-3

- o Sketch the traffic paths for all operations as required by the task sequence
- o Identify functional (operational) dependencies, as required.

Sequential functions were overlaid on control room floor plans and sequentially numbered to identify and analyze potential control room traffic patterns. Figure 5-3 presents an example traffic analysis.

5.2.3.2 Verification of Equipment Availability — The objectives of this subtask were to identify availability (presence) of required instrumentation and controls in the control room to support performance of system functions. The presence of unused equipment was incidentally identified during walk-throughs.

The basic criteria for the subtask were: 1) the control and display designs should match the task needs and operators' capabilities, 2) frequently required or important instrumentation or controls should be located in the control room, and 3) infrequently used or unimportant instrumentation should be excluded from the primary panel locations in the control room.

The method used to verify equipment availability included the walk- and talk-throughs of the SFRT, the GSFRT, and the task data forms.

During the walk-/talk-throughs, the following equipment availability questions were asked of the operators:

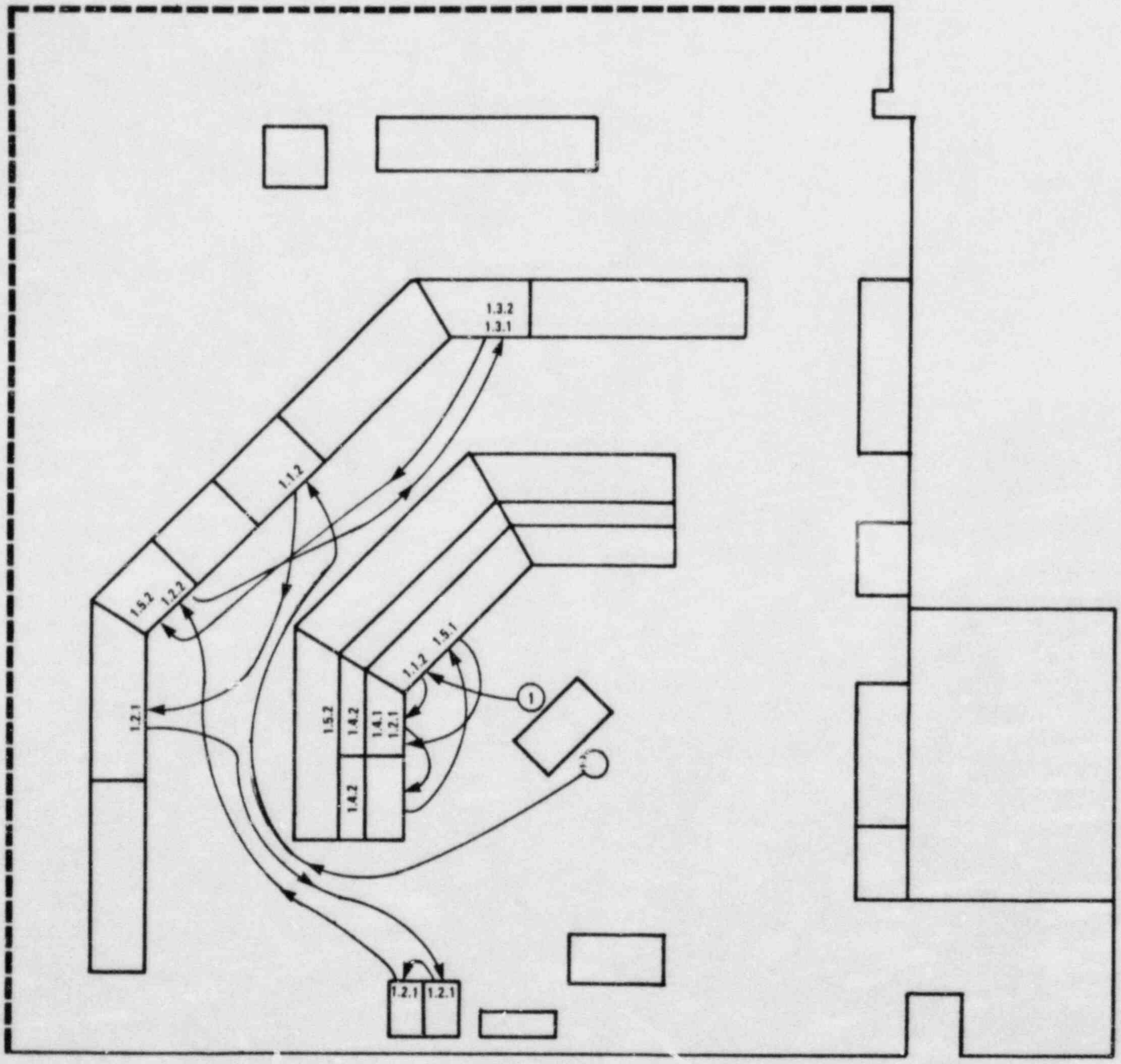
- o Is all the information you require present in the control room to perform the task(s)
- o All needed controls provided to perform the task(s)
- o Do the controls and/or displays provide the appropriate range of information/control
- o Are the controls/displays adequate in terms of precision and accuracy?

Potential equipment availability questions identified during task data collection and analysis (from the comments section of the task data form) were specifically addressed during the walk-through. All findings were documented in the form of HEDs.

5.2.3.3 Verify Human Engineering Suitability — The objective of this subtask was to identify man-machine interface problems that may affect task performance, but that may not be evident in component surveys.

There are four major design issues that this subtask addressed: 1) the grouping of components with respect to function, sequence, importance, and frequency-of-use criteria; 2) control and display integration to ensure that associated controls and displays are

TOLEDO EDISON COMPANY
DAVIS-BESSE UNIT 1
1.0 SYMPTOMS – TRAFFIC PATTERN



① OPERATOR 1

② OPERATOR 2

FIGURE 5-4

not dispersed and that their designs are compatible; 3) component discrimination through enhancements such as demarcation and coding techniques; and 4) panel layouts for consistency of conventions across all panels/units. Specific checklist items regarding the above issues were used as compliance standards.

Verification of human engineering suitability was performed 1) during conduct of the task analysis review of S-OSD and traffic patterns, and 2) walk-through of task sequences by Davis-Besse operators using the CR mockup.

With regard to the first method, verification during task data collection and analysis, potential interface problems were identified by the human factors analysts. These included preliminary HEDs when obvious panel layout problems were evident (such as S-OSDs revealing sequential tasks at distant locations) or when control room instrumentation did not support task performance (for example, lack of required information). For the most part, suitability issues identified during analysis were verified and validated during the second method, task walk-through and observation.

The objectives of the walk-/talk-throughs were twofold. First, to verify the completeness of the task analysis, and second, to review the human engineering suitability of the control room design.

During the walk-through, all tasks analyzed were observed and reviewed in terms of human engineering suitability. Over the course of one week, two systems engineers, two human factors specialists, and two Davis-Besse operators walked and talked through each of the operator allocated and analyzed tasks using a full scale, color mockup of the Davis-Besse control room. The walk-/talk-throughs were not conducted in a real time environment. Instead, each task was simulated in terms of performance, and task requirements discussed by the review team. At the end of each task or groups of related tasks, the participating operators were asked the following questions pertinent to task performance:

- o Does the CR design adequately support task performance?
- o Does equipment layout adequately support task performance?
- o Does equipment design adequately support task performance?
- o Do you know of any errors which have occurred during performance at this (these) task(s)?

In addition, and as appropriate, questions were asked concerning workload, excessive task complexity, and time constraints in task performance. In all cases where suitability issues were identified, the issue was discussed in detail and subsequently documented in the form of HEDs. At the conclusion of the walk-/talk-through, task performance checklists were applied to ensure all HEDs were identified. Findings (HEDs) are presented along with validation findings in Appendix B (V&V summary tables).

5.2.4 Task Analysis/Verification and Validation Findings

Once the task analysis was validated, all recurrent tasks were collated and documented in the task analysis verification and validation form (see Appendix B). A list of the tasks included in the V&V activity is presented in Table 5-3. Recurrent tasks and their task requirements are summarized across tasks and sequences. The information on the form includes for each task:

- o Information and control requirements
- o Information/control range required
- o Summary of information/control availability
- o Summary of human engineering suitability assessment
- o Comments (including HED numbers. if appro
- o Task number

One hundred fifteen H
and validation efforts. Tabl
with cross references to HEI
remarks.

WHY ISNT CABINET ROOM INCLUDED ?

I CANT BELIEVE WE WOULD LET SFAS/SFRCS DATA LIGHTS ESCAPS CORRECTION.

TABLE 5-3
VERIFICATION AND VALIDATION TASK LIST

1 Verify Reactor Trip
2 Verify Turbine Trip
3 Verify SFAS Actuation
4 Verify SFRCS actuation
5 Verify Rapid Feedwater Reduction (RFR) Control
6 Verify Turbine Bypass Valve Setpoint Transfer
7 Verify Fast Dead Bus Transfer
8 Isolate Letdown
9 Verify Containment Isolation
10 Verify NNI Power AC and DC
11 Verify ICS AC and DC Power
12 Verify AC Emergency Buses are Energized
13 Verify Auto Start and Loading of Emergency Diesels
14 Makeup System Operation
15 Verify Main Feedwater Operation
16 Instrumentation Air System Operation
17 Verify Auxiliary Feedwater Operation
18 Verify Steam Generator Tube Rupture (RCS to Secondary Integrity)
19 Check if RCS Depressurization can be Stopped
20 Verify Adequate Subcooling Margin
21 Verify Primary to Secondary Heat Transfer
22 Check for Secondary integrity (Steam Line Rupture)
23 Verify Steam Generator Level Control by AFW
24 Trip Reactor Coolant Pumps
25 Start reactor Coolant Pumps
26 Check for Natural Circulation
27 Check for RCS Integrity (LOCA)
28 Verify SUFP Availability
29 Start SUFP
30 Check for Inadequate Core Cooling
31 Tranfer SUFP Suction from D. A. Storage Tank To C.S.T.
32 Check for Major LOCA

TABLE 5-3

VERIFICATION AND VALIDATION TASK LIST

(Continued)

33 Initiate MU/HPI Cooling

34 Check for Excessive Heat Transfer (Overcooling)

35 Lineup HPI and LPI for Piggyback Operation

36 Verify Pressurizer Operability

37 Transfer Electrical Loads from Aux Transformers to S/U Transformers

38 Verify Pressurizer and Loop High Point Vent Operability

39 Control Rod Drive System (Manual Reactor Shutdown)

40 Transfer Makeup Pump Suction to BWST

41 Verify LPI System Operation

42 Verify CCW System In Service

43 Verify Service Water System in Service

44 Verify Containment Spray System Operation

45 Monitor and Control Containment Conditions

46 Establish Decay Heat Removal System Cooling

47 Control Turbine Bypass Valves

48 Control Atmospheric Vent Valves

49 When BWST Level Decreases to 8' Transfer LPI (and Core Spray if Running) Pump Suctions to Recirculation from the Containment Emergency Sump

50 Establish a Bubble in the Pressurizer

51 Initiate RCS Boration

52 Determine if Safety Injection can be Terminated

53 Establish Flow to the Steam Generators

54 Use Essential Power Indicators X and/or Y

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.1.2 CONSISTENCY OF MANNING WITH EQUIPMENT LAYOUT					
a. **COVERAGE** — Control room manning and task assignments should ensure complete and timely coverage of controls, displays, and other equipment required during all modes of operation.	O I	NO	9.2-43 9.2-46	IIA III	SFRCS Study
b. **UTILIZATION OF ADDITIONAL PERSONNEL** — Additional onsite or offsite personnel may augment the normal crew complement under certain conditions (e.g., refueling). If so, acivities and task assignments should be planned to ensure proper coordination. (Note: special training for this situation may be required.)	I	NO	9.2-46 9.2-50	III --	 Deleted
6.1.3.1 UNIT INTEGRATION AND INTERFERENCE					
a. **EQUIPEMENT ARRANGEMENT** — Equipment should be arranged with movement and communication patterns in mind, so that each unit operations do not interfere with each other.		N/A			
b. **SENIOR OPERATOR STATION** — Senior operators who supervise and assist operations of more than one unit need to be stationed so that they can communicate effectively with operators in each unit and have an unobstructed visual path to the control boards of each unit.		N/A			

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.3.1 (Cont'd)					
c. SHARING OF PERSONNEL — Where operators may assist those of another unit, potential task loading should be evaluated to assure that each unit can be covered adequately in all situations.		N/A			
6.1.3.2 UNIT MIRROR IMAGING					
If a mirror image design has been used:					
a. DEDICATED CREWS — Operational crews should be committed to one or the other unit. They should not be allowed to alternate between the two mirrored units. This includes operators manning a single center desk station.		N/A			
b. ACCENTUATE DIFFER ENCES — The distinction between the mirrored units should be heightened as much as possible so that there will be no confusion about where one unit ends and the other begins. This can be done by using a different color scheme for the elements of each unit, including carpeting, desks, and other work station equipment, as well as the board surface areas.		N/A			

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.4.2.2 CODING OF CONTROLS					
f(2) When color coding is used to relate a control to its corresponding display, the same color should be used for both the control and the display.		N/A			
6.4.3.1 PUSHBUTTON DESIGN PRINCIPLES					
a. **POSITION** — Pushbuttons in a row or matrix should be positioned in a logical order, or in an order related to the procedural sequence.		N/A			
6.8.1.1 ASSIGNING PANEL CONTENTS					
Controls and displays should be placed within the control room at locations which promote efficient procedures, safe operation, and maximum operator awareness of the current system condition. There are three general methods for achieving this condition. They are: (a) grouping by task sequence, (b) grouping by system function, and (c) grouping by importance and frequency of use.					
a. **GROUPING BY TASK SEQUENCE** — Controls and displays should be assigned to work stations so as to minimize operator movement. To the extent, practical, this assignment should consider both normal and emergency procedures. It should be practical to perform all frequently occurring routine tasks, with a minimum of human movement from panel to panel.	D I O	NO	9.2-1 9.2-2 9.2-3 9.2-4 9.2-5 9.2-20 9.2-30 9.2-43	IIA IIC III IIB IIB IIA IIA IIA	

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.8.1.1 (Cont'd)					
b. **GROUPING BY SYSTEM FUNCTION** — Within the constraints of grouping by task sequence, controls and displays should be assigned to panels in functional groups related to system structure. This grouping should promote easy understanding of the relationship between contrc is and system, and should assi: graphic or pictorial display or system relationships.	O I	NO	9.2-20 9.2-30 9.2-40	IIA IIA III	
c. **GROUPING BY IMPORTANCE AND FREQUENCY OF USE** — Within the constraints of grouping by task sequence and by system function, controls and displays should be assigned to panels depending on their importance and frequency of use. Controls or displays which are neither important to plant safety nor frequency of use. Controls or displays which are neither important to plant safety not frequently used should be installed in secondary panel locations.	O I	NO	9.2-20 9.2-30	IIA IIA	

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.8.1.2 EFFECTIVE PANEL LAYOUT					
The location of controls and displays within a single panel should make the effective use of the viewing and manual manipulative areas. The allocation of panel positions should first ensure the integrity of arrangement or grouping by system function and task sequence. Within those constraints, consideration should be given to the following factors: (a) the frequency with which controls and displays are used; (b) the significance of controls and displays in terms of their possible use during an emergency; (c) the importance of controls and displays to overall system performance; and (d) special requirements in using a control device or display instruments, such as the need for accuracy, speed, application of force, or a particular type of movement.	O I D	NO	9.2-2 9.2-3 9.2-5 9.2-20 9.2-30 9.2-40 9.2-50 9.2-56 9.02-60	IIC III IIB IIA IIA III -- -- --	 Deleted Deleted - Location confirmed in V&V walk-through Deleted - Arrangement confirmed in V&V walk-through
6.8.1.3 ENHANCING RECOGNITION AND IDENTIFICATION					
a. **SPACING** — Spacing consists of physically separating groups of components on a panel with enough space between groups so that the boundaries of each group are obvious. Spacing between groups should be at least the width of a typical control or display in the group (see Exhibit 6.8-1).	O I	NO	9.2-33 9.2-47 9.2-58 9.2-59	IIA IIA IIC IIC	SFRCS Study

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.8.1.3 (Cont'd)					
b. **DEMARCATION** — Demarcation consists of circumscribing functional or selected groups of controls and displays with a contrasting line. The application of demarcation techniques should conform to Guideline 6.6.6.2 (See also Exhibit 6.8-1).)	O I	NO	9.2-47 9.2-61	IIA IIC	
6.8.2.1 SEQUENCE, FREQUENCY OF USE, AND FUNCTIONAL CONSIDERATIONS					
a. **SEQUENCE** — Controls and displays which are used together during a normal task sequence should be grouped together.					
(1) Displays which are observed in a specified sequence, as during hot-leg temperature check for all reactor coolant loops, should be grouped together. It is desirable that they be positioned so that they are normally used in a left-to-right, top-to-bottom, or other natural sequence.	O I	NO	9.2-30	IIA	
(2) Controls which are operated in sequence, as in energizing a system or aligning a series of valves for a particular function, should be grouped together. It is desirable that they be positioned so that they are normally used in a left-to-right, top-to-bottom, or other natural sequence.	O I	NO	9.2-53 9.2-54 9.2-55 9.2-56	IIC IIA III --	 Deleted - Location confirmed in V&V walk-though

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.8.2.1a. (Cont'd)					
(3) When there is a set of related controls and displays, the layout of displays should be symmetrical with the controls they represent.	O I	NO	9.2-60	--	Deleted - Location confirmed in V&V walk-through
b. **FREQUENCY OF USE** — Frequently used controls and displays should be arranged to reduce search time and minimize the potential for error during use.	O	YES			
(1) They should be near the center of the preferred visual and manual areas.					
(2) They should be positioned so as to be easily identified.					
c. **FUNCTIONAL CONSIDERATIONS** — Functionally related controls and displays should be grouped together when they are:	O I	NO	9.2-53 9.2-54 9.2-55 9.2-56 9.2-60	IIC IIA III -- --	 Deleted - Location confirmed in V&V Deleted - Location confirmed in V&V
(1) Used together to perform tasks related to a specific function (e.g., operation of the residual heat removal system).					
(2) Identical in purpose (e.g., reactor coolant pumps).					
6.8.2.2 LOGICAL ARRANGEMENT AND LAYOUT					
b. **OTHER EXPECTATIONS** — Where other operator expectations can be identified, components should be arranged to match these expections.	O I	NO	9.2-23	III	

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.8.2.4 STANDARDIZATION When a precedent has been established in the arrangement and location of controls and displays, that standard practice should be followed unless other crucial considerations necessitate a change.					
a. PANEL TO PANEL STANDARDIZATION -- Standardization should be maintained where similar functions or panels are located at several work stations or units are located at several work stations or units and must be used by the same personnel.	O I	NO	9.2-6	IIA	
b. SIMULATOR-TO-CONTROL ROOM STANDARDIZATION — Standardization should be maintained where simulators or procedure trainers are used that simulate the actual operational equipment.		N/A			
6.8.3.2 STRINGS OR CLUSTERS OF SIMILAR COMPONENTS On occasion it may be necessary to have a large group of similar components arranged together in strings, matrices, or other clusters. Those human factors principles presented in Section 6.8.2, Layout Arrangement Factors, should not be compromised where large clusters of components are concerned. However, considerations such as search time, discriminability of components, and avoidance of selection errors will often make a string or matrix the preferred arrangement. The following criteria should apply:					

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.8.3.2 (Cont'd)					
a. **ORIENTATION** — Horizontal rows of displays should be used rather than vertical columns (see Exhibit 6.8-4)	O I	YES			
b. **STRING LENGTH** — Strings of small displays should not exceed about 20 inches on the control board.	O I	YES			
c. **NUMBER OF COMPONENTS**					
(1) No more than 5 similar components should be laid out in an unbroken row or column.	O I	YES			
(2) If more than 5 similar components must be laid out together, the string or cluster should be broken up by techniques such as physical spacing or demarcation (see Exhibit 6.8-5).	O I	YES			
6.8.3.3 MIRROR IMAGING					
Mirror-imaging is an arrangement in which two functional groups are laid out symmetrically so that one is a complete, or almost complete, reversal of the other. Mirror-imaging should not be used, and any recurring functional groups should be replicated.		N/A			
6.9.1.1 SINGLE CONTROL AND DISPLAY PAIRS					
Controls and displays which are normally used together should be located in close proximity to each other, but positioned and separated sufficiently so that the display is not obstructed during operation.	O I	NO	9.2-4	IIB	

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.9.1.1 (Cont'd)					
a. **PROXIMITY** — A visual display that will be monitored during control manipulation should be located sufficiently close that an operator can read it clearly and without parallax from a normal operating posture.	O I	NO	9.2-4	IIB	
b. **OBSCURATION** — Controls and displays should be located so that displays are not obscured during control operation (see Exhibit 6.9-1).	O I	YES			
c. **ASSOCIATION** — Related controls and displays should be easily identified as being associated. This association can be established (or enhanced) by (1) location, (2) labeling, (3) coding, (4) demarcation, and (5) consistency with operator expectations. The following relationships should be immediately apparent to the operator: (1) Association of displays with controls. (2) The direction of movement of control and display. (3) The rate and limits of movement of the control and display.	O I	NO	9.2-20	IIA	

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.9.1.2 MULTIPLE CONTROLS OR DISPLAYS The control and monitoring of nuclear power plant systems will occasionally require either multiple controls or multiple displays. Control display relationships in multiple arrays should be apparent to the operator and consistent with human expections.					
a. **MULTIPLE CONTROLS, SINGLE DISPLAY —** (1) Controls should be mounted below the display. (2) Controls should be centered on the display. (3) Controls should be grouped in a line or matrix. (4) If not feasible to mount controls directly below the display, controls should be mounted to the right of the display. (5) Where there is a normal order of use, controls should be arranged for use in left-to-right, top-to-bottom, or other natural sequence. (6) Where the above techniques cannot apply, or where for other reasons the relationships are not readily apparent, layout enhancement techniques should be employed — spacing, demarcation, color shading, insert panels, panel relief, and the use of mimics. See Guideline 6.8.1.3.		N/A			

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.9.1.2 (Cont'd)					
b. SINGLE CONTROL, MULTIPLE DISPLAYS —		N/A			
(1) Displays should be located above the control.					
(2) The control should be placed as near as possible to the display, and preferably underneath the center of the display array.					
(3) Displays should be arranged horizontally or in a matrix.					
(4) If it is not feasible to mount displays above the control, they should be mounted to the left of the control.					
(5) Where there is a normal order of use, displays should read from left-to-right, top-to-bottom, or in other natural sequence.					
(6) Where the above techniques cannot apply, or where for other reasons the control-display relationship is not clearly apparent, layout enhancement techniques should be employed. See Guideline 6.8.1.3.					
(7) Displays should not be obscured during control manipulation.					
c. DISPLAY SELECTORS — Where display are selected for viewing using a rotary selector switch, the following should apply:					

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.9.1.2c (Cont'd)					
(1) The control should move clockwise from OFF (if appropriate) through settings 1, 2, 3...n.	O I	YES			
(2) The control room position sequence should conform to the display sequence.	O I	YES			
(3) Control position indications should correspond with display labels.	O I	YES			
6.9.2.1 LOCATION AND ARRANGEMENT OF CONTROL-DISPLAY GROUPS					
a. **FUNCTIONAL INTEGRITY —** Multiple controls or displays related to the same function (e.g., power, status, test) should be grouped togther.	O I D	NO	9.2-20	IIA	
b. **SEQUENCE OF USE —** Sequence of use should be as follows:		YES			
(1) Left to right.					
(2) Top to bottom.					
(3) The above combined (normal reading order).					
6.9.2.2 SINGLE PANEL ARRANGEMENTS					
Appropriate arrangements for control-display relationship, in order of preference, are (a) display above each control, (b) displays and controls in matched rows, and (c) multi-row displays with a single row of controls. Practice should be consistent, so that operator expectations are not confused.		NO	9.2-4	IIB	

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6,9.2.2 (Cont'd)					
a. DISPLAY ABOVE EACH CONTROL — The preferred configuration is as shown by Exhibit 6.9-3, with the display above each control. If this configuration is used the following should apply:					
(1) Each display should be located directly above its associated control.					
(2) The display/control pairs should be arranged in rows.					
b. CONTROLS AND DISPLAYS IN ROWS — As an alternative, displays may be arrayed in rows as the upper portion of a panel, matched to controls arrayed in similar rows below, as shown in Exhibit 6.9-4.					
(1) Each control should occur the same relative position as the display to which it is associated.					
(2) Controls and displays should have corresponding labels.					
c. MULTI-ROW DISPLAYS WITH SINGLE-ROW CONTROLS — A less desired arrangement is that of Exhibit 6.9-5, in which two or more rows of displays are arrayed above a single row of controls.					
(1) Displays should be ordered left to right and top to bottom (in normal reading order), and matched to controls ordered left to right.					

