TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

August 20, 1981

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U.S. NUCLEAR REGULATORY COMMISSION

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Acting Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Adensam:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

Enclosed are TVA responses and proposed corrective actions for those deficiencies identified by the NRC during a human factors Engineering Design review/audit of the Watts Bar Nuclear Plant control room conducted October 6-10, 1980. This information reflects the resolution of deficiencies discussed by TVA and the NRC during the meeting of June 16, 1981.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills, Manager
Nuclear Regulation and Safety

Sworn to and subscribed before me
this 20th day of Aug. 1981.
Paulette H. White
Notary Public

My Commission Expires 9-5-84

Enclosure

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GUIDELINES SECTION

6.1 CONTROL ROOM WORKSPACE

Category

A. Emergency Equipment

Protective Clothing - There are several problems:

- Donning is difficult.

- Changing air tanks is a two-man operation.

- With the 5-minute warning bell, there is perhaps too little time to change.

- Mask virtually prohibits the wearer from speaking to anyone.

- There are too many steps to don gear. 1

Response: Operators will undergo periodic drills and training to maintain proficiency in donning emergency gear. Protective clothing sizes will be clearly identified.

An effort is presently underway to determine the best system for improving communications when wearing the emergency breathing apparatus. The possible modification to the emergency breathing

apparatus face mask involves equipping the masks with standard telephone transmitter-receiver units mounted in such a way as to not jeopardize the integrity of the face seal. Each device would have a transmitter transfer unit which would permit the operator to switch between the telephone and paging systems.

B. Communications

(1) There are no labels on the six area sound powered phone jacks to identify the area to which they are hard wired. 2

Response: Labels will be installed on sound powered jacks SP1-SP6 prior to fuel loading. Operators will be instructed as to the designated areas to which the jacks are wired.

(2) No headsets are located on any of the back cabinets. 2

Response: Headsets will be installed on the back cabinets to improve control room communications. This will be done prior to fuel loading.

(3) Distance and noise interferes with voice communication between the unit 2 control room operator at the panels and the operator at the common panels. The problem is particularly acute when a breathing apparatus is worn by both.

1

Response: To help reduce the background noise level, carpet will be installed prior to fuel loading. Noisy equipment which interferes with voice communications will be identified and modified to reduce noise output (e.g., the radiation monitoring cabinet has been moved to a location outside the horseshoe).

Additional noise measurements will be made after the above improvements have been made and further corrective action taken if necessary. Results will be submitted to the NRC 120 days prior to the issuance of an operating license.

A proposed modification to the emergency breathing apparatus face mask involves equipping the masks with standard telephone transmitter-receiver units mounted in such a way as to not jeopardize the integrity of the face seal. Each device would have a transmitter transfer unit which would permit the operator to switch between the telephone and paging systems. Headsets will be provided for common and back panels.

6.2 WORKSPACE ENVIRONMENT

Category

A. Lighting

Items 1, 2, 5 and 7 have been combined under one response.

(1) The control room lighting design appears to be for general illumination purposes and not specifically for effective man-machine interface ___2___

(2) The plastic prismatic luminous ceiling diffusers minimize indirect glare but they contribute to direct glare on panel meters, recorders, printers, and polished surfaces. ___2___

(5) The AC emergency lighting illuminating level is too low for optimum reading of displays. ___1___

(7) The ratio of luminosity (background luminous ceiling and the green painted metal reading surface of panels/consoles) 140-foot lamberts/18-foot lamberts, is 8/1. This is 3 times the recommended standard. ___2___

Response: TVA control room lighting is divided into three categories: normal, emergency, and standby. The normal lighting system is powered by offsite AC power. The present normal control room lighting consists of a luminous ceiling which provides general illumination to the control panels, walkways, etc.

The emergency incandescent lighting system is battery powered and functions when the main lighting power has failed. It activates before operator action is required and operates until the diesel generators are activated and the standby lighting system goes in service. See response to items 6.2.a.6 for further information.

Presently approximately 12 percent (40 luminaires) of the luminaires are used for standby lighting. (See attached drawings 55W416-3, 4 for lighting details. An LC designation denotes normal, LS denotes standby, and LD denotes emergency lighting.)

