REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8004170076 DOC.DATE: 80/04/09 NOTARIZED: NO DOCKET #
FACIL:50-275 Diablo Canyon Nuclear Power Plant, Unit 1, Pacific Ga 05000275
50-323 Diablo Canyon Nuclear Power Plant, Unit 2, Pacific Ga 05000323
AUTH.NAME AUTHOR AFFILIATION
CRANE,P.A. Pacific Gas & Electric Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation

SUBJECT: Forwards Revision 3 to response to NUREG-0578 re short term Lessons Learned Task Force recommendations.

DISTRIBUTION CODE: B001S COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 29
TITLE: PSAR/FSAR AMDTS and Related Correspondence

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
ACTION:	05 PM BUCKLEY	1	1	AD LWR	1	0
	BC LWR 1	1	0	LA LWR1	1	0
INTERNAL:	01 REG FILE	1	1	02 NRC PDR	1	1
	06 I & E	3	3	08 OPERA LIC BR	1	1
	09 GEOSCIEN BR	4	4	10 QAB	1	1
	11 MECH ENG BR	1	1	12 STRUC ENG BR	1	1
	13 MATL ENG BR	2	2	15 REAC SYS BR	1	1
	16 ANALYSIS BR	1	1	17 CORE PERF BR	1	1
	18 AUX SYS BR	1	1	19 CONTAIN SYS	1	1
	20 I & C SYS BR	1	1	21 POWER SYS BR	1	1
	22 AD SITE TECH	1	0	26 ACCDNT ANLYS	1	1
	27 EFFL TRT SYS	1	1	28 RAD ASMT BR	1	1
	29 KIRKWOOD	1	1	AD FOR ENG	1	0
	AD PLANT SYS	1	0	AD REAC SAFETY	1	0
	AD SITE ANLYSIS	1	0	DIRECTOR NRR	1	0
	HYDRO-METEOR BR	2	2	MPA	1	0
	OELD	1	0			
EXTERNAL:	03 LPDR	1	1	04 NSIC	1	1
	30 ACRS	10	10			

ADD: WILLIAMS,M. 1 1

J HANCHETT 1 1

APR 21 1980

LTR
MOORE
EPB1 BC
KIRSLIS
EPB1 LA

MA 4

60

TOTAL NUMBER OF COPIES REQUIRED: LTTR ~~52~~ 58 ENCL ~~44~~ 43

PACIFIC GAS AND ELECTRIC COMPANY

PG&E

77 BEALE STREET, 31ST FLOOR • SAN FRANCISCO, CALIFORNIA 94106 • (415) 781-4211

MALCOLM H. FURBUSH
VICE PRESIDENT AND GENERAL COUNSEL

ROBERT OHLBACH
ASSOCIATE GENERAL COUNSEL

CHARLES T. VAN DEUSEN
PHILIP A. CRANE, JR.
HENRY J. LaPLANTE
JOHN B. GIBSON
ARTHUR L. HILLMAN, JR.
CHARLES W. THISSELL
DANIEL E. GIBSON
ASSISTANT GENERAL COUNSEL

GILBERT L. HARRICK
GLENN WEST, JR.
JOSEPH I. KELLY
HOWARD V. GOLUB
JAMES C. LOGGDON
ROBERT L. GORDON
PETER W. HANSCHEN
THEODORE L. LINDBERG, JR.
DOUGLAS A. DOLESSY

EDWARD J. McGANNEY
DAN GRAYSON LUBBOCK
JACK F. FALLIN, JR.
BERNARD J. DELLABANTA
JOSHUA BAILEY
JOSEPH B. ENGLERT, JR.
ROBERT L. HARRIS
RICHARD F. LOCKE
DAVID L. LUDVIGSON

