

SAN ONOFRE NUCLEAR  
GENERATING STATION  
UNITS 2 AND 3

CONTROL ROOM DESIGN REVIEW  
INTERIM REPORT

JULY 25, 1980

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PDR ADOCK 05000361  
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SAN ONOFRE 2 AND 3  
CONTROL ROOM DESIGN REVIEW

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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.

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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.

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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

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- 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.

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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

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4.2 PANEL ARRANGEMENTS

Main control room and emergency evacuation panels will be reviewed for location of devices by systems. Demarcation by system and subsystem 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



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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.

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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.

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5. CONCLUSION

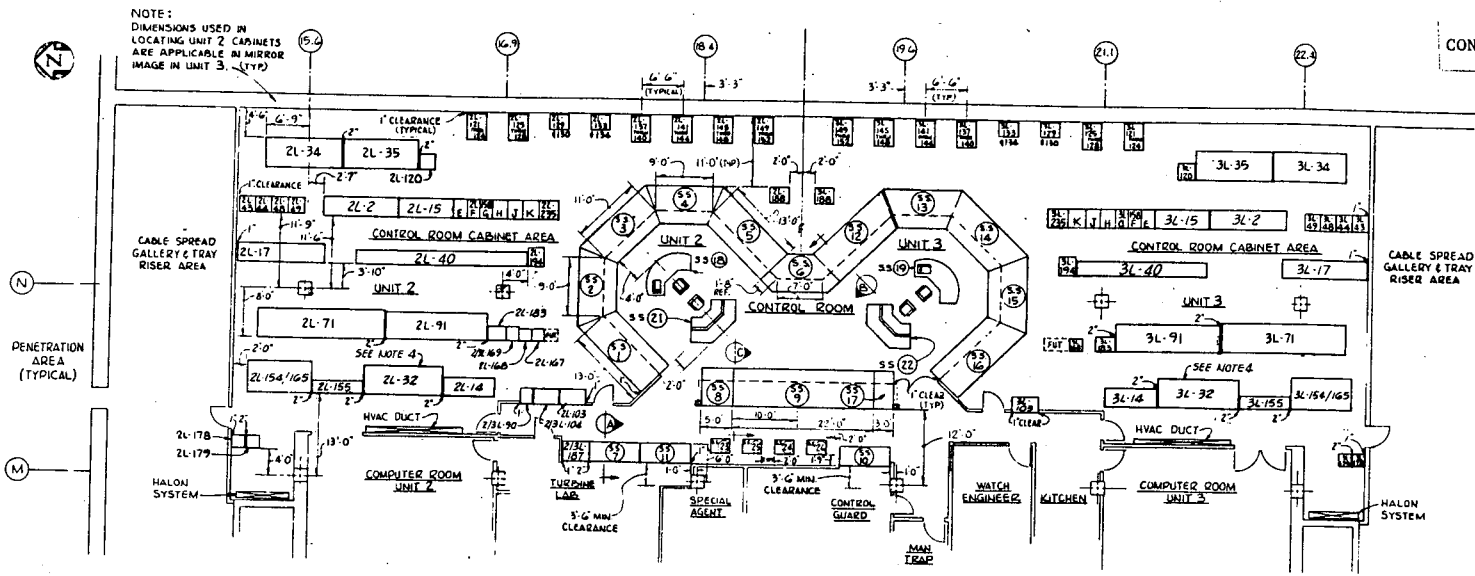
The following actions have been initiated to meet the objective of maximizing the probability of successful operator control of the plant under all conditions:

- 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

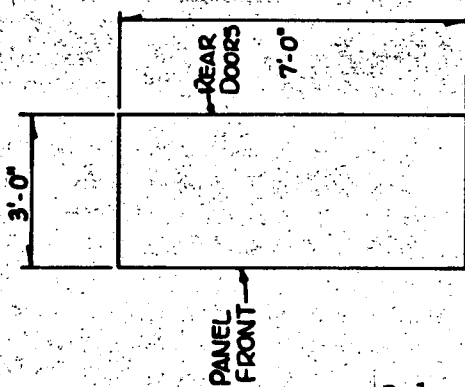
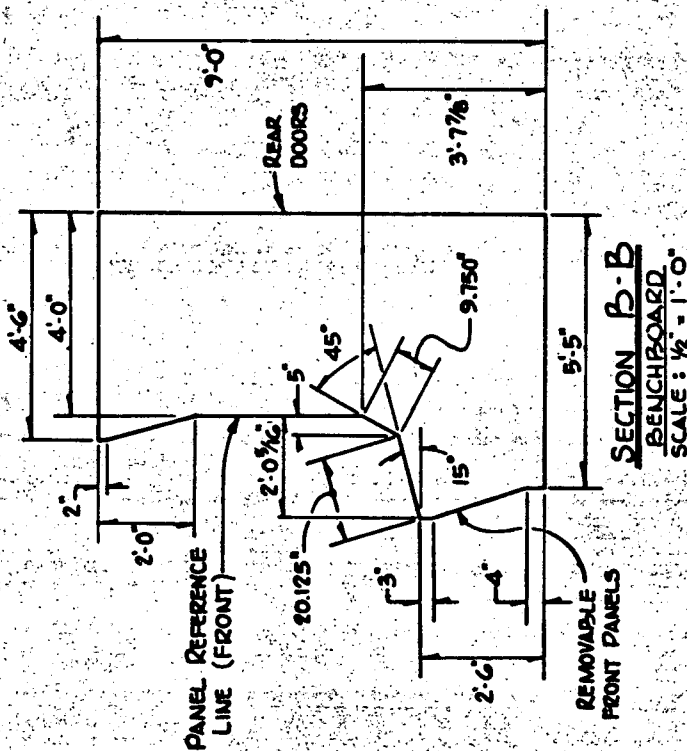
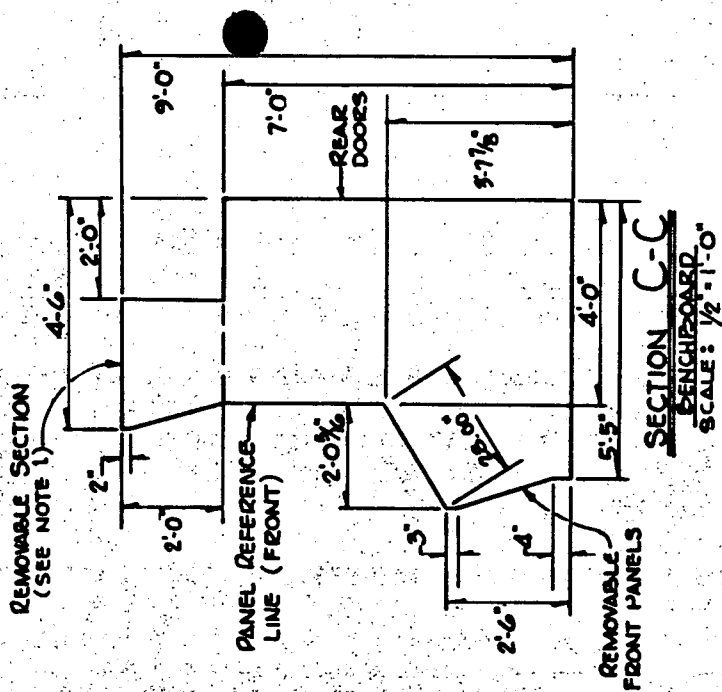