Based upon the results of a preliminary control room review, lighting glare is not a problem. This concern has been adequately resolved by the painting (where practical) of reflective surfaces and by adjusting the overhead lighting by the operators.

A luminosity ratio of below 8/1 is advisable in any TVA control room. There appears to be a question however, as to whether the background luminous ceiling reading was 140-foot lamberts or 140-foot candles.

The luminous ceiling provides sufficient versatility to meet the present lighting requirements of the control room. However, present plans call for the replacement of this ceiling due to an NRC concern over its flame spread and smoke density characteristics. (Reference letter from L. M. Mills to A. Schwencer dated April 30, 1981 (NEB 810505 564).) Photographs and photometric measurements will be taken at Watts Bar following installation of the new ceiling and will be submitted to the NRC 120 days prior to the issuance of an operating license (assuming ceiling replacement has been completed by this time). Detailed information as to how the measurements are taken will also be provided.

(3) A number of burned out or extinguished overhead lights were observed indicating poor maintenance practices. ___3___

Response: Burned out lights are routinely replaced. Some lights are intentionally turned off to reduce background illumination. However, present plans call for the replacement of this ceiling due to an NRC concern over its flame spread and smoke density characteristics. Light levels will be measured and the results submitted to the NRC 120 days prior to the issuance of an operating license.

(4) Dirt on overhead plastic diffusers reduced lighting levels indicating poor maintenance. 3

Response: Diffusers will be cleaned prior to fuel loading. Cleaning will be performed as required.

(6) DC emergency lighting incandescent lamps are not located for optimum reading of displays. 1

Response: The dc emergency lighting system has been tested to provide 1 foot-candle of light from one train of emergency lighting and 3 foot-candles of light from both trains of emergency lighting in designated areas of the control room. The system is designed to provide the above light levels for a period of 2 hours as the vital battery voltage decays to 105 volts. Light level readings were taken next to and parallel to the face of the board or working surface. Since August of 1980, a number of light fixtures have been added to the system, as well as increasing the wattage of some of the incandescent bulbs to ensure that the 1 and 3 foot-candle requirement could be met as specified by the preop test scoping document (preop test No. TVA 35). Therefore, the present system is adequately designed. (See attached drawings 55W416-3, 4 for details. An LD designation denotes emergency lighting.) However, present plans call for the replacement of this ceiling due to an NRC concern over its flame spread and smoke density characteristics. The light levels will be measured and the results given to the NRC 120 days prior to the issuance of an operating license.

The preop test will be performed again after the new ceiling is installed.

6.3 ANNUNCIATORS

Category

Items A and B have been combined under one response.

A. There is no autoclear capability when alarmed parameters are returned within tolerance limits. Each alarmed tile requires operator manual action to clear. ___1___

B. There is no capability for silencing an alarm while preserving the flashing tiles (for diagnostic purposes). ___1___

Response: The present system requires manual action to clear the alarms. If the alarmed condition has returned to normal, the window light goes off when reset. If the alarmed condition has not returned to normal, the window light goes from a flashing to a steady state when acknowledged. The present manual-action-to-clear feature is desirable since it requires the operator to give specific attention to the annunciator window and hence the parameter being alarmed.

The duration of the horn is adjustable and will be adjusted from 30 to approximately 5 seconds before fuel loading. The window will continue to flash until acknowledged.

C. The auditory alarms that were functional were barely detectable above the ambient background noise. 1

Response: Since the alarms have been partially disabled during the construction phase, it is possible that they are at times difficult to hear during construction activities. However, all annunciator alarms will be operational before fuel loading. Also efforts are underway to reduce the background noise level (installing carpet, relocating the radiation monitoring equipment, etc.) before fuel loading.

Even though the present alarm level is adequate, the alarm level of the annunciation system will be measured during the NUREG-0700 review. The alarm level will be increased to 6-8 dBA above the background noise level if the NUREG-0700 review indicates a need.

D. Poor organization of annunciator tiles, difficult to locate in the standard operating instruction (SOI). No cross references provided. 1

Response: A window numbering system will be utilized as a means to help the operator refer to specific annunciator information in the SOI. This will be done prior to fuel loading.