SENIOR COUNSEL

DAVID W. ANDERSON
DIANA BERGHAUSEN
LEIGH B. CASSIDY
HEATHER S. CISENA
BRIAN S. DENTON
WILLIAM H. EDWARDS
DONALD D. ERICKSON
DAVID C. GILBERT
JUAN M. JAYO
F. RONALD LAUPHEIMER
HARRY W. LONG, JR.
PAULA Y. MAINS
ROBERT B. McLENNAN
RICHARD M. MOSS
J. MICHAEL REIDENBACH
IVOR E. SAMSON
SUE ANN LEVIN SCHIFF
JACK W. SHUCK
DAVID J. WILLIAMSON
BRUCE R. WORTHINGTON

J. PETER BAUMGARTNER
STEVEN P. BURKE
PAMELA CHAPPELLE
AUDREY DAINES
MICHAEL G. DESMARAIS
GARY P. ENGINAS
JOHN N. FRYE
PATRICK G. GOLDEN
KERMIT R. KUBITZ
MEREK E. LIPSON
JOHN R. LOW
A. KIRK McKENZIE
RICHARD L. MEISS
ROGER J. PETERS
ROBERT R. RICKETT
SHIRLEY A. SANDERSON
JO ANN SHAFFER
LOUIS E. VINCENT
SHIRLEY A. WOO
KENNETH YANG

ATTORNEYS

April 9, 1980

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Phillips Buildings
7920 Norfolk Avenue
Bethesda, Maryland 20014

BY COURIER

Re: Docket No. 50-275
Docket No. 50-323
Diablo Canyon Units 1 and 2

Dear Mr. Denton:

Enclosed are 20 copies of the Revision 3 pages for the report entitled "Pacific Gas and Electric Company Response to NUREG-0578: Short-Term Lessons Learned Requirements."

This revision incorporates the results of the PGandE Diablo Canyon Control Room review.

Twenty additional copies will be forwarded to you by regular mail and copies for the service list will be mailed not later than April 10, 1980.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it to me in the enclosed addressed envelope.

Very truly yours,

Philip A. Crane, Jr.

Enclosures

cc w/enc.: Service List

B001
S E 1
ADD: M WILLIAMS 11

A

8004170 076

INSTRUCTIONS FOR INSERTION OF NUREG-0578 RESPONSE REVISION 3 PAGES

1. Replace the Rev. 1 pages indicated below with Rev. 3 pages:

   III-MM-1, III-MM-2.

2. Replace the Rev. 2 pages indicated below with Rev. 3 pages:

   I-A-1, I-A-4.

3. Add the Rev. 3 pages indicated below:

   III-MM-3 through III-MM-25.

PACIFIC GAS AND ELECTRIC COMPANY

RESPONSE TO

NUREG-0578: SHORT TERM LESSONS LEARNED REQUIREMENTS

April 9, 1980

Revision 3
4/9/80

TABLE OF CONTENTS (Continued)

Task I.D.1. - Control Room Design Review

Position

Perform comprehensive review of control room using NRC human factors design guidelines and evaluation criteria. Modify to correct significant deficiencies. Issue report describing methods of review, results of review, including bases for findings made, and implementation schedule. Applicants to be granted operating licenses prior to September 1981 must perform a preliminary assessment of their control rooms to identify and correct significant human factors and instrumentation deficiencies.

Licensees and applicants will complete review and implement short lead-time revisions by September 1981 or prior to issuance of operating license, whichever is later. Long lead-time revisions will be completed by April 1982 or prior to issuance of operating license, whichever is later.

PG&E Response and Status

During mid March 1980, PG&E reviewed the Diablo Canyon Unit 1 Control Room to identify and correct, if found, any significant human factors and instrumentation deficiencies. Additionally any modifications which could simplify and ease the operator's job were reviewed. The report of this review follows.