PANELS & CABINETS WITHIN MAIN CONTROL ROOM			
SHIPPING SECTION	BECHTEL PANEL NO.	DESCRIPTION	PANEL ENTRY FIELD CABLE
1	2CR-57	ENGINEERED SAFETY FEATURES SYSTEM	BTM
2	2CR-56	PLANT PROT. SYST. & REACTOR COOLANT PUMPS	BTM
3	2CR-58 50, 51	CHEM. VOL. CONTROL, REACTOR COOLANT AND REACTIVITY SYSTEMS	BTM
4	2CR-52 & 53	STM. GEN. WATER LEVEL CONTROL AND FEEDWATER & CONDENSATE	BTM
5	2CR-54 & 64	TURBINE AND SALT/WATER & 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	3CR-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 #	DESCRIPTION	PANEL ENTRY FIELD CABLE	
2L 2	3L-2 TURBINE PROTECTION CUBICLE (ELECT)	BTM	
2L14	3L-14 UNIFIED ACTUATOR PANEL	BTM	
2L-15	3L-15 TURBINE SUPERVISORY EQUIP. CUBICLE	BTM	
2L-17	3L-17 ELECTRIC GOVERNOR CUBICLE (ENGI)	BTM	NOTE 3)
2L-32	3L-32 PLANT PROTECTIVE SYSTEM CABINET	BTM	NOTE 4&5)
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 BACK	BTM	
2L-44	3L-44 REACTIVITY REGULATING SYST. NO 2 BACK	BTM	
2L-48	3L-48 FEEDWATER CONTROL SYSTEM NO 1 BACK	BTM	
2L-49	3L-49 FEEDWATER CONTROL SYSTEM NO 2 BACK	BTM	
2L-71	3L-71 NSSS AUX. RELAY CABINET	BTM	
2/3L-40	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	3L-121 SPEC. 200 CABINETS	BTM	
THRU THRU	(EXCEPT 2L31-131, 132, 135 & 136)	BTM	
2L-152	3L-152 (NOT REQUIRED)	BTM	
2L-154&63	3L-154&63 HVAC SYSTEMS CONTROL	BTM	
2L-155	3L-155 HVAC SYSTEMS CONTROL	BTM	
2L-158	3L-158 BECHTEL INTERFACE CABINET (60P) (SPEC 200)	BTM	
2L-167	NONE	BTM	
2L-168	3L-168 SEISMIC EVENT RECORDING	BTM	
2/3L-169	CIRC. WATER TEMP. DATA LOGGER	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	
2/31-197	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