E. Alarms are not prioritized. 1

Response: The alarms will be prioritized by implementing a priority alarm system which is presently being developed. Each priority will have its own unique color for identification purposes. Annunciator windows will be color coded according to their priority. Two colors will be utilized - red for high priority alarms and white for all others. This will be done prior to fuel loading.

F. The contrast between steady state and flashing tiles is poor. ___1___

Response: The present flash rate of two to three flashes per second is adequate.

G. The contrast between illuminated and non-illuminated tiles is too low. 1

Response: Contrast will be improved by utilizing a reflector surface with a high reflectivity. This will be done prior to fuel loading.

H. The poor relationship between the acknowledge-reset controls and their associated annunciator displays could result in the incorrect acknowledgement of an alarm. 1

Response: This has been corrected. The acknowlege-reset controls XS-55-4A and XS-55-4D have been relocated to positions 100 and 134 of panel 1-M-4, respectively (per ECN 2710).

I. Location of acknowledge-reset controls are not standardized on each panel. 2

Response: Switches are shape coded and highlighted with yellow striping to improve visibility. Also, an effort has been made to locate the switches midway up the ends of the panels. In some instances, however, this would upset the layout of other switches and controls. In these cases, the annunciator switches were located as close to these positions as possible.

J. Replacement of annunciator bulbs frequently subject the operator to a shock. 1

Response: This is a floating voltage system. A shield will be placed over the leading and bottom edges of the power busses prior to fuel loading. This action will correct this concern.

6.4 CONTROLS

Category

A. The Location of some controls disregards the capabilities of the 5th percentile person. 2

Response: Enclosure 1, "Table I. Human Body Dimensions Significant for TVA Control Station Design" lists 14 static body dimensions of 5th and 95th percentile persons. Dimensions 6 (Functional Reach), 7 (Functional Reach, Extended), and 8 (Overhead Reach, Standing), as limiting dimensions, are of particular concern for 5th percentile operators. Dimensions 6 and 7 are shown in anthropometric worksheet, Enclosure 2, "Figure 1 5th Percentile Mannequin, Side Elevation, Watts Bar Nuclear Plant, MCR Console." This worksheet also shows a projection (dashed line) of the upper limit of the dynamic reach of the 5th percentile female, from the arm-shoulder pivot point to approximately the 5'6" elevation of the console. The 5'6" elevation is above all the principal controls of the MCR consoles.

The present system can accommodate a 5th percentile female even though some operator movement may be required to accomplish tasks involving controls located on the vertical portion of the panels. (The addition of a guard rail will preclude the accidental actuation of controls).