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.9.2.2c (Cont'd)					
(2) Controls and displays should have corresponding labels.					
d. **CONSISTENT PRACTICE —** Arrangements of functionally similar controls and displays should conform to the same convention throughout the control room.					
e. **CONTROL/DISPLAY PACKAGES —** When controls and related displays are assembled using modular packaged units, the design of the packages will limit the location and arrangement which can be achieved. In this case, modules should be selected and arranged to achieve maximum conformity with the principles described above.					
6.9.2.3 CONTROLS AND DISPLAYS IN SEPARATE PLANES					
a. **SEPARATE CONTROLS AND DISPLAYS —** Where displays are on separated panels, they should preferably be on the adjacent upper panel from their associated controls. See Exhibit 6.9-6.	O I	YES			
b. **FACING PANELS —** In no case should related controls and displays be located on separate panels that face each other.	O	N/A			

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.9.3.1 GENERAL MOVEMENT RELATIONSHIPS					
a. **ROTARY CONTROLS —** Rotary controls should turn clockwise to cause an increase in parameter value. The associated display movements should be as follows:	O I	YES			
(1) Linear scales, up or to the right.					
(2) Digital displays, increasing in value.					
(3) Strings of indicator lights, bottom-to-top or left-to-right.					
(4) Circular meter pointers, clockwise.					
b. **LINEAR CONTROLS —** Linear controls should move up or to the right to cause an increase in parameter value. The associated display relationships should be:	O	N/A			
(1) Linear scales, up or to the right.					
(2) Digital scales, increasing in value.					
(3) Strings of indicator lights, bottom-to-top, or left-to-right.					
c. **DISPLAY RESPONSE TIME LAG —**					
(1) There should be no time lag between system condition change and display indication.	O I	YES			

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.9.3.1c (Cont'd)					
(2) When there is a time lag between control actuation and ultimate system state, there should be an immediate feedback indication of the process and direction of parameter change.	O I	YES			

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.1.1 ACCESSIBILITY OF INSTRUMENTATION/EQUIPMENT					
a. **PRESENT IN THE CONTROL ROOM** — Control room instrumentation and equipment should include all controls and displays needed for (1) detection of abnormal conditions, and (2) bringing the plant to a safe shutdown condition.	I D	NO	9.8-3 9.2-12 9.2-13 9.2-14 9.2-18 9.2-39 9.2-57 9.2-62 thru 9.2-115	IIA IIC III III IIA IIC -- Vari-ous	Addendum Under operations review Under operations review Deleted See HED Summary Table for V&V
b. **ARRANGED TO FACILITATE COVERAGE** — Operators should not have leeway to leave the primary operating area (see Exhibit 6.1-1) to attend control room instrumentation on back panels during operational sequences in which continuous monitoring or the timing of control actions may be critical.	I O D	NO	9.2-43 9.2-50	IIA --	 Deleted
6.1.3.1 UNIT INTEGRATION AND INTERFERENCE					
d. **SHARING OF PROCEDURES** — Each unit should have its own set of procedures and other reference documents as required to make sure that references are easily available to personnel in each unit, and to avoid conflicting needs for the same reference.		N/A			
e. **SHARING OF EQUIPMENT** —		N/A			
(1) Control of plant equipment from one control room should not affect the ability of operators of other control rooms to maintain control of their respective units.					

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.1.3.1e (Cont'd)					
(2) The status of plant equipment under the control of one control room should be displayed in all control rooms capable of controlling that equipment.		N/A			
(3) If control of plant equipment from one control room renders that equipment unavailable to other control rooms, availability status indications should be displayed in all control rooms.		N/A			
(4) A single, centrally located control panel/console may be used for dual-unit control rooms within the same isolation boundary when this design does not conflict with the panel layout and control-display integration guidelines of Sections 6.8 and 6.9		N/A			
(5) Administrative procedures should be in place which assign responsibility for allocation of use of controls of shared plant equipment to single control room.		N/A			
6.3.4.3 ANNUNCIATOR RESPONSE PROCEDURES					
a. **AVAILABILITY** — Annunciator response procedures should be available in the control room.	O I	YES			

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.3.4.3 (Cont'd)					
b. **INDEXING** — Annunciator response procedures should be indexed by panel identification and annunciator tile coordinates.	I	YES			
6.5.1.1 INFORMATION TO BE DISPLAYED					
a. **TASK ANALYSIS** — Analysis of operator tasks in relation to system engineering and system functional objectives is recommended as the surest means of establishing operator information requirements.	O I D	NO	9.2-31 9.2-51 9.2-57	IIC -- --	 See Appendix C Deleted based on I&C review
b. **COMPLETENSS OF INFORMATION** — Visual displays provided in the control room should give operators all the information about system status and parameter values that is needed to meet task requirements in normal, abnormal, and emergency situations.		NO	9.8-3 9.2-21 9.2-22 9.2-26 9.2-28 9.2-29 9.2-41 9.2-44 9.2-48 9.2-51	IIA -- IIC III IIB IIC III III -- --	 Deleted On SPDS See Appendix C
c. **UNNECESSARY INFORMATION** — Efficient performance requires not only display of all needed information but also avoiding the display of extraneous information in the prime operating area.		NO	9.2-15	III	
d. **REDUNDANCY** — Redundancy in the presentation of information items should be limited to cases where needed for backup or to avoid excessive operator movement.	I	YES			

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.1 (Cont'd)					
e. **DEMAND INFORMATION VERSUS STATUS INFORMATION** — Demand information shows that equipment has been commanded (by control settings or otherwise) to a particular state or level. It shows only what is demanded — not what is actually being realized. Status information shows the state or level actually in effect.					
(1) To prevent operator confusion, it is essential that displays be identified as to whether they reflect demand or actual status.	I O	NO	9.2-28 9.2-42	IIB IIA	
(2) Visual display of actual system/equipment status should be displayed for all important parameters.	I O	NO	9.2-16	IIC	
f. **DISPLAY FAILURE** — When panel instruments, such as meters, fail or become inoperative, the failure should be apparent to the operator (e.g., through off-scale indication).	O I	NO	9.2-21 9.2-29 9.2-34	-- IIC --	Deleted Deleted based on operations review
6.5.1.2 USABILITY OF DISPLAYED VALUES					
a. **SCALE SELECTION** — Scale units should be consistent with the degree of precision and accuracy needed by the operator.	O I D	NO	9.2-7 9.2-10 9.2-17 9.2-19 9.2-35 9.2-37	IIA III IIC IIC IIC IIC	
b. **ELIMINATION OF OPERATOR CONVERSION** — All displays should indicate values in a form immediately usable by the operator without requiring mental conversion.	O I D	NO	9.2-9 9.2-21 9.2-23 9.2-26 9.2-34 9.2-36 9.2-38 9.2-49	IIC -- III III -- IIC IIC III	 Deleted Deleted based on I&C review

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.2 (Cont'd)					
c. **PERCENTAGE INDICATION** — Percentage indication may be used may be used when the parameter is meaningfully reflected by percentage.	O I	NO	9.2-38	IIC	
d. **CALE RANGE** — Scales hould be selected to: (1) Span the expected range of operational parameters, or (2) Employ appropriate scale ranging techniques, or (3) Be supported by auxiliary wide-range instruments.	O I	NO	9.2-8 9.2-11 9.2-41 9.2-44 9.2-48 9.2-50	IIC IIC III III -- --	 Deleted-on SPDS Deleted
e. **SCALE SIZE** — Scale ranges may be expanded (or contracted) by multiplying or dividing indicated scale values by powers of ten. All such scales should be clearly marked as to whether the indicated values should be multiplied or divided, and the factor involved (e.g., 10, 100, 1000).	I	YES			
f. **SENSITIVITY** — Display dynamic sensitivity should be selected to minimize the display of normal random variations in equipment performance.	I	NO	9.2-24 9.2-32	III IIC	 Under study
6.5.1.4 PRINTING ON THE DISPLAY FACE					
a. **SCALE COMPATIBILITY** — When two or more displays of the same parameter (e.g., pressure, temperature) must be compared, scales should be compatible in numerical progression and scale organization. (See Exhibit 6.5-6).	O I	NO	9.2-42 9.2-49	IIA III	

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.5.1.4 (Cont'd)					
e. **LINEAR VS LOGARITHMIC SCALES** — Logarithmic scales should be avoided unless needed to display a range of values.	I	NO	9.2-17	IIC	
f. **MULTISCALE INDICATORS** — Multiscale indicators (i.e., single pointer, multiple scales) should be avoided unless they can be justified as of operational benefit, and precautions are taken to avoid operator confusion.	I	NO	5.1-9	IIA	
6.9.1.2 MULTIPLE CONTROLS AND DISPLAYS					
c. (4) Displays should read off-scale, not zero, when not selected, especially if zero is a possible parameter displayed (see Exhibit 6.9-2).		N/A			
6.9.3.2 CONTROL-DISPLAY RATIO					
a. **CONTROLS** — Controls should provide a capability to affect the parameter controlled easily, with the required level of precision. They should be effective in sufficient time, under expected dynamic conditions, and within the limits of manual dexterity, coordination, and reaction time.	I	YES			
b. **DISPLAYS** — Displays should provide a capability to distinguish significant levels of the system parameter controlled.	I O	NO	9.2-25 9.2-27 9.2-49	IIC IIC III	

TABLE 5-4
TASK ANALYSIS/VERIFICATION & VALIDATION
FINDINGS & HEDS GENERATED

GUIDELINE	METHODS	COMPLIANCE	HED NUMBER	CATEGORY	REMARKS
6.9.3.2 (Cont'd)					
c. EXCESS PRECISION — Both displays and controls should have a precision which does not greatly exceed that required.					
d. FEEDBACK — Feedback from the display should be apparent for any deliberate movement of a control.	I O	NO	9.2-57	--	Deleted based on I&C review

6.0 ASSESSMENT AND DISPOSITION OF HEDs

Once a Human Engineering Discrepancy was identified, its disposition had to be determined. This section of the summary report: 1) describes the means whereby Human Engineering Discrepancies were assessed for error-inducing potential and system consequences of induced errors, and 2) details the means by which Human Engineering Discrepancies will be disposed of (enhancement, design changes, additional studies). The assessment process determined the category and priority of the HED as a function of the potential consequences of the discrepancy. The disposition process determined the means by which a Human Engineering Discrepancy will be corrected. This process is described below.

6.1 Assessment

The basic assessment process was divided into four steps, as follows:

- Assess extent of deviation from NUREG-0700 guidelines
- Assess Human Engineering Discrepancy impact on error occurrence
- Assess potential consequences of error occurrence on plant operation/safety
- Assign Human Engineering Discrepancy scheduling priority.

A Human Engineering Discrepancy Assessment Form and a Logic Diagram are presented in Figure 2-3. Human engineering discrepancies were reviewed by a committee consisting of, as a minimum, two human factors specialists, two systems engineers, two I&C engineers, and two operations specialists from Davis-Besse.

6.1.1 Assess Extent of Deviation from NUREG-0700 Guidelines

This step required that a subjective assessment of the extent of discrepancy from NUREG-0700 guidelines be made with regard to the control room. For example, symbol/background contrast might be 40 percent rather than 50 percent, or only small amounts of parallax may exist in a display. A judgement was made based on the content of the guideline being applied and the control room component under assessment. Extent of deviation was subjectively scaled from "1" (some deviation) to "5" (complete deviation). There was also a category N/A (not applicable) for Human Engineering Discrepancies which are not described in NUREG-0700 but which have been reported by operators as problems. Extent of deviation judgements are not used directly to assess priority or scheduling of backfits, but relate to assessment of operational error potentials. It is possible to have little deviation from the guidelines and high error assessments, and vice versa.

6.1.2 Categorization of HEDs

Given that no control system can be designed to be operationally error-free, the purpose of the assessment process was to estimate Human Engineering Discrepancy impact on hypothetical (unknown) baseline error rates of control room components; e.g., will additional errors be induced by discrepancies from the guidelines? Estimates of Human Engineering Discrepancy impact on error occurrence were qualitatively arrived at by consideration of the interaction of the discrepancy and the following:

- o Body physiology
  - fatigue/physical stress
  - discomfort
  - injury
  - anthropometry
- o Sensory/perceptual performance
  - vision
  - audition
  - proprioception
  - touch
- o Information processing
  - overload
  - confusion
  - recall
  - pattern matching/recognition
  - data manipulation (comparing, extrapolating, etc.)
- o Learning
  - inhibition
  - habituation
  - response predominance
  - transfer
  - response competition
  - response latency
- o Task demands
  - frequency
  - duration
  - competition
  - sequence
  - speed
  - communication
  - precision
  - information.

Assessment of error occurrence was estimated for the following:

- o Overall operator performance is/is not degraded by the Human Engineering Discrepancy impact on body physiology?
- o The Human Engineering Discrepancy does/does not degrade sensory performance?
- o Information processing capability is/is not exceeded as a result of the Human Engineering Discrepancy?
- o The Human Engineering Discrepancy does/does not directly induce error due to principles of learning?
- o Task difficulty and reliability is/is not affected by the Human Engineering Discrepancy?

Based on the above, a subjective error assessment was generated on a 5-point scale; "1" indicating a low probability of induced errors is expected as a result of the Human Engineering Discrepancy, and "5" indicating a high probability of additional errors being induced. Any discrepancy having an error probability assessment greater than "1" was classified as a Category II HED.

Category I Human Engineering Discrepancies are those which have been noted from documented operational errors or problems reported by operators. All Category I Human Engineering Discrepancies are deemed to increase error potential, but consequences must still be assigned to determine ultimate scheduling priority. Category II Human Engineering Discrepancies are those discrepancies noted during field surveys, task analysis, and/or operator interviews, which have been determined to be of valid concern and require corrective action, but for which no documented cases of operator error were found during the Review of Operating Experience, but which have an error potential greater than "1". Category III Human Engineering Discrepancies are those discrepancies noted by field surveys and/or operator interviews which have been determined to have little or no impact on operator performance, and for which no documented cases of operator error were found during the Review of Operating Experience.

6.1.3 Prioritization of HEDs

Once an HED had been categorized, its priority was determined by evaluating the potential effect of the hypothesized error on plant safety. Review team, technical staff, and operations representatives evaluated system consequences of hypothesized operational errors. Four determinations were made:

- o Does the Human Engineering Discrepancy relate to plant safety functions?

- Does the Human Engineering Discrepancy relate to plant functions required to mitigate the consequences of an accident?
- Could an error lead to unsafe operations or plant conditions?
- Could an error lead to violations of technical specifications?

Each of these required a yes/no type response. The Logic Diagram in Figure 2-3 (Human Engineering Discrepancy Form) shows how these data were integrated to assign categories and priorities to Human Engineering Discrepancies.

As indicated in Figure 2-3, three HED priorities were assigned: "A," "B," and "C." Each of these priorities and its associated scheduling implications are presented below.

- Priority A — Prompt-first outage, given engineering lead time, availability of materials and coordination with the Integrated Living Schedule
- Priority B — Near term - second outage, given engineering lead time, availability of materials and coordination with the Integrated Living Schedule
- Priority C — Long term.

6.2 HED Disposition

After an HED had been assessed and [illegible] sition was selected. D[illegible] bility and effectivenes[illegible] selected solution was [illegible] Section 7.0).

WHO (QUALIFICATIONS) IS THE HED REVIEW COMMITTEE?

Due to [illegible] mpanies backfits to a [illegible] extreme caution with [illegible] dies are being conduct[illegible] ve and well-integrate[illegible] s have been initiated:

- [illegible]
- L[illegible] aids study
- Controls study
- Displays study
- Noise study
- Illumination and lighting study

- Computer study
- SFRCS study
- Engineering study
- Operations study.

Toledo Edison is proceeding to integrate these studies with the Davis-Besse living schedule. A summary of HED status and disposition is presented in Appendix C. Original HEDs are being maintained in the central project files.

7.0 IMPLEMENTATION AND SCHEDULE OF CORRECTIVE ACTIONS

As indicated in Section 6.0 of this report, two major types of dispositions are being implemented as a result of the Detailed Control Room Design Review as follows:

7.1 Short Term Corrective Actions

Based on the HED assessment and disposition process, a number of HEDs were identified which were amenable to short term corrective actions (enhancements, procedure revisions, training, etc.) without jeopardizing the integrated control room design improvement plans that emerge from the special studies described below. A list of the affected HEDs is provided in Table 7-1. Refer to Appendix C for the specific corrective actions.

7.2 Special Studies

The goal of the disposition process was an integrated control room design improvement effort that will solve problems cost effectively without introducing new problems. Therefore it was decided that the total package of solutions and the overall effects on the control room as an integrated system be considered before committing to individual design solutions. To this end, a series of special studies are being conducted to ensure that all proposed changes are both maximally effective and well-integrated into the existing design. At present, the following special studies are being initiated:

- o Annunciator study
- o Labels and location aids study
- o Controls study
- o Displays study
- o Illumination and lighting study
- o Computer study
- o SFRCS study
- o Noise study
- o Engineering study
- o Operations study.

Table 7-2 provides a list of the HEDs that will be addressed in each special study. The objective of each special study will be as a minimum to review and resolve each associated HED listed in Table 7-2 while assuring that the resolution does not generate any additional HEDs. Each special study will be conducted in three phases as follows:

- Planning Phase — During this phase a clear definition of the study will be provided including the required tasks, the management and staffing of the study, and the final deliverables will be defined.
- Review Phase — During this phase, appropriate documents will be reviewed, personnel will be interviewed, and the methodology developed in the planning phase will be implemented.
- Recommendation Phase — Based upon the findings of the review phase, recommendations including conceptual designs will be provided. Recommendations will be made in an integrated fashion factoring in the results of all related special studies.

As per NRC Letter to Toledo Edison Company dated 6/5/84 re: "Supplement 1 to NUREG-0737: Request for Modification of Commission Order dated 2/21/84," in January of 1985 Toledo Edison will provide detailed schedules for the completion of the short term actions and the special studies discussed herein. Scheduling of all DCRDR activities will be based on the categorization and prioritization system discussed in Section 6.0 and will ultimately be factored into Toledo Edison's Integrated Living Schedule.

TABLE 7-1

LIST OF HEDs FOR WHICH SHORT TERM CORRECTIVE ACTIONS HAVE BEEN IDENTIFIED

HED NO.	TITLE
P.1.1-3	Work Space - Reference Document Storage
P.1.1-5	Work Space - Dedicated Communication Links
P.1.6-6	Noise - Signal discriminability
P.1.7-1	Maintainability - Recorder supplies
P.1.7-5	Maintainability - Bulb and recorder markings
P.1.7-6	Maintainability - Spare parts records
P.1.7-7	Maintainability - Paper and ink replenishment
P.1.7-9	Maintainability - Bulb replacement
P.1.7-11	Maintainability - Lights shorted out
P.2.1-2	Communication - Telephone cords
P.3.1-29	Annunciators - Alarm typer
P.3.1-35	Annunciators - Coordinate Designators
P.3.1-36	Annunciators - Annunciator response procedures
P.4.1-1	Controls - Critical control guards
P.4.1-7	Controls - Interlocks
P.9.2-7	V&V - Walk-through - AFW Display Accuracy
P.9.2-30	V&V - Walk-through - Display Visibility
P.9.2-37	V&V - Walk-through - Display Accuracy
P.9.2-88	V&V - Walk-through - Timers

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TABLE 7-2

SPECIAL STUDIES VERSUS HUMAN ENGINEERING DISCREPANCY REPORT NUMBERS

SPECIAL STUDIES	HUMAN ENGINEERING DISCREPANCY REPORT NUMBERS
Annunciator Study	P.1.6-4, P.1.7-8 P.3.1-11, P.3.1-13, P.3.1-14, P.3.1-15, P.3.1-17, P.3.1-18, P.3.1-20, P.3.1-21, P.3.1-23, P.3.1.-24, P.3.1-25, P.3.1-26, p.3.1-27, P.3.1-28, P.3.1-30, P.3.1-32, P.3-1-33, P.3.1-34, P.3.1-37, P.3.1-38, P.3.1-39, P.3.1-40, P.3.1-41, P.5.1-5 P.9.2-67, P.9.2-72, P.9.2-83, P.9.2-89, P.9.2-91
Computer Study	P.7.1-1, P.7.1-3, P.7.1-4, P.7.1-5, P.7.1-7, P.7.1-8, P.7.1-9, P.7.1-10, P.7.1-11, P.7.1-12, P.7.1-13, P.7.1-14, P.7.1-15, P.7.1-16
Controls Study	P.4.1-5, P.4.1-6, P.4.1-11, P.4.1-13, P.4.1-14, P.4.1-15, P.4.1-16, P.4.1-19, P.4.1-20, P.4.1-24, P.4.1-25, P.4.1-26, P.4.1-27, P.4.1-28, P.4.1-29, P.4.1-30, P.4.1-31 P.9.2-2, P.9.2-6, P.9.2-15, P.9.2-53, P.9.2-55, P.9.2-97
Displays Study	P.1.7-10 P.5.1-1, P.5.1-2, P.5.1-4, P.5.1-6, P.5.1-7, P.5.1-9, P.5.1-10, P.5.1-16, P.5.1-24, P.5.1-25, P.5.1-26, P.5.1-27, P.5.1-28, P.5.1-29, P.5.1-30, P.5.1-31, P.5.1-35, P.5.1-36 P.9.2-4, P.9.2-15, P.9.2-16, P.9.2-17, P.9.2-20, P.9.2-24, P.9.2-25, P.9.2-35, P.9.2-38, P.9.2-40, P.9.21-65, P.9.2-70, P.9.2-74, P.9.2-76, P.9.2-79, P.9.2-80, P.9.2-81, P.9.2-82, P.9.2-84, P.9.2-85, P.9.2-86, P.9.2-90, P.9.2-94, P.9.2-107, P.9.2-111 P.9.8-7, P.9.8-8, P.9.8-11
Engineering Study	P.9.2-8, P.9.2-11, P.9.2-28, P.9.2-31, P.9.2-95
Illumination and Lighting Study	P.1.5-1, P.1.5-4, P.1.5-5, P.1.5-6, P.1.5-7

TABLE 7-2

SPECIAL STUDIES VERSUS HUMAN ENGINEERING DISCREPANCY REPORT NUMBERS
(Continued)

SPECIAL STUDIES	HUMAN ENGINEERING DISCREPANCY REPORT NUMBERS
Labels and Location Aids Study	P.4.1-4 P.5.1-21, P.5.1-22, P.5.1-23, P.5.1-37, P.5.1-38, P.5.1-39, P.5.1-40 P.6.1-1, P.6.1-3, P.6.1-4, P.6.1-5, P.6.1-7, P.6.1-9, P.6.1-10, P.6.1-11, P.6.1-12, P.6.1-16, P.6.1-17, P.6.1-18, P.6.1-19, P.6.1-20, P.6.1-23, P.6.1-24, P.6.1-25, P.6.1-26, P.6.1-27, P.6.1-28, P.6.1-29, P.6.1-30, P.6.1-31, P.6.1-32 P.8.1-1, P.8.1-2, P.8.1-3, P.8.1-4, P.8.1-5, P.8.1-6 P.9.2-5, P.9.2-9, P.9.2-22, P.9.2-23, P.9.2-33, P.9.2-36, P.9.2-47, P.9.2-49, P.9.2-58, P.9.2-59, P.9.2-61, P.9.2-66 P.9.8-5
Noise Study	P.1.6-1, P.1.6-2 P.3.1-9, P.3.1-10
Operations Study	P.1.7-7 P.6.1-2, P.6.1-15
Steam Feedwater line Rupture Control System (SFRCS)	P.9.2-1, P.9.2-18, P.9.2-42, P.9.2-43, P.9.2-54, P.9.2-68, P.9.2-73, P.9.2-75, P.9.2-92, P.9.2-96

APPENDIX A
OPERATOR QUESTIONNAIRES

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

BIOGRAPHICAL DATA:

Name: ______________________________ Age: __________

Sex: __________ Height: __________ Weight: __________

Current Position/Title: ______________________________

1. Do you have a current reactor operator's license? YES ______ NO ______

2. Amount of licensed experience at this plant: ______________________

3. Total amount licensed experience: ______________________

4. Related experience and amount (example: operator-trainee, Hodge NPP Unit 1, 1 yr.):

5. Education:

   a. Highest level attained: ______________________

   b. Specialized Schools or courses (list):

6. Military experience:

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

1. Are there any noticeably great differences in the illumination level or a given work area? YES NO

2. In remote areas or where fixed illumination may not be adequate, is there sufficient supplemental lighting available to support your required job in that area? YES NO

3. Are there areas in the primary operating area where illumination is not sufficient for the task performed? YES NO

4. Do shadows ever interfere with reading labels, instructions, and other written information? YES NO

5. Does glare ever interfere with the readability of displays, labels, or indicators? YES NO

6. Are colors used on panel surfaces, controls, and displays recognizable under both normal and emergency lighting conditions? YES NO