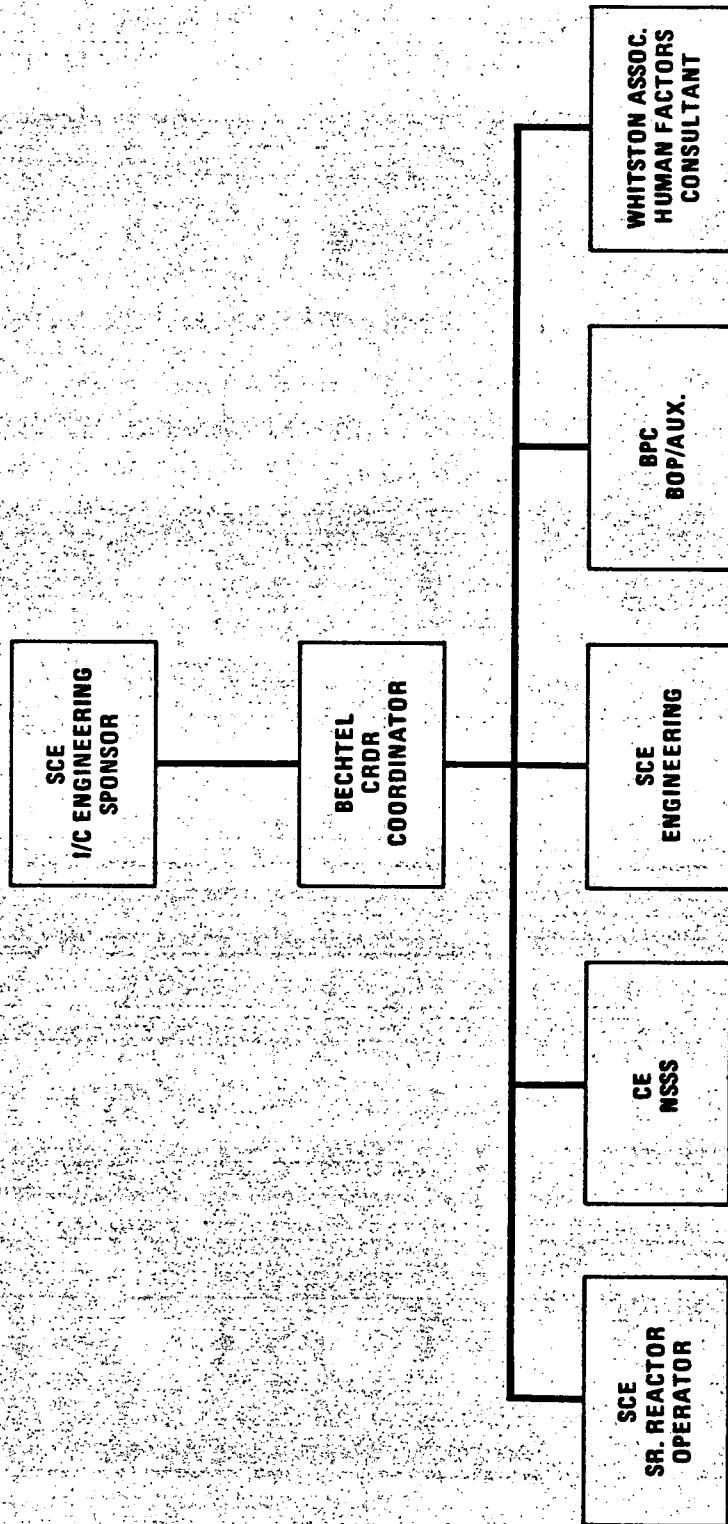
CONTROL BOARD DESIGN



SECTION A-A  
VERTICAL PANEL  
SCALE: 1/2" = 1'-0"

SAN ONOFRE UNITS 2 & 3 CONTROL PANEL DIMENSIONS

ORGANIZATION CHART OF THE  
CONTROL ROOM DESIGN REVIEW  
WORKING GROUP



SCE - SOUTHERN CALIFORNIA EDISON  
BPC - BECHTEL POWER CORPORATION  
CE - COMBUSTION ENGINEERING

CRDR WORKING GROUP ORGANIZATION  
AND RESPONSIBILITIES

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.

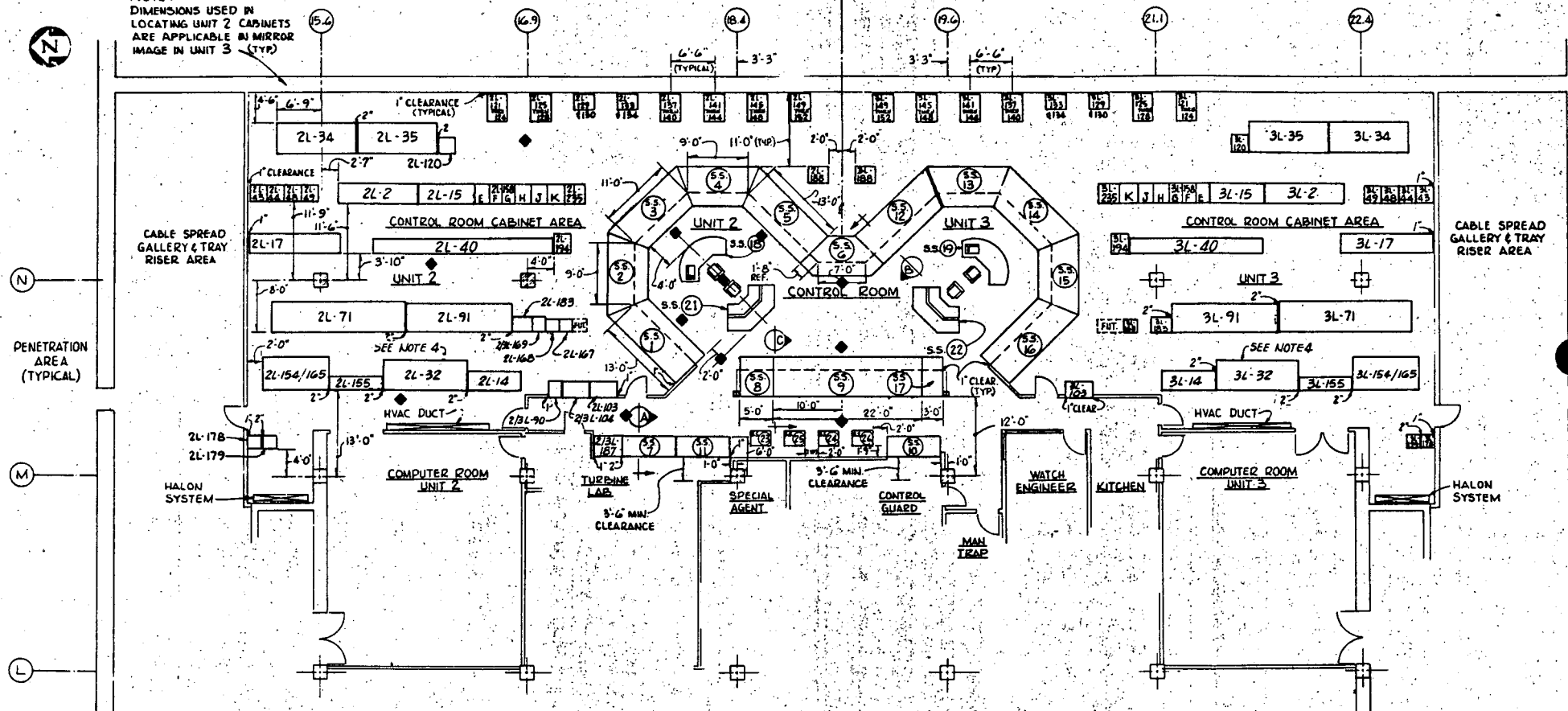
Southern California Edison (SCE) - I/C engineering

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.