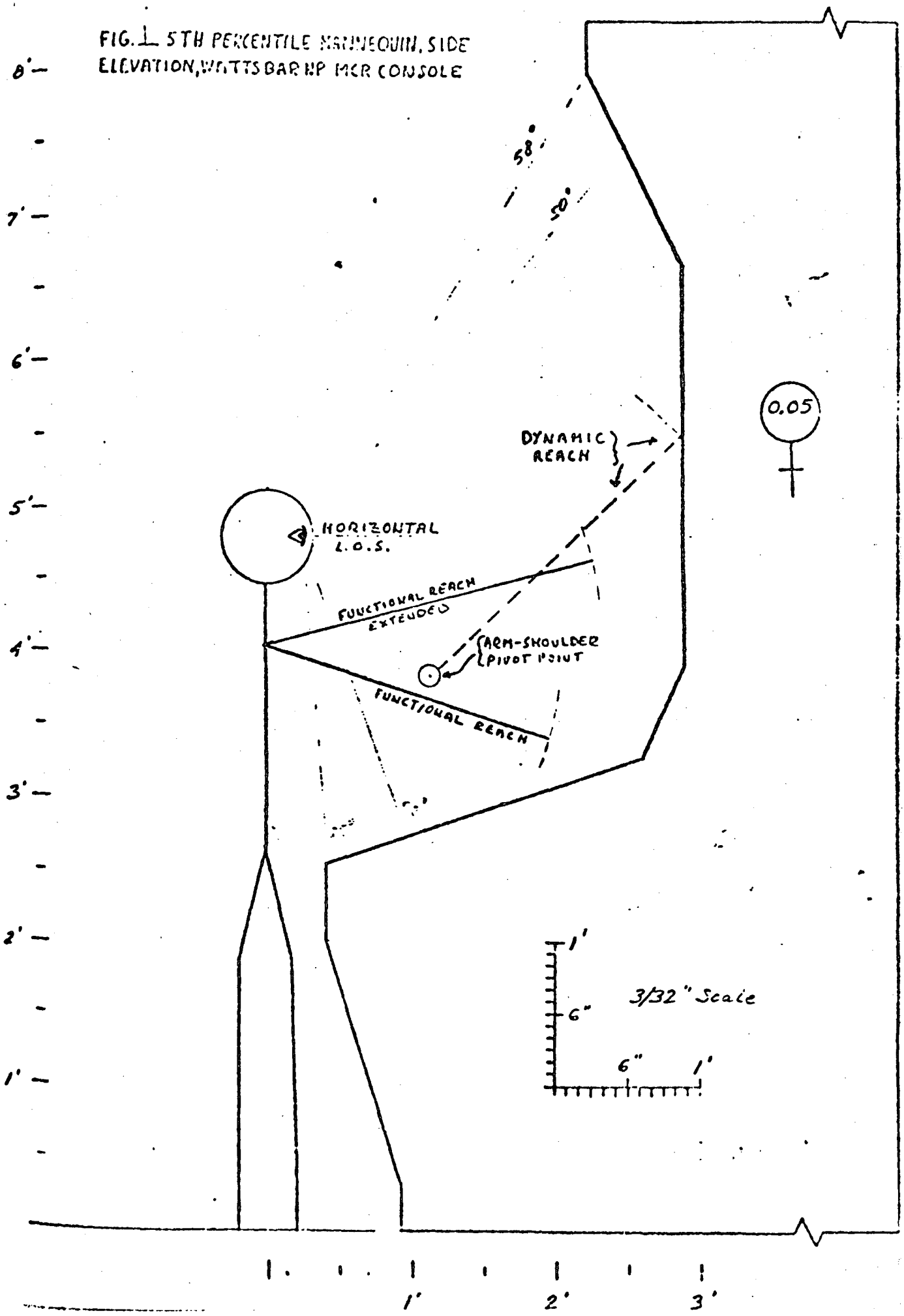
Source: MIL-STD-1472B, Notice 2, 10May78
Items 1, 2, 6, 7, 8, 9, 10 - Table XVII, page 118
Items 3, 4, 5, 12, 13 - Table XII, page 103
Item 11 - Table XI (with addition of 1 inch for footgear), page 10
Item 14 - Table XV, page 109

TABLE I. HUMAN BODY DIMENSIONS SIGNIFICANT FOR TVA CONTROL STATION DESIGN

	5th Percentile		95th Percentile	
	Male	Female	Male	Female
1. Weight (pounds)	129.1	107.6	198.8	164.5
2. Height	66.4	61.8	74.4	70.3
3. Sitting Height, Erect	32.9	31.1	38.2	35.8
4. Sitting Height, Relaxed	32.1	30.5	37.3	35.3
5. Knee Hight, Sitting	19.6	18.5	23.7	21.8
6. Functional Reach	28.6	25.2	34.0	31.1
7. Functional Reach, Extended	33.2	28.9	39.8	36.5
8. Overhead Reach, Standing	78.9	73.0	90.8	84.7
9. Overhead Reach, Sitting	50.3	46.2	57.9	54.9
10. Functional Leg Length	43.5	39.2	50.3	46.7
11. Eye Height, Standing	60.5	56.5	69.2	64.9
12. Eye Height, Sitting, Erect	28.3	26.6	33.3	31.2
13. Eye Height, Sitting, Relaxed	27.6	26.1	32.5	30.7
14. Hand Breadth	3.2	2.7	3.8	3.3

Note: Weight in pounds. All other dimensions in inches.

FIG. 1 5TH PERCENTILE MANNEQUIN, SIDE ELEVATION, WATTS BAR NP MCR CONSOLE



B. Labeling on many valve controllers does not consistently or clearly associate direction of movement with resulting action. A clockwise movement does not always result in opening the valve. 2

Response: Direction arrows will be applied prior to fuel loading and shape coding of the controller knobs will be implemented if practical.

C. Controls located near front edge of sloping console create a potential for inadvertent actuation, if not guarded. 1

Response: Panel guard rails will be installed prior to fuel loading.