ILLUMINATION QUESTIONNAIRE

QUESTION NUMBERS

OPERATOR NUMBERS	1	2	3	4	5	6	
1	+	+	+	+	–	+	
2	+	+	+	–	–	+	
3	+	+	+	+	–	+	
4	+	–	+	+	–	+	
5	+	+	+	+	+	+	
6	+	+	+	+	+	+	
7	–	+	+	+	+	N/A*	* OPERATOR HAS NEVER EXPERIENCED EMERGENCY LIGHTING
8	–	+	–	+	–	+	
9	+	+	+	+	+	N/A*	* OPERATOR HAS NEVER EXPERIENCED EMERGENCY LIGHTING
10	–	–	+	+	–	+	
11	+	+	+	+	–	+	
12	+	+	+	+	+	+	
13	+	+	+	+	–	+	
	3– 10+	2– 11+	1– 12+	1– 12+	8– 5+	11+ 2 N/A	

KEY
+ — Positive Response
– — Negative Response
N/A — Non-applicable

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

BIOGRAPHICAL DATA:

Name: ______________________________ Age: __________

Sex: __________ Height: __________ Weight: __________

Current Position/Title: ______________________________

1. Do you have a current reactor operator's license? YES ______ NO ______
2. Amount of licensed experience at this plant: ______________________
3. Total amount licensed experience: ______________________
4. Related experience and amount (example: operator-trainee, Hodge NPP Unit 1, 1 yr.):

5. Education:

   a. Highest level attained: ______________________

   b. Specialized Schools or courses (list):

6. Military experience:

ANNUNCIATOR SYSTEM

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

1. Are there any areas of the control room that are so noisy you can't hear or be heard when using normal noise levels? YES NO

2. Are there any areas of the control room where you feel that background noise should be lowered more than normally, or that an intercom should be required? YES NO

3. Are auditory signals coded in such a way that you can identify them anywhere within your normal work area? YES NO

4. Are there any auditory signals that seem to interfere with other signals or voice communciations because they are too loud or distracting? YES NO

5. Are there any auditory signals that sound similar to you, yet they have contradictory meanings? YES NO

6. Do auditory alarm horns which announce a malfunction or a failure sound different to you than routine signals such as bells, buzzers, etc.? YES NO

AMBIENT NOISE

OPERATOR NUMBERS	QUESTION NUMBERS 1	2	3	4	5	6	7
1	+	+	+	–	+	+	+
2	+	+	+	–	+	+	+
3	+	+	+	–	+	+	+
4	+	+	+	–	–	–	–
5	+	+	+	–	+	+	+
6	+	+	+	+	+	–	+
7	+	+	+	+	+	+	+
8	+	+	N/A	–	+	+	+
9	+	+	+	–	+	–	–
10	+	+	+	–	+	–	–
11	+	–	+	–	+	+	–
12	+	+	+	+	+	+	+
13	+	+	+	+	+	–	+
	13+	1– 12+	12+ 1 N/A	9– 4+	1– 12+	5– 8+	4– 4+

KEY
+ — Positive Response
– — Negative Response
N/A — Non-applicable

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

BIOGRAPHICAL DATA:

Name: ______________________________ Age: __________

Sex: ____________ Height: ____________ Weight: __________

Current Position/Title: ______________________________

1. Do you have a current reactor operator's license? YES ______ NO ______
2. Amount of licensed experience at this plant: ______________________
3. Total amount licensed experience: ______________________
4. Related experience and amount (example: operator-trainee, Hodge NPP Unit 1, 1 yr.):

5. Education:

   a. Highest level attained: ______________________

   b. Specialized Schools or courses (list):

6. Military experience:

MAINTAINABILITY

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

1. Do you have an adequate supply of expendable items such as ink, pens, printer paper, etc.? If NO, please list the expendables and the amounts you feel you need. YES NO

2. Do you have an adequate supply of spare parts such as fuses, bulbs, etc.? If NO, please list the spare parts and amounts you feel you need. YES NO

DUMB QUESTION

3. Do you have all nec
needed to install ex
room? If NO, pleas

WON'T OPERATORS BE BIASED WRT CONTROL ROOM DESIGN (INDUSTRIOUS ENOUGH TO WORK AROUND MOST PROBLEMS)?

THEY ALSO WON'T KNOW THAT SOME OTHER STATION HAS "A BETTER IDEA/DESIGN"

4. Are the expendables
accessible?

5. Are the spare parts that are stored in the control room easily accessible? YES NO

6. Are all necessary or special replacement tools needed to install expendables and spare parts easily accessible? YES NO

MAINTAINABILITY

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

7. Is there ample storage space available in the control room for expendables, spare parts, and tools? YES NO

8. When different types, sizes, or styles of expendables are required, are they clearly visible? YES NO

9. When different types, sizes, or styles of spare parts are required, are they clearly marked? YES NO

10. Do you keep records on the status of expendables and spare parts for inventory? YES NO

11. Are recorders designed to permit quick and easy replenishment of paper and ink? YES NO

12. Are periodic maintenance tests performed on all communication systems in your control room to ensure that the systems are functioning adequately? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

13. If bulbs are replaced in annunciator panels that require legend tiles to be removed, are the tiles marked to ensure that they will be replaced in the correct position? YES NO

14. Have you (or any one that you know of) ever been shocked while replacing a bulb? YES NO

15. Are the legend pushbuttons in your control room provided with either dual filaments, dual lamps, or lamp test function? YES NO

16. Can you replace bulbs in legend pushbuttons from the front of the panel? YES NO

17. Have legend pushbuttons ever shorted out while you were replacing a bulb? YES NO

18. Have you ever inadvertently activated a legend pushbutton while replacing a bulb? YES NO

MAINTAINABILITY

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

19. Are legend covers keyed or marked in some way to prevent you from interchanging the covers? YES NO

20. Do all indicator lights have either dual filaments, dual bulbs, or bulb test function? YES NO

21. Can you replace indicator light bulbs easily, with the power on, and without danger to yourself or the equipment? YES NO

22. Are indicator light lenses designed in such a way that they cannot be interchanged? YES NO

23. Do you have an operational procedure which prevents the interchanging of indicator light lenses? YES NO

MAINTAINABILITY QUESTIONNAIRE

QUESTION NUMBERS

OPERATOR NUMBERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
1	+	+	+	+	+	+	+	+	+	–	–	+	–	–	–	+	–	+	–	–	+	–	–	
2	+	+	–	+	+	+	+	+	+	–	+	+	* N/A	+	–	+	+	+	–	–	+	–	–	* OPERATOR SAYS BULBS ARE CHANGED ONE AT A TIME
3	+	+	+	+	+	+	+	+	+	–	* N/A	+	* N/A	+	–	+	–	+	–	–	+	–	–	* I & C REPLACES PENS AND INK & CHANGES BULBS
4	+	+	+	+	+	+	+	–	–	–	* N/A	+	–	+	–	+	+	+	–	–	+	–	–	* I & C REPLACES PENS AND INK
5	–	+	+	–	+	+	–	+	+	–	+	+	–	+	–	+	–	+	–	–	+	–	–	
6	–	–	+	–	+	+	+	+	+	–	* N/A	+	–	–	–	+	+	+	–	–	–	–	–	* I & C REPLACES PENS AND INK
7	–	+	–	+	+	+	+	+	+	–	+	+	–	+	–	+	–	+	–	–	+	–	–	
8	–	+	+	+	+	+	–	+	+	–	+	+	+	–	–	+	+	+	–	–	+	–	–	
9	–	+	+	–	+	+	+	–	–	–	+	+	–	–	–	+	+	+	–	–	+	–	–	
10	–	+	–	–	+	+	+	–	+	–	+	+	–	+	–	+	+	+	–	–	+	–	–	
11	+	+	+	+	+	+	+	+	+	–	* N/A	+	–	+	–	+	+	+	–	–	+	–	–	* I & C REPLACES PENS AND INK
12	+	+	+	+	+	+	+	+	+	–	–	+	–	+	+	+	–	+	–	–	+	–	–	
13	–	+	+	+	+	+	+	–	+	–	+	+	–	+	–	+	–	+	–	–	+	–	–	
	7- 6+	1- 12+	3- 10+	4- 9+	13+	13+	2- 11+	4- 9+	2- 11+	13-	2- 7+ 4 NA	13+	10- 2 NA	4- 9+	12- 1+	13+	6- 7+	13+	13-	13-	1- 12+	13-	13-	

KEY
+ – Positive Response
– – Negative Response
N/A – Non-applicable

415-1/0

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

BIOGRAPHICAL DATA:

Name: ______________________________ Age: __________

Sex: __________ Height: __________ Weight: __________

Current Position/Title: ______________________________

1. Do you have a current reactor operator's license? YES ______ NO ______
2. Amount of licensed experience at this plant: ______________________
3. Total amount licensed experience: ______________________
4. Related experience and amount (example: operator-trainee, Hodge NPP Unit 1, 1 yr.):

5. Education:
   a. Highest level attained: ______________________
   b. Specialized Schools or courses (list):

6. Military experience:

ANNUNCIATOR SYSTEM

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

1. Do you have a first out annunciator panel where only the tile associated with the reactor trip event illuminates and all subsequent alarms on that panel are "locked out"? YES NO

2. Do you know of any automatic reactor trip functions that do not have a separate annunciator tile on the first out panel (either missing or shared with other functions)? YES NO

3. Are the annunciator panels in the control room identified by a label above each panel? YES NO

4. From your primary operating area, can you read all annunciator panel labels with a minimum of effort? YES NO

5. Is the annunciator system priority coded by color, position, shape, or symbolic coding of the tiles? YES NO

6. If color coding is used, are there more than eleven colors used for coding the panels? YES NO

7. If color coding is used, is the meaning redundant, as an example, if priority coding uses color, does it also use tile position? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

8. Is there only one meaning attached to each color used for coding the tiles? YES NO

9. Are all meanings attached to any color coded tiles standard to those color meanings throughout your control room? YES NO

10. For color coded tiles is:

   a. red always used for unsafe, danger, immediate operator action required, or as an indication that a critical parameter is out of tolerance? YES NO

   b. green always used for safe, no operator action required, or as an indication that a parameter is within tolerance? YES NO

   c. amber (yellow always used for hazard (potentially unsafe), caution, attention required, or as an indication that a marginal value or parameter exists? YES NO

11. Do you know of any unnecssary color coding on the annunciator tiles or panels? YES NO

12. For colors used in tile coding, are any difficult to tell apart? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

13. Are auditory signals priority coded by pulse, frequency change (warbling), intensity, or different frequencies for different signals? YES NO

14. If you have separate alarm horns, can you easily identify the work station or system where the auditory signal originated? YES NO

15. Do you have different alarm horns for work areas not at the main control board? YES NO

16. If the auditory alarm signal has only one source, is the sound coded to direct you to different work areas? YES NO

17. Do any of the alarm horns startle or irritate you? YES NO

18. If you have different alarm horns, do any of them sound too loud or too soft in comparison to the others at your normal work station? YES NO

19. Do you have a silence control with each set of response controls in your primary operating are? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

20. Is a control provided which terminates a flashing visual tile, but allows a steady illumination until the alarm is cleared? YES NO

21. Can you acknowledge an alarm from more than one response control area? YES NO

22. If cleared alarms do not reset automatically, do you have a control to reset them yourself? YES NO

23. Does the reset control silence the auditory signal as well as extinguish the illumination? YES NO

24. Does the reset control operate from more than one response control area? YES NO

25. Can you defeat any of the annunciator controls, such as locking out the audible alarm or locking down the acknowledge control? YES NO

26. Can you test the auditory and flashing illumination signals of all tiles for each panel? YES NO

APPENDIX B2

OPERATOR INTERVIEW/QUESTIONNAIRE

27. Is there an administrative procedure that controls the periodic testing of all annunciators? YES NO

28. Are all tiles dark on annunciator panels when no alarm is indicated? YES NO

29. Can you easily tell if a tile is normally on for an extended duration during normal operating conditions? YES NO

30. Are you immediately aware if an annunciator tile is out of service? YES NO

31. Can you immediately determine when the flasher of an alarm tile fails? YES NO

32. Do you know of any alarms that occur so frequently that you consider them a nuisance? YES NO

33. Do you know of any alarms that do not give you ample time to respond to a warning condition? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

34. When responding to an alarm tile, can you readily locate the controls and displays required for corrective or diagnostic action? YES NO

35. Do you have access to annunciator response procedures in the control room? YES NO

36. Do you know of any alarms which require you to obtain additional information from a source outside the control room area? YES NO

37. Are there too many alarms which require additional information from panels outside your operating area? YES NO

38. If alarms are used that require information outside the control room, do they allow you ample time to respond? YES NO

39. Are alarms provided for shared equipment in all control rooms? YES NO

40. Is there a status display or signal provided for shared equipment in all control rooms which indicates that the equipment is currently being operated? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

41. Do you have any tiles with dual messages such as HIGH-LOW? YES NO

42. Does the multi-input alarm have a reflash capability that reflashes the visual tile after an auditory alert even if the first alarm has not been cleared? YES NO

43. Do multi-input annunciators provide you with an alarm printout? YES NO

44. Does the multi-input alarm typer have sufficient speed to print the alarm data fast enough for your needs? YES NO

45. Does the alarm typer ever skip or loose information, or garble (mix up) the printing? YES NO

ANNUNCIATOR SYSTEM QUESTIONAIRE

QUESTION NUMBERS

OPERATOR NUMBERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	-	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	+	-	-	-	+	+	+	+
2	-	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	+	+	N/A	+	+	-	+	-	N/A
3	-	+	-	-	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	+	-	-	-	+	+	+	N/A
4	-	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	+	-	-	N/A	+	+	+	+
5	-	+	+	+	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	+	-	-	+	+	-	-
6	-	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	+	-	+	+	-	+	-	+
7	-	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	+	+	+	+	+	+	+	-
8	-	+	+	+	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	+	-	-	+	-	+	-	+
9	-	+	-	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	-	-	-	-	-	+	-	-
10	-	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	+	-	+	-	+	-	+	-	-
11	-	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	+	-	+	+	-	+	-	+
12	-	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	+	+	-	+	+	+	+	-	+
13	+	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	-	-	+	+	+	+	+	+
	12- 1+	13+	2- 11+	1- 12+	2- 11+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12- 1+	8- 4+ 3 N/A	3- 10+	9- 3+ 1 N/A	6- 7+	8- 4+ 1 N/A	6- 7+	13+	8- 5+	4- 7+ 2 N/A

OPERATOR NUMBERS	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
1	+	+	+	+	+	+	-	-	-	-	+	+	+	-	+	+	N/A	N/A	-	-	+	-	-
2	N/A	-	+	+	+	+	+	-	-	-	+	+	+	+	+	+	N/A	N/A	-	-	+	+	-
3	N/A	N/A	+	+	+	+	-	-	-	-	+	-	+	-	+	+	N/A	N/A	+	-	-	+	+
4	+	-	+	+	+	-	-	-	-	-	+	+	+	-	+	+	N/A	N/A	-	-	+	+	-
5	+	-	+	+	+	-	+	-	-	-	+	+	+	+	+	+	N/A	N/A	+	-	+	+	-
6	+	-	+	+	+	+	-	-	-	-	+	-	+	-	+	+	N/A	N/A	-	-	+	*N/A	*N/A
7	+	-	+	+	+	+	+	-	-	-	+	+	+	+	+	+	N/A	N/A	-	-	+	+	+
8	+	-	+	+	+	+	+	-	-	-	+	+	+	+	+	+	N/A	N/A	-	N/A	+	+	-
9	-	-	-	+	+	-	+	-	-	-	+	+	+	+	-	+	N/A	N/A	-	-	-	+	-
10	+	-	+	+	+	+	+	-	-	-	-	+	+	+	+	+	N/A	N/A	-	+	+	+	-
11	-	-	+	+	+	+	-	-	-	-	+	+	+	-	+	+	N/A	N/A	-	+	-	+	+
12	-	-	+	+	+	+	+	-	-	-	+	+	+	+	+	+	N/A	N/A	-	-	+	+	-
13	+	+	+	+	+	+	-	-	+	-	+	+	+	-	-	+	N/A	N/A	-	-	+	+	-
	3- 8+ 2 N/A	10- 2+ 1 N/A	1- 12+	13+	13+	3- 10+	6- 7+	13-	12- 1+		1- 12+	2- 11+	13+	6- 7+	2- 11+	13+	N/A	N/A	11- 2+	10- 2+ 1 N/A	3- 10+	1- 11+ 1 N/A	9- 3+ 1 N/A

* HAS NOT HAD ANY EXPERIENCE IN THE USE OF THE TYPER

KEY
+ — Positive Response
− — Negative Response
N/A — Non-applicable

415-1/0

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

BIOGRAPHICAL DATA:

Name: ______________________________ Age: __________

Sex: ______________ Height: ______________ Weight: __________

Current Position/Title: ______________________________________

1. Do you have a current reactor operator's license? YES ______ NO ______

2. Amount of licensed experience at this plant: ______________________

3. Total amount licensed experience: ______________________________

4. Related experience and amount (example: operator-trainee, Hodge NPP Unit 1, 1 yr.):

5. Education:

   a. Highest level attained: ______________________________

   b. Specialized Schools or courses (list):

6. Military experience:

CONTROLS

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

1. Do you know of any controls that activate a critical function that do not have a movable cover or guard? YES NO

2. When you open a cover or guard, does it get in your way when you activate that control or any adjacent control? YES NO

3. Do you know of any areas on the board where toggle, lever, or pushbutton controls should be replaced with rotary controls because of accidental activation? YES NO

4. Have you ever accidently activated an adjacent control because it was positioned too close to the one you wanted to manipulate? YES NO

5. Have you ever had difficulty activating a control because an adjacent control was in the way? YES NO

6. Do you know of any controls that interlock unnecessarily? YES NO

7. Are there any controls that you think should require an interlocking device, but don't? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

8. When a strict sequential activation is necessary, do you know of any controls which are not provided with some type of interlock? YES NO

9. Does each step in a sequentially operated switch require a new control action (i.e., a release of the knob and then a reactivation)? YES NO

10. Can you recall any controls that you are never required to use? YES NO

11. Are there any controls that are duplicated unnecessarily? YES NO

12. Can you recognize a control in terms of its function, such as one type handle or a specialized color for all pumps? YES NO

13. Are there any controls that you would expect to be of a certain type or size, and they are not? YES NO

14. If control color coding is used (in addition to indicator light colors), are there more than eleven colors (list actual number used)? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

15. Where control color coding is used, could you identify all you need to know about the controls if the colors were not there? YES NO

16. Is there only one meaning attached to each color used for control coding? YES NO

17. Are all meanings attached to control color coding, including indicator lights and flags, standard to your control room conventions? YES NO

18. For control indicator lights, flags, and general control coding is:

   a. Red always used for unsafe, danger, immediate operator action required, or as an indication that a critical parameter is out of tolerance? YES NO

   b. Green always used for safe, no operator action required, or as an indication that a parameter is within tolerance? YES NO

   c. Amber (yellow) always used for hazard (potentially unsafe), caution, attention required, or as an indication that a marginal value or parameter exists? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

19. Do you know of any unnecessary control color coding? YES NO

20. For the colors that are used in control coding, are any difficult to tell apart such as a yellow-amber and an orange-yellow? YES NO

21. Do you know of any key-operated switches that are used solely as a means of shape coding? YES NO

22. Do keys with double row teeth fit into locks with either side up or forward? YES NO

23. Do you know of any keys that can be removed from locks in positions other than the OFF or SAFE position? YES NO

24. Can you recall any knobs or handles of control switches that slip or are loose on their shafts? YES NO

CONTROLS

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

25. Are there any controls that move so easily that you can't tell when you've activated them? YES NO

26. Rotary selector controls should be used when three or more detented positions are required. Do you know of any place where this is not true? YES NO

27. Do you know of any discrete rotary selector switches that do not have detents at each control position? YES NO

28. Can you position any selector switches between detented positions? YES NO

29. Are knobs on spring-loaded selector switches large enough to be held against the spring torque comfortably and without causing fatigue? YES NO

30. Do you know of any small J-handles that should be larger because of the torque required to operate them? YES NO

CONTROLS

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

31. Do you know of any selector switches that do not have stops which limit the range of control? YES NO

32. Are there any controls that allow you a wider range than you need? YES NO

33. Do you know of any controls with a greater accuracy than you need? YES NO

34. Are there any controls that are difficult to adjust to the precise level you need? YES NO

35. Do you get immediate feedback that a pushbutton has been activated? YES NO

36. Does the ambient lighting cause any legend pushbuttons to appear off when they are on, or on when they are off? YES NO

37. Do all stepped (i.e., with detents) thumbwheels have detents at each position? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

38. Do any of the stepped thumbwheels slip out of detent positions too easily? YES NO

39. Do you know of any continuous adjustment thumbwheels that do not have a detent in the OFF position? YES NO

40. Do all of the toggle switches that you know of snap, rather than slide, into position? YES NO

41. Do toggle switches provide you with some source of feedback upon activation? YES NO

42. Do all of the rocker switches that you know of snap, rather than slide, into positon? YES NO

43. Do rocker switches provide you with some source of feedback upon activation? YES NO

44. Do any of the rocker switches slip out of position too easily? YES NO

CONTROL QUESTIONNAIRE

QUESTION NUMBERS

OPERATOR NUMBERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18a	18b	18c	19	20	21	22	23
1	–	+	–	–	+	+	+	+	–	+	+	–	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	–	–	–	–	+	+	+	+	–	+	+	–	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	–	+	–	–	+	+	+	+	–	–	+	–	–	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	+	+	–	+	–	+	+	+	–	–	+	+	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	+	+	–	+	+	+	+	+	+	–	+	–	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	–	+	–	NA	NA	+	+	–	+	–	–	+	–	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7	+	+	–	–	+	+	+	+	NA	+	+	–	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	–	–	–	+	+	+	+	+	–	+	+	–	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
9	+	+	–	+	+	+	+	+	+	+	+	+	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10	–	+	–	–	+	–	+	+	–	+	–	+	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	–	+	+	–	+	+	+	+	–	+	+	–	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	–	+	–		+	+	+	+	–	–	+	–	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13	–	+	–	–	+	+	+	–	+	+	+	+	+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	9-	2-	12-	8-	1-	1-		2-	8-	5-	2-	8-	1-												
	4+	11+	1+	4+	11+	12+	13+	11+	4+	8+	11+	5+	12+												
				1 NA	1 NA				1 NA					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

OPERATOR NUMBERS	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	+	+	–	+	+	+	+	–	+	+	–	–	+	–	+	–	+	–	NA	NA	NA
2	+	+	+	+	+	+	+		+	+	+	+	+	NA	NA	NA	+	+	NA	NA	NA
3	+	–	+	+	–	+	+	+	+	+	+	+	+	+	+	+	+	–	NA	NA	NA
4	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+	–	+	+	NA	NA	NA
5	+	+	+	+	+	+	+	+	+	+	–	+	+	+	+	+	+	–	NA	NA	NA
6	* NA	* NA	–	* NA	* NA	* NA	* NA	* NA	* NA	* NA	* NA	–	+	* NA	* NA	* NA	* NA	* NA	NA	NA	NA
7	+	+	+	+	–	+	+	+	+	+	+	–	+	+	+	+	–	+	NA	NA	NA
8	+	+	+	+	–	–	+	+	+	+	–	+	+	–	+	+	+	+	NA	NA	NA
9	+	+	+	+	+	+	+	+	+	+	–	–	+	+	+	+	+	+	NA	NA	NA
10	–	+	+	+	+	–	+	+	+	+	–	+	+	+	+	+	+	+	NA	NA	NA
11	+	+	+	+	–	–	+	+	+	+	–	–	+	+	+	–	+	+	NA	NA	NA
12	–	+	+	+	–	+	+	+	+	+	+	+	+	NA	NA	NA	+	+	NA	NA	NA
13	+	+	+	+	+	+	+	+	+	–	–	+	+	–	+	+	–	+	NA	NA	NA
	2-	1-	1-		5-	3-			1-	1-	8-	5-		3-		3-	2-	3-			
	10+	11+	12+	12+	7+	9+	12+	12+	11+	11+	4+	8+	13+	7+	10+	7+	10+	9+			
	1 NA	1 NA		NA	1 NA	1 NA	1 NA	1 NA	1 NA	1 NA	1 NA			3 NA	3 NA		1 NA	1 NA	NA	NA	NA

* DOES NOT OPERATE CONTROLS

KEY
+ — Positive Response
– — Negative Response
NA — Non-applicable

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APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

1. Does the ambient lighting cause any indicator lights to appear off when they are on, or on when they are off? YES NO

2. Is system/equipment status inferred by any indicator light being off instead of illuminated? YES NO

3. Are any indicator lights used as alert or alarm signals or as a substitute for an annunciator alarm signal? YES NO

4. Are there any indicator lights in which the colors are ambiguous or faded (i.e., a yellowish white lens or a faded yellow or amber lens)? YES NO

5. If display color coding is used, are there more than 11 colors? YES NO

6. Is the meaning applied to the color of a color coded display redundant information; that is can you determine all you need to know without the color? YES NO