NOTE:  
DIMENSIONS USED IN  
LOCATING UNIT 2 CABINETS  
ARE APPLICABLE IN MIRROR  
IMAGE IN UNIT 3 (TYP)

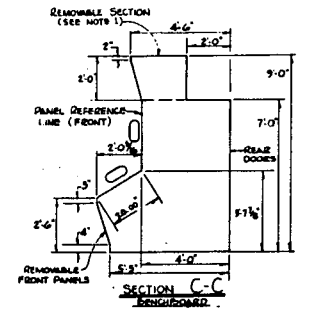
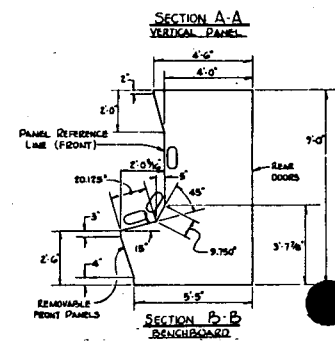
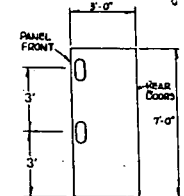
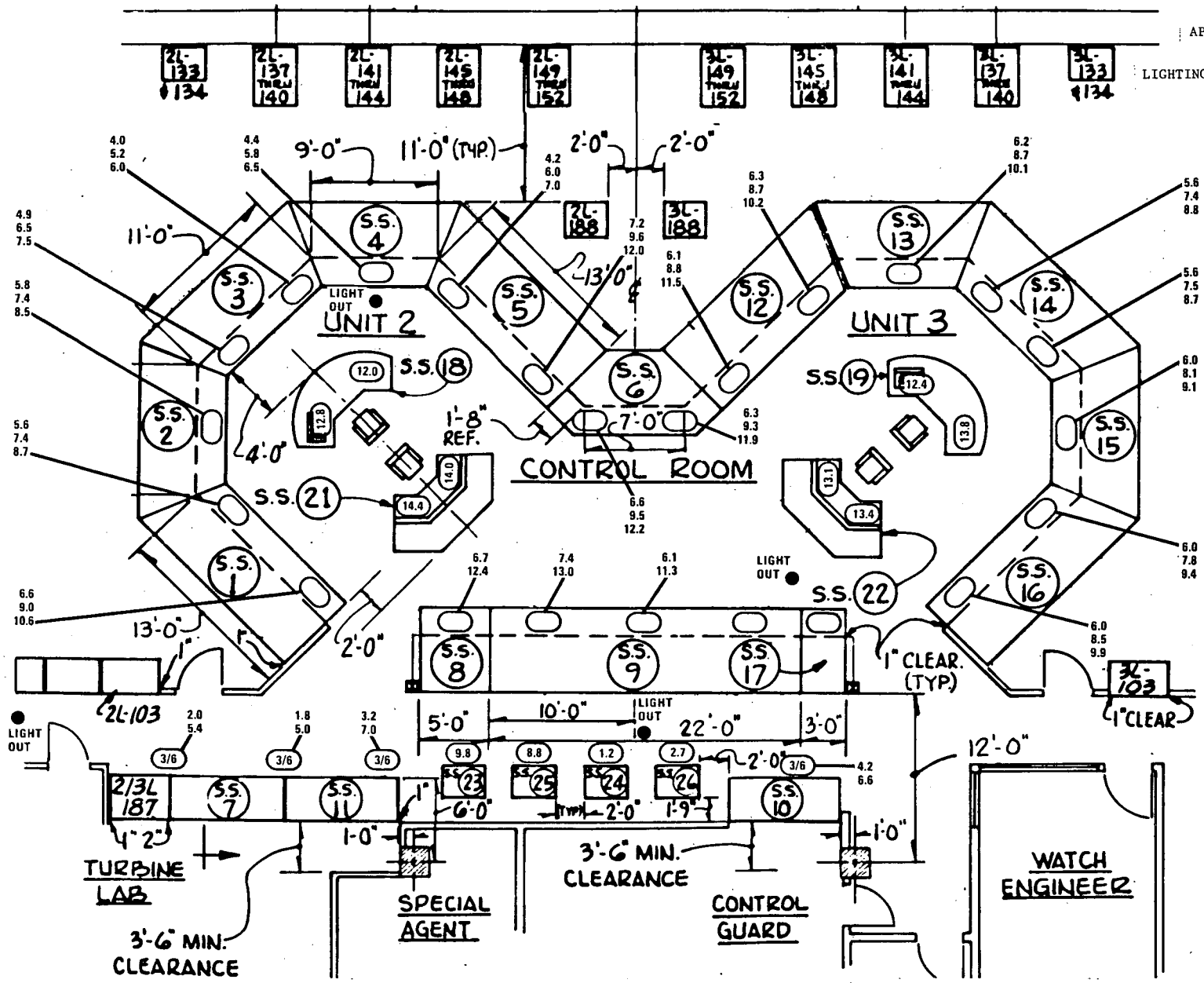


