ATTACHMENT 2

SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 AND 3

CONTROL ROOM DESIGN REVIEW INTERIM REPORT

JULY 25, 1980

SAN ONOFRE 2 AND 3

CONTROL ROOM DESIGN REVIEW

TABLE OF CONTENTS

SAN ONOFRE 2 AND 3

CONTROL ROOM DESIGN REVIEW

1. INTRODUCTION

In order to maximize the probability of the operator taking the proper actions to control the plant under all conditions and consistent with NUREG 660-NRC Action Plans Developed as a Result of the TMI-2 accident 5/80 and NUREG 585-TMI-2 Lessons Learned Task Force Final Report 10/79, the San Onofre Control Room Design Review (CRDR) Working Group was activated on June 10, 1980. The Working Group will address the following items for San Onofre Nuclear Generating Station (SONGS) Units 2 and 3:

- Identification of potential and real problem areas in control room and panel design;
- Development of criteria to resolve problems identified;
- Recommendations for solutions to certain identified problems;
- Recommendations for on-going study of other problems.

The purpose of this interim report is to describe the CRDR Working Group review plan and provide the status of the item analysis and resolution at this time. This interim report is divided into three main parts, as follows:

- Control Room Design General Information for SONGS Units 2 and 3.
- Review Plan of the CRDR Working Group for SONGS Units 2 and 3.
- Status of Item Analysis and Resolution for SONGS Units 2 and 3.

This report concludes with the actions to be initiated before fuel load.

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION

San Onofre Nuclear Generating Station Units 1, 2 and 3 are located four miles south of San Clemente, California. Units 2 and 3, the subject of this review, are Combustion Engineering Pressurized Water Reactor (PWR) units, 1100 MWe each.

2.2 CONTROL ROOM ARRANGEMENT

The control room arrangement is shown in Appendix A. There is a single control room area housing the control panels for two units. The main control panels for each unit are U-shaped and are joined by a single panel that contains information and controls for systems common to both units. Dedicated Operators' Desks and Computer consoles are located within the U-shaped portion for each unit. The open portion of the double U contains panels for Electrical Mimic Buses and Heating and Ventilating. Behind the main control panels are additional panels for the Chemical Control, Recorders, and Radiation Monitoring, and the Computer Operator's and Documentation Printers.

2.3 CONTROL BOARD DESIGN

The configuration of the panels are shown in Appendix B. The main control panels utilize a combined bench/vertical operating surface contour. Those panels behind the main control panels and external to the main control room are vertical panels.

3. REVIEW PLAN

3.1 SUMMARY

The Control Room Design Review (CRDR) Working Group was activated on June 10, 1980. The objective of the Working Group is to review the control room within the context of man/machine systems analysis, operability analysis, and human factors data and principles in order to maximize the probability of successful operator performance and to permit the operator to take the proper actions to control the plant. Appendix C shows the organization of the CRDR Working Group.

3.2 GUIDELINES

The control room and panels will be reviewed with respect to known human factors criteria and operability. Appendix D shows a matrix to be used in this evaluation.

The following is a listing of reference documents used in this review:

- NUREG 585 -TMI-2, Lessons Learned Task Force Final Report 10/79
- NUREG 660 -NRC Action Plans Developed as a Result of the TMI-2 Accident 5/80
- EPRI NP-1118, Human Factors Methods for Nuclear Control Room Design - Final Report 11/79 and 2/80
- NRC Review - North Anna - Unit 2 -Essex Corporation - Consultants
- NRC Review - TVA Sequoyah Plant - Essex Corporation - Consultants
- NRC Review - PSE&G Salem Unit 2 - Essex Corporation - Consultants

- NRC Review - Duke-McGuire Unit 1 - Biotechnology Inc. - Consultants
- Clinch River Control Room Task Force - Final Report (Draft) 6/3/80

3.3 SCHEDULE

The results of the CRDR Working Group will be a report stating the objectives, discussion of review techniques, potential and real problem areas that have been identified, criteria to be used in solution of the problem, and solutions that satisfy the criteria for implementation before fuel load and before on-line operation. The report will also address the requirements for an on-going program which will address potential problem areas identified. The final report is presently scheduled to be complete on September 15, 1980. However, implementation of certain changes will be started prior to this date.

4. STATUS ITEM ANALYSIS AND RESOLUTIONS

4.1 ANNUNCIATORS

As designed, there is no means to differentiate the various windows with regard to importance of operator response. Priorities will be established by color coding of windows for the following four levels of importance.

Priority 1. Alarms indicative of a degradation to system functional capability sufficient to challenge safety, unit availability, or the acceptable performance of a major system.

Priority 2. Alarms indicative of degradation to equipment functional capability sufficient to introduce the potential for, and, in some cases, high probability of a Priority 1 alarm.

Priority 3. Alarms indicative of an operating constraint for which the condition can be verified and assessed from visual displays within the control room.

Priority 4. Alarms indicative of an operating constraint for which there are no control room visual displays available to verify and assess the alarmed condition.

The final report will provide recommendations and criteria for use in a continuing study of the annunciator system in the following areas:

- Window engraving-terminology and consistency
- Panel directional signaling
- Window relocation

4.2 PANEL ARRANGEMENTS

Main control room and emergency evacuation panels will be reviewed for location of devices by systems. Demarcation by system and sub-system will be added to the panels before fuel load to assist the operators in identifying the total system boundaries.

Relocation of devices will be made prior to fuel load to eliminate mirror image location of certain redundant instruments. Also, a small number of devices will be relocated to improve system demarcation. These relocations will contribute to the satisfaction of the objective of maximizing the probability of successful operator performance.

Recommendations for additional changes in device arrangement on the various panels may be made in the September report to improve uniformity and consistency of instruments arrangement.

4.3 PANEL DESIGN

The benchboard design of the control panels, generally, meets the requirements of accepted Human Factors anthropometric standards with respect to configuration dimensions and line of sight zones, reach distances, etc. A specific review of instrument locations on the panels will be undertaken as a part of the working group activities and recommendations pertaining to the solution to identified problems will be included in the September 15, 1980 report by the CRDR group.

4.4 ENVIRONMENTAL CONDITIONS

At the present time, much of the equipment that would provide noise interference to communication within the control room is not in operation (HVAC, etc.). Noise measurements will be made

within the control room area when sufficient equipment is in operation to provide a meaningful survey. Appendix E shows the tentative location of noise measurements to be taken within the control room area.

Any interference to person-to person communications or the ability of the operator to hear the annunciator's audible signal will be corrected prior to the fuel load. Adequacy of communication when personnel are suited-up for emergency response will also be reviewed and corrected as required.

Lighting surveys were made of the control room area and the results are included in Appendix F. Analysis of this data has not been completed as of the date of this report.

The use of color in the control room, including color use on the control panels, is also under review and incomplete at the time of this report. Refer to Appendix G for the photo, slide, and location key.

Preliminary color coding for annunciator prioritization, demarcation, and labeling has been developed. Final color coding will be included in the September report.

4.5 LABELING

Labeling of panels and devices, and abbreviations used appear to be inconsistent. Legibility is marginal in some cases due to color contrasts, size of engraving, and amount of descriptive information on a label. Normal and abnormal instrument operating ranges are also not identified on the devices at present.

Before fuel load, some relabeling of the control panels will be completed incorporating consistent use of abbreviations and identification of operating ranges. Criteria is being developed to be used in longer term changes to the control panel equipment labels.

4.6 COMPUTER

The use of the computer as an operating tool will be reviewed in an effort to determine that the information needed by the operator is available and presented in a useful form in the control room. In addition, the computer system to be used as a part of the onsite Technical Support Center will be reviewed for possible incorporation as a normal operating tool. The final report will address this area in more detail with recommendations for further study.

4.7 OPERATING INSTRUCTION REVIEW

The CRDR working group will review samples of the operating instructions for the plant for normal, abnormal and emergency conditions. The minimum of instructions to be reviewed are listed in Appendix D. These instructions will be reviewed for clarity and completeness and will be verified in a walk-through by an operator using either the plant control panels or a full size mock-up. During this review the individual devices (i.e. indicators, recorders, control stations, push buttons, etc.) will be reviewed for suitability, adequacy of information shown, and protection from inadvertent actuation, where required, on push buttons.

Adequacy of information includes such items as instrument range, source of process data (direct vs. inferred), range of devices requiring comparison being compatible, etc. Criteria will be established, where applicable, to correct any deficiencies. Consistency of operation at the control panels, i.e., left to right and top to bottom orientation of control stations, clockwise open, etc., will be reviewed and criteria established.

5. CONCLUSION

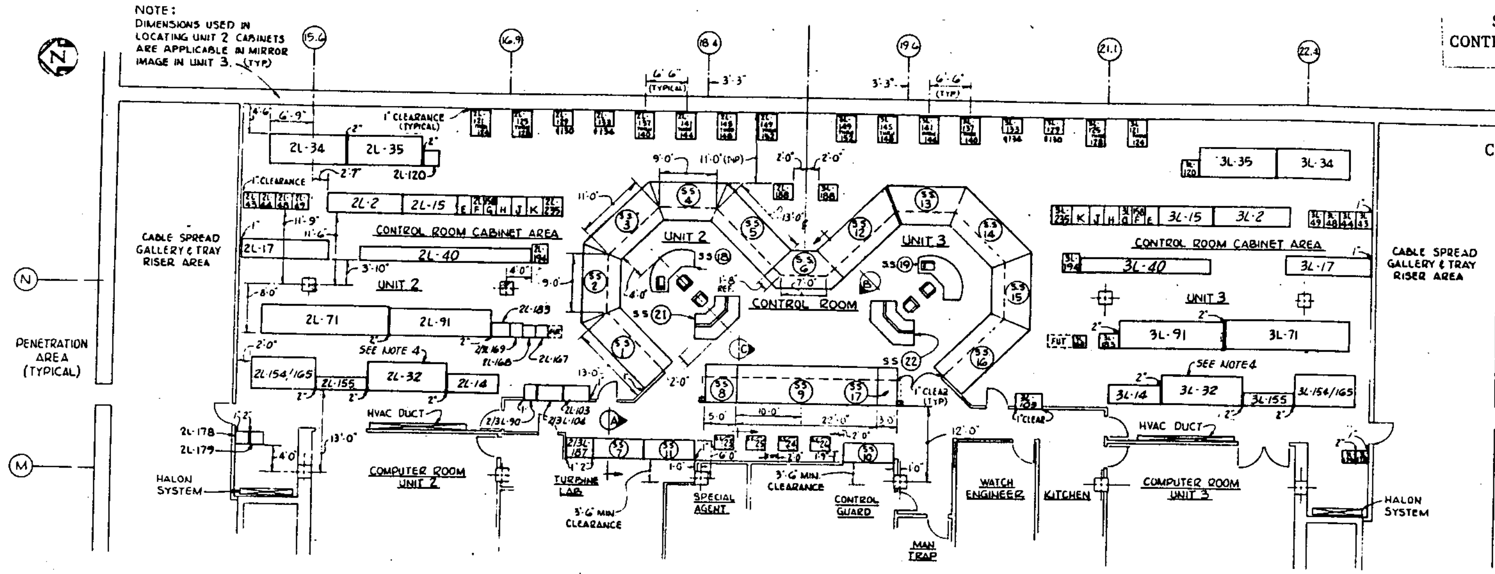
The following actions have been initiated to meet the objective of maximizing the probability of successful operator control of the plant under all conditions:

- System demarcation of the existing control panels
- Prioritization of the annunciator windows on the main control panels
- Relabeling of some devices to incorporate consistent use of abbreviations
- Identification of operating ranges on various instruments
- Limited relocation of devices to eliminate mirror image arrangement of redundant instruments

It is anticipated these items will be accomplished before fuel load on Unit 2.

APPENDIX A

CONTROL ROOM ARRANGEMENT



PANELS & CABINETS WITHIN MAIN CONTROL ROOM

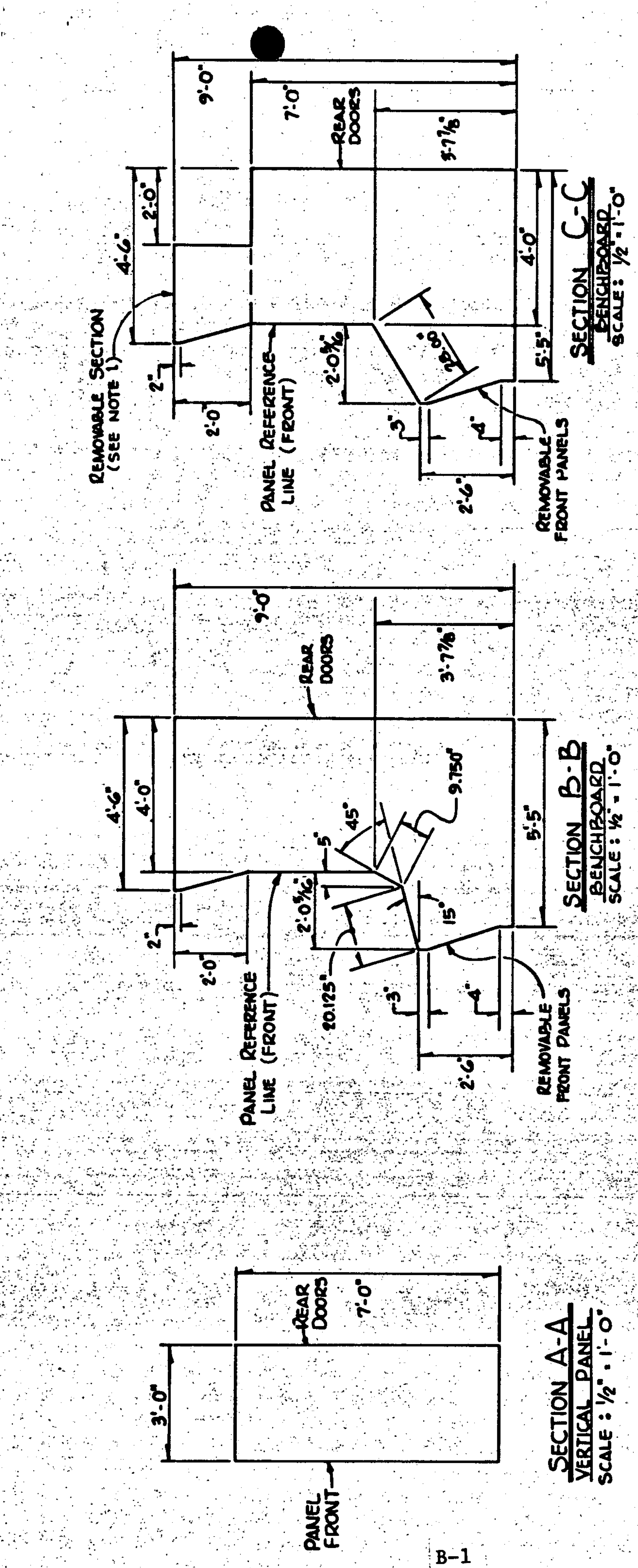
SHIPPING SECTION	BECHTEL PANEL NO.	DESCRIPTION	PANEL ENTRY (FIELD CABLE)
1	2CR-57	ENGINEERED SAFETY FEATURES SYSTEM	BTM
2	2CR-56	PLANT PROT. SYST. & REACTOR COOLANT PUMPS	BTM
3	2CR-58 50, 51	CHEM. VOL. CONTROL, REACTOR COOLANT AND REACTIVITY SYSTEMS	BTM
4	2CR-52 & 53	STM. GEN. WATER LEVEL CONTROL AND FEEDWATER & CONDENSATE	BTM
5	2CR-54 & 64	TURBINE AND SALTWATER & COMPONENT COOLING WATER SYST.	BTM
6	2/3CR-61	COMMON SYSTEMS	BTM
7	2/3CR-62	CHEMICAL CONTROL	BTM
8	2/3CR-60	HEATING & VENTILATING-UNIT 2 & COMMON (SEE NOTE 1)	BTM
9	2/3CR-63	ELECTRICAL MIMIC BUS (SEE NOTE 1)	BTM
10	3CR-59	RECORDERS	BTM
11	2CR-59	RECORDERS	BTM
12	3CR-57	ENGINEERED SAFETY FEATURES SYSTEM	BTM
13	3CR-56	PLANT PROT. SYST. & REACTOR COOLANT PUMPS	BTM
14	3CR-58, 50 & 51	CHEM. VOL. CONTROL, REACTOR COOLANT AND REACTIVITY SYSTEMS	BTM
15	3CR-52 & 53	STM. GEN. WATER LEVEL CONTROL AND FEEDWATER & CONDENSATE	BTM
16	3CR-54 & 64	TURBINE AND SALT WATER & COMPONENT COOLING WATER SYST.	BTM
17	3CR-60	HEATING & VENTILATING UNIT 3 (SEE NOTE 1)	BTM
18	2CR-65	OPERATORS DESK - UNIT 2	BTM
19	3CR-65	OPERATORS DESK - UNIT 3	BTM
20	—	————	—
21	2CR-55	COMPUTER CONSOLE	BTM
22	3CR-55	COMPUTER CONSOLE	BTM
23	2L-100	OPERATOR S PRINTER	BTM
24	3L-100	OPERATOR'S PRINTER	BTM
25	2L-101	DOCUMENTATION PRINTER	BTM
26	3L-101	DOCUMENTATION PRINTER	BTM