7. Is there only one meaning attached to each color used for display color coding? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

8. Are all meanings attached to any colors used in color coded displays standard to your control room conventions? YES NO

9. For display color codes does:

   a. Red always mean unsafe, danger, or parameter out of tolerance? YES NO

   b. Green always mean safe or parameter in tolerance? YES NO

   c. Yellow always mean caution, potentially unsafe, or marginal parameter value? YES NO

10. Do you know of any unnecessary display color coding? YES NO

11. Are any display colors used for coding difficult to tell apart? YES NO

12. Do operational parameters of displayed values on meter scales span the range that you would expect? YES NO

DISPLAYS

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

13. Do you know of any scale ranges which are too wide for the maximum displayed values (i.e., meter <u>never</u> indicates over half scale)? YES NO

14. Do you know of any scales where maximum values are too large for the scale (i.e., pointer reaches maximum, then stops) and supporting wide-range instruments are not provided? YES NO

15. Do all meters fail off-scale? YES NO

16. Do you know of any logarithmic scales that could be linear because of the range you are required to use? YES NO

17. Do you know of any multiscale displays (i.e., single pointer, multiple scales) that should be single scale displays? YES NO

18. Are any of the multiscale displays confusing to read? YES NO

19. Are any displays difficult to read because of poor contrast between the pointer and the background? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

20. Do you know of any displays that would be easier to read if the pointer was larger? YES NO

21. Are all recorders that you are required to use located within your primary work area? YES NO

22. Do you know of any recorders that are used for a purpose other than to record trend information and material for later reference? YES NO

23. Do you have a fast and a slow paper-speed adjustment on all recorders? YES NO

24. Is it easy to make notes on the recording paper (i.e., is there a backing plate and is the paper speed slow enough or can you slow it down)? YES NO

25. Can you easily read all the data through the window of the recorder without opening it? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

26. Do you know of any graphic recorders in which the ink clogs the pens or smudges the paper? YES NO

27. Do all recorders have a takeup spool? YES NO

28. Can recorder paper be torn off easily to provide permanent records for storage? YES NO

29. Do you know of any strip chart or impact recorders in which the pens or the printing heads are frequently driven to their maximum, then tend to mechanically or electrically hang up? YES NO

30. Where multiple channel inputs are control- or switch-selectable for display on a strip chart recorder, do you know of any case where after input selection, there is an appreciable delay before the parameter is actually displayed? YES NO

DISPLAYS

QUESTION NUMBERS

OPERATOR NUMBERS	1	2	3	4	5	6	7	8	9a	9b	9c	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	+	+	−	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	−	+	+	+	+	+	+	−	−	+	−	−	+	−	−	+
2	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	−	−	−	−	+	+	+	−	+	+	−	+	−	+	+	+	−	+
3	−	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	−	+	+	+	+	+	+	+	+	+	−	+	−	+	−	+
4	−	−	−	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	−	+	−	−	+	+	+	−	−	+	+	*N/A	+	−	+	+	+	+	+
5	+	+	−	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	−	+	+	−	−	+	+	+	+	−	+	−	+	+	+	−	+
6	−	−	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	−	−	+	−	+	+	+	+	+	+	−	−	−	+	+	+	−	+	+
7	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	−	+	+	+	+	−	+	−	−	+	−	+	+	*N/A	−	+
8	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	−	+	−	+	+	+	−	−	−	−	+	−	−	−	+	+	+	+
9	−	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	−	+	−	−	+	+	+	+	−	−	−	+	+	+	−	+
10	+	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	−	−	−	−	+	+	+	+	+	+	+	−	+	−	−	+	+	−	+
11	+	−	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	−	+	+	+	−	+	+	+	−	+	+	−	+	−	+	+
12	+	−	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	−	+	+	−	−	−	+	+	−	+	+	−	+	−	−	+
13	−	−	−	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	−	+	−	+	+	+	+	−	+	−	+	−	+	−	+	+	+	+	+
	5− 8+	5− 8+	4− 9+	13+	NA	NA	NA	NA	NA	NA	NA	NA	NA	4− 9+	4− 9+	5− 8+	11− 2+	1− 12+	2− 11+	3− 10+	5− 8+	5− 8+	2− 11+	4− 9+	10− 2+ 1 NA	3− 10+	10− 3+	5− 8+	1− 12+	4− 8+ 1 NA	8− 5+	13+

* DOES NOT KNOW, I & C MAKES ALL ADJUSTMENTS

* DOES NOT KNOW, HAS NOT TRIED IT

KEY
+ – Positive Response
− – Negative Response
N/A – Non-applicable

415-1/0

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

BIOGRAPHICAL DATA:

Name: ______________________ Age: ________

Sex: ________ Height: ________ Weight: ________

Current Position/Title: ______________________

1. Do you have a current reactor operator's license? YES ______ NO ______

2. Amount of licensed experience at this plant: ______________________

3. Total amount licensed experience: ______________________

4. Related experience and amount (example: operator-trainee, Hodge NPP Unit 1, 1 yr.):

5. Education:

   a. Highest level attained: ______________________

   b. Specialized Schools or courses (list):

6. Military experience:

LABELS AND LOCATION AIDS

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

1. Are color coded labels and location aids supported by additional cues (e.g., shape or functional nomenclature) which designate their meaning; that is, can you determine all you need to know without the color? YES NO

2. Do you know of any unnecessary label color coding? YES NO

3. Is the meaning attached to each color coded label narrowly defined and reserved only for that color? YES NO

4. Are all meanings attached to any colors used in color coded labels standard to your control room conventions, with the colors red, green, and amber reserved for the following uses:

   a. Red: unsafe, danger, immediate operator action required, or an indication that a critical parameter is out of tolerance? YES NO

   b. Green: safe, no operator action required, or an indication that a parameter is within tolerance? YES NO

   c. Amber (yellow): hazard (potentially unsafe), caution, attention required, or an indication that a marginal value or parameter exists? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

5. Are the meanings assigned to particular colors consistent across all applications within the control room, including panel surfaces, signal lights and CRTs? YES NO

6. Are any label colors used for coding difficult to tell apart? YES NO

7. Are controls, displays, and other equipment items appropriately and clearly labeled to enable rapid and accurate location, identification, and manipulation (if applicable)? YES NO

8. Are labels pertinent to control actuation visible during actuation? YES NO

9. Are labels periodically cleaned as a maintenance procedure? YES NO

10. Do labels describe the primary function of equipment items? YES NO

11. Do the words employed in the label express exactly what action is intended, if action is necessary? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

12. Are instructions on labels clear and direct? YES NO

13. Do words have a commonly accepted meaning for all users? YES NO

14. Are there any unusual technical terms used in labels? YES NO

15. Are there any symbols (e.g., abstract symbols like %) which have uncommon meanings? YES NO

16. Are symbols used in a commonly accepted standard configuration? YES NO

17. Is the use of temporary labels restricted to only necessary situation (e.g., need to replace a damaged, dropped, or changed label while a permanent one is made)? YES NO

18. Does the method used for "tagging-out" a control prevent actuation of the control? YES NO

APPENDIX B2
OPERATOR INTERVIEW/QUESTIONNAIRE

19. Is there any place in the control room where mimic lines are difficult to distinguish quickly due to similarity in color and/or placement in a parallel configuration. YES NO

LABELS AND LOCATION AIDS QUESTIONNAIRE

QUESTION NUMBERS

OPERATOR NUMBERS	1	2	3	4a	4b	4c	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	+	+	+	+	+	+	+	+	+	+
2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	+	+	+	+	+	+	+	+	–	–
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–	+	–	+	+	+	+	+	+	+	+	+	–
4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–	+	–	–	+	+	+	+	+	–	+	+	+
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	+	+	+	+	+	+	+	+	+	+
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	–	+	–	+	+	+	–	+	+	+	+	+	–
7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	+	+	+	+	+	+	+	+	+	+
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	+	–	+	+	+	+	+	+	+	–
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	+	+	+	+	+	+	–	+	–	+
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	–	+	+	+	+	+	+	+	+	+
11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	+	+	+	+	+	+	+	+	+	–
12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	–	+	+	+	+	+	+	+	–	+
13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	–	+	+	+	+	+	+	+	+	+	+
	NA	NA	NA	NA	NA	NA	NA	NA	3– 10+	13+	13–	3– 10+	1– 12+	13+	1– 12+	13+	13+	2– 11+	13+	3– 10+	5– 8+

KEY
+ – Positive Response
– – Negative Response
N/A – Non-applicable

415-1/0

VERIFICATION OF TASK PERFORMANCE

APPENDIX B2
OPERATOR/I & C INTEVIEW/QUESTIONNAIRE

BIOGRAPHICAL DATA:

Name: ______________________________ Age: __________

Sex: ____________ Height: ____________ Weight: __________

Current Position/Title: ______________________________

1. Do you have a current reactor operator's license? YES _____ NO _____

2. Amount of licensed experience at this plant: ______________________

3. Total amount licensed experience: ______________________

4. Related experience and amount (example: operator-trainee, Hodge NPP Unit 1, 1 yr.):

5. Education:

   a. Highest level attained: ______________________

   b. Specialized Schools or courses (list):

6. Military experience:

VERIFICATION OF TASK PERFORMANCE

APPENDIX B2
OPERATOR/I & C INTEVIEW/QUESTIONNAIRE

1. Are all the instrumentation and equipment necessary for you to detect abnormal plant conditions present in the control room? YES NO

   If no, please explain.

2. Are all the instrumentation and equipment necessary for you to bring the plant to a safe shutdown condition present in the control room? YES NO

   If no, please explain.

3. Are there any operational sequences in which you are required to leave the primary operating area to attend to instrumentation on back panels when continuous monitoring or control actions may be critical? YES NO

   If yes, please explain.

4. Are you aware of any cases in which control of shared plant equipment from the control room will interfere with the operators' ability to control the shared equipment from the other control room? YES NO

   If yes, please explain.

5. Is the status of all shared plant equipment, including availability status, displayed in all control rooms? YES NO

   If no, please explain.

VERIFICATION OF TASK PERFORMANCE

APPENDIX B2
OPERATOR/I & C INTEVIEW/QUESTIONNAIRE

6. Are there administrative procedures available that assign responsibility for allocation of use of controls for shared equipment in a single control room? YES NO

   If yes, what is the procedure name and number?

7. (I & C) Were operator tasks analyzed to determine operator information requirements prior to selection of control room display? YES NO

   If yes, is a copy of the task analysis available?

8. Do the visual displays in the control room provide all the information that you need to meet task requirements for normal, abnormal, and emergency operations? YES NO

   If no, please explain.

9. Are there any visual displays in the control room that are uncessary or should be replaced by more important displays? YES NO

   If yes, please explain.

10. Are there any redundant displays that are not needed for backup or to avoid excessive operator movement? YES NO

    If yes, please explain.

11. Are all displays that present equipment status clearly labelled to indicate whether the display is of actual or demand status? YES NO

    If no, please explain.

APPENDIX B2
OPERATOR/I & C INTERVIEW/QUESTIONNAIRE

12. Are there any displays that indicate demand status for safety-related equipment that you believe should indicate actual status? YES NO

    If yes, please explain.

13. Is there always a positive indication that an instrument, such as a meter, has failed or become inoperative? YES NO

    If no, please explain.

14. Are there any displays that have scales that do not provide the precision or accuracy you require when using them? YES NO

    If yes, please explain.

15. Are there any displays that require you to perform some form of conversion in order for you to effectively use the information (e.g., converting percent level to gallons in a storage tank)? YES NO

    If yes, please explain.

16. Are there any displays that indicate percentage instead of level or flow as some other value that would be more useful to you? YES NO

    If yes, please explain.

17. Are all display scales adequate in terms of the range they span, or are they at least supported by auxiliary wide-range instruments? YES NO

    If no, please explain.

APPENDIX B2
OPERATOR/I & C INTERVIEW/QUESTIONNAIRE

18. Are there any displays that are difficult to use because they display normal random variations in equipment performance? YES NO

If yes, please explain.

19. Are there any displays for which information is required to use the display (e.g., multiply display out by 100) but the information is not located on or adjacent to the display? YES NO

If yes, please explain.

20. When you have to compare two or more displays of the same parameter (e.g., pressure, level) are the scales always compatible in terms of numerical progression and scale design? YES NO

If no, please explain.

21. Are there any unnecessary logarithmic scales in the control room? YES NO

If yes, please explain.

22. Are there any unnecessary multiscale indicators (i.e, single pointer, multiple scales) in the control room? YES NO

If yes, please explain.

23. For selectable displays (e.g., multiple channel displays), nonselected displays read off-scale, not zero. YES NO

If no, please explain.

VERIFICATION OF TASK PERFORMANCE

APPENDIX B2
OPERATOR/I & C INTERVIEW/QUESTIONNAIRE

24. Do all controls provide the precision necessary for you to easily and effectively control the affected parameter? YES NO

If no, please explain.

25. Do displays of controlled parameters allow you to distinguish significant levels (changes) in the parameter being controlled. YES NO

If no, please explain.

26. Are there any controls or displays that are either overly precise or not precise enough for the tasks you have to perform? YES NO

If yes, please explain.

27 Is adequate feedback concerning control movement available through control room displays. YES NO

If no, please explain.

VERIFICATION OF TASK PERFORMANCE QUESTIONNAIRE

QUESTION NUMBERS

OPERATOR NUMBERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
1	+	+	+	N/A	N/A	N/A	–	+	+	+	–	+	–	–	+	+	+	+	+	+	+	+	N/A	–	+	+	+	
2	+	+	–	N/A	N/A	N/A	* N/A	+	–	+	–	–	–	–	–	–	+	+	+	+	+	+	N/A	–	+	–	+	* OPERATOR DOES NOT KNOW
3	+	+	+	N/A	N/A	N/A	–	+	+	+	–	–	–	+	–	–	+	+	+	+	+	+	N/A	+	+	+	+	
4	+	+	–	N/A	N/A	N/A	+	+	+	+	+	+	–	–	–	–	+	+	+	–	+	+	+	+	+	–	+	
5	+	+	–	N/A	N/A	N/A	* N/A	+	–	+	+	+	–	–	+	+	+	+	+	+	+	+	+	+	+	+	+	* OPERATOR DOES NOT KNOW
6	+	+	+	N/A	N/A	N/A	–	+	+	+	–	–	–	+	+	+	–	+	+	+	+	+	–	+	+	+	+	
7	+	+	+	N/A	N/A	N/A	–	+	+	+	+	+	–	–	–	+	+	+	+	+	+	+	N/A	–	+	+	+	
8	+	+	+	N/A	N/A	N/A	–	–	–	+	–	+	–	–	–	+	+	+	+	+	+	+	+	+	+	+	+	
9	+	+	–	N/A	N/A	N/A	–	+	+	+	–	+	–	–	+	+	+	+	+	–	+	+	N/A	+	+	+	+	
10	+	+	–	N/A	N/A	N/A	+	+	+	+	+	+	–	–	–	–	+	+	+	+	+	–	–	+	+	+	+	
11	+	+	–	N/A	N/A	N/A	* N/A	+	+	+	+	+	–	+	–	+	+	+	+	+	+	+	N/A	+	+	+	+	* OPERATOR DOES NOT KNOW
12	+	+	+	N/A	N/A	N/A	–	+	–	+	+	+	–	–	–	–	+	+	+	+	+	+	–	+	+	–	+	
13	+	+	–	N/A	N/A	N/A	–	+	+	+	+	+	+	–	+	–	+	+	+	+	+	+	N/A	+	+	–	+	
			7-				8-	1-	4-		6-	3-	12-	10-	8-	6-	1-			2-		1-	3-	3-		4-		
	13+	13+	6+				2+	12+	9+	13+	7+	10+	1+	3+	5+	7+	12+	13+	13+	11+	13+	12+	3+	10+	13+	9+	13+	
				NA	NA	NA	3 NA																7 NA					

KEY
+ — Positive Response
– — Negative Response
N/A — Non-applicable

APPENDIX B

VERFICATION AND VALIDATION SUMMARY TABLES

Toledo Edison Company
Davis-Besse Unit No. 1

APPENDIX B

VERIFICATION AND VALIDATION SUMMARY TABLE

Report No. 415-1/0
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Task No. 1
Task Designation: Verify Reactor Trip
TA/SFRT: 1.1.1, 1.1.2, 1.5.1, 2.1.1, 3.1, 3.2, 4.6.1, 4.15(3), 4.15(10), 8.1, 8.1.1, 8.1.2, 8.6, 8.6.1, 8.6.2

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o All rods insert (rod bottom lights)	In - Out	X			X	Except Group 8 HED 9.2-25 addresses light distinguishability
o Rod position indication (all rods in)	0 - 100%	X		X		
o Reactor neutron flux indication	0 - 120%	X		X		
- Source range	10^{-1} - 10^{6} cps	X		X		
- Intermediate range	10^{-11} - 10^{-3} amps	X		X		
- Power range	0 - 120%	X		X		
o Startup rate meter	-.5 - +5 dpm	X				
o Reactor trip breakers status	Open/closed		X			HED 9.2-108
o Annunciator alarms	Off/on	X		X		
o Manual reactor trip pushbuttons	On/off	X		X		
o Reactor trip breakers	Open/closed		X			HED 9.2-108
o Control rod drive breakers (local)	Open/closed	X		X		
o RPX channel trips		X		X		

Toledo Edison Company
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Task No. 2
Task Designation: Verify Turbine Trip
TA/SFRT: 2.1.2, 2.1.3, 2.1.5, 3.3, 4.7.1, 8.6, 8.6.1

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VERIFICATION AND VALIDATION SUMMARY TABLE

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Turbine stop valve position indication	Open/closed	X		X		
o Turbine governor valve position indication	Open/closed	X		X		
o Turbine combined intermediate valve indication	Open/closed	X		X		
o Turbine generator breakers position	Open/closed	X		X		
o Turbine shaft speed	0 - 2500 rpm	X		X		
o Generator electrical load display	0 - 1200 mw	X		X		
o Generator field circuit breaker position	Open/closed	X		X		
o Turbine bypass valve position	0 - 100%	X			X	HED 9.2-9 concerning display scaling
o Main steam pressure	600 - 1200 psig	X		X		
o Annunciator alarms		X		X		
o Manual turbine trip pushbuttons	On/off	X		X		
o Switches to manually open generator breakers	Open/closed	X		X		
o Switch to manually open generator field circuit breaker	Open/closed	X		X		

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 3
Task Designation: Verify SFAS Actuation
TA/SFRT: 1.2.1, 1.2.2, 1.5.2, 2.2.1, 4.9.1, 4.9.2, 4.9.3, 4.9.4, 4.9.5, 4.9.6, 4.15(8), 6.2.8, 8.14.2, 8.18.3, 10.2, 10.7, 11.2, 12.2, 13.2, 13.4

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Status indication for Safety Features Actuation System equipment.		X			X	HED 9.2-20 addresses SFAS SAM light arrangement in general
- Valve position	Open/closed	X			X	HED 9.2-61 addresses demarcation
- Pump operation	Running	X		X		
- SFAS channel status	Activated/off	X			X	HED 9.2-26/9.2-27 addresses difficulty in interpreting SAM lights
o Safety injection flow indication						
- High pressure injection flow	0 - 500 gpm	X			X	HED 9.2-8 addresses scale ranges
- Low pressure injection flow	0 - 5,000 gpm	X			X	HED 9.2-8 addresses scale ranges
- Containment spray flow	0 - 2,000 gpm	X			X	HED 9.2-8 addresses scale ranges
o Annunciator alarms		X			X	HED 9.2-91, item 32, addresses SFAS annunciators
o Pump discharge presure indication			X			No discharge pressure displays for engineered safety features pumps. HED 9.2-86
o Emergency diesel generators running	0 - 1,200 rpm	X		X		
o Ammeters for HPI, LPI, CS pumps	0 - 150, 100, 300 amps	X		X		
o SAM lights	Activated/off	X			X	HED 9.2-26/27
o Containment emergency coolers and fans on	Start/normal/stop	X		X		
o Manual pushbuttons to activate SFAS channels	Activate/off	X		X		
o Manual controls for Safety Features Activation System equipment		X		X		
- Pumps	On/off	X		X		
- Valves	Open/closed	X		X		
- Emergency diesels						

APPENDIX B

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 3 (continued)
Task Designation: Verify SFAS Actuation
TA/SFRT: 1.2.1, 1.2.2, 1.5.2, 2.2.1, 4.9.1, 4.9.2, 4.9.3, 4.9.4, 4.9.5, 4.9.6, 4.15(8), 6.2.8, 8.14.2, 8.18.3, 10.2, 10.7, 11.2, 12.2, 13.2, 13.4

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o SFAS bypass pushbuttons		X			X	HED 9.2-14 concerns SFAS blocks and unassociated equipment
o SFAS reset pushbuttons		X			X	HED 9.2-6 concerns control type and operator expectancy

Task No. 4
Task Designation: Verify SFRCS Actuation
TA/SFRT: 1.3.1, 1.3.2, 2.3.1, 4.2.2, 4.3.3, 4.4.2, 4.7.2, 4.8.1, 4.10.1, 4.10.2, 5.3, 6.5.4, 6.11.1, 7.3, 7.3.1, 7.3.2, 7.13, 7.14, 7.20.1, 7.28, 7.29, 7.31.1, 8.14.4, 8.18.5

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Valve position indication for:		X			X	
- Atmospheric vent valves	Open/closed	X				HED 9.2-1 addresses SFRCS component arrangement. In general, arrangement is unsuitable for SFRCS system as a whole.
- MSIV bypass valve position	0 to 100%	X				
- Main steam drain valves	Open/closed	X				
- Startup feedwater control valves	Open/closed	X				HED 9.2-32 concerns possible failure to get SFRCS.
- Main steam to AFPT	Open/closed	X				
- Main steam isolation valves	Open/closed	X				
- AFP discharge valves	Open/closed	X				
- Main feedwater block valves	Open/closed	X				
- Main feedwater control valves	Open/closed	X				
- AFW discharge to steam generators	Open/closed	X			X	HED 9.2-7 addresses accuracy
o Turbine tripped by SFRCS		X		X		
o Steam generator level	0 - 650"	X			X	HED 9.2-42 & 49 addresses temp. compensation
o Steam generator pressure	0 - 1200 psig	X			X	HED 9.2-18 addresses information appropriateness
o SFRCS trip confirmed status	Trip-off	X			X	HED 9.2-18 addresses SFRCS logic, and annunciators
o Annunciator alarms		X			X	
o Feedwater to steam pressure AP			X		X	HED 9.2-18 P not available
o Valve switches to operate valves	Open/closed	X			X	HED 9.2-43 addresses control locations
o SFRCS Manual initiation switches	Trip-off	X			X	HED 9.2-54 discusses locations/ arrangements
o SFRCS block switch	Blocked/unblocked	X			X	HED 9.2-43 addresses control locations

Task No. 5
Task Designation: Verify Rapid Feedwater Reduction (RFR) Control
TA/SFRT: 2.1.4, 4.8.2

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Main feedwater pump speed	0 - 8000 RPM	X		X		
o Main feedwater control valve position	0 - 100%	X		X		
o Startup feedwater control valve position	0 - 100%	X		X		
o Steam generator operate level	0 - 100%	X			X	HED 9.2-49 addresses temp. compensation
o Steam generator wide range level	0 - 650"	X			X	
o Steam generator startup range level	0 - 250"	X			X	HED 9.2-42 addresses display appropriateness
o Main feedwater flow	0 - 7000 kpph	X			X	HED 9.2-28 addresses potential for misleading FW flow indication
o Main feedwater pump speed control		X		X		
o Main feedwater control valve manual control stations		X		X		
o Startup feedwater control valve manual control stations		X		X		

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No.6
Task Designation: Verify Turbine Bypass Valve Setpoint Transfer
TA/SFRT: 2.1.3

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Main steam pressure	600 - 1200 psig	X		X		
o Steam generator pressure	0 - 1200 psig	X		X		
o Turbine bypass valve position indication	0 - 100%	X		X		
o RCS pressure	1700 - 2500 psig	X		X		
o RCS inlet temperature	520° - 620°F	X		X		
o RCS outlet temperature	520° - 620°F	X		X		
o RCS average temperature	520° - 620°F	X		X		
o Turbine bypass valve setpoint controller	0 - 100%	X			X	HED 9.2-9 Addresses unit conversions

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 7
Task Designation: Verify Fast Dead Bus Transfer
TA/SFRT: 2.1.5, 4.1.1, 4.1.2, 4.1.3, 4.9.4, 4.15 (4)

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Generator breakers position	Open/closed	X		X		
o Generator field breaker position	Open/closed	X		X		
o Startup transformers breaker status	Open/closed	X		X		
o Electrical buses voltage indication	Various	X			X	HED 9.2-19 addresses size of meters
o Electrical Buses Ammeters	Various	X			X	
o Electrical bus feeder breaker positions	Open/closed	X		X		
o Reserve source selector switch		X		X		
o Generator breakers control		X		X		
o Generator field breaker control		X		X		