**SOUND LEVEL SURVEY:**

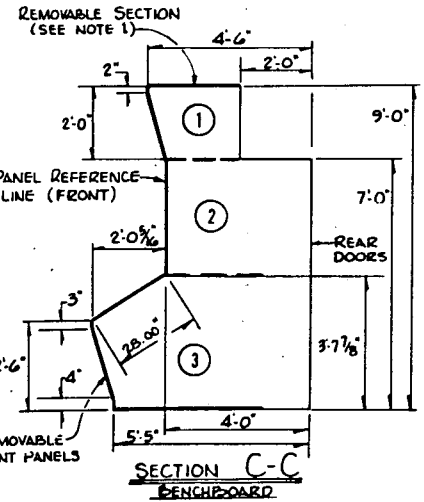
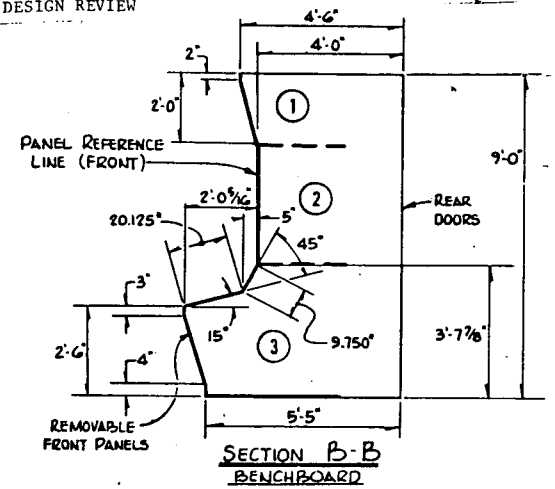
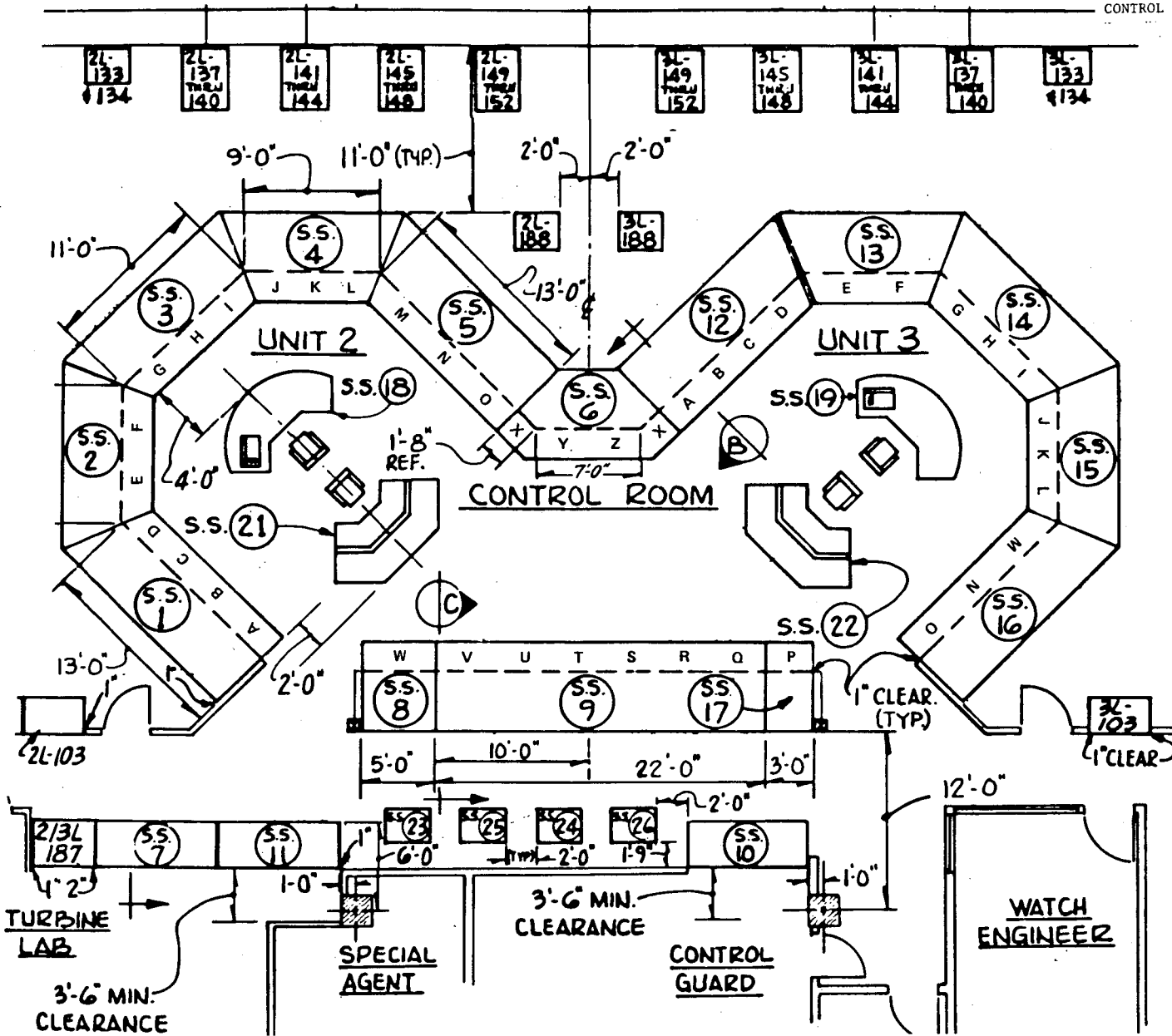
1. READINGS SHOULD BE TAKEN FIVE (5) FEET ABOVE FLOOR.
2. READINGS SHOULD BE IN dBA (dB WEIGHTED AVERAGE AS DEFINED BY DSHA).
3. ◆ : INDICATES SUGGESTED POINTS FOR READINGS. ADDITIONAL READINGS MAY BE TAKEN AT ANY OTHER POINT, PARTICULARLY IN AREAS WITH HIGHER NOISE LEVELS THAN FORESEEN.
4. READING LOCATIONS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

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

Normal lighting intensity readings 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.