Task I.D.1 (Continued)

REVIEW METHODOLOGY:

The layout and design of the control room and control boards at Diablo Canyon was a cooperative effort between instrumentation and control system engineers and operating department personnel with nuclear power plant operating experience. As a result, the design placed emphasis on proper functional grouping rather than employing continuous rows of identical devices prevalent in other control boards of the same vintage. Experience gained during startup testing led to further improvements in the layout. In accomplishing the control room review, it was recognized that changes made over the years could have affected the original design intent. A review team was formed that included instrumentation and control system engineers, electrical engineers, and operating personnel. The operating personnel on the team were selected because they are directly responsible for operator training and are familiar with those control board features which were sometimes troublesome or confusing to operators during training and testing sessions.

The first step in the review was for the operator training personnel to review the control board layout and find any changes which might be desirable to eliminate possible confusion and to simplify the operator's job. This step took approximately 2 man-weeks to accomplish and resulted in proposed changes which included bolder labeling, more demarkations, module changes, label revisions, and annunciator window relocations and relabeling. Because of the care used in the original control board layout, most of the changes were minor. Many of the changes involved revisions as a result of experience at TMI or requirements of Regulatory Guide 1.97.

The next step in the review was the development of review and acceptance criteria. These criteria are listed in Attachment 1 and were developed by considering the documents referenced therein. This step required about twelve man-days of effort.

The last step prior to the actual walkdown was the review of each module relocation proposed in the first step in light of the criteria, revisions not yet finalized, and their effect on operation.

The actual control room walkdown required an effort of approximately nine man-days by the review team.

MAJOR FINDINGS OF THE CONTROL ROOM REVIEW:

A. General Control Room:

All lighting levels in the control room, ranging from full illumination by AC-powered fluorescent lights to the illumination provided only by battery-powered emergency lights, were found to be acceptable. Although there was no problem with the fully illuminated room, the most comfortable lighting level was with three banks of normal AC powered lights turned off.

The present furniture layout in the control room is for temporary use during construction. The permanent furniture layout will consider easy access to plant procedures and an adequate work area.

The tops of the control consoles were found to be well designed to provide laydown room for procedures and schematics for use at the vertical boards. It was noted that plasticized copies of schematics and location drawings were kept at these locations.

The control console writing surface was found to be inconvenient to use because the operator's telephone was located there.

1. Action Item: Mount the operator's telephone adjacent to, but not on, the control board writing surface by fuel loading.

Several annunciator lists were found to be obsolete. They were properly marked as obsolete, but the operator should have current lists.

2. Action Item: Provide current lists and schematics by fuel loading.

Each section of the control board as well as the RMS, NIS, and Incore Racks had a telephone jack.

The noise level in the control room was quite acceptable. Typewriters were the major source of noise, and normal conversations could be carried on at 15-20 feet. Personnel could communicate from corner to corner of the room using reasonably raised voices. The operators noted that, during startup testing, there was no appreciable rise in noise level.

B. Annunciator:

The two separate annunciator systems (main and computer) had distinct and readily identifiable audible alarms. No provisions for separate sounds for each panel were provided, and all operators polled during the walkdown opposed the addition of this feature.

Three colors are used for the annunciator panels; red for critical alarms, white for other alarms, and yellow for alarms which are normally on during full power operation. In all cases, the lit windows were quite visible against the background, even with one of the redundant bulbs burned out. Some red windows had faded with age, but no corrective actions appeared necessary other than routine maintenance. A yellow window with a burned-out bulb was found to be difficult to distinguish from a white window with a burned-out bulb unless the two are next to each other. Yellow is used elsewhere (on indicator faces) to denote caution areas instead of "normal" as used on the annunciator. Yellow lenses are also used on large tank level indicators.

3. Action Item: As a long-term item, investigate colors other than yellow for alarms normally on during full power operation.

4. Action Item: Remove yellow lens tints on indicator lenses by fuel loading.

All annunciator windows met the basic visibility criteria. Several lettering styles existed, and one was definitely inferior. The others were acceptable, but one, the heavy-lined style most recently adopted, was superior.