D. Direction of control movement on "Trip" controllers is not standardized. 2

Response: The switch on panel 1-M-4 follows convention - "Trip" to right, "Reset" to left. Controller on panel 1-M-6 "Trips" to the right, movement to the left is not used and is blocked from movement. However, the labeling on the switch on panel 1-M-6 is confusing. It functions only as a trip control but is labeled both trip and reset. This will be corrected prior to fuel loading and will eliminate the confusion over apparent nonstandardization of trip control movement.

E. The reactor Trip-Reset controller on Panel 1-M-6 is incorrectly labeled. It only functions as a trip control. 1

Response: This will be corrected prior to fuel loading by relabeling the switch to indicate its function as Trip only.

F. Specific control handles were not easily distinguishable when in a bank of controls (i.e., a string of 5 with one different). 1

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

G. Handles of star switches obscure some of the labels. 1

Response: Many star handled switches are located on vertical surfaces where label viewing is not a problem. For switches located elsewhere, this is not a problem because operators are able to move their heads if unable to view a tag from a particular angle. Additionally, these switches are shape coded to aid in the identification of the "selector" function of the switch.

H. Valve control handles which must be held for many seconds are difficult to hold. 1

Response: Most of the valve control circuits have seal-in features which automatically drive the valves to the desired position after momentary actuation of the control switch. However, some valve control circuits intentionally do not have such a feature, but in such cases complete valve travel is generally accomplished within 5 seconds.

I. The function (i.e., use of pull out/in feature) of some J-handle switches are not clearly labeled. 1

Response: This response has been combined with the response to item 6.8.9.

The responses to items J and K have been combined.

J. There are no protection guards over the emergency "start" and "stop" push-buttons on the diesel generator panel. 1

K. The vertical cabinets along the walkway between Units 1 and 2 contain numerous protruding controls which could be inadvertently actuated. 1

Response: This will be corrected prior to fuel loading by the installation of red carpet at the base of the vertical panels to designate an off-limit area to personnel not performing a required task.

Protective guards are not required because switches presently have raised bezels to prevent inadvertent actuation.

6.5 DISPLAY

A. Meters

(1) Scale divisions and ranges are not always immediately obvious. 2

Response: The indicator scales will be color coded before fuel loading to indicate normal and abnormal operating range on indicators where it is a benefit to operators.

(2) Information obtained from some meters is not directly usable. It has to be converted to other units to be meaningful, i.e., "HP Turbine Impulse Chamber" reads in PSIA and must be converted to percent power. 3

Response: The impulse chamber indicators (PI-1-72 and PI-1-73 on Panel 1-M-4) will be modified to read in percent power for consistency with other percent power indicators.

In addition the following indicators will also be modified to read in units consistent with other devices. In some instances this may involve dual scaling of the indicators.

1. The Safety Injection system (SIS) cold leg accumulator tank level indicators (LI-63-60, 81, 82, 89, 99, 109, 119, and 129).

2. The Upper Head Injection (UHI) accumulator surge tank indicators (LI-87-1, 4).

3. The boric acid tank level indicators (LI-62-238 and 242).

4. The Reactor Coolant system (RCS) pressurizer relief tank pressure indicator (PI-68-301).

5. The steam generator level indicators (LI-3-148, 156, 164, 171, 172, 173, 174, 175).

6. The SIS reactor water storage tank level indicators (LI-63-50, 51, 52 and 53).

7. The condensate storage tank level indicators (LI-2-230A and 233A).

8. The containment recirculation sump level indicators (LI-63-180, 181, 182 and 183).

Items 3 and 4 have been combined with the same response.

(3) Some meters required for post accident monitoring are intermixed with other meters. ___1___

(4) All of the post accident monitor (PAM) displays are labeled with temporary red tape. ___1___

Response: The location of PAM equipment is in compliance with Reg Guide 1.97, section 1.5.

The color coding for identifying PAM equipment on local panels will be applied to the PAM devices on the MCR panel. The temporary red tape will be replaced with permanent colored identification tags. PAM symbols will be utilized. This will be done prior to fuel loading.