- NOTE:
1. ALL READINGS ARE IN FOOTCANDLES.
  2. THERE ARE 4 LIGHTS THAT WERE BURNED 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.



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

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.

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

ENCLOSURE 1  
ATTACHMENT 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:wpm  
Enclosure

bcc: (See attached page)

15pp

PDR

~~601100378~~

Mr. Frank Miraglia

-2-

October 29, 1980

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.	NM	10/28/80
/	Lic. Gr. Ldr.	JKR	10/12/80 10-15-80
/	Proj. Mgr.	ABR	10-20-80
/	Proj. Engr.	R	10-20-80
/	Law	J	11-20-80
	Power Supply		
	Qual. Assr.		
	Env. Affairs		
/	Tech. Org.		
/	I & C	JKR	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 boundaries (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. 1)

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) |

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. 1)

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. 1)

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. 1)

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 accidentally selecting the wrong pushbutton so labeling, coding, and demarcation must be particularly 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.

3.5 Displays

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 obscure 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 particularly 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 hierarchical 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 mislabeled 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 will be prior to completion of the first refueling outage.

### 3.8 Communications

#### I. 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 reset 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 acceptability 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 annunciators 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, decrease).

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 multiplier.

- 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

- 8 -

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.

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- 9 -

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.

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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

jwb 9-14

1 (Slide.)

2 MR. PRICKETT: Good afternoon, gentlemen.

3 My name is Jerry Prickett, and I am the Instrumenta-  
4 tion and Control Specialist in the Engineering Organization  
5 for Southern California Edison.

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

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

18 The CRDR Working Group was activated on 10 June  
19 1980 at the Bechtel Power Corporation, the Whittier Office,  
20 with Bechtel providing the Group Coordinator and Management  
21 assistance on an as-required basis by the group.

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

25 To identify all the man-machine interface areas

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

3 To propose recommendations for approval and  
4 implementation.

5 (Slide.)

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

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

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

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

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

25 And finally, Whitston Associates provided a human

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

4 The group represented 150 years total of instru-  
5 ment control experience, mostly in the power field, but some  
6 aerospace and industrial design gave an added perspective to  
7 the design philosophy.

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

14 (Slide.)

15 The Task Force charter was as follows:

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

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

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

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

25 No prior design or conceptual experience with the

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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



1 control room. Prior to the audit, the CRDR Task Force  
2 provided the NRC team with a briefing of their findings to  
3 date and a preliminary list of items identified for resolu-  
4 tion. The resulting Action Item list from the audit  
5 includes the major items identified by the CRDR Task Force.  
6 All items on the audit list were categorized for implementation  
7 scheduling, and agreed to in subsequent meetings with the NRC  
8 team.

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

14 Control panel --

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

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

25 MR. CATTON: Okay.

1 MR. PRICKETT: Okay, the control room panel boards  
2 essentially we did sub-system demarcation, component reloca-  
3 tion, and color coding.

4 The annunciator system: Prioritization of alarms.  
5 Labeling: Hierarchy, consistency, and so on.  
6 Scaling: Scale coding, correct ranges, upper/  
7 lower limits.

8 Environmental, which included lighting, sound,  
9 and colors.

10 And review of normal/emergency operating  
11 instructions.

12 Phase II, then, were the items for follow-on:  
13 Additional work with the annunciator alarms with  
14 regard to plant computer interface;

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

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

20 (Slide.)

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

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

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

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

15 An interesting aspect of this configuration --

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

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

24 MR. WARD: And that was done when?

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

1 or a little more.

2 MR. WARD: Yes.

3 MR. PRICKETT: And at that time -- if I might add,  
4 one of the key points of that is that the operator sits at  
5 this console here (indicating) and every instrument is within  
6 13 feet of him. It's very convenient.

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

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

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

19 Let's touch on the key area here.

20 (Slide.)

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

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

3 (Slide.)

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

9 (Slide.)

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

17 (Slide.)

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

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

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

5 MR. PRICKETT: That's correct.

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

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

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

14 MR. PRICKETT: Right.

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

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

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

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

1 combination.

2 MR. CATTON: Or all.

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

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

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

17 MR. DITTO: And operators are not --

18 MR. PRICKETT: And those --

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

21 MR. PRICKETT: Right.

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

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

1 adept at a lot of the different --

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

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

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

15 MR. PRICKETT: Yes.

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

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

22 (Slide.)

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



Beg #10

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

3 (Slide.)

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

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

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

17 (Slide.)

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

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

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

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

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

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

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

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

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

9 MR. PRICKETT: Yes.

10 MR. BENDER: Can we watch those?

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

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

15 (Slide.)

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

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

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

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

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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?

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

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

12 Okay, the other item, as previously noted --

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

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

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

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

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

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

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

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

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

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

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

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

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

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

19 How were those procedures handled in the control  
20 room?

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

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

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

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

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

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

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



1 we will have another meeting of this subject only.

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

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

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

15 (Slide.)

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

21 (Slide.)

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

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

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

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

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

13 MR. WARD: What does that mean?

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

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

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

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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

1 agenda is instrumentation?

2 MR. MOODY: Yes.

3 MR. BENDER: Go ahead.

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

7 (Slide.)