5. Action Item: All future windows will use the new heavy-lined lettering. All of the inferior lettering will be replace by fuel loading.

Labeling on some of the windows was not self-explanatory and did not conform to the PGandE approved standard abbrevations list.

6. Action Item: Revise annunciator windows to conform to PGandE approved standard abbreviations by fuel loading.

Some windows were not above the control panel that would be used to respond to the alarm.

7. Action Item: As a long-term item, relocate the annunciator windows to more nearby above the proper panel.

There are several peripheral annunciators in the control room which are related to the fire system and which alarm on the main annunciator. Several problems were found with window labeling and arrangement. The major problem identified with the peripheral annunciator was a lack of reflash capability.

8. Action Item: As a long-term item, relabel and rearrange fire system annunciators.

9. Action Item: As a long-term item, review reflash capability of fire system annunciators.

C. Main Control Board:

The layout revisions identified as desirable, in order to improve functional grouping, were reviewed for feasibility. All problems were resolved during the review.

10. Action Item: Proceed to implement layout revisions associated with TMI and Regulatory Guide 1.97 issues on a time schedule consistent with regulatory requirements. Other layout revisions will be implemented on a long-term basis.

Most of the existing demarkation lines on the main control board are adequate. However, large scale labeling and additional demarkations as described in EPRI NP-1118 would be an improvement.

11. Action Item: Add large scale labeling and more demarkations by fuel loading.

The same abbreviation inconsistency was found that was noted for the annunciators. All labels could be read at 4 feet, the acceptance criteria limit.

12. Action Item: Revise inconsistent main control board labeling by fuel loading.

All indicators had their labels immediately below them and all switches and controllers had their labels on the modules between the switches and the lights or indicators. This placement of switch labels assures nameplate visibility during switch operation.

Glare on the indicators had no effect on the ability to read any indicator or recorder at normal lighting levels. At lower lighting levels, the glare became more apparent. When using only battery-operated lights, glare was significant enough to require head movement to read portions of the scales. This head movement created no parallax problem for indicators, but did result in parallax problems with certain recorders above the eye level of short people. These recorders are all related to turbine startup, and would not be used under these lighting conditions.

Controls were examined to determine whether they could be operated by operators with differing physical characteristics, as well as whether inadvertent operation would be likely. It was determined that all operators would be able to reach all controls with ease. If operation requires leaning over a control board, inadvertent operation of controls is unlikely. The edges of all switch handles located on control boards with vertical sections were at least 3 inches from the edge of the board. Two switches related to generator voltage adjustment, located on the console, came within 2-1/2 inches of the edge of the board. Inadvertent operation is very improbable due to the lack of vertical sections on this board. Even if inadvertent operation occurred, it would have no detrimental effect on plant safety.

Even though most of the indicators would be above a short person's eye level, he would have no trouble reading the indicators and would not experience any parallax problems. This is due to the split-depth scale of the Westinghouse VX252 indicator which is used at Diablo Canyon. The indicator pointer is on the same plane as the scale itself, so parallax is eliminated.

A few indicators had black pointers instead of the normal fluorescent red.

13. Action Item: Paint black indicator pointers on VX252s fluorescent red by fuel loading.

All indicators had movement space below "zero". "Zero" is at 4 mA, so that on loss of signal the needle drops below scale.

Several problems were noted with scales that had minor divisions not equal to 1, 2, or multiples of 5, and in some cases had less than optimal designations (e.g., 0 - 150°C was used where 32 - 300°F should be used to be consistent).

14. Action Item: Modify non-optimal indicator scales by fuel loading.

Our present method of indicating acceptable ranges on indicators is with green, yellow, and orange transparent strips on the lens face over the scale. A short person would have parallax problems with this system on the gauges mounted higher on the panel. Placing these strips directly on the scale face would eliminate this problem.

15. Action Item: Move range demarkation strips from the indicator lens face to the gage face under the pointer by fuel loading.