(5) Displays indicating sequential information are not always located sequentially or grouped together for ease in visual scanning. 2

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

(6) Meters indicating parameters which must be compared are not grouped for ease in distinguishing similar or different values. 1

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

(7) Meters that indicate different parameters look alike, have similar scales, and are similarly labeled. Reading errors could result. 1

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

Some manufacturer supplied equipment utilizes a different color code other than the TVA color code. Through operator training and labeling (where possible) this inconsistency does not present a problem.

The grouping of lights over the three turbine oil pump switches indicate oil pump ACB position and the presence or absence of oil pressure. Operators are aware of this through training and experience. There presently is inadequate room to label each lamp.

(8) Identification of a specific meter is not always obvious among a string of meters. 1

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

(9) Meters labeled "B" left and "A" right violate stereotypical convention. 2

Response: This will be corrected prior to fuel loading (per ECN 2710).

(10) Meters mounted high on panels are difficult to read by 5th percentile persons and introduce parallax problems. 2

Response: Parallax is an intrinsic problem of analog indicating meters. However, since operator actions are generally precipitated by significant departures from a standard operating band - not by departures as small as those indicated by parallax - this is not a problem.

(11) The significance of the green scale markings on the frequency meters, Panel 0-M-26 is not clear. 3

Response: The green scale on the frequency meters is the mechanical zero point of the meter and is not used by the operator.

(12) Sub-cooling margin monitor is not yet installed or on site. Readouts and displays could not be observed. 1

Response: This device has been procured and will be installed prior to fuel loading (requisition number 828101).

6.5.B Legend Lights and Indicators

Item 6.7.L has been included in this response.

(1) Control position indicator bulbs have single filaments and no lamp test capabilities. 1

6.7.L A lamp test capability is provided only for the overhead annunciator panels and status panels. 1

Response: The control boards are under constant surveillance by the operators and burned out bulbs are replaced upon detection. Also, the shift change procedures will be revised to instruct the operators to check the lamps at shift change. This will be done prior to fuel loading.

(2) The status of the MFPT A Turbine Trip/Reset switch is confusing. It Indicates "Red" when in the reset position and "Green" when tripped. 1

Response: The colors used to denote switch status conform to TVA standards. Red denotes the active or in-service state of a device and green denotes the inactive or out-of-service state of a device. This switch conforms to this standard.

(3) The valve position indicator on the EH Fluid operator's subpanel (1-M-2) is not clear. A green lens indicates "Valve Open." 1

Response: This has been corrected by replacing the green lens with a red lens.

(4) Blank windows are intermixed with active windows on the statalarm panels. Windows are not always in the "OFF" mode during normal operation. 3

Response: Blank windows will be blacked out prior to fuel loading. The operating instructions define the status of these panels for any plant mode.

(5) The scale on the "boric acid flow to blender" indicator is not graduated to indicate decimal point to "tenths" for last digit. 3

Response: The boric acid flow indicator (FI-62-139) on panel 1-M-6 is scaled in tenths.

(6) Status Monitoring-Engineering Safety -

In the matrix of indicator lights, failure to achieve a proper system status is often given by a light "off." No check is made during EP for failed lights. This could lead the operator to assume that an operating system had failed. 1

Response: This has been corrected by revising control room procedures to instruct operators to use the lamp test feature on the status monitoring panels to verify that a lamp is not burned out.

(7) Status Monitoring-Engineering Safety -

In the matrix of lights spares are intermixed with operating lights, since the operator's task is to determine "all on," "spares off" creates a requirement for the operator to review all lights to assure that only the spares are off. 1

Response: Spare windows will be blacked out prior to fuel loading.

C. Recorders

(1) There is no recorder for indicating cold leg temp. 1

Response: There are presently two recorders for indicating cold leg temperature. Cold leg 1 and 2 temperature recorder is on panel 1-M-5 (cutout 66, device TR-68-18). Cold leg 3 and 4 temperature recorder is also on panel 1-M-5 (cutout 69, device TR-68-60). Therefore, this is not a valid concern.

(2) Some recorders do not indicate in real time. 3

Response: Date and time are logged on to the leading edge of the chart paper when it is loaded. Knowing chart speed it is possible to determine the time of a particular event. Chart paper which is graduated in real time is adjusted accordingly when loaded.