8 My presentation this afternoon embodies a discus-  
9 sion on the work conducted and in process for San Onofre Units  
10 2 and 3 dealing with inadequate core cooling instrumentation.  
11 In my presentation I intend to cover or touch on the following  
12 six items:

13 First, I intend to review briefly the requirements;

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

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

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

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

24 Sixth, discuss an implementation schedule.

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

ENCLOSURE 1  
ATTACHMENT 8

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

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

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

9 MR. BENDER: Further questions?

10 (No response.)

11 MR. BENDER: Thank you.

12 MR. WINDSOR: You're welcome.

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

15 MR. SINGER: Good afternoon. My name is John  
16 Singer. I want to talk to you very briefly about the human  
17 factors control room design review that was conducted on San  
18 Onofre Units 2 and 3. This review was begun in June of  
19 1980, and the completion of this review satisfies the  
20 requirements of NUREG-585 and 660.

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

24 (Slide.)

25 The organization we put together to conduct this

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

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

14           (Slide.)

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

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

25           We also were asked to review the operating

1 instructions from a human factors standpoint.

2 (Slide.)

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

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

13 (Slide.)

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

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

25 While the general layout of the instruments on the



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

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

12 (Slide.)

13 Can you all see this all right?

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

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

1 system, as well as these instruments.

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

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

15           (Slide.)

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

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

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

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

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

10           MR. WARD: Could I ask you a question?

11           MR. SINGER: Yes, sir.

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

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

23           It was a numerical calculation.

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

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

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

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

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

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

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

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

7 (Slide.)

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

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

16 (Slide.)

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

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

25 The yellow are priority two. They are component

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

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

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

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

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

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

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

1 (Slide.)

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

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

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

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

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

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

3           Communications is an ongoing study.

4           (Slide.)

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

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

14           (Slide.)

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

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



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

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

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

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

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

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

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

7 MR. BENDER: Thank you.

8 MR. SINGER: We were asked in the Subcommittee  
9 meeting in February to respond to the question of whether we  
10 looked into the area outside the control room from a human  
11 factors standpoint. In an attempt to answer that, what I  
12 would like to say is that the study that was done in the  
13 control room, while we had to relocate or recommended the  
14 relocation of 150 instruments on the control panels, we did  
15 not replace any instruments anyplace in the control room.  
16 We determined that the type of instrument used was  
17 adequate for the service intended. The criteria that was  
18 used for the selection of instruments on the control panels  
19 is the same criteria that was used for the specification and  
20 purchase of all equipment instrumentation and control  
21 equipment throughout the plant.

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

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

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

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

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

9 MR. MOELLER: Thank you.

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

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

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

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

1 (Slide.)

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

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

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

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

25 In addition, at the completion of construction the

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

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

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

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

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

25           (Slide.)

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

10           Are there any questions?

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

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

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

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

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

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

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

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

4 MR. SINGER: No, sir.

5 MR. BENDER: How will I find that out?

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

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

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

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

15 Go ahead, Dave.

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

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

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

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

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

6 MR. SINGER: I would like to defer that one to --  
7 I'll put it another way. The annunciators system,  
8 do you expect it to function at the CBE or is it designed to  
9 do this or what? I'm just trying to understand how you  
10 chose to treat the non-safety-related equipment in the  
11 control room.

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

14 MR. OKRENT: Okay, fine.

15 MR. BENDER: Next questions? More questions?

16 (No response.)