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 8
Task Designation: Isolate Letdown (Return Letdown to Service)
TA/SFRT: 3.4, 4.9.5(2), 5.5.2, 7.2, 8.20.4, 13.8, 13.10

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Letdown flow	0 - 160 gpm	X			X	HED 9.2-35 addresses display scale
o Letdown temperature	0 - 200°F	X		X		
o Letdown pressure	0 - 30 psid	X		X		
o Letdown isolation valve position	Open/closed	X			X	HED 9.2-69 addresses indication of these valves
o Letdown radiation indication		X		X		
o Letdown flow controller position	0 - 100%	X		X		
o Letdown isolation valve switch	Open/closed	X		X		
o Letdown flow controller	0 - 100%	X		X		

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 9
Task Designation: Verify Containment Isolation
TA/SFRT:

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Automatic isolation logic status		X			X	
o Valve position indication for all containment isolation valves	Open/closed	X			X	HED 9.2-20, 26 address SAM grouping HED 9.2-27 addresses brightness discriminations
o Personnel airlock closure status			X			No display for airlock HED 9-2-104
o Equipment access hatch closure status			X			No display for equipment access hatch HED 9-2-104
o Air supply isolation dampers position	Open/closed	X		X		
o Air exhaust isolation dampers position	Open/closed	X		X		
o Containment pressure	0 - 60 psia	X		X		
o Containment temperature	0 - 200°F	X		X		
o Containment cooling and filter units start indication	On/off	X		X		
o Valve switches to close valves	Open/closed	X		X		
o Damper switches to close dampers		X		X		
o Isolation damper block switches		X		X		

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 10
Task Designation: Verify NNI Power AC and DC
TA/SFRT: 4.3.1, 4.3.2, 4.3.3, 4.15(5), 5.12.1, 5.12.2, 8.8.3

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o NNI AC and DC power source status	On/off	X			X	HED 9.2-34 addresses NNI logic
o Meter status meters labeled X or Y		X			X	
o Annunciators		X			X	HED 9.2-89, addresses NNI annunciators

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 11
Task Designation: Verify ICS AC and DC Power
TA/SFRT: 4.4.1, 4.15(6), 7.20.1, 7.31.1, 7.31.2

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o ICS AC and DC power source status	On/off	X		X		
o ICS AC and DC power source failures (annunciators)	On/off	X			X	HED 9.2-89, addresses ICS annunciators

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 12
Task Designation: Verify AC Emergency Buses are Energized
TA/SFRT: 4.1

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Voltage indication for emergency AC electrical buses	0 - 5.25 kv	X			X	HED 9.2-19 concerns display readability due to size, location, scaling
o Breaker position for emergency AC buses	Open/closed	X		X		
o Ampere indication for emergency AC electrical buses	0 - 1500 amps	X		X		
o Switches to operate emergency AC bus breakers	Open/closed	X		X		

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 13
Task Designation: Verify Auto Start and Loading of Emergency Diesels
TA/SFRT: 4.1.2, 4.1.3, 4.9.4

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Diesel generator tachometer	0 - 1200 rpm	X		X		
o Diesel generator voltage	0 - 5.25 kv	X			X	HED 9.2-57 addresses immediacy of information availability
o Diesel generator frequency	55 - 65 hz	X			X	
o 4160 volt emergency bus voltmeters	0 - 5.25 kv	X		X		
o 4160 volt emergency bus ammeter	0 - 600 amps	X		X		
o Diesel generator synchroscope	Slow-fast	X		X		
o Diesel generator ammeter	0 - 600 amps	X		X		
o Fuel oil day tank level			X			HED 9.2-107 addresses DG info.
o Control power status			X			HED 9.2-107 addresses DG info.
o Starting air pressure			X			HED 9.2-107 addresses DG info.
o Crankcase pressure			X			HED 9.2-107 addresses DG info.
o Bearing temperatures			X			HED 9.2-107 addresses DG info.
o Jacket water temperature			X			HED 9.2-107 addresses DG info.
o Lube oil pressure			X			HED 9.2-107 addresses DG info.
o Excitation voltage			X			HED 9.2-107 addresses DG info.
o CCW pump running indication	0 - 100 amps	X			X	HED 9.2-31 addresses CCW logic
o MU pump running indication	0-100 amps	X		X		
o Annunciator alarms		X		X		
o Service water pump running indication	0 - 150 amps	X			X	HED 9.2-31 addresses SW logic
o Diesel generator incoming voltage	0 - 5.25 kv	X			X	HED 9.2-107 addresses DG info.
o Instrument air compressor running indication			X			HED 9.2-105 addresses IA info.
o Diesel generator running voltage	0 - 5.25 kv	X		X		
o Diesel generator manual start	Start	X		X		
o Diesel generator manual stop	Stop	X		X		

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 13 (Continued)
Task Designation: Verify Auto Start and Loading of Emergency Diesels
TA/SFRT: 4.1.2, 4.1.3, 4.9.4

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Diesel generator governor control	Lower/raise	X		X		
o Diesel generator exciter auto/manual switch	Auto/manual		X			HED 9.2-107 addresses DG info.
o Diesel generator manual voltage control		X		X		
o Diesel generator output breaker control	Open/closed	X		X		
o Diesel generator droop switch		X		X		
o Diesel generator unit/parallel switch	Unit/parallel (local)	X		X		
o CCW pump switch	On/off	X			X	HED 9.2-31 addresses CCW logic
o MU pump switch	On/off	X		X		
o Service water pump switch	On/off	X			X	HED 9.2-31 addresses SW logic
o Instrument air compressor switch			X			HED 9.2-105 addresses IA info.

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 14
Task Designation: Makeup System Operation
TA/SFRT: 4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.9.5(2), 7.1, 7.1.1, 7.1.2, 8.13.4, 8.17.3, 8.20.2, 8.20.3, 8.20.4, 8.20.6, 8.20.8, 9.1, 10.8, 11.3, 12.10, 12.12, 13.8

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Makeup header pressure	0 - 3000 psig	X		X		
o Letdown flow	0 - 160 gpm	X			X	HED 9.2-35 addresses display scaling
o Letdown temperature	0 - 200°C	X		X		
o Letdown pressure		X		X		
o Makeup tank level	0 - 100"	X		X		
o Makeup tank pressure	0 - 100 psig	X		X		
o Makeup filter D/P	0 - 30 psi	X		X		
o Letdown filter D/P	0 - 30 psi	X		X		
o Makeup pump discharge pressure	0 - 3000 psig	X		X		
o Makeup flow indication	0 - 160 gpm	X			X	HED 9.2-11 addresses display range
o Seal injection flow	0 - 80 gpm	X		X		
o Seal injection filter D/P	0 - 30 psi	X		X		
o Demineralizer diff. pressure indicator			X			HED 9.2-109 addresses demin.
o Letdown radiation indication		X		X		
o Makeup pump amp indication	0 - 100 amps	X		X		
o Makeup pump controls	Off/auto/on	X		X		
o AC lube oil pump controls	Off/auto/on	X			X	HED 9.2-16 concerns MU pump logic for lube system
o DC lube oil pump controls	Off/auto/on	X			X	
o Letdown flow controller	0 - 100%	X		X		
o Makeup flow controller	0 - 100%	X		X		
o AC gear oil pump controls	Off/auto/on	X			X	HED 9.2-16 lube oil logic
o Seal injection flow controller	0 - 100%	X		X		
o Valve switches to operate essential valves	Closed/open	X			X	HED 9.8-3 addresses local controls

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VERIFICATION AND VALIDATION SUMMARY TABLE

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Task No. 15
Task Designation: Verify Main Feedwater Operation
TA/SFRT: 4.8.2, 4.8.3, 6.1, 6.1.1, 6.1.2, 6.5.1, 6.6.1, 7.5.1, 7.6.1, 7.6.2, 7.6.3, 7.9, 8.3.5, 12.10

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o MFW pump speed indication	0 - 8000 rpm	X		X		
o MFW pump discharge pressure indication	0 - 1500 psig	X		X		
o MFW flow indication	0 - 8 mil-lbs/hr	X			X	HED 9.2-28 addresses meter readout
o SG level indication	0 - 650"	X			X	HED 9.2-42 and 49 addresses temp. compensation
o DEAR storage tank pressure	0 - 80 psig	X		X		
o SG pressure indication	0 - 1200 psig	X		X		
o Feedwater flow control valve indication	0 - 100%	X		X		
o DEAR storage tank level	0 - 16'	X		X		
o Feedwater isolation valves indication	Open/closed	X		X		
o FPT vibration		X		X		
o Feedwater heaters valve indication	Open/closed	X		X		
o FPT condenser vacuum		X		X		
o Feedwater temperature	0 - 600°F	X		X		
o Vacuum trip reset	Normal/close	X		X		
o Main FW valve pressure differential	0 - 100 psig	X		X		
o Turbine turning gear status	Engaged/disengaged	X		X		
o Bearing oil pump controls	Start/stop/auto	X		X		
o Emergency bearing oil pump controls	Start/stop/auto	X		X		
o Turning gear motor controls	Start/stop/auto	X		X		
o Controllers for FW control valves	Open/closed	X		X		
o MFW pump turbine reset pushbuttons	Normal/reset	X		X		
o Manual controllers for main feedwater pump turbines	Raise/lower	X		X		
o Valve switches to manually operate the valves	Open/closed	X		X		

Task No. 15 (Continued)
Task Designation: Verify Main Feedwater Operation
TA/SFRT: 4.8.2, 4.8.3, 6.1, 6.1.1, 6.1.2, 6.5.1, 6.6.1, 7.5.1, 7.6.1, 7.6.2, 7.6.3, 7.9, 8.3.5, 12.10

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o MFW pump manual trip pushbuttons		X		X		

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 16
Task Designation: Instrument Air System Operation
TA/SFRT: 4.2.1, 4.15.7, 7.31.2

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Instrument air compressor status	On/off		X			HED 9.2-105 addresses IA info.
o Instrument air pressure	0 - 150 psig	X		X		
o Instrument air temperature			X			HED 9.2-105 addresses IA info.
o Instrument air compressor controls	Start/stop	X				HED 9.2-105 addresses IA info.
o Emergency instrument air compressor controls	Auto/start/stop/lockout	X				

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VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 17
Task Designation: Verify Auxiliary Feedwater Operation
TA/SFRT: 4.10.2(3), 5.3, 6.1, 6.1.1, 6.1.2, 7.5.2, 7.7, 7.7.1, 7.7.2, 7.16, 7.16.1, 7.16.2, 7.17, 7.17.1, 7.17.2, 7.17.3, 7.19, 7.25, 7.27, 7.29, 7.30
9.9, 10.13, 12.10

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o AFW pump status	On/off	X		X		
o AFW flow	0 - 1000 gpm	X			X	HED 9.2-7 addresses AFW meter accuracy
o AFW pump discharge pressure	0 - 1500 psig	X		X		
o AFPT speed indication	0 - 5000 rpm	X		X		
o AFPT governor valve position	Open/closed	X		X		
o Condensate tank level	C - 50'	X		X		
o Condenser hotwell level	0 - 7'	X		X		
o AFW suction valve position	Open/closed	X		X		
o Steam generator levels	0 - 650"	X			X	HED 9.2-42 and 49 addresses display appropriateness
o RCS Cooldown rate	520° - 620°	X		X		
o AFW Pump discharge valve position	Open/closed	X		X		
o AFP emergency suction switch position	Open/closed	X		X		HED 9.2-33 addresses overall AFW instrumentation and controls
o AFW pump switches	Off/auto/on	X			X	HED 9.2-20 concerns AFW controls located in level 4 SFAS SAM light group
o AFW valve flow controller	0 - 100%	X		X		
o AFPT governor speed control	Raise/lower	X		X		
o AFW Valve switches	Open/closed	X		X		

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 18
Task Designation: RCS to Secondary Integrity/Verify Steam Generator Tube Rupture
TA/SFRT: 1.4.1, 1.4.2, 3.1, 4.14.1, 4.14.2, 4.15(9), 5.15.1, 5.15.2, 6.22, 6.22.1, 6.22.2, 6.22.3, 7.12, 7.12.1, 7.12.2, 7.22, 7.22.1, 7.22.2, 7.22.3 7.33, 7.33.1, 7.33.2, 8.0, 8.3, 8.3.1

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Condenser off-gas radiation indication		X		X		
o Main steam lines radiation monitors		X			X	HED 9.2.10 concerning cycle time trending, sensitivity HED 9.2-12 addresses possible radiation detection errors HED 9.2-17 addresses scaling
o Secondary sample analysis		X		X		
o Reactor coolant system pressure indication	0 - 2500 psig	X		X		
o Pressurizer level indication	0 - 320"	X		X		
o Makeup tank level indication	0 - 100"	X		X		
o RCS makeup flow indication	0 - 160 gpm	X			X	HED 9.2-11 addresses scale range
o Steam generator level	0 - 650"	X			X	HED 9.2-42 and 49 addresses display appropriateness
o Position or flow indication for main steam line safety valves			X			HED 9.2-110 addresses MS safety valves
o Failed fuel detector		X		X		
o Steam generator pressure	0 - 1200 psig	X			X	HED 9.2-37 concerns display precision

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Task No. 19
Task Designation: Check if RCS Depressurization can be Stopped
TA/SFRT: 5.5.1, 5.5.3, 5.5.4

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Pressurizer spray valves position	Closed/open	X		X		
o Pressurizer block valves position	Closed/open	X		X		
o Pressurizer PORV position	Closed/open	X		X		
o Pressurizer code relief valve position	Closed/open	X		X		
o Relief valve discharge line temperature			X			HED 9.2-101 addresses RCS depressurization
o Acoustic monitor on PORV discharge			X			HED 9.2-101 addresses RCS depressurization
o Differential pressure indicator on discharge lines			X			HED 9.2-101 addresses RCS depressurization
o Pressurizer sample isolation valves position	Closed/open	X		X		
o Pressurizer level	0 - 320"	X			X	HED 9.2-49 addresses temperature compensation
o Pressurizer vent valve position	Closed/open	X		X		
o Pressurizer spray isolation valve position	Closed/open	X		X		
o Reactor coolant system pressure	0 - 2,500 psig	X			X	HED 9.2.37 addresses meter precision
o Switches to manually operated valves	Closed/open	X		X		

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Task No. 20
Task Designation: Verify Adequate Subcooling Margin
TA/SFRT: 4.9.3(4), 4.11.1, 4.11.2, 5.6.1, 5.6.2, 6.2.7, 6.21, 6.21.1, 6.21.2, 7.11, 7.11.1, 7.11.2, 7.21, 7.21.1, 7.21.2, 7.32, 7.32.1, 7.32.2, 9.1, 11.11

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Saturation meter	Digital	X		X		
o RCS outlet temperature (T hot)	520 - 620°F	X			X	HED 9.2-4 addresses channel selection.
o RCS inlet temperature (T cold)	50 - 650°F	X			X	HED 9.2-4 addresses channel selection.
o RCS differential temperature	0 - 70°F	X		X		
o RCS pressure	0 - 2,500 psig	X			X	HED 9.2-37 addresses display reading and precision.
o Incore thermocouple temperatures	0 - 2,300°F	X		X		
o Pressurizer pressure			X			HED 9.2-112 addresses PZR pressure
o Pressurizer temperature	0 - 700°F	X		X		
o Steam tables		X		X		
o Pressure/temperature display		X		X		

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Task No. 21
Task Designation: Verify Primary to Secondary Heat Transfer
TA/SFRT: 4.12.1, 4.12.2, 5.8.1, 5.8.2, 5.9.1, 5.9.2, 5.13.1, 5.13.2, 6.0, 6.12.1, 6.12.2, 6.14.2, 6.14.3, 6.14.4, 6.16, 6.16.1, 6.16.2, 6.18.1, 6.18.2, 6.19, 9.11, 9.11.2, 9.16, 9.16.1, 9.16.2, 10.3, 11.6, 12.10

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o RCS inlet temperature (T cold)	50 - 650°F	X			X	HED 9 2-30 covers display arrangement and location.
o RCS outlet temperature (T hot)	520 - 620°F	X			X	HED 9.2-30 covers display arrangement and location.
o Saturation meter	Digital	X		X		
o RCS differential temperature	0 - 70°F	X		X		
o RCS pressure	0 - 2,500 psig	X			X	HED 9.2-37 addresses display precision.
o Incore thermocouple temperatures	0 - 2,300°F	X		X		
o Steam generator pressure	0 - 1,200 psig	X			X	HED 9.2-37 addresses display precision.
o Steam generator temperature	0 - 700°F	X		X		
o Pressure/temperature display		X		X		

Task No. 22
Task Designation: Check for Secondary Integrity (Steam Rupture)
TA/SFRT: 7.23, 7.23.1, 7.26

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Steam pressure	0 - 1,200 psig	X			X	HED 9.2-37 addresses precision required.
o Steam generator level	0 - 650"	X			X	HED 9.2-49 and 42 address display appropriateness.
o Pressurizer level	0 - 320"	X			X	HED 9.2-49 addresses temperature compensation.
o RC pressure	0 - 2,500 psig	X			X	HED 9.2-37 addresses precision required.
o Containment Building pressure	0 - 60 psia	X		X		
o Containment Building temperature			X			No indication of containment temperature. HED 9.2-103
o Condenser hotwell level	0 - 7'	X		X		
o Condensate storage tank	0 - 50'	X		X		
o SFRCS status display	On/off	X		X		
o RCS temperature	50 - 650°F	X		X		
o RCS pressure/temperature display		X		X		
o Manual actuation for SFRCS	On/off	X			X	HED 9.2-1 addresses control/display locations.
o Switches for SFRCS valves	On/off	X			X	HED 9.2.43 and 54 address control locations/arrangements.

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Task No. 23
Task Designation: Verify Steam Generator Level Control by AFW
TA/SFRT:

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Steam generator level	0 - 650"	X			X	HED 9.2-42 and 49 concern temperature compensation.
o AFW flow	0 - 1,000 gpm	X			X	HED 9.2-7 addresses display accuracy.
o AFW pump status	Off/on	X		X		
o AFW pump speed	0 - 5,000 gpm	X				
o AFW pump speed controller	0 - 100%	X		X		

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Task No. 24
Task Designation: Trip Reactor Coolant Pumps
TA/SFRT: 5.1, 6.2.7

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Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Reactor coolant pump status	Off/on	X		X		
o Reactor coolant pump amp meters	0 - 600 amps	X		X		
o Reactor coolant flow	0 - 90 mil-lbs/hr	X		X		
o Reactor coolant pump annunciators		X		X		
o Reactor coolant pump vibration		X			X	HED 9.2-50 addresses location, range, and annunciators.
o Reactor coolant pump eccentricity		X		X		
o Reactor coolant pump switches	On/off	X		X		
o RCP AC oil lift pump switches	On/off	X		X		
o RCP DC oil lift pump switches	On/off	X		X		
o RCP backstop oil pump switches	On/off	X		X		

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Task No. 25
Task Designation: Start Reactor Coolant Pumps (Bump Pumps)
TA/SFRT: 5.12, 5.12.1, 5.13.1, 6.13.2, 6.14.1, 6.14.4, 6.17, 6.17.1, 6.17.2, 8.9, 8.9.1, 8.9.2, 8.9.3, 8.18.1, 9.8, 9.12, 9.12.1, 11.6, 11.12, 12.10, 13.7

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Reactor coolant pump breaker status	Open/closed	X		X		
o Reactor coolant pump amp meters	0 - 600 amps	X		X		
o Reactor coolant pump flow	0 - 90 $\frac{\text{mil-lbs}}{\text{hr}}$	X		X		
o Reactor coolant pump vibration		X			X	HED 9.2-50 discusses location, alarms, and range.
o Reactor coolant pump annunciators		X		X		
o RCP seal injection flow	0 - 15 gpm	X		X		
o Reactor coolant pump eccentricity		X		X		
o CCW flow			X		X	HED 9.2-31 addresses CCW logic.
o Reactor coolant pump switches	On/off	X		X		
o RCP AC oil lift pump switches	On/off	X		X		
o RCP DC oil lift pump switches	On/off	X		X		
o RCP back stop oil pump switches	On/off	X		X		
o CCW pump switch	On/off	X		X		

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Task No. 26
Task Designation: Check for Natural Circulation
TA/SFRT: 7.31.3

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Reactor coolant system outlet temperature	520 - 620°F	X			X	HED 9.2-30 addresses display locations. HED 9.2-4 addresses channel selection.
o Reactor coolant system inlet temperature	50 - 650°F	X			X	HED 9.2-30 addresses display locations. HED 9.2-4 addresses channel selection.
o Reactor coolant system differential temperature	0 - 70°F	X		X		
o Incore thermocouple temperatures	0 - 2,300°F	X		X		
o Heat removal from OTSGs		X		X		
- Turbine bypass valve position	0 - 100%	X		X		
- Atmospheric dump valve position	0 - 100%	X		X		
- Feedwater valve position	0 - 100%	X		X		
o Subcooling margin	Digital	X		X		

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Task No. 27
Task Designation: Check for RCS Integrity (LOCA)
TA/SFRT: 5.10.1, 5.10.2, 5.11, 6.9.1, 6.9.2

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Reactor coolant system pressure	0 - 2,500 psig	X			X	HED 9.2-37 addresses display precision.
o Reactor coolant system makeup flow	0 - 160 gpm	X			X	HED 9.2-11 addresses scale range.
o Makeup tank level	0 - 100"	X		X		
o Pressurizer level	0 - 320"	X			X	HED 9.2-49 addresses temperature compensation.
o Containment Building temperature			X			No indication for containment temperature. HED 9.2-103.
o Containment Building pressure	0 - 60 psig	X		X		
o Containment Building radiation level	0 - 1,000 mr/hr	X			X	HED 9.2-12 addresses scaling. HED 9.2-17 addresses display scale. HED 9.2-36 addresses device nomenclature.
o Containment [illegible] level	0 - 2.6'	X		X		
o RCP [illegible] flow [illegible]	0 - 85 gpm	X		X		
o Pressurizer quench tank level	0 - 10'	X			X	HED 9.2-44 addresses display range.
o Pressurizer quench tank temperature			X			No indication for quench tank temperature. HED 9.2-87.
o Pressurizer quench tank pressure	0 - 20[illegible] psia	X		X		
o Acoustic monitor for pressurizer PORV			X			HED 9.2-101 addresses RCS depress.
o Letdown flow	0 - 160 gpm	X			X	HED 9.2-35 addresses scale.
o P indication for pressurizer code safety valves			X			HED 9.2-101 addresses RCS depress.
o Temperature indication on pressurizer discharge lines			X			HED 9.2-101 addresses RCS depress.
o PORV positive valve position	Open/closed	X		X		
o Switches to manually close pressurizer block valves	Open/closed	X		X		
o Switches to manually close pressurizer PORV	Open/closed	X		X		

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 27 (continued)
Task Designation: Check for RCS Integrity (LOCA)
TA/SFRT: 5.10.1, 5.10.2, 5.11, 6.9.1, 6.9.2

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o LPI flow	0 - 5,000 gpm	X			X	HED 9.2-8 addresses scale range.
o HPI flow	0 - 500 gpm	X			X	HED 9.2-8 addresses scale range.

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Task No. 28
Task Designation: Verify SUFP Availability
TA/SFRT: 6.3, 6.3.1, 6.3.2, 6.3.3, 6.5.9, 6.6.9

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Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o SUFP pump breaker indication	Open/closed	X		X		
o SUFP flow path status (valves operability)	Open/closed	X			X	HED 9.2-76, addresses SUFW valve indication.
o SUFP throttling valve controller availability	0 - 100%	X		X		
o DA storage tank level	0 - 16'	X		X		
o Condensate storage tank level	0 - 50'	X		X		

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Task No. 29
Task Designation: Start SUFP
TA/SFRT: 6.5.3, 6.5.4, 6.5.5, 6.5.6, 6.5.7, 6.5.8, 6.6.3, 6.6.4, 6.6.5, 6.6.6, 6.6.7, 6.6.8

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o SUFP flow	0 - 5,000 kpph	X			X	HED 9.2-76, addresses SUFP flow, as does HED 9.2-28.
o SUFP discharge pressure	0 - 1,500 psig	X		X		
o SUFP amp meter	0 - 75 amps	X		X		
o Steam generator pressure	0 - 1,200 psig	X			X	HED 9.2-37 addresses display precision.
o DA storage tank level	0 - 16'	X		X		
o Condensate storage tank level	0 - 50'	X		X		
o Steam generator level	0 - 650"	X			X	HED 9.2-42 and 49 address temperature compensation.
o SUFP control switch	Stop - normal - start	X			X	
o Switches to control system valves	On/off	X			X	
o SUFP throttling valve controller	0 - 100%	X			X	HED 9.2-92, addresses SUFW SFRCS block status. HED 9.2-43 addresses access to SUFW valve SFRCS block.