PANELS & CABINETS WITHIN CONTROL ROOM CABINET AREA

BECHTEL PANEL # UNIT 2	BECHTEL PANEL # UNIT 3	DESCRIPTION		PANEL ENTRY (FIELD CABLE)
2L 2	3L-2	TURBINE PROTECTION CUBICLE (ELECT)		BTM
2L14	3L-14	UNITISED ACTUATOR PANEL	(NOTE 3)	BTM
2L-15	3L-15	TURBINE SUPERVISORY EQUIP. CUBICLE		BTM
2L-17	3L-17	ELECTRIC GOVERNOR CUBICLE (EHG)	(NOTE 3)	BTM
2L-32	3L 32	PLANT PROTECTIVE SYSTEM CABINET	(NOTE 4&5)	BTM
2L-34	3L-34	ENG SAF. FEAT. ACT. SYST. AUX. CAB. "A"		BTM
2L-35	3L-35	ENG. SAF. FEAT ACT. SYST AUX. CAB. "B"		BTM
2L-40	3L-40	ANNUNCIATOR LOGIC CABINET		BTM
2L 43	3L-43	REACTIVITY REGULATING SYST NO 1 RACK		BTM
2L-44	3L-44	REACTIVITY REGULATING SYST NO 2 RACK		BTM
2L-48	3L-48	FEEDWATER CONTROL SYSTEM NO 1 RACK		BTM
2L 49	3L 49	FEEDWATER CONTROL SYSTEM NO 2 RACK		BTM
2L-71	3L-71	NSSS AUX. RELAY CABINET		
2/3L-90		RADIATION MONITOR SYSTEMS		BTM
2L-91	3L-91	AUXILIARY PROTECTIVE CABINET		BTM
2L-103	3L-103	RADIATION MONITOR SYSTEMS		BTM
2/3L-104		RADIATION MONITOR SYSTEMS		BTM
2L-120	3L-120	STEAM BYPASS CONT. SYSTEM RACK		BTM
2L-121 THRU 2L-152	3L 121 THRU 3L 152	SPEC. 200 CABINETS (EXCEPT 2&3L-131,132,135 & 136) NOT REQUIRED		BTM
2L-154/165	3L 154/165	HVAC SYSTEMS CONTROL		BTM
2L-155	3L-155	HVAC SYSTEMS CONTROL		BTM
2L-158	3L-158	BECHTEL INTERFACE CABINET (BOP) (SPEC 200)		BTM
2L-167	NONE	SEISMIC EVENT RECORDING		BTM
2L-168	3L-168	CIRC. WATER TEMP. DATA LOGGER		BTM
2/3L-169		CIRC. WATER FLOW MEASUREMENT		BTM
2L-178	3L-178	HYDROGEN RECOMBINER CONTROL		BTM
2L-179	3L-179	HYDROGEN RECOMBINER CONTROL		BTM
2L-183	3L-183	F.W. PUMP & TURB. SUPERVISORY INSTR. PANEL		BTM
2/3L-187		METEOROLOGICAL DATA LOGGER		BTM
2L-188	3L-188	BECHTEL INTERFACE CABINET (NSSS)(SPEC 200)		BTM
2L-194	3L-194	LOOSE PARTS MONITORING CABINET		BTM
2L 235	3L-235	MISC. NSSS EQUIPMENT RACK		BTM

APPENDIX B

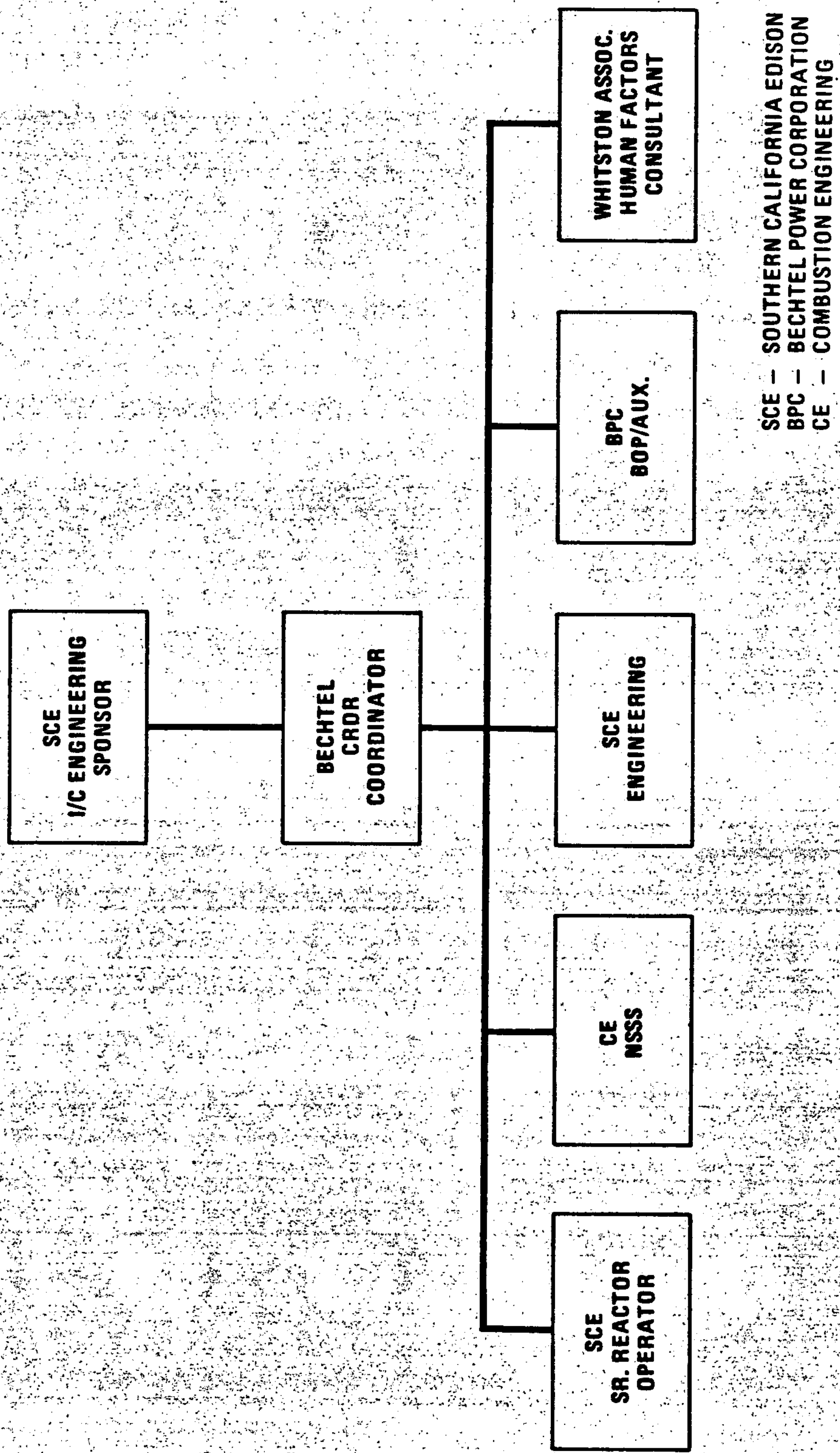
CONTROL BOARD DESIGN



SAN ONOFRE UNITS 2 & 3 CONTROL PANEL DIMENSIONS

APPENDIX C

ORGANIZATION CHART OF THE CONTROL ROOM DESIGN REVIEW WORKING GROUP



CRDR WORKING GROUP ORGANIZATION AND RESPONSIBILITES

Bechtel Power Corporation (BCP) - CRDR Project Coordinator

The CRDR Project Coordinator will manage the CRDR program and coordinate the various participants' activities as required to provide a complete review of all areas related to the CRDR required by NUREG - 0585 and NUREG - 0660.

Combustion Engineering Corporation (CE) - NSSS

The CE representative's primary responsibility will be to provide technical support on all NSSS related items and input to the overall control room control and display analysis including the task (link) analysis.

Bechtel Power Corporation (BPC) - BOP/AUX

The BPC representative's primary responsibility will be to provide technical support on all BOP/AUX related items and input on the overall control room control and display analysis including the task (link) analysis.

Southern California Edison (SCE) - Operations

The SCE Nuclear Operator's primary responsibility will be to input the operator's philosophy of system operation for NSSS and BOP/AUX Systems and assist in the review of selected operating procedures. He will also be responsible for recommending the list of procedures from which a sample group will be selected for review during the three month CRDR.

Southern California Edison (SCE) - Consultant

The SCE Contracted Consultant's primary responsibility will be to provide the Human Factor's Engineering man/machine interface and related services. He will also be responsible for guidance in the preparation of the final CRDR report.

Southern California Edison (SCE) - I/C engineering

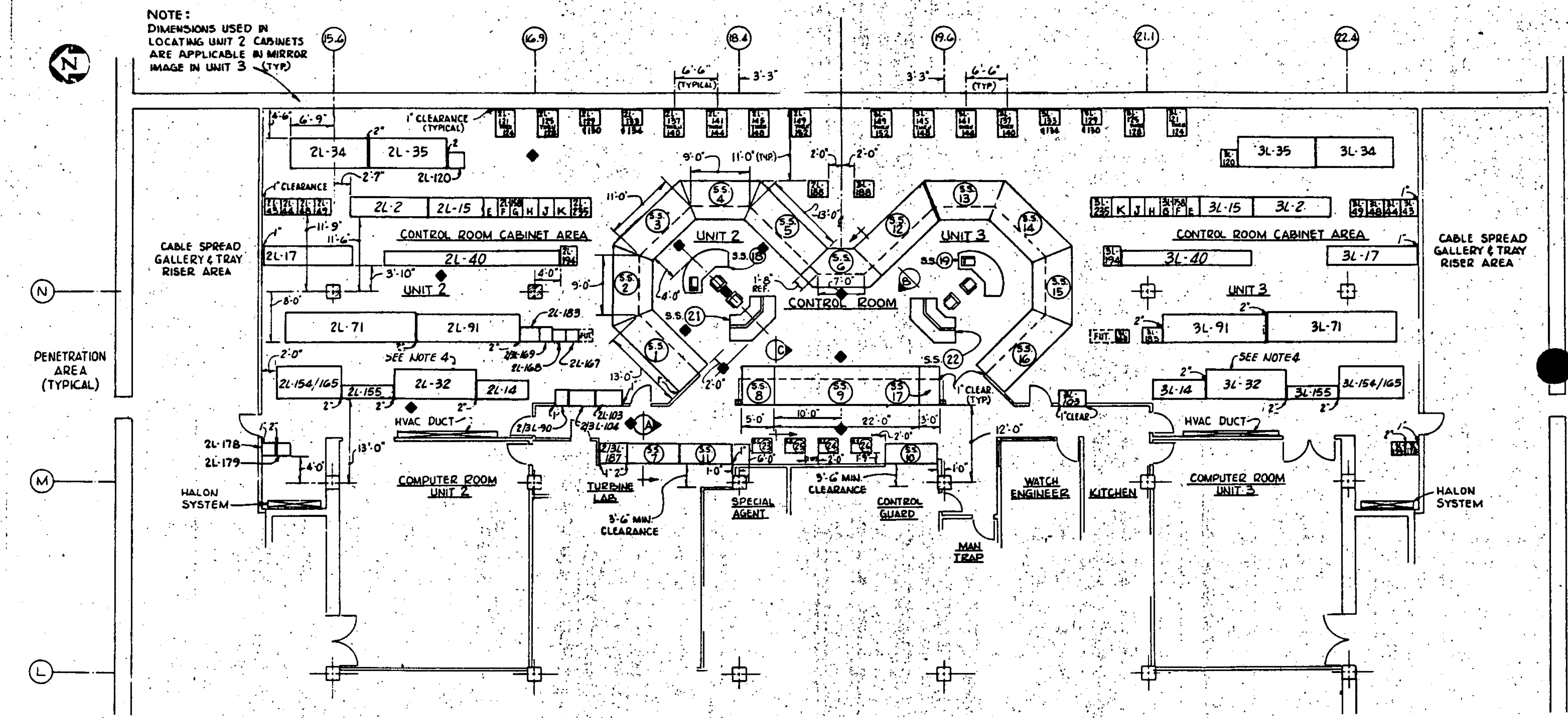
The SCE Engineering Representative's primary responsibility will be to assure the Project direction is maintained and that all SCE discipline inputs are integrated into the CRDR.

HUMAN FACTORS EVALUATION CRITERIA MATRIX

SAN ONOFRE 2 AND 3
CONTROL ROOM DESIGN REVIEW

APPENDIX D

HUMAN FACTORS EVALUATION CRITERIA	Annunciators		Containment Cooling	Containment Spray	Containment Isolation	Safety Injection	Cont. Sump Recirc.	Main Steam Isolation	Auxiliary Feedwater	Control Room Isolation	Toxic Gas Isolation	Fuel Handling Isolation	Cont. Purge Isolation	Cont. Comb. Gas		Nuclear Instrumentation	Reactor Regulation	Feedwater Regulation	Reac. Chem. & Volume	Reactor Protection	Main Steam	Feedwater & Condensate	Main Turb. Hydraulic Gov.		S023 3-2.7 Safety Inj. Sys. Oper.	S023 3-2.17 Main Stm. Iso. Valve Oper.	S023 3-2.9 Cont. Spray Sys.	S023 2-4.0 Aux. Feed Pump Oper.	S023 3-5.1 Emerg. Plant Shut Down	S023-3-5.15 Reac. Reg. Sys. Malfunc.	S023-3-2.1 CVCS Chg. & Letdown	S023-2-1.0 Main Feedwater Pump Oper.			Control Boards - Physical	Control Room & Furnishings
			SAFETY CONTROL SYSTEMS													POWER PRODUCTION CONTROL SYSTEMS									OPERATING INSTRUCTIONS											
CONTROLS Location, Movement, Spacing, Coding, Accidental Activation			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓													
VISUAL DISPLAYS Orientation, Location, Viewing Distance, Coding, Scale Ranges, Scale Coding, Lamp Test	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓													
CONTROL/DISPLAY INTEGRATION Location, Grouping, Group Layout, Group Identification	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓													
LABELING Abbreviations, Consistency of Location, Functional, Viewing Distance, Coding	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓													
AUDITORY COMMUNICATIONS Types, Signal Variations, Discrimination	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓													
STATIC ANTHROPOMETRICS Structural, Passageway & Accesses, Reach, Movement, Position																																			✓	✓
ENVIRONMENT Ventilation, Temperature, Humidity, Dust, Odors, Illumination, Noise																																			✓	✓
WORKSPACE DESIGN Kickspace, Handles, Work Surface, Storage Space, Knee Room, Armrests																																			✓	✓
HAZARDS AND SAFETY Safety Labels, Emergency Exits, Stairs Obstructions, Access, Edge Rounding, Electrical, Mechanical, Toxic					✓					✓	✓	✓	✓																						✓	✓
DESIGN FOR MAINTAINABILITY Malfunction Identification, Removal, Repair, Adjustments, Access, Instructions	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓												✓	✓
INFORMATION ENTRY, ACCESS, STORAGE & RETRIEVAL Visual or Auditory, Type of Display, Stimulus Dimension	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓													
DESIGN FOR PERSONAL REQUIREMENTS Sensory/Perceptual, Intellectual, Output, Physical Skills	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓



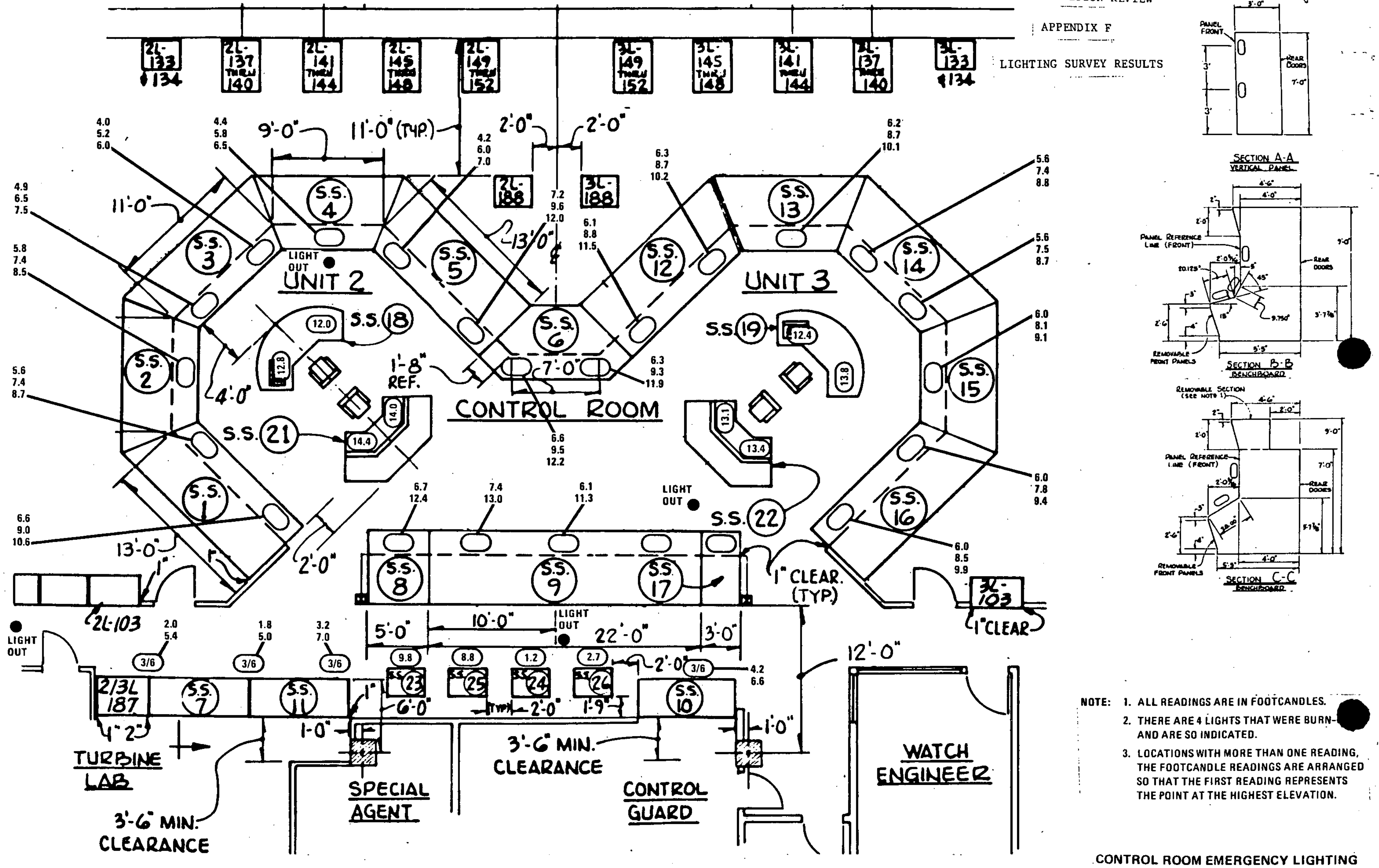
SOUND LEVEL SURVEY:

1. READINGS SHOULD BE TAKEN FIVE (5) FEET ABOVE FLOOR.
2. READINGS SHOULD BE IN dBA (dB WEIGHTED AVERAGE AS DEFINED BY OSHA).
3. ◆ : INDICATES SUGGESTED POINTS FOR READINGS. ADDITIONAL READINGS MAY BE TAKEN AT ANY OTHER POINT, PARTICULARLY IN AREAS WITH HIGHER NOISE LEVELS THAN FORESEEN.
4. READING LOCATIONS HAVE BEEN IDENTIFIED ONLY IN UNIT 2 AND COMMON AREAS. IT IS DESIRABLE THE SURVEY COVER EQUIVALENT LOCATIONS IN UNIT 3.

SAN ONOFRE 2 AND 3
CONTROL ROOM DESIGN REVIEW
TENTATIVE LOCATION OF NOISE MEASUREMENTS

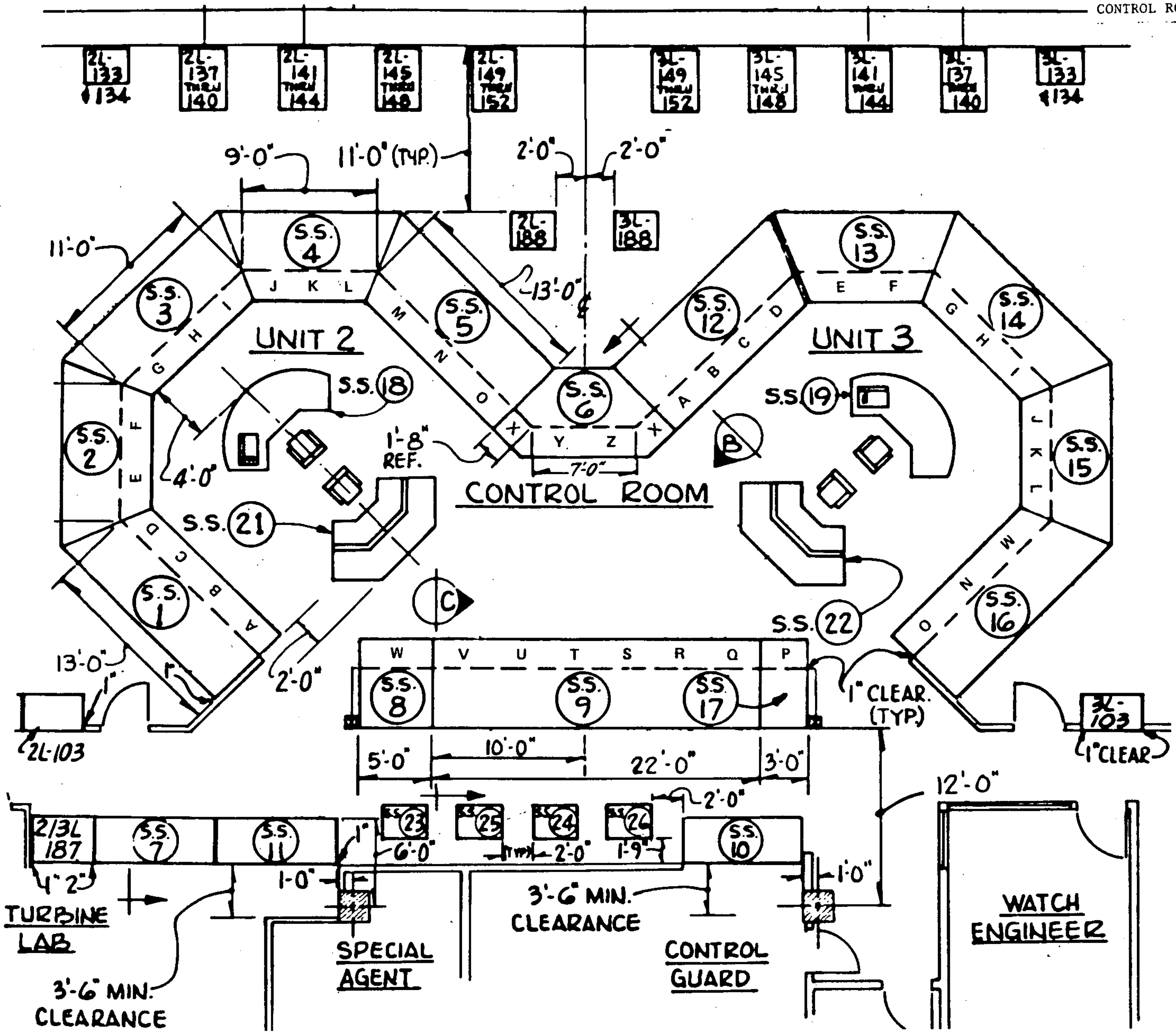
Normal lighting intensity readings not not available due to an excessive number of fluorescent fixtures burned out, and San Onofre Craft and Labor Union out on strike, and unavailability for relamping.

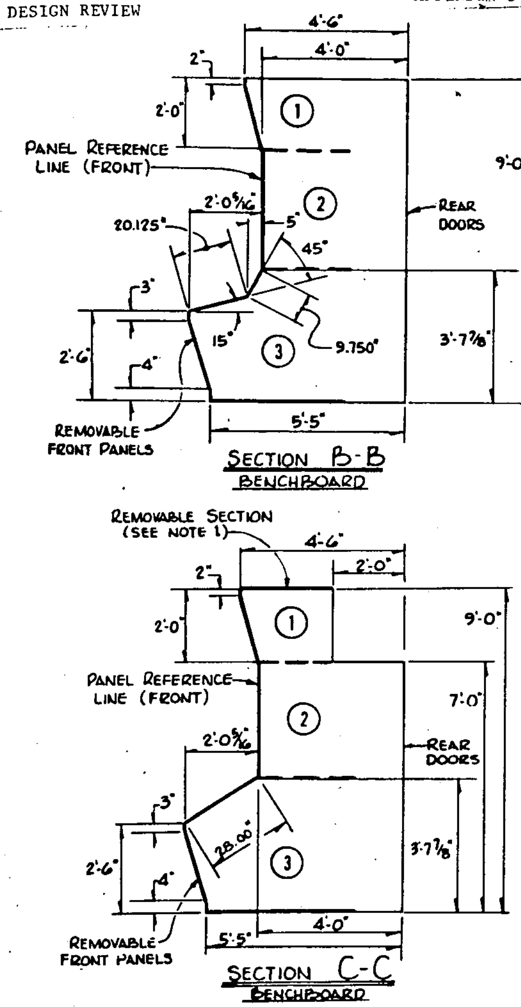
LIGHTING SURVEY RESULTS



NOTE:
1. ALL READINGS ARE IN FOOTCANDLES.
2. THERE ARE 4 LIGHTS THAT WERE BURN- AND ARE SO INDICATED.
3. LOCATIONS WITH MORE THAN ONE READING, THE FOOTCANDLE READINGS ARE ARRANGED SO THAT THE FIRST READING REPRESENTS THE POINT AT THE HIGHEST ELEVATION.

CONTROL ROOM EMERGENCY LIGHTING





UNIT 2 IS PREFIX 2A
UNIT 3 IS PREFIX 3A
COMMON IS PREFIX *

I.E. 2A-1 UNIT 2 SECT. A TOP PANEL
I.E. *Y-3 COMMON SECT. Y BOTTOM PANEL

NOTE: 1. COMMON PANELS ARE P, Q, R, S, T, U, W, Y & Z

2. UNITS 2 & 3 PANELS ARE A, B, C, D, E, F, G, H, I, J, K, L, M, N, O AND X.

PHOTO/SLIDE LOCATION KEY

ENCLOSURE 1
ATTACHMENT 3

ATTACHMENT 3

AD12AB
SO 2/3

October 29, 1980

Director, Office of Nuclear Reactor Regulation
Attention: Mr. Frank Miraglia, Branch Chief
Licensing Projects Branch 3
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

The NRC Human Factors Engineering Staff conducted a four-day audit of the San Onofre Nuclear Generating Station Unit 2 Control Room during the week of August 4-8, 1980. On August 29, 1980, SCE was provided with a draft report delineating the NRC's audit findings and conclusions.

SCE met with members of the NRC's Human Factors Engineering Staff on September 16, 1980 to discuss responses to the NRC's audit findings. Consistent with the staff's request during the meeting, sixty-three copies of SCE's responses to the audit findings are enclosed. These responses reflect the comments made by the NRC during the meeting and satisfy the concerns identified as a result of the August 4-8, 1980 NRC audit.

If you have any questions or comments concerning this matter, please contact me.

Very truly yours,

K. P. Baskin
Manager of Nuclear Engineering,
Safety, and Licensing

FRN:wpn
Enclosure

bcc: (See attached page)

15pp. PDR
~~8011100378~~

bcc: w/ Enclosures
D. W. Gilman (SDG&E)
D. R. Pigott (Chickering & Gregory)
H. Peters (SDG&E)
R. Dietch
J. T. Head, Jr.
A. Arenal
H. B. Ray
H. L. Richter
D. E. Nunn
C. R. Kocher/J. A. Beoletto
H. L. Ottoson
W. C. Moody
J. G. Haynes
H. E. Morgan
M. O. Medford
F. R. Nandy
G. E. Reeder
R. M. Rosenblum
A. Pressman (Bechtel)
NRC Files
EDM Files

Correspondence Date: 10-15-80

	ORGAN	Initials	Date
	Mgr, EDO		
/	Mgr, GES		
	Chief, Nucl.		
/	Supv., Lic.	[illegible]	10/28/80
/	Lic. Gr. Ldr.	[illegible]	10/28/80 10-15-80
/	Proj. Mgr.	[illegible]	10-20-80
/	Proj. Engr.	[illegible]	10-20-80
/	Law	[illegible]	10-20-80
	Power Supply		
	Qual. Assr.		
	Env. Affairs		
/	Tech. Or[illegible]		
/	I & C	[illegible]	10/20/80

RESPONSES TO THE NRC'S HUMAN FACTORS ENGINEERING CONTROL ROOM DESIGN REVIEW SAN ONOFRE NUCLEAR GENERATING STATION UNIT 2

The NRC Human Factors Engineering staff conducted a four-day audit of the San Onofre Nuclear Generating Station Unit 2 Control Room during the week of August 4-8, 1980. The audit focused on the following:

Control and display design and location
Work station layout, including visibility and reach
Control room environment, specifically noise and illumination

The NRC Control Room Design Review (CRDR) Audit Team provided, to SCE, a draft report delineating their findings and conclusions. Each discrepancy and/or deficiency was assigned a subjective risk assessment based on the likelihood that the discrepancy and/or deficiency would precipitate or contribute to operator error during critical activities. These ratings are divided into three categories as follows:

Category 1. Serious Concern - Human/System performance degradation with serious potential safety consequence (implementation prior to fuel load).

Category 2. Moderate Concern - Human/System performance degradation with moderate potential safety consequence (implementation prior to operation above 5% power).

Category 3. Other Concerns - These require an evaluation by the licensee for future resolution.

SCE met with the NRC Control Room Design Review (CRDR) Audit Team members on September 16, 1980 to discuss responses to their findings generated as a result of the August 4-8, 1980 Audit. SCE's responses to the NRC Audit findings are provided below. These responses reflect the comments made by the NRC during the September 16, 1980 meeting and satisfy the concerns of the audit team members. The reference numbers used for the following NRC positions and SCE responses are consistent with the numbering scheme used in the NRC CRDR Audit Team's Report:

3.1 Annunciators

a. NRC Position -

No prioritization of annunciators. (Cat. 2)

SCE Response -

Control Room annunciator windows will be prioritized utilizing color coding:

1. Red -System Priority Alarms
2. Yellow -Equipment Priority Alarms
3. White -Non-Priority Alarms (Control Room Verification)
4. Blue -Non-Priority Alarms (No Control Room Verification)

Implementation will be prior to operation above 5% power.

b. NRC Position -

Master acknowledge allows operators to acknowledge alarms from distant locations. (Cat. 2)

SCE Response -

Master acknowledge capabilities will be deleted.
Master silence capabilities will be retained.

Implementation will be prior to operation above 5% power.

c. NRC Position -

No alarm clear signal - operators must periodically reset annunciator to clear windows that are back in limits. (Cat. 2)

SCE Response -

Annunciator system will be modified to incorporate a second flash rate/audible scheme alerting the operator of an alarm returned to normal. The reset will clear the flashing window/audible signal.

Implementation will be prior to operation above 5% power.

3.2 Control Room Environment

a. NRC Position -

It appears that the lighting was arranged without regard for specific task lighting needs for optimum operator performance, readability is impaired on displays due to excessive glare. (Cat. 3)

SCE Response -

A review of the Control Room lighting has been initiated to determine the changes or additions required.

The required modifications will be identified prior to operation above 5% power. Implementation will be prior to completion of the first refueling outage.

b. NRC Position -

Many areas have unsatisfactory or no illumination levels with both normal and emergency lighting - the hallway, (shift engineers office) and in the confined areas adjacent to the control room. (Cat. 3)

SCE Response -

The shift engineer's office does have emergency lighting.

A review of the Control Room lighting which includes the hallway and confined areas adjacent to the Control Room has been initiated to determine the changes or additions required.

These modifications will be identified prior to operation above 5% power.

c. NRC Position -

File cabinets and bookcases restrict visual access to panels. (Cat. 2)

SCE Response -

All required storage will be located in a manner which does not inhibit operator actions and visual access to panels.

Implementation will be prior to operation above 5% power.

d. NRC Position -

Chemistry lab is within Control Room isolation boundries (need further analysis on potential impacts on operators due to the lab). (Cat.3)

SCE Response -

Analysis of the potential impact of the chemistry lab on the control room and Control Room Operators will be performed and corrective action established.