There is a standard arrangement and meaning of indicator lights on switch modules. Several modules were found which violate this standard.

16. Action Item: As a long-term item, modify non-standard switch modules. In those cases where the standard is not applicable, label indicator lights, as required.

To replace a monitor or status light bulb, the entire indicator module must be removed. If two indicator modules were removed simultaneously, they could be replaced in the wrong positions.

17. Action Item: Write a procedure, by fuel loading, to administratively control indicator module removal, for light bulb replacement, to allow only one module at a time to be removed.

The monitor light boxes indicate when important valves are not in their required position or pumps are not operating as required. Three of the four light boxes have their light potential busses deenergized except when safeguards actuation has been initiated. When all lights are off all inputs are satisfactory. All lights would also be off if a power failure had occurred.

18. Action Item: As a long-term item, provide an indication of voltage availability.

The status light boxes provide an indication of the status of the reactor protection system. No indication of power availability is provided.

19. Action Item: As a long-term item, connect one window to indicate power availability. As the lights are related to separate channels each of which is powered from a different power source, a light for each source will be required.

There are identical lights and pushbuttons on the turbine control and valve test panels. The PGandE convention is to distinguish between lights and pushbuttons by using black barriers for lights and white barriers for pushbuttons.

20. Action Item: Replace black barriers with white barriers on lit pushbutton switches by fuel loading.

There is presently no means to test the by-pass and permissive light boxes.

21. Action Item: As a long-term item, add test capability to the by-pass and permissive light boxes.

There were several kinds of tags that may be attached to switches and indicators, and that could obstruct other switches or lights.

22. Action Item: Investigate alternative tags for control board switches and implement any required changes by fuel loading.

Conclusion

The control room review for Diablo Canyon was intended to identify and correct any significant human factor and instrumentation deficiencies. Additionally the review identified many changes which could be made to improve operator efficiency. Few, if any, deficiencies were found that could be categorized as significant, and certainly no deficiencies were found which could have an adverse effect on Reactor Safety. Implementation of the modifications identified is desirable to provide a more efficient and convenient control room design.

Summary of Action Items

The action items resulting from the review are as follows:

A. GENERAL CONTROL ROOM:

1. Mount the operator's telephone adjacent to, but not on, the control board writing surface by fuel loading.

2. Provide current lists and schematics by fuel loading.

B. ANNUNCIATOR:

3. As a long-term item, investigate colors other than yellow for alarms normally on during full power operation.

4. Remove yellow lens tints from indicator lenses by fuel loading.

5. Replace inferior annunciator labeling by fuel loading.

6. Revise annunciator windows to conform to PGandE approved standard abbreviations by fuel loading.

7. As a long-term item, relocate the annunciator windows to more nearly above the proper panel.

8. As a long-term item, relabel and rearrange fire system annunciators.

9. As a long-term item, review reflash capability of fire system annunciators.

C. MAIN CONTROL BOARD:

10. Proceed to implement layout revisions associated with TMI and R.G. 1.97 issues on a time schedule consistent with regulatory requirements. Other layout revisions will be implemented on a long-term basis.

11. Add large scale labeling and more to demarkations by fuel loading.

12. Revise inconsistent main control board labeling by fuel loading.

13. Paint black indicator pointers on VX252s fluorescent red by fuel loading.

14. Modify non-optimal indicator scales by fuel loading.

15. Move range demarkation strips from the indicator lens face to the gage face under the pointer by fuel loading.

16. As a long-term item, modify non-standard switch modules. In those cases where the standard is not applicable, label indicator lights, as required.

17. Write a procedure, by fuel loading, to administratively control indicator module removal, for light bulb replacement, to allow only one module at a time to be removed.

18. As a long-term item, provide an indication of voltage availability.

19. As a long-term item, connect one window to indicate power availability. As the lights are related to separate channels each of which is powered from a different power source, a light for each source will be required.