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Task No. 30
Task Designation: Check for Inadequate Core Cooling
TA/SFRT: 5.7, 5.7.1, 5.7.2, 6.2.9, 6.2.9.1, 6.2.9.2

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Saturation meter	Digital	X		X		
o Reactor coolant outlet temperature	520 - 620°F	X			X	HED 9.2-30 addresses display locations. HED 9.2-4 addresses channel selection.
o Incore thermocouple temperature	0 - 2,300°F	X		X		
o Reactor coolant system pressure	0 - 2,500 psig	X			X	HED 9.2-37 concerns display precision.
o RCS differential temperature	0 - 70°F	X		X		
o Reactor coolant inlet temperature	50 - 650°F	X			X	HED 9.2-30 addresses display precision. HED 9.2-4 addresses channel selection.
o Reactor coolant system flow	0 - 90 $\frac{\text{mil-lbs}}{\text{hr}}$	X		X		
o RC pump motor current	0 - 600 amps	X		X		
o Steam tables		X		X		
o Source range nuclear instrumentation	10^{-1} to 10^{6} cps	X		X		
o RCS sample		X		X		

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 31
Task Designation: Transfe. SUFP Suction from DA Storage Tank to CST
TA/SFRT: 6.8, 6.8.1, 6.8.2

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o DA storage tank level	0 - 16'	X		X		
o Condensate storage tank level	0 - 50'	X		X		
o SUFP flow	0 - 5,000 kpph	X			X	HED 9.2-76, addresses SUFP flow, as does HED 9.2-28.
o SUFP amp meter	0 - 75 amps	X		X		
o SUFP discharge pressure	0 - 1,500 psig	X		X		
o Steam generator pressure	0 - 1,200 psig	X			X	HED 9.2-37 addresses display precision.
o Steam generator level	0 - 650"	X			X	HED 9.2-42 and 49 address display appropriateness.
o Switches to operate valves	On/off	X			X	HED 9.2-92, addresses SUFW SFRCS block status. HED 9.2-43 addresses access to SUFW valve SFRCS block.
o SUFP control switch	Stop - normal - start	X			X	HED 9.2-92, addresses SUFW SFRCS block status. HED 9.2-43 addresses access to SUFW valve SFRCS block.
o SUFP flow control valve controller	0 - 100%	X			X	

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Task No. 32
Task Designation: Check for Major LOCA
TA/SFRT: 5.10.1, 5.10.2, 5.11, 6.9.1, 6.9.2, 10.0

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Reactor coolant system pressure	0 - 2,500 psig	X			X	HED 9.2-37 addresses display precision.
o Core flood tank level	0 - 14'	X		X		
o Core flood tank pressure	0 - 700 psig	X		X		
o Containment Building pressure	0 - 60 psia	X		X		
o Containment Building temperature			X			HED 9.2-103 addresses cont. temp.
o Containment Building radiation	0 - 1,000 mr/hr	X			X	HED 9.2-17 display scale. HED 9.2-36 addresses device nomenclature. HED 9.2-12 addresses availability of information.
o Core flood tank outlet valves position	Open/closed	X		X		
o Core flood tank vent valve position	Open/closed	X		X		
o Core flood tank N_2 supply valve position			X			HED 9.2-102 addresses CF info.
o Containment sump level	0 - 2.5'	X		X		
o Core flood tank fill line isolation valve position	Open/closed	X		X		
o Core flood tank sample valve position	Open/closed	X		X		
o Containment vessel wide range level		X		X		
o Switches to operate core flood tank outlet valves	Open/closed	X			X	HED 9.2-39 addresses control availability.
o HPI/LPI flow	0 - 500/5,000 gpm	X			X	HED 9.2-8 addresses scale range.
o Switches to operate N_2 supply to the core flood tanks			X			HED 9.2-102 addresses CF info.
o Core flood tank fill line isolation valve switch	Open/closed	X		X		
o Switches to operate core flood tank sample valves	Open/closed	X		X		
o Switches to operate core flood vent valves	Open/closed	X		X		

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Task No. 33
Task Designation: Initiate MU/HPI Cooling
TA/SFRT: 4.9.3(6), 5.2, 6.2, 6.2.1, 6.13.3, 6.19.5, 8.13.4, 8.17.3, 8.20.2, 8.20.3, 8.20.4, 8.20.6, 9.1, 10.6, 10.10, 11.3, 11.14, 11.15, 11.17, 12.10, 12.12, 13.8

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Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o HPI flow	0 - 500 gpm	X			X	HED 9.2-8 addresses scale range.
o HPI pump amps	0 - 150 amps	X		X		
o BWST level	0 - 50'	X		X		
o HPI pump discharge pressure			X			HED 9.2-86 addresses HPI discharge press.
o MU system pressure	0 - 3,000 psig	X		X		
o MU pump amp meter	0 - 100 amps	X		X		
o MU system flow	0 - 160 gpm	X			X	HED 9.2-11 addresses scale range.
o BWST temperature	0 - 250°F	X		X		
o Containment sump level	0 - 2.5'	X		X		
o Annunciator alarms		X		X		
o HPI recirculation valve position	Closed/open	X		X		
o HPI system valve switches	Closed/open	X		X		
o HPI pump control switches	Stop - normal - start	X		X		
o HPI flow control valve switches	Closed/open	X		X		
o HPI manual initiation pushbutton	Off/actuated	X		X		
o MU pump control switches	Stop - normal - start	X		X		
o MU pump AC oil pump switch	Stop - normal - start	X			X	HED 9.2-16 addresses MU pump oil supply logic configuration.
o MU pump DC oil pump switch	Stop - normal - start	X		X		
o MU pump AC gear oil pump switch	Stop - normal - start	X		X		
o MU system valve switches	Closed/open	X		X		
o HPI recirculation valve control switches	Closed/open	X		X		

Task No. 34
Task Designation: Check for Excessive Heat Transfer (Overcooling)
TA/SFRT: 4.13.1, 4.13.2, 5.4.1, 5.4.2, 5.14.1, 5.14.2, 7.0, 7.4, 7.4.1, 7.4.2, 7.5, 7.5.1, 7.5.2, 7.5.3, 7.5.4, 7.6, 7.6.1, 7.6.2, 7.6.3, 7.7, 7.7.1, 7.7.2, 7.8.1, 7.8.2, 7.8.3, 7.9, 7.15, 7.15.1, 7.15.2, 7.16, 7.16.1, 7.16.2, 7.23, 7.23.1, 7.24.1, 7.24.2, 7.26

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Steam generator levels	0 - 650"	X			X	HED 9.2-42 and 49 address display appropriatenes.
o Steam generator pressure	0 - 1,200 psig	X			X	HED 9.2-37 addresses precision.
o Main feedwater flow	0 - 7,000 kpph	X			X	HED 9.2-28 addresses accuracy.
o Auxiliary feedwater flow	0 - 1,000 gpm	X			X	HED 9.2-28 addr:sses accuracy.
o Turbine bypass valve position	0 - 100%	X			X	HED 9.2-81, address AVV position indication.
o Atmospheric relief valve position	0 - 100%	X			X	HED 9.3-82, address AVV position indication.
o Reactor coolant inlet temperature	520 - 620°F	X			X	HED 9.2-30 discusses display locations. HED 9.2-4 addresses channel selection.
o Reactor coolant outlet temperature	50 - 650°F	X			X	HED 9.2-30 discusses display locations. HED 9.2-4 addresses channel selection.
o Pressurizer level	0 - 320"	X			X	HED 9.2-42 and 49 address display.
o RCS pressure	0 - 2,500 psig	X			X	HED 9.2-37 addresses precision.
o RCS pressure/temperature display		X		X		
o Auxiliary feedwater isolation valves	Open/closed	X		X		
o Main feedwater isolation valves	Open/closed	X		X		
o Turbine bypass valve controller	0 - 100%	X		X		
o Atmospheric relief valve controller	0 - 100%	X		X		
o Main feedwater flow control valve controller	0 - 100%	X		X		
o Auxiliary feedwater flow control valve controller	0 - 100%	X		X		

Task No. 35
Task Designation: Lineup HPI and LPI for Piggyback Operation
TA/SFRT: 8.3.3, 8.7, 8.7.1, 8.7.2, 8.20.9, 10.19, 11.7, 11.17, 12.7

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Component cooling water pump status	Off/on	X		X		
o Component cooling water pump amp meter	0 - 100 amps	X		X		
o Component cooling water valves position	Closed/open	X		X		
o Component cooling water temperature indication	0 - 250°F	X		X		
o HPI pump status	Off/on	X		X		
o HPI pump amp meter	0 - 150 amps	X		X		
o HPI injection valves position	Closed/open	X		X		
o HPI flow	0 - 500 gpm	X			X	HED 9.2-29 addresses valve position indication. HED 9.2-8 concerning display range.
o HPI discharge pressure			X			No HPI discharge pressure display exists. HED 9.2-86.
o Component cooling water pump discharge pressure			X			No CCW pumps discharge pressure display exists. HED 9.2-111.
o Component cooling water flow			X			No CCW system flow display exists. HED 9.2-70.
o Containment vessel wide range level		X		X		
o LPI pump status	Off/on	X		X		
o LPI pump amp meter	0 - 100 amps	X		X		
o LPI pump discharge pressure			X			No LPI discharge pressure display exists. HED 9.2-86.
o LPI flow	0 - 5,000 gpm	X			X	HED 9.2-8 concerns display range.
o Containment sump level	0 - 2.5'	X		X		
o Cross-connect valve position	Closed/open	X		X		
o Switches for cross-connect valves	Closed/open	X		X		
o Component cooling water pump controls	Stop - normal - start	X		X		
o Switches for CCW valves	Closed/open	X		X		

Task No. 35 (continued)
Task Designation: Lineup HPI and LPI for Piggyback Operation
TA/SFRT: 8.3.3, 8.7, 8.7.1, 8.7.2, 8.20.9, 10.1, 11.7, 11.17, 12.7

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o HPI pump controls	Stop/normal/start	X			X	HED 9.2-47 and 59 address pump control location.
o Switches for HPI injection valves	Closed/open	X		X		
o LPI pump controls	Stop/normal/start	X			X	HED 9.2-47 and 59 address pump control location.
o Switches for LPI injection valves	Closed/open	X		X		
o Switches for LPI suction valves	Closed/open	X		X		
o Switches for HPI suction valves	Closed/open	X		X		

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Task No. 36
Task Designation: Verify Pressurizer Operability
TA/SFRT: 4.3.3(4), 4.9.3, 6.2.2, 6.2.3, 6.:0, 6.10.2, 6.10.3, 6.19.1, 8.10, 8.13.1

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Pressurizer level	0 - 320"	X			X	HED 9.2-49 addresses temperature compensation.
o Pressurizer pressure			X			No pressurizer pressure display exists. HED 9.2-112.
o Pressurizer temperature	0 - 700°F	X		X		
o Pressurizer heater status	On/off	X		X		
o Pressurizer spray isolation valve position	Open/closed	X		X		
o Pressurizer spray valve position	Open/closed	X		X		
o Pressurizer PORV position	Open/closed	X		X		
o Pressurizer code relief valve position			X			No indication for pressurizer code relief valves. HED 9.2-99.
o Pressurizer quench tank level	0 - 10'	X			X	HED 9.2-44 address scale range.
o Pressurizer quench tank pressure	0 - 200 psia	X		X		
o Pressurizer quench tank temperature			X			No quench tank temperature display exists. HED 9.2-87.
o Pressurizer quench tank recirculation pump status	Start/stop/auto	X		X		
o Pressurizer quench tank vent valve position	Open/closed	X		X		
o Pressurizer sample isolation valves position	Open/closed	X		X		
o Pressurizer spray bypass valve position	Open/closed	X		X		
o Pressurizer heater switches	On/off	X		X		
o Pressurizer spray valve switch	Open/closed	X		X		
o Pressurizer block valve switch	Open/closed	X		X		
o Pressurizer PORV switch	Open/closed	X		X		
o Pressurizer quench tank recirculation pump switch	On/off	X		X		
o Pressurizer quench tank vent valve control	Open/closed	X		X		
o Pressurizer sample isolation valve controls	Open/closed	X		X		

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 37
Task Designation: Transfer Electrical Loads from Auxiliary Transformers to S/U Transformer
TA/SFRT: 8.3.7

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Auxiliary transformer status	0 - 18 kV AC	X		X		
o Startup transformer status	0 - 18 kV AC	X		X		
o AC electrical buses voltage indication	Various	X		X		
o AC electrical breaker control position	Open/closed	X		X		
o AC electrical buses ampere indication	Various	X		X		
o Load transfer breaker controls	Open/closed	X		X		

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Task No. 38
Task Designation: Verify Pressurizer and Loop High Point Vent Operability
TA/SFRT: 5.5.5, 5.5.6, 6.2.4, 6.2.5, 6.2.6, 6.19.2, 6.19.3, 5.19.4, 8.20.7

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Pressurizer Vent Valve position	Open/closed	X		X		
o RCS Loop A High Point Vent Valve position	Open/closed	X		X		
o RCS Loop B High Point Vent Valve position	Open/closed	X		X		
o Reactor Coolant System Pressure	0 - 2500 psig	X			X	HED 9.2-37 addresses display precision
o Reactor Coolant System Temperature	520 - 620°F	X		X		
o RCS Loop A High Point Vent Valve Controls	Open/closed	X		X		
o RCS Loop B High Point Vent Valve Controls	Open/closed	X		X		
o Pressurizer Vent Valve Controls	Open/closed	X		X		

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Task No. 39
Task Designation: Control Rod Drive System (Manual Reactor Shutdown)
TA/SFRT: 3.2.3 (1), 8.2, 8.2.1, 8.2.2, 8.4

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Reactor Power Indication	0 - 120%	X		X		
(a) Source Range	10^{-1} to 10^{6} cps	X		X		
(b) Intermediate Range	10^{-11} to 10^{-3} Amps	X		X		
(c) Power Range	0 to 120%	X		X		
o Control Rod position Indication	0 to 100%	X		X		
(a) Absolute position	0 to 100%	X		X		
(b) Relative position	0 to 100%	X		X		
o Auto Control Status	Off-Activated	X		X		
o Manual Control Status	Off-Activated	X		X		
o Control Power Status		X		X		
o Switches to Transfer Rods from Normal to Aux. Power Supplies		X		X		
o Manual Control Switch		X		X		
o Auto Control Switch		X		X		
o Manual Command Switch (Insert/Withdraw)	Insert/Withdraw	X		X		
o Group Select Switch		X		X		
o Rod Speed Switch (Run)		X		X		
o Rod Speed Switch (Jog)		X		X		

Task No. 40
Task Designation: Transfer Makeup Pump Suction to BWST
TA/SFRT: 4.3.3(4)3, 4.9.3(5)

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Makeup tank level	0 - 100"	X		X		
o BWST level	0 - 50'	X		X		
o MU pump suction valve from BWST position	Open/closed	X		X		
o MU system flow	0 - 160 gpm	X			X	HED 9.2-11 addresses display range
o MU system pump discharge pressure	0 - 3000 psig	X		X		
o MU pump amp meter	0 - 100 amps	X		X		
o Makeup pump suction valve switch	Open/closed	X		X		
o Makeup pump suction valve from BWST switch	Open/closed	X		X		

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Task No. 41
Task Designation: Verify LPI System Operation
TA/SFRT: 4.94(3)

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Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o LPI Flow	0 - 5000 GPM	X			X	HED 9.2-8 addresses scale range.
o LPI Pump Status		X		X		
o LPI Pump Discharge Pressure			X			No LPI Pump discharge pressure display. HED 9.2-86.
o LPI Injection Valve Position	Open/closed	X		X		
o BWST Level	0 - 50'	X		X		
o LPI Suction Valve Status	Open/closed	X		X		
o Containment Sump Level	0 - 2.5'	X		X		
o CCW Flow to D.H. Removal Coolers			X			No CCW Flow display to D.H. Removal Coolers exist. HED 9.2-70.
o RCS System Pressure	0 - 2500 psig	X		X		
o LPI Pump Amp. Meter	0 - 100 Amps	X		X		
o LPI Pump Switches	Stop/Normal/Start	X		X		
o LPI Flow Throttle Valve Control	Open/closed	X		X		
o Switches for System Valves	Open/closed	X		X		

Task No. 42
Task Designation: Verify CCW System in Service
TA/SFRT: 4.1.2(7), 4.9.5(3)

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o CCW Pumps Status (Running)	On/off	X		X		
o CCW Pump Flow			X			No CCW Pump Flow Display Exists. HED 9.2-70.
o CCW Pump Discharge Pressure			X			No CCW Pump Discharge Pressure Display Exist. HED 9.2-111.
o CCW System Temperature	0 - 250°F	X		X		
o CCW Surge Tank Level	0 - 60"	X		X		
o CCW Surge Tank Pressure			X			No CCW surge tank pressure display exists. HED 9.2-113.
o CCW Pump Amp. Meter	0 - 100 Amps	X		X		
o CCW Pump Switches	Stop/Normal/Start	X			X	HED 9.2-31 addresses CCW logic (applies to CCW system)
o Switches to operate CCW Valves	Open/closed	X			X	

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Task No. 43
Task Designation: Verify Service Water System in Service
TA/SFRT: 4.1.2

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o SW Pump Status (Running)	On/off	X		X		
o SW Pump Discharge Pressure			X			No SW Pump Discharge Pressure Display exists. HED 9.2-111.
o SW System Flow			X			No SW System Flow Display exist. HED 9.2-70.
o SW Pump Amp Meter	0 - 150 Amps	X		X		
o SW Pump Switches	Stop/Normal/Start	X			X	HED 9.2-31 addresses SW System Logic (as a system)
o Switches to operate SW Valves	Open/closed	X			X	

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Task No. 44
Task Designation: Verify Containment Spray System Operation
TA/SFRT: 10.7, 10.11, 12.8

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o CS Flow	0 - 2000 GPM	X		X		
o CS Pump Status (Running)	Stop/Normal/Start	X		X		
o CS Pump Amp. Meter	0 - 300 Amps	X		X		
o CS Pump Discharge Pressure			X			
o BWST Level	0 - 50'	X		X		
o CS Pump Discharge Valve Position	Open/closed	X		X		
o System Valve Status for Changing Suctions	Open/closed	X		X		
o Containment Spray Pump Controls	Stop/Normal/Start	X		X		
o Containment Spray Pump Discharge Valve Switch	Open/closed	X		X		
o Switches for System Valves to Change Pump Suctions	Open/closed	X		X		

Task No. 45
Task Designation: Monitor and Control Containment Conditions
TA/SFRT: 11.10, 10.15, 12.5, 13.5

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Containment Pressure	0 - 60 Psia	X		X		
o Containment Temperature			X			No containment temperature display exists. HED 9.2-103.
o Containment Radiation Level	0 - 1000 mR/hr	X			X	HEDs 9.2-12, 17 & 36.
o Containment H_2 Concentration	0 - 10%	X		X		
o Containment Water Level	0 - 2.5 ft.	X		X		
o SW Pump Amp Meter	0 - 150 Amps	X		X		
o SW Pump Status (Running)	On/off	X		X		
o SW Pump Discharge Pressure			X			No SW Pump Discharge pressure display exists. HED 9.2-111.
o SW Inlet and Outlet Valve Status to the Containment Air Cooler Units	Open/closed	X		X		
o CSS Pump Amp Meter	0 - 300 Amps	X		X		
o CSS Flow	0 - 2000 GPM	X		X		
o SW Flow			X			No SW system flow display exists. HED 9.2-70.
o Containment Air Cooler Fan Status (Running) Slow Speed	Off/Slow/Fast	X		X		
o SW Cooler Supply and Discharge Temperatures			X			No SW cooler supply and discharge temperature display exists. HED 9.2-114.
o BWST Level	0 - 50'	X		X		
o BWST Temperature	0 - 250°F	X		X		
o Containment Sump Level	0 - 2.5 ft.	X		X		
o DHRS Valve Status (CSS Supply of Water from BWST to CES)	Open/closed	X		X		
o Containment Spray System Status						
(a) Pumps	Stop/Normal/Start	X		X		
(b) Valves	Open/closed	X		X		
o Hydrogen Recombiners Status			X			

Task No. 45 (Continued)
Task Designation: Monitor and Control Containment Conditions
TA/SFRT: 11.10, 10.15, 12.5, 13.5

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Hydrogen Recombiner Valves, Heaters, Fan Status			X			
o SW Pump Controls	Stop/Normal/Start	X		X		
o Switches for SW Valves	Open/closed	X		X		
o Containment Air Cooler Fan Controls	Off/Slow/Fast	X		X		
o DHR Valve Controls	Open/closed	X		X		
o Containment Spray Pump Controls	Stop/Normal/Start	X		X		
o Containment Spray Valve Controls	Open/closed	X		X		
o BWST Valve	Open/closed	X		X		
o Containment Emergency Sump Valve	Open/closed	X		X		

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Task No. 46
Task Designation: Establish Decay Heat Removal System Cooling
TA/SFRT: 8.20.9

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Reactor Coolant System Pressure	0 - 2500 psig	X			X	HED 9.2-37 addresses precision.
o Reactor Coolant System Temperature	0 - 650°F	X		X		
o Containment Sump Level	0 - 2.5 ft.	X		X		
o Decay Heat Removal Pump Status	On/off	X		X		
o Decay Heat Removal Pump Suction Temperature	0 - 400°F	X		X		
o Decay Heat Removal Pump Discharge Pressure			X			No DH removal pump discharge pressure display exists. HED 9.2-86.
o Decay Heat Removal Cooler Outlet Temperature	0 - 400°F	X		X		
o Decay Heat Removal Flow	0 - 5000 GPM	X		X		
o BWST Level	0 - 50 ft.	X		X		
o BWST Temperature	0 - 250°F	X		X		
o Decay Heat Removal Valve Status	Open/closed	X		X		
o Component Cooling Water Flow to the Decay Heat Removal Heat Exchangers			X			No CCW flow display exists. HED 9.2-70.
o Service Water Flow to the Component Cooling Water Heat Exchangers			X			No SW flow display exists. HED 9.2-70.
o Component Cooling Water Outlet Temperature	0 - 250°F	X		X		
o Decay Heat Removal Pump Controls	Stop/Normal/Start	X			X	HED 9.2-47 & 59 addresses pump control location.
o Decay Heat Removal Valve Controls	Open/closed	X		X		
o Switches for Component Cooling Water Pumps	Stop/Normal/Start	X		X		
o Switches for Component Cooling Water Valves	Open/closed	X		X		
o Switches for Service Water Valves	Open/closed	X		X		

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Task No. 47
Task Designation: Control Turbine Bypass Valves
TA/SFRT: 7.8.1, 7.8.2, 7.10, 8.5, 8.6, 8.6.1, 8.6.2, 8.14, 8.14.1, 8.14.6, 8.14.7, 8.18, 8.18.2, 8.18.8, 8.20.2, 8.20.3, 11.6, 11.14, 11.15, 13.13

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Steam Generator Pressure	0 - 1200 psig	X			X	HED 9.2.37 addresses display precision.
o Turbine Bypass Valve Position Indication	0 - 100%	X			X	HED 9.2-9 concerns scaling.
o Reactor Coolant System Temperature	0 - 650°F	X		X		
o Reactor Coolant System Pressure	0 - 2500 psig	X			X	HED 9.2.37 addresses display precision.
o Saturation Meter	Digital	X		X		
o Steam Generator Temperature	0 - 700°F	X		X		
o Steam Generator Level	0 - 650"	X		X		
o Incore Thermo Couple Temperatures	0 - 2300°F	X		X		
o Turbine Bypass Valve Hand/Auto Control Station		X			X	HED 9.2-9 concerns control scaling.
					X	HED 9.2-46 addresses possible work overloading.

Task No. 48
Task Designation: Control Atmospheric Vent Valves
TA/SFRT: 6.11, 6.11.1, 6.15, 6.20, 7.5.3, 7.20, 7.20.2, 7.31, 8.14, 8.14.1, 8.14.5, 8.14.6, 8.14.7, 8.18, 8.18.2, 8.18.4, 8.18.6, 8.18.8, 8.20.1, 8.20.2, 8.20.3, 9.3.1, 9.3.2, 9.13.2, 11.6, 11.14, 11.15, 13.13

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o Steam Generator Pressure	0 - 1200 psig	X			X	HED 9.2-37 concerns display precision.
o Steam Generator Temperature	0 - 700°F	X		X		
o Steam Generator Level	0 - 650"	X			X	HEDs 9.2-42 & 49 addresses display appropriateness.
o Reactor Coolant System Temperature	0 - 650°F	X		X		
o Reactor Coolant System Pressure	0 - 2300 psig	X			X	HED 9.2-37 concerns display precision.
o Saturation Meter	Digital	X		X		
o Atmospheric Vent Valve Position Indication	0 - 100%	X			X	HED 9.2-82 addresses AVV position indication.
o Incore Thermocouple Temperatures	0 - 2300°F	X		X		
o Atmospheric Vent Valve Hand/Auto Control Station		X			X	HED 9.2-82.