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

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

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



ENCLOSURE 1  
ATTACHMENT 9

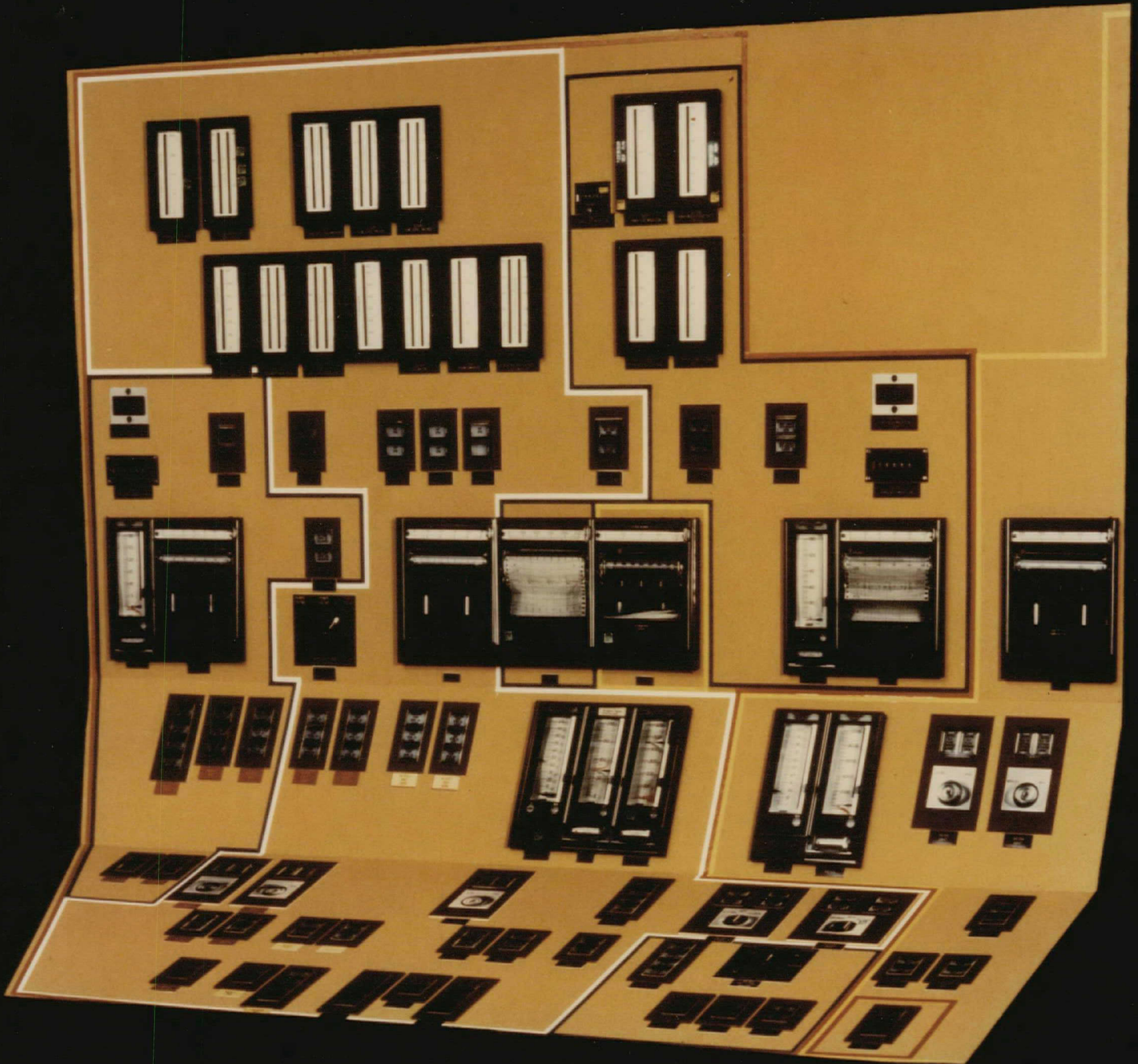


Exhibit A3.7-A  
Photo of Model A Present Arrangement,  
Existing Background - Line Demarcation

ENCLOSURE 1  
ATTACHMENT 10

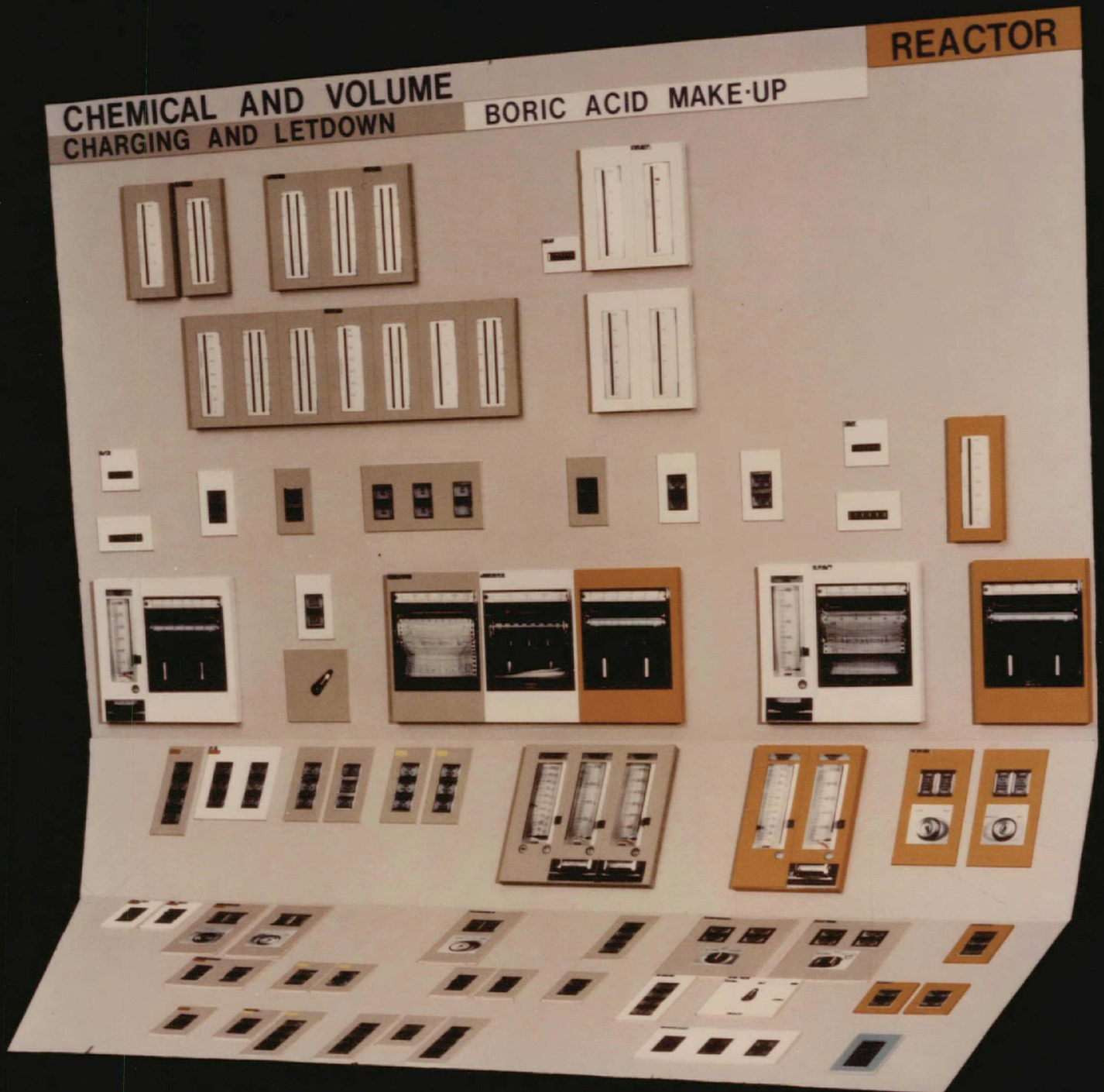


Exhibit A3.7-C  
Photo of Model C Present Arrangement,  
New Background - Bezel Color Demarcation

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.

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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

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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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