(3) To use the CT Flux Differential Meter Data required the use of the Technical Spec Limit Curve. 2

Response: The CT meter is not an identifiable item. However, the delta I flux meter is. The curve for this device is provided for operator convenience and is not required since the plant computer utilizes this curve and automatically signals the operator if there are any deviations from it. The curve is used because the delta I flux changes throughout the life of the core.

(4) Recorder scales and paper scales are not always compatible. 1

Response: This will be corrected prior to fuel loading by instructing the plant to order the correct paper as required.

(5) Labels indicating color code of pens are not always compatible with color of pen trace indicating that parameter. 1

Response: This will be corrected by the addition of labels prior to fuel loading.

(6) Some recorders do not identify the parameter units indicated on both the scales and paper. 1

Response: The computer addressable recorders utilize many ranges making the identification of a particular range on the scale impractical. However, the operator labels the recorder with stick-on labels to indicate the parameter and range being used. The scales for the remaining recorders will be reviewed and revised if necessary prior to fuel loading.

(7) In some instances the test and calibration labels cover meter faces or paper scale indication. 1

Response: Test and calibration labels will be removed from meter faces and paper scales prior to fuel loading.

(8) Some dual function recorders do not have name plates indicating the parameters being monitored. 1

Response: This concern will be corrected with the addition of nameplates prior to fuel loading (per ECN 2604).

(9) Steam Generator Strip Charts - Labels on chart windows contradict those under chart units. Appears that recorders were reinstalled incorrectly after maintenance. 2

Response: Chart recorders are presently in their correct locations.

6.6 PANEL LAYOUT

A. Controls are not arranged in logical order, i.e., by function or sequentially. 2

Response: This is not a problem since controls are grouped by system. Within this system controls are grouped by function. Approximately 62 devices are being moved to conform to this arrangement (per ECN 2710). Also demarcation lines and functional nametags will be added prior to fuel loading (per ECN 2604).

B. Demarcation between Units 1 and 2 and common controls and displays are not clearly indicated. 1

Response: Common panels containing controls and displays from both units will be modified by adding color coding and specific unit numbering to provide unique identification of each control and display. This will be done prior to fuel loading.

C. Switch Confusion - Large string/matrices of switches are located at several places on panels.

(1) Component cooling water

(2) Water service systems

(3) Essential raw cooling water

(4) Ventilation panel 2

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

D. Violation of Stereotype - Feedwater and condensate system - 480 THOV had a sequence of valves (left to right) CBABA 2

Response: The 480 THOV is not an identifiable device. However an adequate effort has been made to ensure that devices violating the order of convention are identified and corrected (per ECN 2710).

E. Display Confusion - There are several long strings (greater than 4) of vertical meters. Mounting in strings increases the likelihood that the operator will read the wrong display if it is near the middle of the string. 2

Response: This will be corrected by the addition of demarcation lines and functional nametags prior to fuel loading (per ECN 2604).

6.7 CONTROL/DISPLAY (C/D) ARRANGEMENT

Items A and C have been combined with the same response.

A. Some displays are not located directly above the controls which relate to them. Some are even located on different panels. Effective control/display relationships do not exist. ___1___

C. There are many instances where controls and displays are arranged "B" on left and "A" on right. (Not typical stereotype) ___2___

Response: Approximately 62 devices are being moved to correct violations of conventional arrangements (per ECN 2710).

Functional nametags and demarcation lines will be added prior to fuel loading (per ECN 2604).

B. Maintenance and tests C/D are located on some panels which contain important operating functions. 2

Response: Demarcation lines and functional nametags will be added prior to fuel loading (per ECN 2604). An effort will be made to relocate the test devices to a panel outside of the horseshoe prior to fuel loading.

D. Some functional groups of valves are not arranged according to operating sequence. 2

Response: Valves are grouped by subfunctions within their respective system (per ECN 2710). The grouping of valves by function within their respective system is preferable to operating sequences that can vary for different plant operating modes. Also demarcation lines and functional nametags will be added prior to fuel loading (per ECN 2604).

The response to items E and J have been combined.

E. Some annunciator tiles refer to specific controls or displays which are either not labeled or which have different label information, including inconsistent abbreviations. 1

J. Some annunciator labeling is ambiguous. 1

Response: Functional nametags will be installed prior to fuel loading (per ECN 2604). Nametag size limitations limit the amount of information which can be presented as compared to the annunciator windows. However, since information displayed is as descriptive as practical and since abbreviations conform to TVA standards, the operators do not have a problem interpreting the information as displayed.