Implementation of corrective actions will be prior to completion of the first refueling outage.

e. NRC Position -

No self contained breathing equipment in Control Room. (Cat.1)

SCE Response -

Survivair sufficient for at least nine people will be provided in the control room.

Implementation will be prior to fuel load.

(Reference San Onofre Units 2 and 3 FSAR Section 6.4.4.3)

3.3 Process Computer

The SCE Responses below have been established using the following criteria. The plant computer functions are provided for operator and administrative convenience in the supervision or analysis of plant conditions. None of these functions are required to insure plant safety or permit plant operation. (Reference San Onofre Units 2 and 3 FSAR, Section 7.7.1.6.)

a. NRC Position -

Computer alarms are not prioritized as to safety significance nor does the storage configurations permit quick access to the alarms. (Cat. 3)

SCE Response -

An evaluation of computer alarm prioritization as to safety significance and computer storage configuration for quick access to the alarms will be completed prior to operation above 5% power.

b. NRC Position -

Process computer data base is not up to date. (Cat. I)

SCE Response -

The process computer data base is being updated. Monitoring of the data base parameters will continue with modifications being incorporated as they are identified. The computer data base will be updated to current status prior to fuel load and will be continuously updated and input regularly.

c. NRC Position -

Data point addresses are not cross indexed by name, system/subsystem or functionally grouped. (Cat. 2) I

SCE Response -

A cross index by name, system/subsystem and functional groupings will be provided in the form of a notebook available in the Control Room.

Implementation will be prior to fuel load.

d. NRC Position -

The computer has no graphic trending capabilities. (Cat. 3)

SCE Response -

A review will be conducted to determine the graphic and trending capabilities required. The feasibility of incorporating the required features will be determined. If not, feasible alternate approaches will be studied.

The review will be completed prior to operation above 5% power.

Implementation of the resulting method will be prior to completion of the first refueling outage.

e. NRC Position -

Glare on the CRT display causes degradation in readability. (Cat. 2)

SCE Response -

The CRT glare will be corrected by shielding the CRT display. The CRT glare problem will also be addressed as part of the review of control room lighting (Reference the response to NRC position 3.2a).

Implementation of the CRT shielding will be prior to fuel load.

f. NRC Position -

Operator training is not completed. (Cat. I)

SCE Response -

Operator training is currently in progress.

Trained operating personnel will be available prior to fuel load.

g. NRC Position -

A window fan is used to cool process computer console. Operators use top of console to lay out drawing causing reduction in air circulation. (Cat. I)

SCE Response -

A review of the computer temperature/air circulation problem is currently in progress.

Provisions will be made for laying out drawings which will not impede air circulation.

Implementation of corrective action required for the computer temperature/air circulation will be prior to fuel load.

3.4 Controls/Indicators

a. NRC Position -

Hydrogen purge key operated controls (Unit 2 train A) has correct position but associated indicator is reversed (control closed is left but, left indicator is open, probably reversed lenses). (Cat. I)

SCE Response -

Key operated controls versus associated indicator position will be corrected.

Implementation will be prior to fuel load.

b. NRC Position -

Main feedwater turbine trip/reset controls are not the same for each turbine. (Cat. 3)

SCE Response -

Main feedwater turbine trip/reset controls have already been made consistent.

c. NRC Position -

The only thing that distinguished pushbuttons from indicators is a black strip on the edges of the indicators. (Cat 3)

SCE Response -

The question of enhancement of indicators has been reviewed and the results conclude that the existing black strip is an adequate method for identification of indicators.

d. NRC Position -

No separate lamp test on pushbuttons. Have 2 bulbs and depend on change in intensity to indicate need for new bulb. (Cat. 2)

SCE Response -

Plant Operating Procedures will require the control operators to identify lamps needing replacement whenever a burned out lamp is observed.

Implementation will be prior to fuel load.

e. NRC Position -

There are large numbers of "Master Specialty" pushbuttons, and many clusters. This creates a potential for accidently selecting the wrong pushbutton so labeling, coding, and demarcation must be particurlarly good. (Cat. 2)

SCE Response -

The hierarchy of labeling and nomenclature clarity combined with demarcation will be utilized to enhance operator identification of the pushbutton functions.

Implementation will be prior to operation above 5% power.

f. NRC Position -

Foxboro controller for containment spray is not labeled for control (increase, decrease). (Cat. 2)

SCE Response -

The containment spray controller will be provided with increase/decrease labels.

Implementation will be prior to fuel load.

g. NRC Position

Containment Spray Actuation System (CSAS) is mislabeled CCAS. (Cat. 1)

SCE Response -

Containment Spray Actuation System labeling will be corrected.

Implementation will be prior to fuel load.

h. NRC Position -

The 5th percentile operator has difficulty reaching controls on some panels (Electrical & HVAC). (Cat. 3)

SCE Response -

The operator observed during the Audit was less than the 5th percentile. However, he was able to reach all controls. If operating experience indicates the need for a step stool, one will be provided.

<u>3.5 Displays</u>

a. NRC Position -

Small vertical meter on ESF panel (e.g., flow for HPSI, LPSI, containment spray are 6'9" from floor. (Cat. 3)

SCE Response -

These meters (4) are for valve position indication. Each valve also has open/close position indication on the pushbutton operators. The valves are not modulated; therefore, their normal position is open or closed except during transition. The meters are used for status indication only and are redundant.

b. NRC Position -

Scales for RC Loops Hot Leg Temp on Plant Protection Panel are not optimally marked (e.g., major numbers are 54, 60, 66). (Cat. 2)

SCE Response -

Scales for RC Loop Hot Leg Temperature will be replaced with appropriate scale divisions.

Implementation will be prior to operation above 5% power.

c. NRC Position -

Scales for RC Loops Hot Leg Temp on Reactor Coolant System Panel are different than those on plant protection for same parameter (one has a X10 multiplier) same for Cold Leg Temp. (Cat. 2)

SCE Response -

Scales for the RC Loop Hot Leg and Cold Leg Temperature will be changed to eliminate the X10 multiplier.

Implementation will be prior to operation above 5% power.

d. NRC Position -

SIGMA vertical meters protrude from the board and shadow or obsure labeling below them. The problem is most severe on meters below 5 feet and the "White and Red" (Train A) labels. (Cat. 2)

SCE Response -

All labels will be made flush with the face of the instrument bezel to eliminate shadow effects.

Implementation will be prior to operation above 5% power.

e. NRC Position

There are some make shift techniques for indicating normal operating ranges (e.g., pressurizer pressure and set point). (Cat. 2)

SCE Response -

Normal and abnormal operating range indications will be incorporated where applicable.

Implementation will be prior to operation above 5% power.

f. NRC Position -

Lenses on master speciality switches can be interchanged. (Cat. 3)

SCE Response -

The lenses on Master Specialty switches are mounted on a hinged assembly and the lense is retained by a detente. These features minimize the probability of lense interchange.

g. NRC Position -

Pressurizer pressure indications are 0-750 PSIA and 1500-2500 PSIA. the 750-1500 PSIA range is displayed on the ESF panel about 10 feet away. (Cat. 3)

SCE Response -

This observation is inconsistent with the existing arrangement and instrumentation. There are four pressurizer pressure indicators (one for each channel) with a 1500-2500 PSIA scale (narrow range) for reactor trip inputs and four additional pressurizer pressure indicators with a 0-3000 PSIA scale (wide range) for Reactor Protective System monitoring. These indicators are all located on the PPS panel. The RCS panel (located adjacent to the PPS panel) contains the four 100-750 PSIA

range pressurizer pressure indicators (approximately ten feet away) and these indicators are for shutdown cooling interlocks.

h. NRC Position -

The R.C. drain tank volume control and the R.C. average temperature/R.C. reference temperature indication should be located on the RCS panel. (Cat. 3)

SCE Response -

R.C. drain tank volume indication, R.C. Tavg. indication and RC Tref. are located on the RCS panel. R.C. drain tank volume control is accomplished locally.

i. NRC Position -

Numerous meters are difficult to read beyond 3 feet. (Cat 3)

SCE Response -

All instruments will be reviewed for functional suitability versus readability. The review may conclude that some meters need not be legible beyond 3 feet. For those instruments which need to be legible beyond 3 feet, corrective action will be taken prior to completion of the first refueling outage.

j. NRC Position -

Component cooling water and circulating water system displays are not positioned with respect to their place within the system (heat exchanger inlet and outlet temperature are not adjacent to each other). (Cat. 3)

SCE Response -

The CCW and CWS components will be relocated with respect to their place within the system.

Implementation will be prior to completion of the first refueling outage.

k. NRC Position -

SI verification is apparently by pattern recognition, primarily strings of red and some green lights. There is no cue on panel or in procedures to aid operators in reading what the pattern should be. (Cat. 1)

SCE Response -

Pattern recognition for SI will be provided for incorporation into the operating instructions.

Implementation will be prior to operation above 5% power.

3.6 Labeling

With respect to the general issue of labeling, it should be noted that SCE is currently performing an evaluation for the establishment of a labeling hierarchy, consistency, location, completeness, redundancy, legibility and color coding.

The relabeling will be consistent with the criteria currently being developed and will be fully implemented prior to completion of the first refueling outage. With respect to those items that the NRC Control Room Design Review Audit Team has identified as Category 1 or Category 2, particular attention will be devoted to these items to ensure that the deficiencies are corrected in the required time frame as identified in the responses below. In some instances interim measures may be utilized to correct the deficiencies in the specified time frame until such time that the complete relabeling process is fully implemented.

a. NRC Position

Labeling is generally on the bottom or to the right of components whereas labels at the top are preferred. (Cat. 3)

SCE Response -

Labeling presently at the bottom will be relocated to the top.

Implementation will be prior to completion of first refueling outage.

b. NRC Position -

Labeling is inconsistent with respect to information. For example some labels have nomenclature, instrument number and description of variable. Other labels have only instrument number. (Cat 2)

SCE Response -

Incorrect, inadequate, illegible or missing labeling will be made consistent with the label hierarchy developed. (See general comment made in 3.6).

Implementation will be prior to operation above 5% power.

c. NRC Position -

There is considerable use of Dymo tape and some other temporary labeling. (Cat. 2)

SCE Response -

The existing dymo tape usage will be reviewed for incorporation into the legend hierarchy being developed.

Implementation will be prior to operation above 5% power.

d. NRC Position -

Much information is repeated on labels, this is particulary true on illuminated legends (e.g., on ESF Panel Component Cooling). Labeling is also repeated on illuminated legends and engraved labels below component (e.g., on ESF Panel Component Cooling). (Cat. 3)

SCE Response -

The legend hierarchy being developed will eliminate redundant information.

Implementation will be prior to completion of first refueling outage.

e. NRC Response -

Refueling water flow controller and recorder is mislabeled. Should be Primary Makeup Pump. (Cat. 1)

SCE Response -

Refueling water flow controller and recorder will be relabeled.

Implementation will be prior to fuel load.

f. NRC Position

If there are 4 lines engraved on a legend, the top line is difficult to read when the display is below 4 feet. Have to squat or bend (e.g., Main Steam Isolation Valves and others on ESF Panel. (Cat. 2)

SCE Response -

The legend hierarchy being developed (see general comment made in 3.6) eliminates 4 line legends. All 4 line legends will be replaced.

Implementation will be prior to operation above 5% power.

g. NRC Position -

No demarcation is used; color coding of systems or functions is not used. (Cat 2)

SCE Response -

Color demarcation will be incorporated by painting all component bezels.

Implementation of demarcation will be prior to operation above 5% power.

h. NRC Position -

Emergency feed water system activation controls are not labeled by channel. (Cat. 2)

SCE Response -

Channel identification will be added to the emergency feedwater controls.

Implementation will be prior to fuel load.

i. NRC Position -

Dual function vertical scales are not clearly labeled to identify the function of each scale (e.g., RC Loops 1-2 Temperatures). (Cat. 2)

SCE Response -

The legend hierarchy being developed, (see general comment made in 3.6) will eliminate the confusion relative to dual scale identification.

Implementation will be prior to fuel load.

j. NRC Position -

Labeling is incomplete and inconsistent. However, there apparently is a plan to redo the labeling according to a hierarchial scheme. The examples already in place look good. (Cat. 2)

SCE Response -

Incorrect, inadequate, illegible or missing labeling will be made consistent with the label hierarchy developed (see general comment made in 3.6).

Implementation will be prior to operation above 5% power.

k. NRC Position -

Containment Spray Actuation System (CSAS) is mislabled CCAS. (Cat. 1)

SCE Response -

This is a repeat of NRC position 3.4g, please refer to the response in 3.4g.

l. NRC Position -

HPSI and LPSI Modulating Valves are not labeled as to open/close. (Cat. 1)

SCE Response -

The HPSI and LPSI Modulating Valves will be provided with open/close labels.

Implementation will be prior to fuel load.

m. NRC Position -

Containment Spray Chemical Addition (Foxboro controller). The increase or decrease manual position level is not labeled where you can see it. Also, flow scale does not identify units of measure. (Cat. 2)

SCE Response -

The Containment Spary Chemical controllers will be provided with increase/decrease labels. The flow scale units of measure will be added.

Implementation of labels will be prior to fuel load. Implementation of scale units will be prior to operation above 5% power.

n. NRC Position -

Dual function displays for reactor coolant pumps should have more precise labeling (RCP differential pressure). (Cat. 2)

SCE Response -

Reactor coolant pump labeling will be made consistent by the labeling hierarchy being developed (see general comment made in 3.6).

Implementation will be prior to fuel load.

o. NRC Position -

Legend for Hydrogen Purge control on HVAC panel are reversed (open is over the close position). (Cat. 1)

SCE Response -

This is a repeat of NRC position 3.4a, please refer to 3.4a for the response.

3.7 Control Display Relationship

a. NRC Position -

RCS lacks functional grouping of controls and displays. (Cat. 3)

SCE Response -

RCS functional grouping will be accomplished by a combination of component relocation and color demarcation.

Implementation will be prior to completion of the first refueling outage.

b. NRC Position -

CVCS lacks functional grouping of controls and displays (charging, letdown, and boric acid). (Cat. 3)

SCE Response -

CVCS function grouping will be accomplished by a combination of component relocation and color demarcation.

Implementation wil be prior to completion of the first refueling outage.

3.8 Communications

1. NRC Position -

There are no phone jacks outside main control room area. for communication from back panels. (Cat. 2)

SCE Response -

A study of the overall communication system has been initiated. Phone jacks will be added to the control room back panel area.

Implementation will be prior to operation above 5% power.

3.9 General

a. NRC Position -

Many controls and displays were not installed (core subcooling displays, core protection calculators). (Cat. 1)

SCE Response -

The controls and displays associated with systems which are required to be operational prior to fuel load and prior to operation above 5% power will be installed prior to fuel load and prior to operation above 5% respectively.

b. NRC Position -

Operator guides to the core protection calculators were not in control room. (Cat. 1)

SCE Response -

All required operator guides for the CPC's will be located in the control room.

Implementation will be prior to fuel load.

c. NRC Position -

Aux Feedwater Reset is on the relay cabinet in the back room. If the operator terminated flow by turning off AFW pump and the condition returned - the AFW pump will not start automatically because he did not rest the FWS. This requires an operator to leave the control room. (Cat. 2)

SCE Response -

The operating procedures will require the operator to reset the system once the operator has overridden a safety signal at the component level.

Implementation will be prior to operation above 5% power.

ENCLOSURE 1
ATTACHMENT 4

I.D.1 Control Room Design Review

Position

In accordance with Task Action Plan I.D.1, Control Room Design Reviews (NUREG-0660), all licensees and applicants for operating licenses will be required to conduct a detailed control-room design review to identify and correct design deficiencies. This detailed control-room design review is expected to take about a year. Therefore, the Office of Nuclear Reactor Regulation (NRR) requires that those applicants for operating licenses who are unable to complete this review prior to issuance of a license make preliminary assessments of their control rooms to identify significant human-factors and instrumentation problems and establish a schedule approved by NRC for correcting deficiencies. These applicants will be required to complete the more detailed control-room reviews on the same schedule as licensees with operating plants.

Clarification

NRR is presently developing human-engineering guidelines to assist each licensee and applicant in performing detailed control-room review. A draft of the guidelines has been published for public comment as NUREG/CR-1580, "Human Engineering Guide to Control Room Evaluation." The due date for comments on this draft document was September 29, 1980. NRR will issue the final version of the guidelines as NUREG-0700 in April 1981, after receiving, reviewing, and incorporating substantive public comments from operating reactor licensees, applicants for operating licenses, human-factors engineering experts, and other interested parties. NRR will issue evaluation criteria, by July 1981, which will be used to judge the acceptibility of the detailed reviews performed and the design modifications implemented.