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Task No. 49
Task Designation: When the BWST Level decreases to 8' Transfer LPI (and CTMT. Spray if Running) pump suctions to Recirculation from the Ctmt Emer. Sump.
TA/SFRT: 10.11

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o BWST Level	0 - 50"	X		X		
o Containment Emergency Sump Level	Indicating Light		X			No Containment Emergency Sump Level display HED submitted.
o Containment Emergency Sump Valve Status	Open/closed	X		X		
o BWST Valve Status	Open/closed	X		X		
o LPI Flow	0 - 5000 GPM	X			X	HED 9.2-8 addresses scale range
o LPI Pump Amp. Meter	0 - 100 Amps	X		X		
o Containment Spray Flow	0 - 2000 GPM	X		X		
o Containment Spray Pump Amp. Meter	0 - 300 Amps	X		X		
o Containment Emergency Sump Valve Switches	Open/closed	X		X		
o BWST Valve Switches	Open/closed	X		X		
o LPI Pump Controls	Stop/Normal/Start	X		X		
o Containment Spray Pump Controls	Stop/Normal/Start	X		X		

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 50
Task Designation: Establish A Bubble in the Pressurizer
TA/SFRT: 13.10

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Pressurizer Heater Indication	Local/Remote	X		X		
o Pressurizer Temperature	0 - 700°F	X		X		
o Reactor Coolant System Pressure	0 - 2500 psig	X		X		
o Pressurizer Level	0 - 320"	X			X	HED 9.2-49 addresses temperature compensation. HED 9.2-41 addresses range of information required.
o Letdown Flow	0 - 160 GPM	X			X	HED 9.2-35 addresses display scale.
o Letdown Temperature	0 - 200°F	X		X		
o Pressurizer Pressure			X			No pressurizer pressure display exist. HED 9.2-112.
o Steam Tables		X		X		
o Pressurizer Heater Controller	Auto	X		X		
o Pressurizer Heater Controls	On/off/auto	X		X		
o Letdown Flow Controller	0 - 100%	X		X		
o Letdown Isolation Valves	Open/closed	X		X		

Task No. 51
Task Designation: Initiate RCS Boration
TA/SFRT: 3.2.3(2), 4.6.2

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o RCS Boron Concentration	0 - 55	X			X	HED 9.2-15 addresses boronometer accuracy.
o Make Up Tank Boron Concentration		X			X	
o Boric Acid Mix Tank Level	0 - 100"	X		X		
o Make Up Tank Level	0 - 100"	X		X		
o B.A. Flow Totalizer		X		X		
o B.A. Tank Temperature	0 - 200°F	X		X		
o B.A. Injection Valve Position	0 - 100%	X		X		
o B.A. Flow	0 - 60 GPM	X		X		
o Final Boron Concentration desired in RCS		X		X		
o Total number of gallons necessary for desired concentration		X		X		
o Boric Acid Pump Status	Start/Stop/Auto	X		X		
o RCS Letdown Flow	0 - 160 GPM	X		X		
o RCS Makeup Flow	0 - 160 GPM	X			X	HED 9.2-35 addresses scale increments.
o Makeup pump suction valve from BWST Status	Open/closed	X		X		
o Sample of RCS After Transfer is Complete		X		X		
o BWST Level Indication	0 - 50'	X		X		
o Boric Acid Pump Controls	Start/Stop/Auto	X		X		
o B.A. Tank Heater Controls	On/off	X		X		
o B.A. Batch Quantity Selector		X		X		
o B.A. Injection Valves	0 - 100%	X		X		
o Letdown 3-way Valve Control		X		X		
o Makeup Pump Suction from BWST Valve Control	Open/closed	X		X		
o Makeup Pump Controls	Start/Normal/Stop	X		X		

VERIFICATION AND VALIDATION SUMMARY TABLE

Task No. 52
Task Designation: Determine if Safety Injection can be Terminated
TA/SFRT: 4.9.3(6), 5.2, 6.2, 6.2.1, 6.13.3, 6.19.5, 8.13.4, 8.17.3, 8.20.2, 8.20.3, 8.20.4, 8.20.6, 9.1, 10.6, 10.10, 11.3, 11.14, 11.15, 11.17, 12.10, 12.12, 13.8

Information and Control Requirements	Range Precision Accuracy	Availability		Suitability		HED Number Comments
		Yes	No	Yes	No	
o LPI Flow	0 - 5000 GPM	X			X	HED 9.2-8 concerns scale range.
o Start Time of LPI Injection	Computer Printout	X		X		
o Time of Day		X		X		
o Steam Generator Level	0 - 650"	X			X	HED 9.2-42 & 49 addresses display appropriateness.
o Steam Generator Pressure	0 - 1200 psig	X		X		
o Saturation Meter	Digital	X		X		
o Pressurizer Level	0 - 320'	X			X	HED 9.2-49 addresses temperature compensation.

Task No. 53
Task Designation: Establish Flow to the Steam Generators
TA/SFRT: 6.4, 6.4.1, 6.4.2, 6.5.1, 6.5.7, 6.5.9, 6.6.1, 6.7, 7.18, 7.18.1, 7.18.2, 7.30, 8.12, 8.14.5, 8.16, 8.18.6, 9.2, 9.9.1, 9.13.1, 11.13

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o Main FW Flow	0 - 8 mil.lbs./hr.	X			X	HED 9.2-28 discuses accuracy.
o Auxiliary FW Flow	0 - 1000 GPM	X			X	HED9.2-7 discusses accuracy
o SUFP Amp Meter	0 - 75 Amps	X		X		
o SUFP Discharge Pressure	0 - 1500 psig	X		X		
o Main FW Flow Control Valve Position	0 - 100%	X		X		
o Steam Generator Level	0 - 650"	X			X	HEDs 9.2-42 & 49 addresses display appropriateness.
o Steam Generator Pressure	0 - 1200 psig	X		X		
o MFW Pump Speed	0 - 8000 RPM	X		X		
o MFW Pump Discharge Pressure	0 - 1500 psig	X		X		
o Condenser Hotwell Level	0 - 7 ft.	X		X		
o Condensate Storage Tank Level	0 - 50 ft.	X		X		
o AFW Pump Status	On/off	X		X		
o AFW Pump Discharge Pressure	0 - 1500 psig	X		X		
o D.A. Storage Tank Level	0 - 16 ft.	X		X		
o RCS Cooldown Rate	0 - 650°F	X		X		
o AFW Pump Speed	0 - 5000 RPM	X		X		
o AFW Pump Suction Valve Position	Open/closed	X		X		
o AFW Pump Discharge Valve Position	Open/closed	X		X		
o Switches and Controllers for Valves	Open/closed	X		X		
o Switches and Controllers for Pumps	On/off	X		X		

Task No. 54
Task Designation: Use Essential Power Indicators X and/or Y
TA/SFRT: 4.3.3, 4.3.4

Information and Control Requirements	Range Precision Accuracy	Availability Yes	Availability No	Suitability Yes	Suitability No	HED Number Comments
o X Side Power Indication	Various	X		X		
o Y Side Power Indication	Various	X		X		
o Switch position indication for X and Y side power	X or Y	X		X		
o Switches to transfer between X and Y side power	X or Y	X		X		

APPENDIX C
HED SUMMARY TABLES

HED REPORT STATUS RECORD

Work Space

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.1.1-1	Viewing of controls and displays from the operator's desk.	1-16-84	2nd operator and annunc. system appear to obviate problem.		III
P.1.1-2	Storage of reference documents/procedures.	1-16-84	Provide more storage - Conduct a work space review to assess storage		III
P.1.1-3	Reference documents and procedures are stored in one location.	1-16-84	Standardize storage of documents		III III
P.1.1-4	Location of shift supervisor's office.	1-16-84	S.S. can get to CR quickly		
P.1.1-5	No dedicated communciation link between shift supervisor's office and control room.	1-16-84	Convenience item, will provide link		III

Anthropometrics

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.1.2-1	Controls not 3 inches away from front edge of the bench boa	1-17-84	Controls either have guards or will be ... Test buttons - ...uence		III
P.1.2-2	Controls located lowe... above the floor.		... for critical ...n V&V	No problem noted in V&V	III
P.1.2-3	Controls located abo...		... for critical ...n V&V	No problem noted in V&V	III
P.1.2-4	Displays located bel...		... for critical ...n V&V	No problem noted in V&V	III
P.1.2-5	Displays located abo...		... for critical in V&V	No problem noted in V&V	III
P.1.2-6	Critical controls loc... inches above the flo...		... in V&V	No problem noted in V&V	Delete
P.1.2-7	Critical displays loc... inches above the flo...		...d in V&V	No problem noted in V&V	Delete
P.1.2-8	Critical displays loc... inches above the fl...		...d in V&V	No problem noted in V&V	Delete

WHAT ABOUT ELECTRICAL BREAKER
HANDLES WHEN GO AROUND CORNER
BY LUNCH ROOM

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.1.3-1	No protective clothing in the control room.	1-17-84	No need has been identified		III

Illumination

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.1.5-1	Noticeable differences in the illumination levels.	2-6-84	Modify control room lighting - Lighting study		III
P.1.5-2	Area where illumination is not adequate.	2-6-84	Combine with P.1.5-6		Delete
P.1.5-3	Insufficient illumination within the primary operating area.	1-18-84	Repeat, combined with P.1.5-6		Delete
P.1.5-4	Shadows that interfere with readings on recorders.	2-6-84	Re-evaluate after the illumination has been upgraded - Lighting study		III
P.1.5-5	Glare that interferes with reading displays.	2-6-84	Re-evaluate after the illumination has been upgraded - Lighting study		III
P.1.5-6	Inadequate illumination level.	1-16-84 2-6-84	Improve uniformity of illumination conduct lighting study		IIC
P.1.5-7	Emergency Lighting (DC)	1-16-84 2-6-84	Lighting study		IIC.

HED REPORT STATUS RECORD

Noise

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.1.6-1	Background noise levels are too high in the control room.	2-6-84	Re-evaluate. Background noise is reported nigher since outage. Will take new measurements and question operators.	Originally judged to be not a problem - to be re-assessed under Noise study	Pending
P.1.6-2	Auditory signals that interfere with other signals or voice communciations.	2-6-84	Look at making horns adjustable. Noise study.		IIC
P.1.6-3	Ramtek computer tone is unclear in meaning.	2-6-84	Alarm is not part of CR operations		Delete
P.1.6-4	Auditory signals that sound similar yet have contradictory meanings.	2-6-84	Computer alarms no longer annunciate. Some need to be annunciated. Look into using two alarms to distinguish alarms.	Address in Annunc. study	IIC
P.1.6-5	Auditory signals which are too loud.	1-18-84	Repeat — combined with P.3.1-9.		Delete
P.1.6-6	Signal discriminability.	1-16-84	FCR in place to add annunc. for fire alarm. PNL C5731		III

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.1.7-1	Recorder supplies and fuses are not stored in the control room.	2-6-84	Review rules for changing bulbs & etc. with ops. & I&C to make supplies available to operators CR		IC
P.1.7-2	Inadequate supply of bulbs.	2-6-84	Combine with P.1.7-6 repeat.		Delete
P.1.7-3	Tools needed to change bulbs that are not available in the control room.	2-6-84	Tool available - not a problem		Delete
P.1.7-4	Not enough storage space in the control room.	2-6-84	Book shelves covered in P.1.1-2. Combine with 1.1-2.		Delete
P.1.7-5	Bulbs and recorder paper are not clearly marked to indicate type.	2-6-84	Provide ops. with a cross reference from bulb type to switch type.		IC
P.1.7-6	No records kept on status of expendables or spare parts.	2-6-84	Verify that an adequate supply is available in stores & ops. should establish an inventory control procedure		IC
P.1.7-7	Paper and ink replenishment on recorders is not quick and easy.	2-6-84	Turn over to ops. admin. assist.		IC
P.1.7-8	Interchanging of annunciator tiles.	2-6-84		Error potential low-standard practice is to change one bulb at a time - Annunciator study	III

Maintainability

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.1.7-9	Operators being shocked while replacing bulbs.	2-6-84	Turn over to ops. admin. assist. to train operators.		IC
P.1.7-10	No lamp test, dual bulbs or dual filament bulbs.	2-6-84	Display study to be done to determine equip. that does not have redundant indication and determine if test is needed.		IA
P.1.7-11	Pushbuttons or indicator lights that have shorted out while bulbs were being replaced.	2-6-84	Turn over to ops. admin. assist. to train operators on procedure for changing bulbs.	Proper use of tool should obviate this problem.	IA
P.1.7-12	Legend covers or indicator light covers are not keyed to prevent interchanging of covers.	2-6-84	Historically, is not a problem due to red/green convention. Review admin. procedure to determine if operators are instructed to change one bulb at a time and if instructions refer ops. to panel drawing if ops. is in doubt.	Low error probability.	III

Communications

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.2.1-1	No procedure for handling communications during an emergency.	1-17-84	Procedure in place - delete		Delete
P.2.1-2	Gaitronix cords in traffic paths.	1-17-84	Periodically replace cords as necessary		III
P.2.1-3	Handsets not located to prevent them from being knocked out of the cradle.	1-17-84	Not a problem, no reported occurrences		III
P.2.1-4	The loudness of the ringing is not adjustable at the individual telephones.	1-17-84	Not a problem, no action		III
P.2.1-5	Walkie-talkies do not penetrate all areas in the Aux. Building.	1-17-84	Not a problem, delete		Delete
P.2.1-6	Fixed-base UHF transceivers are not audible at the lowest setting.	1-17-84	Not applicable to Davis-Besse		Delete
P.2.1-7	Volume adjustment on the Gai-Tronix System.	1-17-84	Not a problem, under control of an administrative procedure		Delete
P.2.1-8	Communicating on phone handsets while wearing protective equipment.	1-17-84	Not a problem, operations verified that you can communicate.		Delete

Communications

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.2.1-9	Annunciator alarm is non-directional.	1-17-84	Error assessment low due to size of the control room		III
P.2.1-10	Alarms that are not distinguishable.	1-17-84	Delete - repeat (noise survey), combine with P.1.6-2		Delete
P.2.1-11	False alarms in the control room.	1-17-84	Delete - covered in annunc. interviews, combined w/P.3.1-21		Delete
P.2.1-12	Annunciator speaker not directed towards the primary operating area.	1-17-84	Not a problem due to size of the control room; no action required		III

Annunciator System

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.3.1-1	No first out annunciator panel.	1-18-84	Delete - repeat of P.3.1-30		Delete
P.3.1-2	No labels above annunciator tiles.	2-6-84	Annunc. boxes are labeled with numbers - not a problem, delete		Delete
P.3.1-3	Annunciator panel labels not easy to read from primary operating area.	2-6-84	Annunc. satisfy guidelines - not a problem		Delete
P.3.1-4	No priority coding of the annunciator system.	1-18-84	Delete - repeat of P.3.1-39		Delete
P.3.1-5	Annunciator auditory signals not priority coded.	1-18-84	Repeat of P.2.1-9		Delete
P.3.1-6	There are not separate auditory signals at each work station.	2-6-84	Not a problem due to the size of the control room		III
P.3.1-7	No annunciator horns for work areas not at the main control board.	2-6-84	NA - No alarms outside work areas		Delete
P.3.1-8	Auditory alarm signal is not coded.	2-6-84	NA		Delete
P.3.1-9	Alarm signals that startle or irritate.	2-6-84	Look at making horns adjustable and then determine range within the noise study		IC

Annunciator System

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.3.1-10	Alarm horns that are too loud.	2-6-84	Look at making horns adjustable and then determine range within the Noise study		IC
P.3.1-11	No silence control with each set of annunciator response controls.	2-6-84	Change tone of horn and look into adding an annunc. silence requirement - Annunc. study		IIC
P.3.1-12	No acknowledge control with each set of annunciator response controls.	2-6-84	NA, only one set of annunc. response controls		Delete
P.3.1-13	No reset control for cleared alarms.	2-6-84	Study further - Annunc. study		IIC
P.3.1-14	The reset control does not silence the auditory signal as well as extinguish the illumination.	2-6-84	Study further - Annunc. study		IIC
P.3.1-15	Reset control does not operate from more than one response control area.	2-6-84	Study further - Annunc. study		III
P.3.1-16	Defeating annunciator controls.	2-6-84	NA		Delete

Annunciator System

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.3.1-17	Annunciator tiles that are always on.	2-6-84	Assess in Annunc. study		IIC
P.3.1-18	No distinctive coding for annunciator tiles that are on for an extended period.	2-6-84	Assess in Annunc. study		IIC
P.3.1-19	Annunciator tiles that are out of service.	2-6-84	Tiles are tagged out - not a problem		III
P.3.1-20	No indication of annunciator alarm flasher that is out of service.	2-6-84	Study further - Annunc. study	Determine failure mode of flasher card.	Pending
P.3.1-21	Annunciator alarms that are considered nuisance alarms.	2-6-84	Assess in Annunc. study		IIC
P.3.1-22	Alarms that do not give adequate time to respond.	2-6-84	Not a problem		Delete
P.3.1-23	Controls & displays needed to respond to annunciator alarms that are not easily located.	2-6-84	Assess in Annunc. study		IIC
P.3.1-24	Alarms that require additional information from sources outside the control room.	2-6-84	Assess local Annunc. study		IIC

Annunciator System

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.3.1-25	Alarms that require more details from other annunciator panels located outside the control room.	2-6-84	Assess in Annunc. study		IIC
P.3.1-26	Annunciator tiles that contain dual messages.	2-6-84	Assess in Annunc. study		IIC
P.3.1-27	No reflash capability on multi-input alarms.	2-6-84	Assess in Annunc. study		IIC
P.3.1-28	Multi-input alarms not provided with an alarm printout.	2-6-84	Assess in Annunc. study		IIC
P.3.1-29	Alarm typer loses or skips information.	2-6-84	Being addressed in Computer Alarm Reduction Program		IIC
P.3.1-30	No first out panel for Rx trip.	1-17-84	Review in Annunc. study		IIC
P.3.1-31	Turbine-generator system first out annunciator panel is not located above turbine panel.	1-17-84	Panel is accessible if operators need to get to it		III

Annunciator System

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.3.1-32	Stroke width not consistent on all annunciator tiles.	1-17-84	Address in Annunc. study		III
P.3.1-33	Annunciator light boxes that contain more than 50 tiles.	1-17-84	Look at reducing the number of tiles in Annunc. study		III
P.3.1-34	Annunciator tile coordinate designators are located at the bottom of the ALBs instead of the top.	1-17-84	Not a problem, viewable from the bottom - assess in Annunc. study		III
P.3.1-35	ALB coordinate designators are not labeled with alpha characters.	1-17-84	Relable one coordinate to alpha characters		III
P.3.1-36	Annunciator response procedures are not indexed by panel I.D. and tile coordinates.	1-17-84	Change response procedures using new alphanumeric coordinate designators		IIC
P.3.1-37	Annunciators with inputs from more than one parameter is not avoided.	1-16-84	Annunciator study will be put into place to review problem		IIA

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.3.1-38	Annunciator tiles not grouped by system or subsystem.	1-16-84	Will be reviewed under Annunc. study		IIC
P.3.1-39	No prioritization of the annunciator system.	1-16-84	Will be reviewed under Annunc. study		IIC
P.3.1-40	Ambiguous annunciator tiles.	1-17-84	Address in Annunc. study		IIC
P.3.1-41	No auditory signal for cleared alarms.	6-20-84	Annunc. study		IIC

HED REPORT STATUS RECORD

Controls

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.4.1-1	Controls that activate critical functions that do not have guards.	2-7-84	Provide guards for trip buttons, and all others except for RX coolant pump switches		IIC
P.4.1-2	Guards that interfere with the operation of controls.	2-7-84	Cover has been removed		III
P.4.1-3	Pushbuttons that should be rotary controls because of the possibility of accidental activation.	2-7-84	Not a problem		Delete
P.4.1-4	Controls positioned too close together that adjacent controls were accidentally activated.	2-7-84	Controls are not closer together than others. MU-3971 should be relabeled from open/close to the BWST & Makeup tank - Labelling study.		IA
P.4.1-5	Difficulty activating a control because an adjacent control was in the way.	2-7-84	Problem is with the design of the controller and the way the toggle has to be operated.		III

Controls

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.4.1-6	Controls that interlock unnecessarily.	2-7-84	Investigate for real purpose of interlock and assess ops. training of this - Controls study		IIC IIC
P.4.1-7	Controls with strict sequential activation are not provided with some type of interlock.	2-7-84	Handle in training		
P.4.1-8	Interaction in a sequentially operated switch.	2-7-84	Not a problem, no examples in the CR		Delete
P.4.1-9	Unused controls on control panels.	2-7-84	Combined with 9.2-15		Delete
P.4.1-10	Controls on control panel that are duplicated unnecessarily.	2-7-84	Duplication is required		Delete
P.4.1-11	Control not recognizable in terms of its function such as handle type or color.	2-7-84	Determine the convention and document places where convention cannot be applied due to switch requirements - Controls study		III

HED REPORT STATUS RECORD

Controls

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.4.1-12	Controls that are broken or loose on their shafts.	2-7-84	Not a problem		Delete
P.4.1-13	Controls that move too easily.	2-7-84	Increase resistance on all pot. controls on Bailey controllers - Controls study		IIC
P.4.1-14	Rotary Selector Control not used for a three position switch.	2-7-84	Review this problem in conjunction with FCR to determine if new switch type is needed - Controls study		IIC
P.4.1-15	Selector switches that can be positioned between detented positions.	2-7-84	Review consequence of placing switch in a mid-position and review the switches for excessive wear - Controls study		IIC
P.4.1-16	Spring-loaded selector switches that are not large enough to be held against spring torque.	2-7-84	Re-evaluate, ask operators - Controls study		Pending
P.4.1-17	Controls that allow a wider range than needed.	2-7-84	Not a problem, switch not used for precise control		Delete

HED REPORT STATUS RECORD

Controls

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.4.1-18	Inappropriate range on controllers.	2-7-84	Combine with 9.2-9		Delete
P.4.1-19	Controls that are difficult to adjust to the precision level needed.	2-7-84	Review to determine solutions. Evaluate each case for specific problems - Controls study.		IIC
P.4.1-20	Lack of immediate feedback on pushbuttons.	2-7-84	Controls study		IC
P.4.1-21	Stepped thumbwheels that do not have detents at each position.	2-7-84	NA, no detented thumbwheels in CR		Delete
P.4.1-22	Continuous adjustment thumbwheels with no detent in the off position.	2-7-84	NA, no off position		Delete
P.4.1-23	Toggle switches do not snap into position.	2-7-84	Delete	Toggles are momentary contact and should not "snap" into position	Delete
P.4.1-24	Toggles that do not provide some source of feedback.	2-7-84	Controls study		IIC

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.4.1-25	Controls that are subject to inadvertent actuation and are not provided with fixed protective structures.	1-17-84	Do a detailed review to determine if others are needed and supply guards where needed - Controls study		IIC
P.4.1-26	Messages on legend lights/pushbuttons are ambiguous/not concise.	1-17-84	Controls study		IIC
P.4.1-27	Resistance for pushbuttons is not between 10 to 40 oz.	1-17-84	Controls study		III
P.4.1-28	Open position is not located to the right on all switches.	1-17-84	Controls study		IIC
P.4.1-29	Stop position not located to the left on all switches.	1-17-84	Controls study		III
P.4.1-30	CLOSE position is not located to the left on all switches.	1-17-84	Controls study		Cat IIC
P.4.1-31	Pistol grip handles that are subject to inadvertent activation.	1-16-84	Controls study		IIC

HED REPORT STATUS RECORD

Displays

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.5.1-1	Indicator lights that are too dim.	2-7-84	Evaluate to determine if brighter bulbs are available or if a different lens is available. Display study.		IIC
P.5.1-2	Indicator lights that indicate system/equipment status when light is off.	2-7-84	Display study		IIA - Not all listed would be considered IIA.
P.5.1-3	Indicator lights that are used for alarm signals.	2-7-84	All listed have annunc. or computer alarms as backup, defer to annunc. study		IIC
P.5.1-4	Meter scales that do not span the expected range of operational parameters.	2-7-84	Assess each scale and determine need for making changes - Display study		IIC
P.5.1-5	Scale ranges that are too wide for the maximum displayed values.	2-7-84	Review of scales indicate that scales are not too wide, not a problem		Delete
P.5.1-6	Scales where the maximum values are too large for the scale.	2-7-84	Display study (some items already changed)		IIA

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.5.1-7	Pointers on meters do not fail off scale.	2-7-84	Display study		IIB
P.5.1-8	Logarithmic scale that should be linear.	2-7-84	Not a problem		Delete
P.5.1-9	Multiscale meters that are confusing to read.	2-7-84	Display study		IIA Not all displays on HED are IIA
P.5.1-10	Poor contrast between pointers and scale background.	2-7-84	Display study		IIC
P.5.1-11	Displays have pointers that are too small.	2-7-84	Combine with P.5.1-33, repeat		Delete
P.5.1-12	Recorders located outside the primary work area.	2-7-84	Delete	All primary recorders are located within the primary work area	Delete
P.5.1-13	Recorders used for purposes other than to record trend information and material for later reference.	2-7-84	Only turbine vibration recorder is used as primary indication - not a problem.		III
P.5.1-14	No paper speed adjustment on recorders.	2-7-84	Assessed for critical time indications in V&V - not a problem		III