20. Replace black barriers with white barriers on lit pushbutton switches by fuel loading.

21. As a long-term item, add test capability to the by-pass and permissive light boxes.

22. Investigate alternative tags for control board switches and implement any required changes by fuel loading.

ATTACHMENT I

DIABLO CANYON POWER PLANT

CRITERIA FOR HUMAN ENGINEERING FACTORS

CONTROL ROOM EVALUATION

I. CONTROL ROOM - GENERAL

A. The general layout and equipment in the control room should provide:

1. Adequate space for personnel and their equipment to perform necessary tasks for normal and emergency operations.

2. Adequate illumination for the performance of operation, emergency operation and training.

3. Satisfactory temperatures for operator comfort (75°F), protection against airborne toxic gases (specifically chlorine), airborne radioactivity, smoke from fires inside or outside of the control room, and provision to control CO_2 buildup during periods when airborne contaminates prevent use of outside air.

4. An acceptable range of background noise level to minimize stress and allow adequate internal communication.

5. Adequate physical, visual, auditory, and other communication between personnel and their equipment.

6. Provisions for exclusion of unauthorized personnel to prevent overcrowding, and confusion.

7. Minimal operator fatigue during intended shift time, i.e., eye pleasing colors should be used, adequate comfortable furnishings and meal preparation equipment provided.

B. Procedures:

1. Storage: Adequate space and facilities should be provided for proper storage and use of all procedures, documents, and reference drawings necessary for operation.

2. Indexing: All the above materials should be properly indexed in a manner consistent with the requirements for use of the materials.

3. Priority: Often used materials, or materials of an emergency nature, (such as emergency procedures) should be marked such that they are readily distinguished from lesser used or less important materials.

4. Format: All operating procedures should be written in consistent, approved format.

II. CONTROL - BOARDS

A. Labeling. Existing control board labeling should be examined for:

1. Accuracy: Does printed matter on label clearly and accurately describe identified component.

2. Visibility: Labeling should be sized to be readable at a minimum distance of 4 feet from the label.

3. Association: Labels shall be consistently placed so the association of labels with their corresponding panel elements is unmistakable.

4. Abbreviations: All abbreviations should be clear and consistent with approved abbreviation list.

5. Coding practices: Any color coding or other form of coding should remain consistent and clear throughout the control board.

B. Controls. Control selection and arrangement (valves, circuit breakers, selectors, process controls) should provide:

1. Functional Grouping: Functionally related controls should be located in proximity to one another. The boundaries of these functional groups should be well identified.

2. Sequencing: Except on mimic portions of the control board, a group of identical function controls (such as feedwater valves to each steam generator) should be arranged from top to bottom or from left to right.

3. Association: Controls or functional groups of controls should be located as near as possible to indications or instrumentation necessary for proper control operation.

4. Consistency of Location: Location of recurring functional groups of controls should be consistent from group to group.

5. Inadvertent Operation: All controls should be protected against inadvertent operation, either by design or location.

6. Consistency of Operation: Identical control units should perform intended function in the same manner, i.e., all circuit breakers should be closed by turning control to right. All valves should be opened by turning control to right. Any necessary exceptions should be unmistakably labeled as such.

7. Importance: Controls affecting critical operations, or whose accidental operation could have severe consequences, should be consistently and unmistakably identified.

8. Feedback: Instrumentation or indication should be provided to display control response.

9. Movement Relationships: Feedback and control must have compatible motion, i.e., if control is moved to the right or raised, the feedback must change to the right or raise. Any necessary exceptions should be clearly and unmistakably labeled.