Applicants for operating licenses who will be unable to complete the detailed control-room design review prior to issuance of a license are required to perform a preliminary control-room design assessment to identify significant human-factors problems. Applicants will find it of value to refer to the draft document NUREG/CR-1580, "Human Engineering Guide to Control Room Evaluation" in performing the preliminary assessment. NRR will evaluate the applicants' preliminary assessments including the performance by NRR of onsite review/audit. The NRR onsite review/audit will be on a schedule consistent with licensing needs and will emphasize the following aspects of the control room:

1. The adequacy of information presented to the operator to reflect plant status for normal operation, anticipated operational occurrences, and accident conditions;

2. The groupings of displays and the layout of panels;

3. Improvements in the safety monitoring and human-factors enhancement of controls and control displays;

4. The communications from the control room to points outside the control room, such as the onsite technical support center, remote shutdown panel, offsite telephone lines, and to other areas within the plant for normal and emergency operation.

5. The use of direct rather than derived signals for the presentation of process and safety information to the operator;

6. The operability of the plant from the control room with multiple failures of nonsafety-grade and nonseismic systems;

7. The adequacy of operating procedures and operator training with respect to limitations of instrumentation displays in the control room;

8. The categorization of alarms, with unique definition of safety alarms.

9. The physical location of the shift supervisor's officer either adjacent to or within the control-room complex.

Prior to the onsite review/audit, NRR will require a copy of the applicant's preliminary assessment and additional information which will be used in formulating the details of the onsite review/audit.

Discussion and Conclusions, I.D.1

A. Background

As a part of the staff actions following the TMI-2 accident, we require that all applicants for operating licenses conduct a detailed control-room design review (Item I.D.1, NUREG-0660, Vol. 1, May 1980). We expect these reviews to be initiated within the next several months and be completed in 1982. As an interim measure, Southern California Edison Company (SCE) was required to perform a preliminary design assessment for the San Onofre 2 control room to identify significant human-factors deficiencies and instrumentation problems (SCE, 1980a). The NRC staff and its consultant followed up the SCE assessment with a 4-day onsite control room review and SCE assessment audit. The review covered the nine items listed above under "Position," which included the assessment of control and display panel layout, annunciator design, labeling of panel components, and the usability of selected emergency procedures (USNRC, undated). The review and audit were performed by means of an inspection of the control panels, interviews with operators, and observation and videotaping of operators as they walked through selected emergency procedures.

Although our review identified some human-factors deficiencies, in general we found that the control room was designed to promote effective and efficient operator actions. The controls and displays are, in most cases, functionally grouped and generally well integrated. Alarm displays have good visibility and are easily readable from the main control area. Alarm displays are located over appropriate system controls and displays. The physical design of the vertical boards and the control console reflects consideration of human anthropometry. Alarm panels are tilted down for normal visual access and all controls on bench boards are accessible to operators. In many cases the deficiencies identified by the staff had been previously identified by SCE during their control-room review, and plans are in process to rectify many of these deficiencies.

B. Identification of Human Factors Deficiencies

The more significant human-factors-related deficiencies in the San Onofre Nuclear Generating Station Unit 2 control room which were identified during

the control room review/audit are listed below. The deficiencies are those which we believe could cause the operator to take erroneous actions under normal and stressful operating conditions. These operator actions could initiate a transient or could exacerbate the operator's response to an abnormal event already underway. Items 1, 2, and 3 list the deficiencies which we believe to be significant enough to require correction prior to fuel loading. Items 4 through 8 are deficiencies which offer no significant safety risk to fuel-loading and low-power testing. We require Items 4 through 8 be corrected prior to exceeding the 5% power level (except where noted).

Deficiencies to be Corrected prior to Fuel Loading

1.0 Process Computer

a. The process computer data base is not up-to-date.

The process computer data base is being updated. Monitoring of the data base parameters will continue with modifications being incorporated as needed changes are identified. The computer data base will be updated to current status prior to fuel load and will be updated periodically as required.

b. Operator training is not completed.

Operator training in the use of the process computer is currently in progress. Process computer trained operating personnel will be available on each shift during startup and power operations.

c. A window fan is used to cool the process computer console (operators use the top of the console to lay out drawings, causing reduction in air circulation).

Provisions will be made for laying out drawings which will not impede air circulation through the computer consoles.

d. Data point addresses are not cross indexed by name, system/subsystem or functionally grouped.

A cross index by name, system/subsystem, and functional groupings will be provided in the form of a notebook available in the Control Room.

e. Glare on the CRT display causes degradation in readability.

The CRT glare will be corrected by shielding the CRT display.

2.0 Labeling Errors

a. Containment spray actuation system (CSAS) is mislabeled CCAS.

b. Refueling water flow controller and recorder is mislabeled. Should be primary makeup pump.

c. HPSI and LPSI modulating valves are not labeled as to open/close.

d. Legend for hydrogen purge control on HVAC panel are reversed (open is over the closed position).

All labeling errors identified in items 2a, b, c, and d will be corrected.

3.0 General

a. Verification that safety injection (SI) has occurred is by pattern recognition, primarily strings of red and some green lights. There is no cue on the panel or in procedures to aid operators in reading what the pattern should be.

Pattern recognition information will be incorporated into the emergency operating procedures whenever SI has to be verified.

b. Operator guides to the core protection calculators were not available to the operators in the control room.

Operator guides for use of the core protection calculators will be located in the control room.

Deficiencies to be Corrected prior to Exceeding 5% Power

4.0 Annunciators

a. The annunicators were not prioritized.

Control room annunciator windows will be prioritized utilizing color coding:

1. Red - System Priority Alarms

2. Yellow - Equipment Priority Alarms

3. White - Non-Priority Alarms (Control Room Verification)

4. Blue - Non-Priority Alarms (No Control Room Verification)

b. The master acknowledge allows operators to acknowledge alarms from a distant location (without identifying alarms).

Master acknowledge capabilities will be deleted. Master silence capabilities will be retained.

c. The lack of an alarm clear signal requires operators to periodically reset annunciators to clear alarms that are back within limits in order for operators to receive current plant status information.

Annunciator system will be modified to incorporate a second flash rate/audible scheme alerting the operator of an alarm

returned to normal. The reset will clear the flashing window/ audible signal.

5.0 Control Room Environment

a. It appears that the lighting was arranged without regard for specific task lighting needs for optimum operator performance, readability is impaired on displays due to excessive glare.

SCE has initiated a review of the control-room lighting to determine the changes needed to correct the lighting problems. The necessary modifications will be identified prior to operation above 5% power and will be made prior to the completion of the first refueling outage. The results of the control-room lighting review and proposed modification will be submitted to the NRC staff for approval prior to operating above 5% rated power.

6.0 Labels

a. In general, labeling is incomplete and inconsistent. However, the applicants will redo the labeling according to a hierarchical scheme. The examples already in place are clearly an improvement.

With respect to the general issue of labeling, SCE is evaluating and establishing a labeling hierarchy. Consideration is being given to consistency of location, completeness, redundancy, legibility, and color coding. The implementation of the revised labeling scheme will be completed prior to the completion of the first refueling outage. With respect to those items that the staff has identified, particular attention will be devoted to these items to ensure that the deficiencies are corrected in the required time frame as identified. In some instances, interim measures may be utilized to correct the deficiencies in the specified time frame until such time that the complete relabeling process is fully implemented.

b. Foxboro controller for containment spray is not labeled for control (increase, descrease).

The containment spray controller will be provided with increase/ decrease labels.

c. Scales for reactor coolant (RC) loops hot leg temperature on plant protection panel are not optimally marked (e.g., major numbers are 54, 60, 66).

Scales for RC loop hot leg temperature will be replaced with appropriate scale divisions.

d. Scales for RC loop hot leg temperature and cold leg temperature on reactor coolant system panel are different from those on plant protection for same parameter (one has an X10 multiplier).

Scales for RC loop hot leg and cold leg temperature will be changed to eliminate the X10 mutiplier.

e. SIGMA vertical meters protrude from the board and shadow or obscure labeling below them. The problem is most severe on meters below 5 feet and the "White and Red" (Train A) labels.

All labels will be made flush with the face of the instrument bezel to eliminate shadow effects.

f. There are some makeshift techniques for indicating normal operating ranges (e.g., pressurizer pressure and setpoint).

Normal and abnormal operating range indications will be incorporated on applicable instruments.

g. There is considerable use of Dymo tape and some other temporary labeling.

The existing Dymo tape usage will be reviewed for incorporation into the legend hierarchy being developed. Dymo tape will be used only as an interim measure until a permanent label or marker can be installed.

h. There is no demarcation or color coding of systems or functions.

System demarcation will be incorporated by color coding all component bezels.

i. Emergency feedwater system activation controls are not labeled by channel.

Channel identification will be added to the emergency feedwater controls.

j. Dual function vertical scales are not clearly labeled to identify the function of each scale (e.g., RC loops 1-2 temperatures).

Dual function vertical scales will be clearly labeled to identify each function. The legend hierarchy being developed will eliminate the confusion relative to dual scale identification.

k. Containment spray chemical addition (foxboro controller). The increase or decrease manual position level is labeled where you cannot see it. Also, flow scale does not identify units of measure.

The containment spray chemical controllers will be provided with increase/decrease labels. The flow scale units of measure will be added.

7.0 Lamp Test

There is no separate lamp test for legend switch pushbuttons. These normally have two bulbs and depend on the operator observing the change in intensity to indicate the need for a new bulb.

Plant operating procedures will require the control operators to identify and replace lamps whenever a burned-out lamp is observed.

8.0 Communications

There are no back-panel phone jacks for communications with the main control room area.

Phone jacks will be added to the control room back-panel areas.

C. Minor Deficiencies

Our review identified a number of minor deficiencies, which we believe offer no significant risk to full-power operation. However, to ensure that the additional modifications are made to the control room in the most effective and efficient manner, the staff will not require implementation of the minor design deficiencies until SCE has completed the detailed control-room design review to be required of all operating reactors. As a part of this design review, we will require SCE to evaluate the benefits of installing data recording and logging equipment in the control room to correct the deficiencies associated with trending of important parameters on strip chart recorders in use at most nuclear power plants.

D. Incore Thermocouple Instrumentation Display

There are 56 groups of incore detectors, each group having 6 or more detectors (1 detector in each group is a thermocouple). Individual readouts (one group of 5 detectors) or group trending, utilizing 35 predetermined groups, can be provided via the process computer and CRT display. One group at a time can be displayed; from this each of the 5 individual detectors can be read. For the group-trending capabilities, 35 groups are monitored and any 12 detectors can be displayed. The computer provides thermocouple readouts up to 1650°F. The incore thermocouple system is not consistent with the requirements of Item II.F.2 of NUREG-0737, "Clarification of TMI Action Plan Requirements." The applicants are evaluating the requirements of NUREG-0737, which requires, among other things, a display of temperature to 1800°F and a backup display to be implemented by January 1, 1982 as required by NUREG-0737 (see Item II.F.2 of this report for additional discussion).

E. Conclusions

Based on the findings of this review, it is our judgment that the implementation of the above corrective actions prior to fuel loading for items 1-3 and prior to escalation beyond 5% of rated power for items 4-8 will acceptably lessen the probability of operator errors during emergency operations. We will not issue operating licenses until items 1-3 are implemented. We will condition the operating license, if necessary, to require that items 4-8 are implemented

prior to exceeding 5% power. In addition, we may require additional improvements to be made as a result of the applicants' detailed control-room design review. We expect the completion of the detailed review and most corrective actions to be implemented in 1982 in accordance with Item I.D.1 of NUREG-0737, "Clarification of TMI Action Plan Requirements," dated November 1980. Subject to implementation of the above corrective actions (to be verified by NRC's Office of Inspection and Enforcement), we consider Item I.D.1 to be resolved.

ENCLOSURE 1
ATTACHMENT 5

1. An individual shall not be permitted to work more than 16 hours straight (excluding shift turnover time).

2. An individual shall not be permitted to work more than 16 hours in any 24-hour period, nor more than 24 hours in any 48-hour period, nor more than 72 hours in any seven day period (all excluding shift turnover time).

3. A break of at least eight hours shall be allowed between work periods (including shift turnover time).

4. The use of overtime shall be considered on an individual basis and not for the entire staff on a shift.

Any deviation from the above guidelines shall be authorized by the station manager, his deputy, the operations manager, or higher levels of management, in accordance with established procedures and with documentation of the basis for granting the deviation. Controls shall be included in the procedures such that individual overtime will be reviewed monthly by the station manager or his designee to assure that excessive hours have not been assigned. Routine deviation from the above guidelines is not authorized.

c. Independent Safety Engineering Group (I.B.1.2, SSER #1)

SCE shall have an on-site independent safety engineering group.

d. Procedures for Transients and Accidents (I.C.1, SSER #1, SSER #2, SSER #5)

By May 1, 1982, SCE shall provide emergency procedure guidelines. Emergency procedures based on guidelines approved by the NRC shall be implemented prior to startup following the first refueling outage.

e. Procedures for Verifying Correct Performance of Operating Activities (I.C.6, SSER #1)

Prior to fuel loading, SCE shall implement a system for verifying the correct performance of operating activities, and shall keep the system in effect thereafter.

f. Control Room Design Review (I.D.1, SSER #1)

Prior to exceeding five (5) percent power, SCE shall:

1. Prioritize the control room annunciator windows.

2. Delete master acknowledge capabilities of the annunciator system.

3. Incorporate a second flash note/audible scheme into the annunciator system to alert the operator of an alarm returned to normal.

4. Identify changes required to correct control room lighting for optimum operator performance.

5. Revise control room labeling according to a hierarchical scheme.

6. Label Foxboro containment spray controller.

7. Replace RC loop hot leg temperature scales with appropriate scale divisions.

8. Eliminate 10X multiplier from RC loop hot leg and cold leg temperature.

9. Make all labels flush with the face of the instrument bezel.

10. Incorporate normal and abnormal operating range indications on applicable instruments.

11. Replace Dymo tape with permanent labels or markers.

12. Color code all component bezels.

13. Add channel identification to emergency feedwater controls.

14. Label dual function vertical scales to identify each scale.

15. Provide increase/decrease labels for the containment spray chemical controllers.

16. Incorporate the requirement to replace burned-out lamps in the procedures.

17. Add phone jacks to the control room back-panel areas.

Prior to startup following the first refueling outage, SCE shall complete the changes required to correct control room lighting for optimum operator performance.

g. Special Low Power Testing and Training (I.G.1, SSER #1)

By April 16, 1982, SCE shall provide detailed test procedures and a safety analysis.

ENCLOSURE 1
ATTACHMENT 6

(17) NUREG-0737 Conditions (Section 22)

Each of the following conditions shall be completed to the satisfaction of the NRC. Each item references the related subpart of Section 22 of the SER and/or its supplements.

a. Procedures for Transients and Accidents (I.C.1, SSER #1, SSER #2, SSER #5

Emergency procedures based on guidelines approved by the NRC shall be implemented prior to startup following the first refueling outage that occurs six months or more after NRC approval of the guidelines.

b. Procedures for Verifying Correct Performance of Operating Activities (I.C.6, SSER #1

c. Control Room Design Review (I.D.1, SSER #1)

The control room modifications identified as required in Section 22, Item I.D.1 of Supplement No. 1 to the SER shall be installed and made operational on the schedules identified for each modification in Supplement No. 1 to the SER.

d. Post Accident Sampling System (NUREG-0737 Item II.B.3)

1. By June 1, 1983, SCE shall substantially complete all of the PASS procedures identified in Enclosure 3 of SCE letter of April 14, 1983.

2. Prior to September 1, 1983, SCE shall maintain in effect all compensatory measures other than the PASS that are identified in the SCE letter of April 14, 1983, that are not already covered by Technical Specification surveillance requirements.

3. By September 1, 1983, the PASS shall be operable and the post accident sampling program shall be implemented.

4. Until September 1, 1983, SCE shall provide monthly progress reports on PASS testing, surveillance, maintenance and modifications, and operator training.

ENCLOSURE 1
ATTACHMENT 7

(Slide.)

MR. PRICKETT: Good afternoon, gentlemen.

My name is Jerry Prickett, and I am the Instrumentation and Control Specialist in the Engineering Organization for Southern California Edison.

Since June of 1980, I have been assigned as a Systems Coordinator for the SONGS 2 and 3 control room design review and task force, which I shall hereinafter refer to as the "CRDR Working Group."

This was a human factors' evaluation, and I would like to discuss our activities and findings with you today. As a result of TMI identification of human factors' engineering deficiencies as contributory factors, SCE management elected to commission a task force to perform a human factors' study of the SONGS 2 and 3 control room, even though a NUREG or other specific direction had not been given at that time from the NRC.