HED REPORT STATUS RECORD

Displays

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.5.1-15	Inconvenient to annotate recording paper or recorders.	2-7-84	It is not convenient but annotations can be made, low error assessment		III
P.5.1-16	Visibility of data on recorders.	2-7-84	Consider removing the existing doors on recorder and replace with nonglare plastic with no bezel - Display study		IIC
P.5.1-17	Recorder pens that clog and smudge the paper.	2-7-84	I&C regularly maintains recorders - not a problem		Delete
P.5.1-18	Recorders without takeup spool.	2-7-84	Recorder is not within the primary operating area		Delete
P.5.1-19	Recorder paper that cannot be easily torn off.	2-7-84	Not a problem, paper is not torn off - roll runs out		Delete
P.5.1-20	Recorders that mechanically or electrically hang up.	2-7-84	I&C regularly maintains recorder. Not a problem.		III
P.5.1-21	Indicator lights not labeled.	1-17-84	Address in Labelling study		III
P.5.1-22	Legends that are not legible under ambient illumination with indicator lights off.	1-17-84	Address in labeling study		III

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.5.1-23	Poor contrast of legend lettering.	1-17-84	Paint legend lettering white - Labelling study		IIC
P.5.1-24	Scale multipliers not clearly indicated.	1-17-84	Display study		III
P.5.1-25	Heights of graduation marks.	1-17-84	Display study		III
P.5.1-26	Unnecessary information on display faces.	1-17-84	Remove unnecessary information on display faces - Display study		IIC
P.5.1-27	There are more than nine graduations between numerals on scales.	1-17-84	Display study		IIC
P.5.1-28	Scale graduations do not progress by 1, 2, 5, or 10s.	1-17-84	Display study		IIC
P.5.1-29	Meters with pointers that have parallax problems.	1-17-84	Replace meters - Display study		IIA
P.5.1-30	Zone markings not distinctive on some meters and most meters do not contain zone markings.	1-17-84	Investigate uses for zone markings - Display study		IIC

HED REPORT STATUS RECORD

Displays

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.5.1-31	Colors on meter face interfere with reading of the display.	1-17-84	Display study		III
P.5.1-32	Viewing of a recorder at inconvenient angles.	1-17-84	Very low priority usage - no action required		III
P.5.1-33	Pointers too narrow.	1-17-84	Investigateed for critical meters during V&V walk-throughs - no problem observed	All on electrical distribution panel	III
P.5.1-34	Colors of legend lights not easily distinguishable.	1-17-84	Colors have no particular meaning - not a problem		III
P.5.1-35	Inconsistent type styles within meters.	1-17-84	Display study		III
P.5.1-36	Character heights on labels within meters are too small.	1-17-84	Display study		III
P.5.1-37	Display labels are not used within procedures.	1-17-84	Address in Labeling study		III
P.5.1-38	Standard abbreviations are not used on legend lights.	1-17-84	Address in Labeling study		III

Displays

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.5.1-39	Non-standard abbreviations are used on labels within meters.	1-17-84	Labeling study		III
P.5.1-40	No parameter labels on PAM displays.	1-17-84	Labeling study		IIC

Labels and Location Aids

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.6.1-1	Controls/Displays that are not appropriately or clearly labeled.	2-8-84	Address in CRDR labeling study		Cat. IIC
P.6.1-2	Periodic cleaning of labels.	2-8-84	Turn over to ops.		Cat. III
P.6.1-3	Labels that do not describe the primary function.	2-8-84	Relabel PORVs on PAM panel - Labeling study		Cat. IIC
P.6.1-4	Labels that do not express exactly what action is intended.	2-8-84	Address in CRDR labeling study		Cat. IIC
P.6.1-5	Words that do not have a commonly accepted meaning.	2-8-84	Address in CRDR labeling study		Cat. III
P.6.1-6	Symbols that are not a commonly accepted configuration.	2-8-84	No uncommon symbols on panel		Delete
P.6.1-7	Too many temporary labels on the control board.	1-16-84	Address in CRDR labeling study		Cat. III
P.6.1-8	Tagging-out a control does not prevent actuation of the control.	2-8-84	Not a problem, tag-out procedure prevents operating control		Delete
P.6.1-9	Mimic lines are difficult to distinguish quickly.	2-8-84	Address in CRDR labeling study		Cat. IIC
P.6.1-10	No hierarchical labeling scheme.	1-16-84	Address in CRDR labeling study		Cat. IIC
P.6.1-11	Subordinate labels are not consistently used to identify subsystems or functional groups.	1-16-84	Address in CRDR labeling study		Cat. IIC

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.6.1-12	Labels that are not placed above the panel elements they describe.	1-16-84	Address in CRDR labeling study		Cat. IIA
P.6.1-13	Inconsistent placement of labels.	1-16-84	Delete, combine with P.6.1-12		Delete
P.6.1-14	Labels that are located above eye level and are not easily visible.	1-16-84	Delete, combine with P.6.1-12		Delete
P.6.1-15	Temporary labels and magnetic labels and information tags obscure components/labels.	1-16-84	Establish procedure for the placement of tags/temporary labels - Operations study		Cat. IIA
P.6.1-16	Labels obscured by pistol grip handles.	1-16-84	Where practicable move labels within labeling study		Cat. III
P.6.1-17	Standard abbreviations and consistent wording is not used across all labels.	1-16-84	Address in CRDR labeling study		Cat. III
P.6.1-18	All labels are not dark characters on a light background.	1-16-84	Address label color in CRDR labeling study		Cat. III
P.6.1-19	Readability of temporary labels.	1-16-84	Address in CRDR labeling study		Cat. III
P.6.1-20	No color coding of mimic lines.	1-16-84	Address in CRDR labeling study		Cat. III
P.6.1-21	Differential line widths of mimic lines.	1-16-84	Delete		Delete

Labels and Location Aids

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	PEMARKS	CATEGORY
P.6.1-22	Flow directions not indicated for all mimic lines.	1-16-84	Delete — NA for Elect. Dist. Panel. ESF Panel has arrows		Delete
P.6.1-23	All mimic origin points and terminal points are not labeled.	1-16-84	Address in CRDR labeling study		Cat. III
P.6.1-24	No functional labels on some components on mimic lines/panel.	1-16-84	Address in CRDR labeling study		Cat. IIC
P.6.1-25	No demarcation used in the control room except on PAM panel.	1-17-84	Consider demarcation in CRDR labeling study		Cat. IIC
P.6.1-26	Nomenclature on labels is not consistent with label used in procedures.	1-17-84	Address in CRDR labeling study		Cat. IIC
P.6.1-27	Component labels are not consistent.	1-17-84	Address in CRDR labeling study		Cat. III
P.6.1-28	Functional labels are not 25% larger than component labels.	1-17-84	Address in CRDR labeling study		Cat. III
P.6.1-29	Character height is too small for most labels.	1-17-84	Address in CRDR labeling study		Cat. III
P.6.1-30	Stroke width-to-character height ratio is not between 1:6 and 1:8.	1-17-84	Address in CRDR labeling study		Cat. III
P.6.1-31	Space between characters is not one stroke width.	1-17-84	Address in CRDR labeling study		Cat. III

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.6.1-32	Control positions are not identified for bypass switches.	1-17-84	Address in CRDR labeling study		Cat. III

Computer System

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.7.1-1	Titles on displays do not give a clear indication of display contents.	2-8-84	Review labeling and change titles where needed - Computer study		III
P.7.1-2	Characters are a 5x7 dot-matrix instead of a 7x9.	2-8-84	Not a problem, characters are legible		III
P.7.1-3	Error messages do not contain corrective action statements.	2-8-84	Turn over to computer group for consideration in system upgrades - Computer study		III
P.7.1-4	Colors used on CRTs not consistent with other CR color coding.	2-8-84	Turn over to computer group for consideration in system upgrades - Computer study		III
P.7.1-5	Colors used on CRT displays have multiple meanings.	2-8-84	Incorporate CRT colors into color coding conventions - Computer study		III
P.7.1-6	Computer procedures are outdated.	2-8-84	Update procedures		III
P.7.1-7	Character separation on CRTs.	2-8-84	Turn over to computer group for consideration in system upgrades - Computer study		III

Computer System

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.7.1-8	Symbols on CRTs do not subtend a visual angle of 20 minutes of arc.	2-8-84	Turn over to computer group for consideration in system upgrades - Computer study		III
P.7.1-9	More than two blink rates on CRTs.	2-8-84	Turn over to computer group for consideration in system upgrades - Computer study		III
P.7.1-10	Blink rates are not 2 to 3 blinks per second.	2-8-84	Turn over to computer group for consideration in system upgrades - Computer study		III
P.7.1-11	Flicker on CRTs.	2-8-84	Turn over to computer group for consideration in system upgrades - Computer study		III
P.7.1-12	CRT displays not cross-indexed.	6-20-84	Computer study		III
P.7.1-13	Data groups not labels.	6-20-84	Computer study		III
P.7.1-14	Labels on displays are not highlighted.	6-20-84	Computer study		III
P.7.1-15	Table columns are not separated into groups by spaces between groups of five.	6-20-84	Computer study		III
P.7.1-16	Parameter labels are not displayed for all values.	6-20-84	Computer study		III

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.8.1-1	Inconsistent uses of color in the control room.	1-17-84	Incorporate color coding in Labeling study		III
P.8.1-2	Inconsistent uses of the color red.	1-17-84	Incorporate color coding in Labeling study		III
P.8.1-3	Inconsistent uses of the color green.	1-17-84	Incorporate color coding in Labeling study		III
P.8.1-4	Inconsistent uses of the color amber.	1-17-84	Incorporate color coding in Labeling study		III
P.8.1-5	No list of standard names, acronyms, and part/system numbers.	1-17-84	Incorporate into CRDR Labeling study		III
P.8.1-6	No enhancement techniques are used for emergency controls.	1-17-84	Address in CRDR Labeling study		III

V&V - Walk-Through

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-1	SFRCS Display Arrangement does not support op. tasks.	5-7-84	SFRCS study		Cat. IIA
9.2-2	Related controls not colocated.	5-4-84	Controls study		Cat. IIC
9.2-3	Instrument design & arrangement do not support op. tasks.	5-4-84	Low error potential comparison/balancing task - cover in training		Cat. III
9.2-4	Related controls & displays not collocated.	5-4-84	Operations review under display study		Cat. IIB
9.2-5	Misleading Panel Arrangements (ICS).	5-7-84	Demarcate & label - Labeling study		Cat. IIB
9.2-6	Violation of operator expectancy (control type).	5-7-84	Consider guarding - look at under control study		Cat. IIA
9.2-7	Insufficient display accuracy (AFW) - reliability.	5-8-84	Increase PM to improve reliability		Cat. IIA
9.2-8	Inadequate display range (LPI & HPI flow).	5-8-84	Upgrade display as specified by engineering study		Cat. IIC
9.2-9	Unnecessary display conversion (turbine hdr. pressure)	5-7-84	Review under Labeling study		Cat. IIC

V&V - Walk-Through

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-10	Inadequate display precision (secondary rad recorder).	5-7-84	Not a problem - other indication available in CR		Cat. III
9.2-11	Insufficient display range (makeup flow).	5-7-84	Engineering study		Cat. IIC
9.2-12	Lack of mode selection indication (Victoreen Rad Monitor).	5-7-84	Admin control of mode selection		Cat. IIC
9.2-13	Inadequate C/D capability (dilution pump speed control/display).	5-4-84	Not a problem - local control available		Cat. III
9.2-14	Block control blocks multiple signals (SFAS).	5-8-84	Not a problem - block signal indications are adequate		III
9.2-15	Unused controls & displays.	5-4-84	Remove unused controls & displays - review under Controls and Displays studies		Cat. III
9.2-16	Confusing status logic (MU pump oil supply).	5-7-84	Low error consequence - occurs only if op fails to follow procedure - Displays study		Cat. IIC
9.2-17	Display does not support task requirements (containment rad monitor).	5-7-84	Consider alternative scales, procedures, training - Displays study		Cat. IIC

V&V - Walk-Through

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-18	Availability/consistency of information (SFRCS).	5-7-84	SFRCS study		Cat. IIA
9.2-19	Poor display scale readability (essential Bus volts & amps).	5-7-84	Accuracy not required > ±50 volts		Cat. IIC
9.2-20	Incident isolation groups are not consistent (SFAS).	5-8-84	Review under Displays study		Cat. IIA
9.2-21	Inadequate display of system status (SFAS).	5-8-84	Deleted - Misinformation		Deleted
9.2-22	Indicator light coding violates convention (fire pumps).	5-4-84	Add label - Labeling study		Cat. IIC
9.2-23	Scale label contrary to convention (% neutron error).	5-4-84	Change under label study		Cat. III
9.2-24	Displays unreliable due to static electricity (EHC panel).	5-7-84	Low error assessment - Display study		Cat. III
9.2-25	"Group-in-limit" lights hard to distinguish when illuminated.	5-7-84	Consider removing colored lenses to increase brightness - Display study		Cat. IIC
9.2-26	SFAS actuation verification difficult & confusing.	5-7-84	Combine with 9.2-20		Delete
9.2-27	Brightness discrimination difficult to make.	5-7-84	Combine with 9.2-20		Delete
9.2-28	Misleading FW flow indication.	5-7-84	Remove SU FW, input to ICS - Engineering study		IIB
9.2-29	Misleading valve status indication.	5-8-84	Consolidate 1.7-10 & consider lamp test		Delete

HED REPORT STATUS RECORD

V&V - Walk-Through

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-30	Critical displays not visible from bench-board (T_H & T_C).	5-8-84	Additional P/T screens on SPDS will resolve		IIA
9.2-31	Unexpected system response (CCW&SW).	5-8-84	Refer to engineering — system problem		IIC
9.2-32	Expected system response not obtained (SFRCS).	5-8-84	Engineering study	Will result in low-level SFRCS initiation	IIC
9.2-33	Lack of mimics (AFW).	5-4-84	Labeling study		IIA
9.2-34	ICS logic can be affected by loss of NNI power.	5-7-84	Not a problem - part of plant design basis		Deleted
9.2-35	Improper display graduations (letdown flow).	5-7-84	Put in display study		IIC
9.2-36	Display label contrary to convention (cntmt rad).	5-10-84	Label study		IIC
9.2-37	Displays not readable to required accuracy.	5-10-84	Revise procedure to allow for instrument error.		IIC
9.2-38	Unnecessary display conversion require-ments — various.	5-10-84	Defer to display study to apply operating range bands		IIC
9.2-39	Controls not available in CR (core flood tank isolation valves).	5-10-84	Controls study		IIC
9.2-40	Improper display location (ECS sump pump status lights)	5-10-84	Low error assessment - Display study		III

V&V - Walk-Through

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-41	Insufficient display range (pressurizer).	5-10-84	Procedure based on RCS press not przr level when going solid		III
9.2-42	Logic system SG level control inputs & indications have different compensations (ICS, SFRCS)	5-10-84	SFRCS study		IIA
9.2-43	Control not available in CR (startup valve SFRCS block)	5-10-84	SFRCS study		IIA
9.2-44	Insufficient scale range (quench tank level)	5-10-84	Not a problem		III
9.2-45	Display units do not support task requirements.	5-10-84	Task performance verified during V&V		Delete
9.2-46	Excessive operator workload (simultaneous tasks)	5-10-84	Task performance verified during walk-through of procedures		III
9.2-47	Unclear mimic relationships (decay heat pmp/HPI pmp)	5-10-84	Handle under labeling/mimic study		IIA
9.2-48	Inadequate display design (T_{av} recorder)	5-10-84	Available on SPDS		Delete
9.2-49	Inconsistent display of information (SG level/przr lvl)	5-10-84	Recorder (przer) is compensated but indicators are not - label two indicators (przr level SG op. range level) that are temp comp - Labeling study		III

V&V - Walk-Through

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-50	Inadequate information (RCP vibration)	5-10-84	Not a problem - adequate indication available		Delete
9.2-51/52	Missing displays/controls.	4-11-84	Consolidated with addendum to HED 9.2-86, 9.2-98		Delete
9.2-53	Simultaneous controls not located together.	5-1-84	Low error consequence - Controls study		IIC
9.2-54	Controls not located/arranged to support emergency task sequence.	5-1-84	SFRCS Study		IIA
9.2-55	Controls not properly located (by functional group/MUPS).	5-1-84	Low error assessment - Controls study		III
9.2-56	Operationally related controls not located together - vibration monitor reset - annunciator reset.	5-1-84	Location is appropriate for vibration reset		Delete
9.2-57	Lack of immediately available diesel generator output information.	5-1-84	Deleted based on review of I&C documentation		Delete
9.2-58	Elec distribution mimic not complete.	5-1-84	Labeling study		IIC
9.2-59	ESF panel mimic is misleading & confusing due to info density.	5-1-84	Labeling study		IIC
9.2-60	Controls not properly grouped by sequence, operation or function	5-1-84	Ops review revealed components are properly located/grouped		Delete
9.2-61	Lack of demarcation or highlighting of incident level actuation, (containment isolation) on panel C5717		Labeling study		IIC

HED REPORT STATUS RECORD

V&V - Walk-Through

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-62	Completeness of informtion (przr press).	4-11-84	RCS press adequate indication		Delete
9.2-63	Word selection — clarity.	4-11-84	Delete — follows DBNPS convention		Delete
9.2-64	Lack of guarding of critical controls.	5-1-84	Delete		Consolidate with HED #4.1-1
9.2-65	Inadequate info (main turbine).	5-2-84	Display study		IIB
9.2-66	Lack of effective mimic (MUPS).	5-29-84	Labeling study		IIC
9.2-67	Inadequate info (house power).	5-2-84	Annunciator study		III
9.2-68	Inadequate info — SFRCS-steam-to-feed dP.	5-2-84	SFRCS study		IIC
9.2-69	Inadequate info — MUPS - 03-MU-I A&B.	5-2-84	Combine with 1.7-10		Delete
9.2-70	Inadequate info — CCW&SW-flow indication.	5-2-84	Display study		IIC
9.2-71	Inadequate info — DG-VAR meter.	5-2-84	Operation not performed from CR		Delete
9.2-72	Inadequate info — DG- - speed/voltage annunciator - oil pressure annunciator.	5-2-84	Annunciator study		IIC
9.2-73	Inadequate info — - SU FW valve position.	5-2-84	Display study (SFRCS)		IIC

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-74	Inadequate info — Przr -spray flow.	5-2-84	Display study		IIC
9.2-75	Inadequate info — SG - tube-to shell dT.	5-2-84	SFRCS study		IIC
9.2-76	Inadequate info — SUFW - flow.	5-2-84	Display study		IIC
9.2-77	Inadequate [illegible]o — RCS press - wide range (post transient analysis).	5-2-84	Not needed for ops		Delete
9.2-78	Inadequate info — 24 hr clock.	5-2-84	Low error assessment - provide clock		III
9.2-79	Inadequate info — RCS - cooldown rate meter	5-2-84	Display study		IIC
9.2-80	Inadequate info — R_x - digital incore TC_s	5-2-84	Display study — consider upgrading existing equipment		IIC
9.2-81	Inadequate info — Turbine - TBV position	5-2-84	Display study		IIC
9.2-82	Inadequate info — AV Valves - AVV position	5-2-84	Display study		IIC
9.2-83	Inadequate info — ICS - Track mode	5-2-84	Annunciator study		IIB
9.2-84	Inadequate info — Deaerator - Level control valve position	5-2-84	Display study		IIB

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-85	Inadequate info — Decay heat - flow control valve position	5-2-84	Display study		IIC
9.2-86	Inadequate info — HPI/LPI - discharge pressure	5-2-84	Display study		IIC
9.2-87	Inadequate info — Quench tank - temperature	5-2-84	Display study — info on computer		Delete
9.2-88	Inadequate info — Timers	5-2-84	Provide timers		IIC
9.2-89	Inadequate info — ICS/NNI - Annunciator	5-2-84	Annunciator study		IIC
9.2-90	Inadequate info — Contmt spray - discharge press	5-2-84	Display study		IIC
9.2-91	Inadequate info — - SFAS & SFRCS (Annunciators)	5-2-84	Annunciator study		IIC
9.2-92	Inadequate info — SUFW - SFRCS block status	5-2-84	SFRCS study		IIC
9.2-93	Inadequate info — R_x - incore TC trend recorder	5-2-84	Available on SPDS		Delete
9.2-94	Inadequate info — - Synchrocheck relay status	5-2-84	Display study		IIC
9.2-95	Inadequate control capability - MU211 - bypass valve	5-2-84	Consider converting to MOV with local control - Engineering study		IIC

HED REPORT STATUS RECORD

V&V - Walk-Through

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-96	Inadequate control capability - SUFW valve SFRCS block	5-2-84	SFRCS study		IIC
9.2-97	Inadequate control capability - synchroscope relay test switch	5-2-84	Control study		IIC
9.2-98	Inadequate control capability - emerg. DG auto/manual select switch	5-2-84	Not required for ops		Delete
9.2-99	Inadequate info - code safeties	5-29-84	Alternate indications exist		Delete
9.2-100	Inadequate info - sump level	5-29-84	Display available		Delete - misinformation
9.2-101	Inadequate info - RCS depressurization	5-29-84	Alternate indications exist		Delete
9.2-102	Inadequate info - core flood tanks	5-29-84	Alternate indications exist		Delete
9.2-103	Inadequate info - containment bld temp	5-29-84	Available on SPDS		Delete
9.2-104	Inadequate info - containment access	5-29-84	Controlled by Admin Procedure		Delete
9.2-105	Inadequate info - Instrument air	5-29-84	Indication available		Delete
9.2-106	Inadequate info - feed pump turbine	5-29-84	Indication available		Delete

V&V - Walk-Through

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
9.2-107	Inadequate info - emerg. diesel generator	5-29-84	Display study		IIC
9.2-108	Inadequate info - R_x trip breakers	5-29-84	Alternate indication available		Delete
9.2-109	Inadequate info - demineralizer press	5-29-84	Available on computer		Delete
9.2-110	Inadequate info - main steam relief valves	5-29-84	Alternate indication available		Delete
9.2-111	Inadequate info - CCW pump discharge press	5-29-84	Display study		IIC
9.2-112	Inadequate info - przr press	5-29-84	RCS pressure available		Delete
9.2-113	Inadequate info - CCW surge tank press	5-29-84	CCW level available		Delete
9.2-114	Inadequate info - SW cooler inlet/outlet temp	5-29-84	Alternate indication available		Delete
9.2-115	Inadequate info - hydrogen recombiners	5-29-84	Local control no instrumentation required in CR		Delete

Verification of Task Performance
(Operator Interviews)

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.9.8-1	Operational sequences that require operators to leave the primary operating areas.	2-7-84	Not a problem, always 2 or 3 operators in the CR		III
P.9.8-2	Operator task were not analyzed to determine operator information requirements.	2-7-84	DCRDR Task Analysis performed		Delete
P.9.8-3	Visual displays in the control room do not provide all information needed to meet task requirements.	2-7-84	Assessed in V&V		See HEDs under V&V
P.9.8-4	Unnecessary visual displays in the control room.	2-7-84	Combine with HED 9.2-15		Delete
P.9.8-5	Equipment that is not labeled to indicate actual or demand status.	2-8-84	Labeling study		III
P.9.8-6	Instruments that should indicate actual status.	2-8-84	Redundant indication is available, not a problem		Delete

Verification of Task Performance
(Operator Interviews)

HED REPORT STATUS RECORD

PHED NUMBER	TITLE	REVIEW DATE	REVIEW DISPOSITION	REMARKS	CATEGORY
P.9.8-7	Displays that do not provide the precision or accuracy required.	2-8-84	Displays study		IIC. IIA for PAM panel displays
P.9.8-8	Mental conversion needed to use displays.	2-8-84	Displays study		IIC
P.9.8-9	Displays indicated by a percentage.	2-8-84	Not a problem, scales more meaningful in percentage		Delete
P.9.8-10	Display scales that are not adequate in terms of the range they span.	2-8-84	Assessed under V&V		Delete - specific HEDs in Section 9.2
P.9.8-11	Displays which are compared that do not have compatible scales.	2-8-84	Display study		IIC
P.9.8-12	Unnecessary multiscale indicator in the control room.	2-8-84	Combine w/9.2-15		Delete
P.9.8-13	On selectable displays, nonselected displays read off scale.	2-8-84	NA - none in CR		Delete
P.9.8-14	Controls that are not easy to control the affected parameter.	2-8-84	Combine with 4.1-19 - repeat		Delete
P.9.8-15	Instruments that are either overly precise or not precise enough.	2-8-84	Combine with 5.1-4 - repeat		Delete