C. Instrumentation and indications

1. Location and Arrangement

a. Accuracy: Instruments should be located where they can be read in the degree of accuracy required by operators in the normal operating positions. (Using no ladders - stools, etc.)

b. Orientation: Display faces should be perpendicular to the operators normal line of site whenever possible. Location should be proper to minimize parallax.

c. Grouping: Displays should be arranged in functional groups, with boundaries of these groups well defined.

d. Display-Control Relationship: Any displays, instruments or groups of displays should be located as close as possible to any controls directly affecting those displays.

e. Importance: Very important or critical displays should be placed in a privileged location or otherwise highlighted.

f. Consistency: The arrangement of displays should be consistent from application to application.

2. Indicating Lights

a. Equipment Response: Lights shall display actual equipment response and not control position or demand signals.

b. Positive feedback: The absence or loss of illumination on indicating lights should not be used to denote a go ahead, ready, in tolerance, malfunction or out of tolerance condition.

c. Location: When indicating lights are associated with a control, those lights shall be located as to be immediately and unambiguously associated with the control and visible during control operation.

d. Luminance: The brightness of display lights should at all times be clearly brighter than background levels.

e. Reflection: Provision should be made to prevent lighting from causing reflection that makes displays appear lighted or extinguished when they are not.

f. Color coding: The color coding of indicator lights shall be consistent throughout the control room.

g. Lighted pushbuttons: Where indication only lights are mixed with indicator/pushbuttons, the differences should be clearly indicated.

3. Scale Indicators (Direct Reading Instrument)

a. Linear Scales: Except where system requirements clearly dictate non-linearity, only linear scales should be used.

b. Graduations: Scale graduations should progress by 1, 2 or 5 units or multiples thereof.

c. Intermediate Marks: The number of minor or intermediate marks between numbered scale marks should not exceed 9.

d. Major Marks: Except for measurements normally expressed in decimal form, all major marks should be expressed in whole numbers.

e. Starting Point: Display scale should start at zero, where appropriate.

f. Pointers: Pointers should be sized as to not obscure graduation marks on the scale, and be mounted as close to the scale as possible to minimize parallax.

g. Calibration Information: Provision should be made for placing calibration information on gauge without obscuring any part of gauge display.

h. Coding: Scale faces should be coded, where applicable, to indicate:

desirable range - green
undesirable range - yellow
caution or action area - orange

coding shall be consistent.

i. Consistency: All instruments shall move up (vertical) or to the right (horizontal) or clockwise (circular) to indicate an increase in measured parameter.

4. Printers and Recorders

a. Form of Information: Printed information should be presented in a usable form.

b. Insertion/Removal of Materials: Printers should be designed for quick and easy insertion/removal of materials.

c. Visibility: Printed matter should be arranged so it is readable immediately after printing and available for review any time subsequent to being printed.

d. Illumination: The printer should be arranged with internal illumination if printed matter is not compatible with expected lighting in printer area.

III. ANNUNCIATORS

A. Audio Signals: Audio signals for annunciators should clearly direct the operator to the appropriate annunciator system.

B. Printed Matter: Printed matter on annunciator windows should clearly and unmistakably relay the message intended by the window. Any abbreviations should be clear and consistently used.

C. Visibility: All main annunciators should be visible and readable from a minimum of 20 feet from the panel.

D. Location: Annunciator windows should be located so they "draw" the operator to the area of the control board necessary to check or correct conditions causing the alarm.

E. Lamp Failures: Annunciator lights should be provided with dual bulbs so a burned out bulb will not prevent operation. Provisions to test lamps should be provided.

F. Priority: Annunciator windows representing serious or important alarms should be colored red.

G. Normally Lit Annunciators: Annunciator and status light windows which are normally lit at power should be color coded yellow.

H. Status Lights: Panels containing status lights should have black painted frames to clearly separate these panels from annunciator panels.

REFERENCES

1. EPRI Reports NP-1118 and NP-1118-SY.

2. Rogavin Report, Pp. 180-234 and 335-398, Volume II.

3. Military Standard 1472B.

4. Transactions ANS, Volume 33, Pp. 556-567.

5. IEEE Standard 566-1977.

6. PGandE Standard Drw. 023607.