The CRDR Working Group was activated on 10 June 1980 at the Bechtel Power Corporation, the Whittier Office, with Bechtel providing the Group Coordinator and Management assistance on an as-required basis by the group.

The following guidelines were provided: To review the SONGS 2 and 3 control room from a human factors' standpoint;

To identify all the man-machine interface areas

where significant human factors' enhancement could be accomplished; to develop a criteria for those areas; and

To propose recommendations for approval and implementation.

(Slide.)

It was additionally determined that the Task Force should be multi-organizational to assure objectivity and a proper blend of capabilities and experience. The organization was set up as follows:

First of all, we had a senior reactor operator who was provided from the SONGS operations. He was also an instructor for the other reactor operators, and had prior experience with the control room layout, specifically being assigned at least four months prior to our June '80 date to evaluate positioning of the controls and instrumentation.

We also coordinated with his peers in supervision on a weekly basis to ensure that all of our decisions were in accordance with their opinions.

The next individual was an NSSS engineer provided by CE. The individual -- Also, SCE provided an I/C engineer, myself.

Bechtel Power Corporation provided two engineers for a balance-of-plant and auxiliary systems, and the coordinator for the group.

And finally, Whitston Associates provided a human

factors' consultant under contract to Edison. This individual also had 30 years of instrumentation and controls power plant systems design.

The group represented 150 years total of instrument control experience, mostly in the power field, but some aerospace and industrial design gave an added perspective to the design philosophy.

In addition, there was a total of 50 years of nuclear design engineering experience represented. Finally, the senior reactor operator, in his weekly meetings with his peers and supervisors as well as a senior representative with Navy experience, contributed about an additional 50 years of combined nuclear operation experience.

(Slide.)

The Task Force charter was as follows:

Basically all members were to be 100 percent dedicated to the effort and isolated as much from the project as possible;

Each member was to have an equal vote in all matters brought before the group;

Authority to assign sub-tasks outside the core group on an as-required basis, which we did quite often;

Cost and scheduling was not to be a primary criteria; and, most importantly of all:

No prior design or conceptual experience with the

project to limit the pride-of-authorship.

(Slide.)

A plan of action was developed:

Review all existing documentation -- NUREGs, Standards, specifications, NRC audits, human factors;

To summarize major areas identified for human factors improvement or enhancement;

To develop criteria for application of these human factors engineering to these specific areas identified;

And then to evaluate the control room utilizing that criteria, to summarize the work and provide a report to management in October of '80, which completed the Phase I project.

Phase II was to identify all other areas requiring further study, and that will be due for submittal in March of '81.

Finally, a third phase will be conducted as required to satisfy any remaining needs of NUREG-0700 when it's released for review.

(Slide.)

In July of 1980, our preliminary report and finding of the CRDR Task Force Charter, Organization, and Plan of Action was transmitted to the NRC. On August 4th through the 8th, 1980, the NRC Human Factors Engineering Branch conducted a detailed five-day audit of the San Onofre Units 2 and 3

control room. Prior to the audit, the CRDR Task Force provided the NRC team with a briefing of their findings to date and a preliminary list of items identified for resolution. The resulting Action Item list from the audit includes the major items identified by the CRDR Task Force. All items on the audit list were categorized for implementation scheduling, and agreed to in subsequent meetings with the NRC team.

As a result of the CRDR detailed human factors' study, the Task Force recommended improvements in the following areas to reduce the probability of operator error and increase the speed of response. They are as follows for Phase I:

Control panel --

MR. CATTON: What were the ground rules when you did this study? It looks to me like all of these things that are listed in your table in Phase II are relatively minor changes. Did you do things like running through procedures and then consider maybe moving this valve over closer to that one because that's where it's used? Or was that a "no, no" as --

MR. PRICKETT: Oh, yes, definitely. As I get on into it, I think you'll see that we did a very complete and extensive treatment of the whole thing.

MR. CATTON: Okay.

MR. PRICKETT: Okay, the control room panel boards essentially we did sub-system demarcation, component relocation, and color coding.

The annunciator system: Prioritization of alarms.

Labeling: Hierarchy, consistency, and so on.

Scaling: Scale coding, correct ranges, upper/lower limits.

Environmental, which included lighting, sound, and colors.

And review of normal/emergency operating instructions.

Phase II, then, were the items for follow-on:

Additional work with the annunciator alarms with regard to plant computer interface;

Electrical mimic/remote shutdown panels, through an additional human factors' evaluation;

Communications; use of mimics; critical functions monitor and onsite technical support center installation; and then an extensive list of miscellaneous items.

(Slide.)

Let's discuss these items. We start with the program layout. You'll notice it's a double horseshoe arrangement, which is identical configuration for 2 and 3. It's not a mirror image. Going around clockwise, the remote units, we start with the engineered safety features panel;

plant protection systems and reactor control panel; steam generator, feedwater condensate; and finally, the turbine-generator panel with the water systems being screened away -- the component cooling water, the turbine plant cooling water, saltwater(?) coolant; and circ water.

With a common services panel in the center, opposite that is the electrical mimic panel for both units. On either side, the small panels are emergency HPHCs for Units 2 and 3 respectively.

Above the electrical panel we have the Tech Support Center, which is the viewing gallery. This configuration is the result of extensive work with L- and U-shaped models, and they finally came up with this. In fact, it was the strong input from Operations and Engineering.

An interesting aspect of this configuration --

MR. WARD: Jerry, excuse me. You're saying that this U-shaped design -- That design has been set for several years, hasn't it?

MR. PRICKETT: Oh, yes. But initially when they first set the criteria, they were looking at an L, and then then went to a U, and then they finally came up with the final mockup, the full-scale mockup, of the horseshoe configuration.

MR. WARD: And that was done when?

MR. PRICKETT: Oh, that was about five years ago,

or a little more.

MR. WARD: Yes.

MR. PRICKETT: And at that time -- if I might add, one of the key points of that is that the operator sits at this console here (indicating) and every instrument is within 13 feet of him. It's very convenient.

MR. DITTO: How long does he sit at that console? He's usually up walking around isn't he?

MR. PRICKETT: He's usually over in this area here (indicating). That's where all the action -- but primarily he does sit a lot, and they do study, whatever, with the RO, the interface with the RO, and there's a certain amount of on-the-job training.

Also, the primary console is forward and is the communications console. The one behind it is the computer console which houses three CRTs and five trend recorders. Back behind him, then, outside of the main area, are the line printers for the computer and the multi-points.

Let's touch on the key area here.

(Slide.)

Now focusing on each panel, in regards to demarcation it can be done with lines. It's been typically done in the past by use of color-coding to provide a resolution for this. Our consultant, Whiston Associates, obtained an additional color consultant and built half-scale models of

the left one-third of the reactor panel to show the effects of the various options available.

(Slide.)

This is the first option. This is basically the color scheme existing at this time, with line demarcation. Notice that although the various sections are demarked, you can't readily discern that these (indicating) three systems here are all the same system.

(Slide.)

Going to a color-coding of the vessels, which was about the third iteration as opposed to painting major sections of the panel, you immediately pick up boric acid section here (indicating), here (indicating), and here (indicating), with the charge and letdown straight down through the center. However, the only problem with this is the panel board predominates and your instruments are in the background.

(Slide.)

We finally ended up with the proper color arrangement. The panel board is in the background. Notice the -- all low-intensity colors, by the way, all pastels for low reflectivity and low operator fatigue. You can immediately pick up the systems and they stand out from the panel. Also, notice that we will be creating a hierarchy of legends. The top one is missing, of course, from the reactor, the primary energy. That will be your double two system,

three will be subsystem, four would be your grouping, and five would be your last level, the individual identification.

MR. CATTON: So the ones that stand out in white are one system; the ones in grey are another system?

MR. PRICKETT: That's correct.

MR. CATTON: Is there any reason that they're sort of mixed together, with the light down in the bottom corner and white up at the top?

MR. PRICKETT: That's during the course of the design, at some point in time you have to freeze your panel design, and then you get additional information --

MR. CATTON: That was the question I asked earlier relating to this.

MR. PRICKETT: Right.

MR. CATTON: It seems to me that you would group the various systems together, rather than having them mixed. What you're doing is you're taking the option of color-coding to try to get around -- trying to avoid the problem of moving instruments around.

MR. PRICKETT: Well, not totally. I'll discuss relocation.

MR. CATTON: To a certain extent that's a correct observation, though.

MR. PRICKETT: Right. And actually, it's a tradeoff. You can do one or the other, or both, or a

combination.

MR. CATTON: Or all.

MR. DITTO: I'd like to make an observation about this. You've talked about the operator and his interaction with these meters, these panels, these switches and things like that. That seems to me to be the thrust of this.

Have you spent as much time determining the rest of the length that is where these things go into the reactor, and which of this information is really vital to the operator, whether they are not things that are coming to the operator? Really what you want to see is operator to machine interface, not the operator to the panel interface. All I hear about is the operator to the panel interface.

MR. PRICKETT: Both of those were considered, like I said, through our operator. We worked on this for about four months with the site prior to coming for our --

MR. DITTO: And operators are not --

MR. PRICKETT: And those --

MR. DITTO: Operators are not always known to understand the system quite as well as they might --

MR. PRICKETT: Right.

MR. DITTO: And so I'm not sure that that's the best place to get the information.

MR. PRICKETT: Needless to say, there are a lot of arguments to be made, but our CE NSSS expert was quite

adept at a lot of the different --

MR. CATTON: I imagine there are some utilities who are reworking control rooms in operating plants, and they're actually moving things around. Your plant isn't operational, yet. You have plenty of time to do that, if you choose to.

MR. PRICKETT: That's correct. We are doing that, by the way, including some during hot functional going on right now.

MR. WARD: Jerry, one more question. In the course of your studies of this, did you run across the information on the British system of panel board design? I believe they use what they call a "pile system." The piles can be --

MR. PRICKETT: Yes.

MR. WARD: Do you have any comment on that?

MR. PRICKETT: That was interesting. If you start from scratch, that's a good way to go (inaudible). One of our individuals was on a workshop in Europe -- he happened to be from Atlanta -- and he did bring back some of that information to the group.

(Slide.)

Okay, just to complete out the color, while we're on it, we come up with a correct total color scheme and begin to reduce operator fatigue. We end up -- or we will

Beg #10

upon completion with something that will look pretty much like this.

(Slide.)

Again you can see the individual sections, and understand how readily the operators pick up the individual systems and learn this panel quite well, as opposed to the standard.

Let's talk about subsystem component relocations. These moves were based on an 11-point criteria developed by the CRDR Task Force. These moves were made from left to right, top to bottom for consistency, symmetry, elimination of islands wherever possible, and mirror images. Most importantly, the left-to-right process predominated, particularly associating this with the TMI closed process.

Let's take a quick look at just one of the panels here.

(Slide.)

This is a steam generator panel. Notice here the incursion of steam, main steam in the aux feedwater area.

MR. BENDER: If you could point to the screen, we could see it better. As it is, we're at a disadvantage. Is there a pointer somewhere?

MR. PRICKETT: You will notice the main steam system (indicating) comes over in the aux feedwater area.

Up here (indicating) we have continual interspersion of the steam generator level controls. Here (indicating) pressure indication, and the main steam.

What we did was to relocate the levels. They're alternating pressure and levels. We put all the levels on the top, and all the pressures below. So now we have this effect (indicating) which the operator, by the way, wants anyway. He wants all levels and all pressures. They're supposed to be separate and distinct down here (indicating) in the aux feedwater area. We actually cut out the entire panel. Part of this was due to the addition of controls for the third aux feed pump, but in doing so we were able to align it perfectly in a pseudo-mimic type configuration to eliminate that problem.

Basically that was a similar type thing we did with all the panels. We ended up with a total of 150 moves for 7, 8 panels -- 7, really, not counting the mimic. It figures out to be about 21 moves per panel, which is very substantial I think. There is no doubt in my mind we identified the key areas that needed improvement. We've done them. They've been approved and implemented, and they're being completed at this time.

MR. BENDER: Have you added anything in to provide trend indication, plotting capability on things that were previously just indicated on a point in time basis?

MR. PRICKETT: Basically we determined that most of the items that required trending are on strip charts now. In fact, it's the computer console that has five dual-pin strip charts where you can assign any point in time to those trends, in conjunction with the Tech Support Center which will give us additional graphics capability.

MR. BENDER: Let's take something like level and pressure indications on steam generators.

MR. PRICKETT: Yes.

MR. BENDER: Can we watch those?

MR. PRICKETT: Yes. Those are on pins right now. There is a form for real-term strip charts.

Okay, let's go to the annunciators next. We completed a prioritization of alarms using four levels.

(Slide.)

Priority one is in red. This sign (indicating) indicates degradation to major safety-related systems with a potential for damage or challenge to a safety system.

Priority two is yellow. It would indicate degradation to a safety-related equipment, with again a potential for damage or deterioration to a priority one condition.

Priority three was primarily nonsafety-related, white, and would be associated with alarm nonsafety related which the operator could verify in the control room.

Priority four was the same thing. It is blue, and

that would be indicative, but that would be a point that he would not be able to verify and would have to send EEO out to verify. That would be like a series or multiple-alarm type input. Let me show you what that looks like.

(Slide.)

This is a typical annunciator. We have roughly three of these -- either two or three, depending upon the panel. So the operator immediately knows the ones he should be concerned with.

MR. WARD: You go so far as to have a hierarchy if three alarms come on? Does he have any guidance as to which one he should pay attention to first?

MR. PRICKETT: I'm not too sure about that, but basically those items when they come in in red, basically something has already happened. He's basically just supposed to stand back and assess the situation, and then not do anything for awhile and see how the systems are actuated or operating.

MR. WARD: So the system you're talking about is the four colors, essentially? Is that what you're talking about?

MR. PRICKETT: Right, four colors.

MR. BENDER: How are you sure that the colors you have selected and the ones you've assigned priority to are the right ones?

MR. PRICKETT: We went through quite a process on that. We came up in the group with our own assessment. We then sent it down to Operations for evaluation. They sent back their comments, which really I don't think they challenged more than about something less than 10 percent of the items. And then we took those into a third group of engineers and came up with some good arguments for -- we changed some, and we didn't change others.

We took them back down to Operations and finally agreed that everything we had was right. So it went through quite a process.

Okay, the other item, as previously noted --

MR. ABBOTT: Excuse me. Jerry, did you consider eliminating any of those alarms?

MR. PRICKETT: Yes, we did talk about that -- specifically, the blues, moving them into another area of the control room for strictly a maintenance supervisor to take care of, but Operations indicated that they wanted the operator to be aware of these even though it wasn't his specific responsibility to delegate that to the RO, or maybe a third maintenance-type individual. We did discuss various alternatives for handling that, but it was decided it was best they leave them there. So the operator was aware of this.

MR. ABBOTT: Are you going to eventually prioritize these alarms with the computer, too?

MR. PRICKETT: Yes, that's correct. That's follow-on Phase II work. We're going to update the computer list and possibly change some of them that aren't in full conformance with the criteria we've established for doing that. We're handling the series in multiples. We're looking at identifying about approximately 75 percent of these points. The other 25 percent of them are multiples, three-flash capability. We probably will identify those so the operator which is which.

MR. WARD: Are any of those the -- Let's see. What you just said, maybe I didn't understand what you said. You said a number of those alarms, 25 percent or something, have more than one --

MR. PRICKETT: Yes. Primarily the blue, a smaller percentage.

MR. WARD: Are any of the reds or the yellows?

MR. PRICKETT: No. I think they're all simple inputs with possibly a few exceptions. There are a few exceptions, But in that case the operator should be aware of those and maybe they should be either assigned, or change the dates, or maybe something should happen to those. So that will be worked out at the engineering phase. All the changes will be coordinated with us.

MR. MATHIS: A question, Jerry. You've been talking, now, about your Phase I?

MR. PRICKETT: Phase I, and touching very lightly on Phase II.

MR. MATHIS: What is your schedule, and when will you complete Phase II?

MR. PRICKETT: We will complete the study next month and make recommendations then. Some of them we know already we want to implement in the Category I situation. In other words, we want to put them into the Phase I changes. We knew right away we were going to want to do that prior to exceeding the 5 percent level.

So what we're going to do is pick up those. We're going to assess those so we know we can do it, the ones we want to do that need to be done.

MR. ABBOTT: Just one other question. How are you -- Each one of those annunciators has a procedure associated with it. That is, the annunciator response procedures. They may refer to operating procedures, or just simply say: Go to this pressure source and check it out.

How were those procedures handled in the control room?

MR. PRICKETT: That's really an Operations question. Mr. Carpintino might want to address it. I do know they have numerous procedures that are SRO procedures. We actually went through all of those. As an instructor, I think he wrote some of them, and corrected and verified all

of them. They do respond to an analysis of the situation to go to the right procedure, emergency procedure. I believe there are some 30 procedures for emergencies, and 200-and-some for normal operations. Basically it's an analysis -- not doing a specific analysis from a single point.

MR. ABBOTT: Let me reword the question. If one of those alarms comes on and I find out what its coordinates are, the XY coordinates are, what do I do, then? Do I go to a procedure that tells me how to clear it?

MR. PRICKETT: That's taken care of in the training. He knows what instrument it's associated with. All those alarms are associated with the -- for instance, here (indicating), this is just one of those windows. It's associated with that system directly below it.

So the first thing I'll do is go below and check his indication and he'll see what corrective action he has to take. As I say, there are normal procedures for that, and he would go to that procedure for that system because he knows what system it is.

If there are multiple inputs, then he does have to make an analysis of what the situation really is.

MR. BENDER: Rather than spending a lot of time discussing it in detail, why don't we try to get through this, because we're running behind schedule and there are people here who you can sort of grab in the hall and, if necessary,

we will have another meeting of this subject only.

MR. PRICKETT: I will just make one final statement: That we did evaluate a number of emergency and normal procedures, and we did provide inputs for Operations for correcting those procedures. Those recommendations were implemented, and we did do simulated walk-throughs, by the way.

The other items noted have been or are in the final stages of being addressed. The Action Item list has been forwarded (inaudible).

In summary, then, SCE is aware that the NRC will issue -- let me just flash the implementation. It's basically the same items that I've gone through primarily from Category I.

(Slide.)

Again, prior to obtaining 5 percent power, panel boards: 150 instrument relocations, labeling hierarchy, annunciator prioritizations, scale, coding, and where required revision of the operating instructions, and then additional items as identified in the Phase II study.

(Slide.)

Phase II, then, will cover additional improvement of the alarm points. As regards the computer interface, labeling hierarchy completed for the fourth and fifth level, and any changes that might be indicated as a result of our

environmental study which will not be completed until next month. We are in conformance with the noise requirement, but we're trying to go a little farther to see if we can improve that.

Finally, then, those other items that will be identified in the Phase II study.

MR. WARD: One question. "Addition of a ring-back feature"? Tell me what that means?

MR. PRICKETT: That was one specific item of the annunciator. That's one feature that we don't have that we would like to see, and that's a fairly expensive change and involves getting into the logic of the electronics.

MR. WARD: What does that mean?

MR. PRICKETT: Well, I guess I'm used to the term "flashback," but basically when an alarm has disappeared or has reappeared to indicate to the operator that an alarm is -- if he has not cleared it -- see, you have to understand the function of a typical annunciator. If the operator does not acknowledge, then that alarm will be there until he acknowledges it and it silences the alarm when it will change from a flashing to a steady-on.

Now if he doesn't reset, then the alarm could come back and he wouldn't know there is an additional feature.

MR. WARD: So if he gets another signal from that sensor, it will come back again?

MR. PRICKETT: Yes. So periodically he will reset, but actually something more important than that that I didn't mention is that we are installing a master annunciator mimic in the center panel which will indicate to the operator which segment of the control room his alarms are in, so that if he gets an alarms, if he happens to be looking at a panel and he assumes that that's an alarm, and there's another one behind him, he will look at that master mimic and he knows that when he takes care of that one he has to turn around and take care of another one without extinguishing the master in the alarm behind him that might be a higher priority.

MR. WALT LIPINSKI: Could we go over the annunciator a little, slowly?

MR. BENDER: Why don't we try to move on to the next item, and catch him in the hall and sort that out?

What else do you have?

MR. PRICKETT: Just a summary statement, then.

We're aware that the NRC will issue NUREG-0700 specifying design criteria. We are confident that the proposed Action Plan for the proposed modifications underway are consistent with this NUREG. SCE will evaluate the NUREG when it is issued to be sure that the new criteria specified by the NRC fully considers the SONGS proposals.

Thank you.

MR. BENDER: Let's see. The next item on the

agenda is instrumentation?

MR. MOODY: Yes.

MR. BENDER: Go ahead.

MR. SPINELL: My name is Al Spinell. I'm from Combustion Engineering and Assistant Project Manager on the San Onofre Units 2 and 3 Project.

(Slide.)

My presentation this afternoon embodies a discussion on the work conducted and in process for San Onofre Units 2 and 3 dealing with inadequate core cooling instrumentation. In my presentation I intend to cover or touch on the following six items:

First, I intend to review briefly the requirements;

Second, define a typical ICC detection system; I will refer to a number of acronyms here, and I will identify them initially with their full nomenclature, and then I will abbreviate them.

The third item, I would like to cover the intervals of an ICC event progression.

Fourth, give an example of these intervals for a small-break LOCA.

Fifth, I'd like to define the ICC detection system presently configured and under evaluation by San Onofre.

Sixth, discuss an implementation schedule.

MR. BENDER: Before you go on, both the acronym and

ENCLOSURE 1
ATTACHMENT 8

MR. OKRENT: So it's pretty hard to get it with any precision?

MR. WINDSOR: At that point in the test plan it is, yes. You might be able to correlate backwards. You can take the flux power information.

MR. PLESSET: If you had a few points, that would be all right. Then we could *withstand you not knowing it. Maybe that's what we'll have to be satisfied with.

MR. BENDER: Further questions?

(No response.)

MR. BENDER: Thank you.

MR. WINDSOR: You're welcome.

MR. BENDER: Let's move on to the human factors engineering.

MR. SINGER: Good afternoon. My name is John Singer. I want to talk to you very briefly about the human factors control room design review that was conducted on San Onofre Units 2 and 3. This review was begun in June of 1980, and the completion of this review satisfies the requirements of NUREG-585 and 660.

We are also going to discuss very briefly the human factors considerations outside the control room, and we will discuss conclusions in the two aspects.

(Slide.)

The organization we put together to conduct this

review was under the sponsorship of Edison Instrumentation and Control Engineering. I was the project coordinator. We had assigned a senior reactor operator from SONGS 2 and 3, a design engineer from Combustion Engineering, design engineer from Edison Engineering, and two additional design engineers from Bechtel Engineering. In addition, under contract to Edison we had a representative of Woodson Associates as a human factors consultant.

This group of eight people were assigned 100 percent of their time to this review, and while we all had some familiarity with the plant, no one had original design experience on this particular station. Hence, we did not have to contend with any pride of authorship in our review.

(Slide.)

Edison management chartered this group specifically to perform a human factors review of the control room. Under the criteria established by Woodson Associates, we were to identify potential areas of man-machine interface communication that could be improved; we were to develop criteria for the solution of problems identified; we were also to develop specific solutions that would satisfy the criteria.

We were specifically instructed that cost was not to be a primary consideration.

We also were asked to review the operating

instructions from a human factors standpoint.

(Slide.)

This review was conducted on the Units 2 and 3 control room: Unit 2 on the left of the horseshoe, double horseshoe; common equipment in the middle; Unit 3 on the other side; electrical, mechanical and HVAC systems in this area.

The purpose of this slide is to orient you to the fact that Unit 2 and Unit 3 are same hand. The ESF panel is located to the left as you walk into the horseshoe on both units. This minimizes a chance of operator confusion if they go from one unit to the other.

(Slide.)

The review was conducted in two phases. The first phase was completed in October of 1980, and at the conclusion of this we made certain recommendations, one of which was that we had additional items that we had identified, that required more study, which instituted the second phase of our study, which is to be completed the end of this month.

The recommendations that we made out of both phases of this for implementation in a Category 1 time frame,; which is before exceeding 5 percent power, were as shown here.

While the general layout of the instruments on the

control panels were very good, we did come up with approximately 150 instruments that we suggested be relocated. The reasons for these relocations were specifically to eliminate any mirror-imaging, ensure that there is consistency on the left or right, top to bottom orientation, make sure that items that are being compared are adjacent to one another; and also, with the addition of a third feedwater pump, aux feedwater pump, we took the opportunity to clarify the auxiliary feedwater system.

We made a decision to do subsystem by the use of color.

(Slide.)

Can you all see this all right?

This is a mockup, a half-scale mockup that was made for demonstration purposes. It is approximately one-third of the reactor control panel, and has on it the CVCS system, with the charging letdown, the boric acid, and the reactor coolant system in the three areas.

The purpose of this slide -- and I want to point out that the arrangement on here is as it exists before any changes were made. The purpose of this slide was to demonstrate the use of demarcation of subsystems by lines. As you can see, it's rather difficult to be able to identify that these instruments in the boric acid system are related to the instruments in this area also in the boric acid

system, as well as these instruments.

It was determined that, because of this, a more practical solution would be to use color to identify the subsystems.

An additional feature that we found in reviewing this was that the color, the dark brown color or the sand color of the panel itself, coupled with the extremes of the white and black on the instruments for the most part, and the various switches in this area, which are darker brown, contributed greatly to operator fatigue. As a result of this, our consultant recommended that we go to a color scheme with a grey background, neutral background, with shadings of grey for the contrast and identification of subsystems.

(Slide.)

And accent colors were required where practical. It's now very easy for the operator to see that the boric acid makeup system includes all of the white instruments, and that the reactor coolant system has, in this case, the orange instruments. The use of the colors greatly contributes to the elimination of the operator fatigue factor.

Another thing I would like to point out on this slide is the use of the labeling hierarchy. This section of the panel does not include the annunciators, which are above

here. A level one identification label would be used at the top of each panel section, such as the reactor control panel or the ASF panel. That's a level one label.

The level two labels are the system level. Level three are subsystem. Level four are grouping. And level five are the component labels.

At the present time, all of the component labels are below the instruments. As you can see, the component labels are now going to be above the instruments.

MR. WARD: Could I ask you a question?

MR. SINGER: Yes, sir.

MR. WARD: The operator fatigue issue, is there a technical definition of "operator fatigue"? How do you know that the grey is better from the standpoint of operator fatigue?

MR. SINGER: Our consultant went through a detailed human factors analysis and put together all of the factors with appropriate ratings, rating values, and it came up to show us that there is a very significant difference between the first panel I showed you, the first layout I showed you of colors, and the present one that we're recommending.

It was a numerical calculation.

MR. WARD: So the consultant does have some sort of a technical basis?

MR. SINGER: Yes. It's based on human factors criteria.

MR. OKRENT: Could I ask, the decision not to mimic hydraulic systems, which I assume is the case, is that because it is thought not to be advantageous? Or that it's too difficult because systems are used in different combinations? Or because it's impractical to do in an as-built system, or some other reason?

MR. SINGER: Essentially, it's the middle of the two reasons. There are so many operating modes in a general operation that it's very difficult to do a good mimicking in most systems. In some areas it can be done very nicely. We do not have any mimics in the control room, with the exception of the electtrical mimic panel, which is a full mimic for the substation, for the switchyard.

We determined in our review that by identifying, clearly identifying the subsystems, as we are doing here, with the color coding, that the operator has the information he needs to properly operate the plant. And we didn't feel that a significant advantage could be gained by going to any extensive use of mimics.

MR. OKRENT: I have the feeling that if one were starting from scratch and if it were practical, what you could do is what you do at the subway stations: You press the mode you want and the lineup that you should have is

there. In other words -- so in that case, I would say you have to have something in mind from the beginning.

MR. MOODY: Dr. Okrent, the presentation following Mr. Singer's, concerning the critical function monitoring system, has mimicking capabilities and it will be discussed in the context of the next presentation.

(Slide.)

MR. SINGER: This is an artist's rendering of the control room as it will look after the color coding has been completed.

The next item we have discussed, the relabeling down to the third level of labeling, and we're going to do the panel identification, the system identification, and the subsystem identification in this first category one time period.

(Slide.)

Next we'll look at a typical annunciator window box on, in this case control room panel number 54. The purpose of this slide is to show you that prioritizations that we are proposing to use, that we are using on the annunciator systems.

The red, the priority one, are system alarms that could lead to a challenge to the safety systems in the plant. They must be responded to immediately.

The yellow are priority two. They are component

systems or component alarms, that if not addressed immediately could lead to a priority one alarm.

The white are priority three. These are the non-safety system alarms that can be verified in the control room.

And the blue are priority four. They are also non-safety-related systems, where the verification cannot be done in the control room, but someone must go out in the plant to respond to it.

We are going to provide coding on all of the instrument scales to show safe operating limits, where applicable. Again, it's "where applicable" because on some of these the modes change and therefore it's not practical to put a limit on it.

We have made suggestions with respect to revisions to the operating instructions, essentially to provide consistency in the format, and these are being implemented.

In the second phase, we studied the remote shutdown panel. As a result of that study, we are recommending approximately 15 instruments will be relocated, and we are going to show system demarcation in that case by use of lines, because it is a very simple system.

We are going to complete the color coding in the control room by color coding the electrical mimic according to the various power levels, such as the 4160 or 480 volt.

(Slide.)

The category two changes that we recommended are to be completed before the end of the first refueling outage. These are additional modifications to the annunciator system to provide a ring-back feature that will alert the operator whenever an alarm goes back to the normal status.

And we're also going to provide a computer interface identification so that the operator can readily identify those alarms where he can get additional information from the computer.

We are going to complete the relabeling to the fourth and fifth level, the grouping and component level, on the remainder of the panel. And certain studies were recommended and undertaken in both phase one and phase two regarding the environment of the control room and the communications system.

The environmental studies or the environment studies dealt with sound level and lighting. While the lighting in the control room is essentially satisfactory from an intensity standpoint, we did have problems of glare on the panel, and we are implementing any glare problems as rapidly as we can.

The sound level studies are going to have to wait until more of the equipment is operating in the control

room, and at that time we will develop recommendations for solutions to any problems that arise.

Communications is an ongoing study.

(Slide.)

In conclusion on this part of the presentation, then, we have developed the criteria for revisions as a result of our human factors review. We have come up with recommendations for revisions to the control room, and these revisions are being implemented at the present time.

The human factors requirements have now been satisfied with respect to the control room and, as we said, additional studies are continuing in the environment of the control room.

(Slide.)

I would like to go on to the second phase of this discussion and describe a systems analysis that was done in the form of the annunciator system review. What we did, in order to prioritize the annunciators, was to go out and to look at the initiating alarm point and determine what information the operator would need to respond to that alarm.

So we checked the information required, we checked the type of instrument that he needed in order to respond to it properly. This means that if the information he needs to respond is the status of a motor or a pump or something,

then we have status lights. If it was analogue-type information, such as flow pressure or temperature, then he would have an analogue instrument.

If it was an instantaneous value that he needed to solve his problem, then we would make sure he had an indicator. If it was historical type information as well as the instantaneous value, then he got a recorder.

We verified that the instruments were the proper type for him to respond. In addition, since we had the level four, which were unverifiable in the control room, we ascertained that the location of all of the instruments for his response were in the proper location, either in the control room where they were on the ports or out in the plant.

One outstanding item that we have turned over to the engineering department for an additional study, which is under way at the present time, is the valve position indication. The purpose of this study is to confirm that all valve position indications, in the control room particularly, are in fact based upon an indication that is takn as close as possible to the final plug, if you will, of the valve, and not an indication of a controller output or a positioner output.

MR. BENDER: Excuse me. Did that request come about because of some alertness on your part that that

hadn't been done, or did it come as a result of some request of the staff?

MR. SINGER: I believe that one showed up in many of the audits and many of the previous audits that were conducted, and the question was raised in the audit of our control room that was done by the staff last August.

MR. BENDER: Thank you.

MR. SINGER: We were asked in the Subcommittee meeting in February to respond to the question of whether we looked into the area outside the control room from a human factors standpoint. In an attempt to answer that, what I would like to say is that the study that was done in the control room, while we had to relocate or recommended the relocation of 150 instruments on the control panels, we did not replace any instruments anyplace in the control room.

We determined that the type of instrument used was adequate for the service intended. The criteria that was used for the selection of instruments on the control panels is the same criteria that was used for the specification and purchase of all equipment instrumentation and control equipment throughout the plant.

We went through a confirmation review of all of the specifications for all of the equipment in the plant and verified that the criteria was used in a specification attachment, so that all instruments in the plant are to the

criteria we had reviewed in our human factors review of the control room.

And we can infer from this that the human factors requirements for the balance of plant are also satisfied.

MR. MOELLER: You mentioned moving 150 or so of the instruments. What would the total be, approximately?

MR. SINGER: There are about 2,000 instruments on Unit 2 in common.

MR. MOELLER: Thank you.

MR. SINGER: To clarify that just a little bit, it is not quite as bad as it seems there. In one area we had, I mentioned the auxiliary feedwater system that was realigned because of the addition of the third feedpump. 32 of the moves were caused by that particular realignment.

Another area of an extensive relocation was the elimination of the mirror imaging that was done on the component cooling water system. There were 46 of the 150 that were involved in that one.

So there were relatively few that were moved for the other reasons.

With respect to labeling in the rest of the plant, again the type of criteria that was used in the control room was used for all panel-monitored equipment throughout the plant. They have adequate labeling, they have appropriate labeling in the proper place.

(Slide.)

On all field-mounted instruments, valves and all equipment in the plant, there is a permanently installed stainless steel tag that has a unique number identification for every piece of equipment in our plant. It also has a service description for that piece of equipment. All of this also is installed.

Accessibility is another human factors consideration outside the control room. There has been an ongoing review of accessibility at the plant for the addition of ladders and platforms and the removal of any intererences with respect to accessibility, not only from a maintenance standpoint but also from an operating standpoint.

Verification of what I've been talking about is done indirectly in three ways. During the course of construction, the field engineering forces are required to verify that all of the instrumentation that is going into the plant meets the specifications under which tht equipment was purchased. If they don't, corrections were made or exceptions were made.

The exceptions had to be clarified and had to be cleared through the engineering department. They were not done at the construction level.

In addition, at the completion of construction the

systems were walked down before turnover to startup, to ensure that not only were all of the instruments there or that all of the devices were there, but that they were properly labeled and they were in fact accessible.

Then during startup the adequacy of the instrumentation is checked out because the startup people are using the systems. Any problems that they have show up in this area.

An example of that was a startup problem report that was generatei because a particular temperature gauge on the demineralizer system was mounted a little above eye height and was facing upward and nobody could read it without getting on a ladder. So it was turned around so that the operator could use it.

In addition to that, as a part of the operator maintenance and training program the operations people have also walked down the systems and verified that they are labeled, they are accessible, and they are the type of instruments that they require.

It's our understanding that NUREG-0700 will be addressing the out of control room and systems analysis review in more detail. We feel that we have met the intent of that. However, when we review NUREG-0700, if necessary we will institute a phase three review.

(Slide.)

In conclusion, in the area outside the control room, then, we have verified that the types of instruments used meet the human factors criteria that were established for the control room review. We have confirmed that every component in the plant has a unique identification on a permanent label. And we have also confirmed that all equipment is accessible for maintenance and operations, either from the floor level or from platforms or from ladders. And any intereferences have been taken care of.

Are there any questions?

MR. WARD: In the field, are there valves that might be manually operated? Are they all labeled?

MR. SINGER: Every piece of equipment in the plant, yes, sir.

MR. WARD: Are they labeled with a tag that it is apparent to the operator that the operator can compare to the working flow diagram?

MR. SINGER: Yes, sir. Everything in this plant has a unique -- no two instruments have the same number.

MR. BENDER: If I were to go down --

MR. SINGER: No. I'm an instrumentation control man. I keep referring to instruments. But this is true of all equipment in the plant. It all has a unique identification.

MR. BENDER: Let me try it this way. If I go down

and I see a valve and it says valve number such and such, will that tell me what flow sheet to go to to find out what that valve does?

MR. SINGER: No, sir.

MR. BENDER: How will I find that out?

MR. SINGER: It will give you a service description, and there is a -- I can answer that as far as instrumentation is concerned. I will have to defer --

MR. BENDER: Don't tell me, but think about it some, because that's what the operator needs to do.

MR. SINGER: Let me tell you how it works. We'll get back to you on that.

MR. BENDER: I don't need an answer. It was just a thought.

Go ahead, Dave.

MR. OKRENT: The non-safety indicators and annunciators and so forth in the control room, do they have any seismic design basis? Is it the SSV or the OPE or what?

MR. SINGER: They're seismic category one on all of the safety instruments for operability. Non-safety instruments and the control panels, non-saety-related, are designed to seismic one, but are qualified for seismic two.

They are designed for -- they'll stand up, but they don't have to operate.

MR. OKRENT: Do you actually differentiate? Let's see, it's designed for seismic one, but it is qualified for seismic two.

Tell me what seismic two means to you, then, in this case.

MR. SINGER: I would like to defer that one to --

I'll put it another way. The annunciators system, do you expect it to function at the OBE or is it designed to do this or what? I'm just trying to understand how you chose to treat the non-safety-related equipment in the control room.

MR. MOODY: Dr. Okrent, let us confer for a few minutes and we'll endeavor to answer that in a few minutes.

MR. OKRENT: Okay, fine.

MR. BENDER: Next questions? More questions?

(No response.)

If not, let's go on to the next subject while you're conferring.

MR. MOODY: With respect to the next subject, I'd like to apologize. We don't have a handout for the 45 millimeter slides that are going to be used. We'd like to take a minute and move the slide projector back so they're visible.

MR. PUCAK: My name is Jack Pucak. I'm from Combustion Engineering.

ENCLOSURE 1
ATTACHMENT 9

ATTACHMENT 9

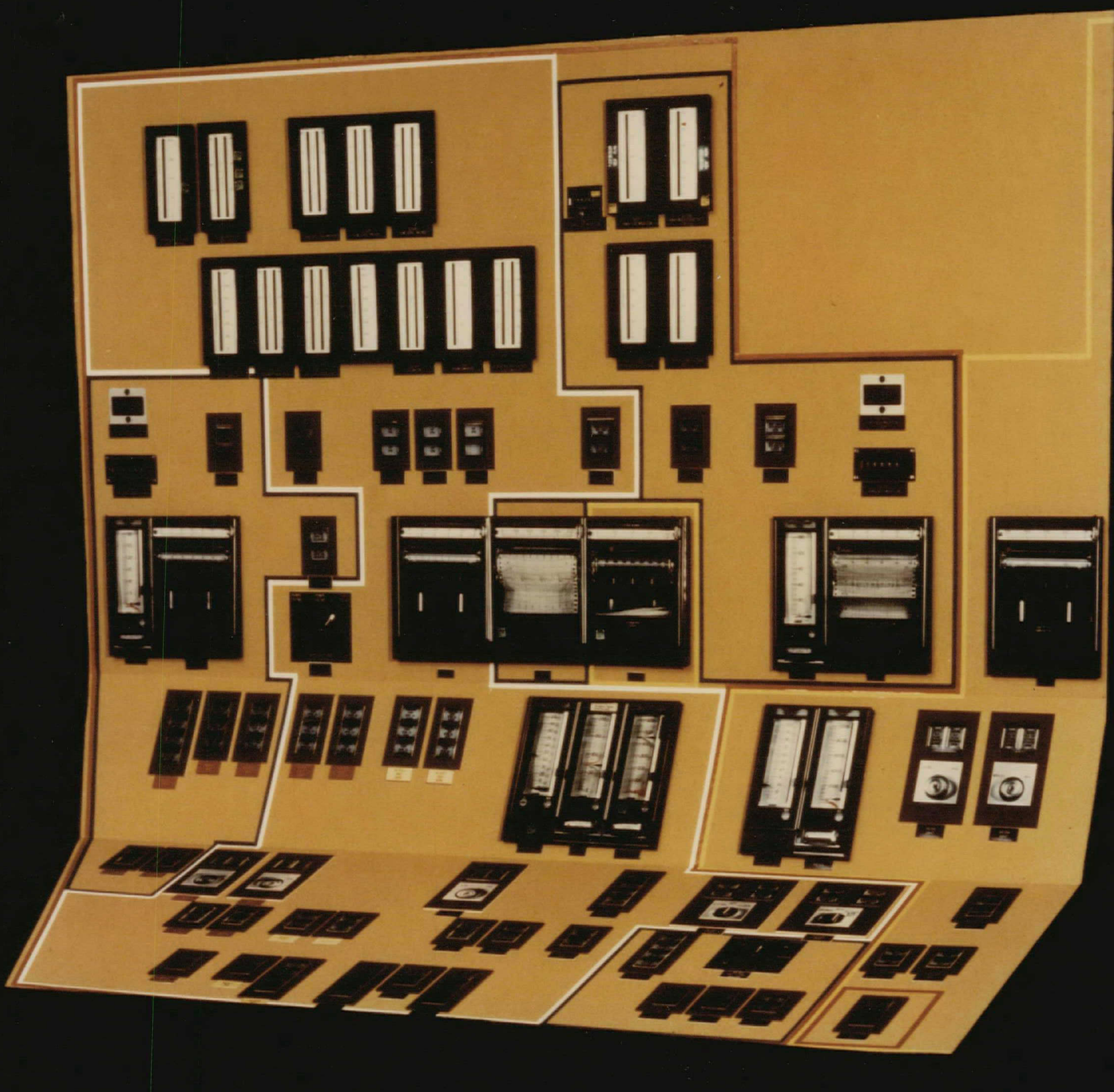


Exhibit A3.7-A
Photo of Model A Present Arrangement,
Existing Backround - Line Demarcation

ENCLOSURE 1
ATTACHMENT 10

ATTACHMENT 10

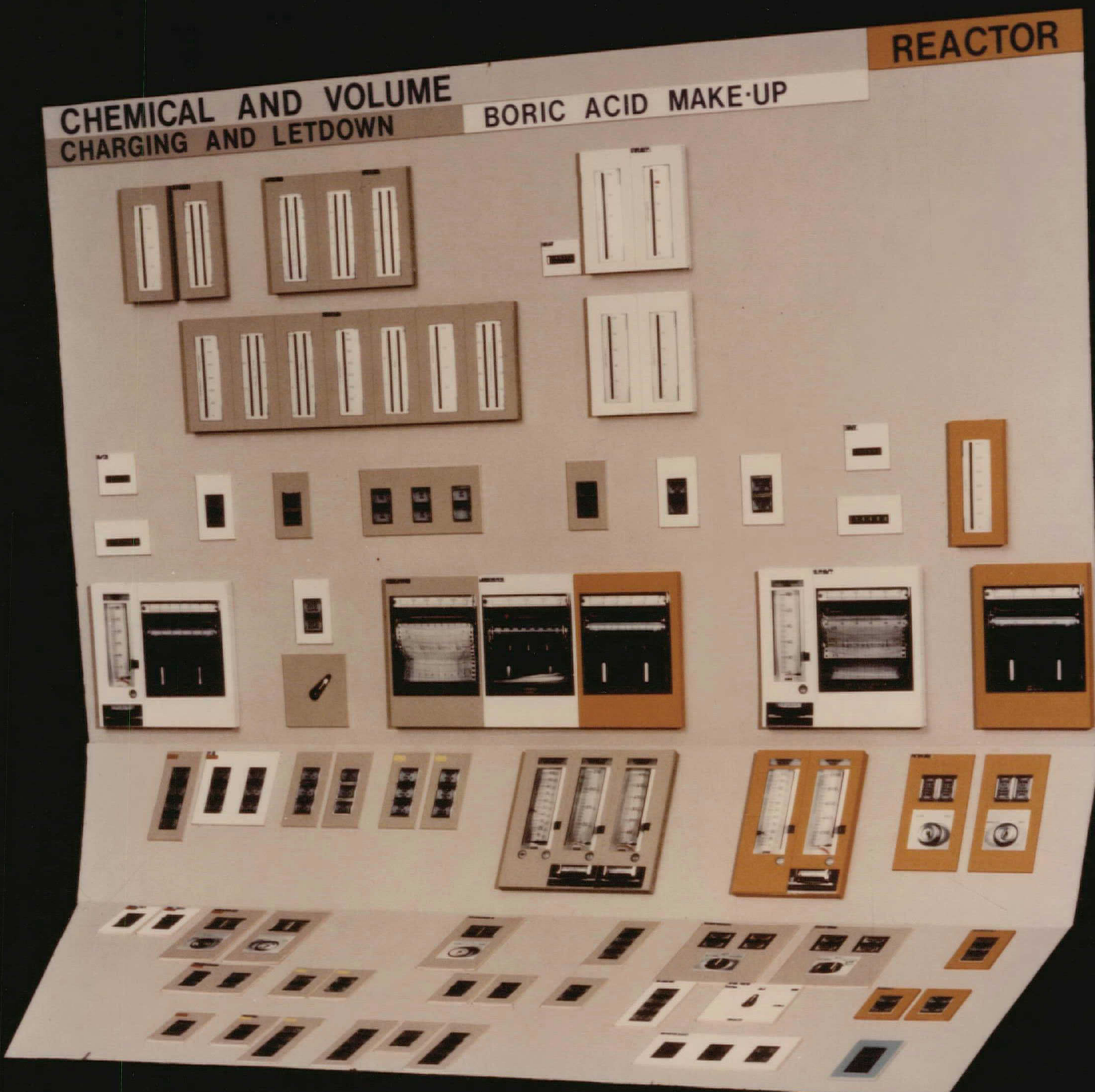


Exhibit A3.7-C
Photo of Model C Present Arrangement,
New Background - Bezel Color Demarcation

ENCLOSURE 2

SAFETY PARAMETER DISPLAY SYSTEM

In response to NUREG-0696 and Supplement 1 to NUREG-0737, SCE has installed an Accident Monitoring System at SONGS 2 and 3. The Critical Function Monitoring System (CFMS) portion of the Accident Monitoring System addresses the requirements for an SPDS.

The CFMS utilizes the concept of critical functions to display a minimum set of information, which define the safety status of the plant. The CFMS evolved as a means of organizing plant data to aid the operator in maintaining plant safety. The critical functions concept is that a nuclear power plant can be maintained in a safe and stable condition if a small number of critical functions are performed successfully. By monitoring the critical functions an operator observes the plant's state, determines if a function is jeopardized and takes appropriate action.

The CFMS monitors, processes and displays 966 input points (SONGS 3) to provide continuous indication of the plant status. Of these inputs, a selected subset of 475 inputs (SONGS 3) is processed through a set of algorithms which determine the status of the eight critical safety functions listed in Table 1. For each critical function, individual logic legs are monitored by the algorithms; and should a condition occur which violates the algorithm's logic leg, that leg will be alarmed to warn the operator of the status of the critical function. The algorithm logic legs and the associated critical functions (Table 2) satisfy the requirements of 4.2.f in Supplement 1 of NUREG-0737. This technique provides a significant reduction of information and allows the operator to continuously monitor a limited set of critical functions. The system's displays are designed from a human factors standpoint to provide both effective presentation of critical function status, as well as concise presentations of supporting information.

Validation testing of the CFMS methodology has been performed in two areas; real time transients testing and dynamic simulator testing. Design transient codes stored on magnetic tape were input to the CFMS, and a determination of the appropriate critical function alarms and sequence of alarms was made for dynamic testing purposes. Further validation efforts were carried out by the Halden Reactor Project to assess the impact of the CFMS on operator performance in assessing ill-behaved plant disturbances. Transients, which presented both severe and complex multiple failure disturbances, were used.

Training in the use and interpretation of the CFMS has been given to operators, plant personnel and management at SONGS 2 and 3 to confirm that the CFMS is readily perceived and comprehended by the SPDS users.

DLC:9073

TABLE 1

CRITICAL SAFETY FUNCTIONS

Reactivity Control	Shut reactor down to reduce heat production
RCS Inventory Control	Maintain a coolant medium around core
RCS Pressure Control	Maintain the coolant in the proper state
Core Heat Removal Control	Transfer heat from core to coolant
RCS Heat Removal Control	Transfer heat from the core coolant
Containment Isolation Control	Close openings in containment to prevent radiation releases
Containment Temperature and Pressure Control	Keep from damaging containment and equipment
Radiation Emissions Control	Contain miscellaneous stored radioactivity to protect public and avoid distracting operators from protection of danger sources

DLC:9073

TABLE 2

Critical Safety Function	Algorithm Logic Legs
Core Reactivity	CEA Drop Malfunction High Post Trip Power Thermal Reactivity Addition Low Boron Concentration
Core Heat Removal	High Core Delta Temperature Low Reactor Vessel Level High Core Exit Temperature Core Saturation Margin Low Reactor Coolant Pump Load
RCS Heat Removal	Shutdown Cooling System Not Cooling Low Safety Injection System Pump Flow Emergency Core Cooling System Not Cooling Steam Generator Not Cooling Low Safety Injection/Feedwater Cooling
RCS Inventory	Low Pressurizer Level Quench Tank Level Quench Tank Pressure Quench Tank Temperature Relief Valve Discharge Temperature
Radiation Emissions	High Condenser Air Ejector Radiation High Containment Radiation High Containment Dome Radiation High Vent/Stack Radiation
Containment Isolation	Containment Isolation Containment Purge Isolation Safety Injection Isolation Main Steam Isolation
Containment Temperature/ Pressure	Fan Coolers Not Operating Low Spray Flow Containment Pressure Change High Containment Pressure Low Containment Pressure High Containment Temperature
RCS Pressure Control	Cold Stress Temperature High Pressurizer Pressure Rate Low Subcooled Margin

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