Abbreviations will be reviewed for consistency in conjunction with the NUREG-0700 review.

F. Pattern recognition requirements on statalarm panels are too complex for rapid verification. 2

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

G. Although most control switches are color-coded by system, associated displays are not color-coded to aid in establishing control/display relationship. 2

Response: This will be corrected by the addition of demarcation lines and functional nametags prior to fuel loading (per ECN 2604).

H. Some annunciator windows on panel 1A are associated with controls located below panel 1C and vise versa. (No standardization) 1

Response: The above windows are on the same panel and can be read from the acknowledge-reset switch. The quantity of annunciator windows does not permit their always being located over their related controls. In these instances, they are located as close to their related controls as possible.

I. Some annunciator windows for panel 1-M-9 are located above panels 1-M-3 and 1-M-5. Also true for some other systems. 1

Response: Since panel 1-M-9 is outside the horseshoe and is not continuously monitored by the operator, the ventilation annunciators have been moved inside the horseshoe where they are readily observable by the operator.

K. Annunciator tile organization over the radiation monitor cabinet is not consistent for both panels. 3

Response: This has been corrected (per ECN-2604).

6.8 LABELING AND CODING

A. Labels

(1) Some control panels lack system, subsystem and functional labels. 1

Response: This will be corrected by the addition of demarcation lines and functional nametags prior to fuel loading. Labeling will be hierarchial, that is by system and function. For example the Feedwater and Condensate System will be labeled by system, subsystem (main and auxiliary feedwater, feedwater control, main feed pump turbine, etc.), and device (MFPT A trip reset, drain valve, etc.).

(2) No hierarchial system of group labeling is used on controls/displays. 1

Response: Labeling will be arranged by system and function prior to fuel loading. Additionally, demarcation lines will be added prior to fuel loading (per ECN 2604).

(3) Many panels have temporary labels. 1

Response: This will be corrected by the addition of permanent functional nametags and demarcation lines prior to fuel loading. Temporary labels have been removed (per ECN 2604).

(4) Control labels are placed below the control. 1

Response: Function labels are placed over the device (per ECN 2604). Labels containing the TVA unique ID number and a brief description are placed below the device. When nameplate size does not allow the device nametag to be placed on the device it is placed below it. This is the case for the controllers.

Demarcation lines will be installed prior to fuel loading (per ECN 2604).

(5) Label legibility at normal viewing distances is marginal. Lettering is not sharp and contrast is low, especially for older labels where lettering is smaller and contrast is lower. 1

Response: This is being corrected by changing the coloring of the nametags to black lettering on white background to improve contrast and legibility (per ECN 2604). A larger font is also being used.

(6) The control position markings for controls mounted high on panels are difficult to view. 1

Response: Enclosure 1 "Table I, Human Body Dimensions Significant for TVA Control Station Design" lists fourteen static body dimensions of 5TH and 95TH percentile persons. Dimensions 6 (Functional Reach), 7 (Functional Reach, Extended), and 8 (Overhead Reach, Standing), as limiting dimensions, are of particular concern for 5TH percentile operators. Dimensions 6 and 7 are shown in anthropometric worksheet, enclosure 2 "Figure 1, 5TH Percentile Mannequin, Side Elevation, Watts Bar Nuclear Plant MCR Console." This worksheet also shows a projection (dashed line) of the upper limit of the dynamic reach of the 5TH percentile female, from the arm-shoulder pivot point to approximately the 5' 6" elevation of the console. The 5' 6" elevation is above all the principal controls of the MCR consoles.

The present system can accommodate a 5th percentile female even though some body movement may be required to accomplish tasks involving controls located on the vertical portion of the panels.

(7) Some groups of controls/displays have no functional identification labels. 1

Response: This will be corrected by the addition of functional nametags prior to fuel loading (per ECN 2604).

(8) Position markings for some J-handle switches are not clear. Some 2-position switches have only 1 position labels. 1

Response: This is not a problem because operator training is such that the operators understand the use of this function. Also, many switches are momentary contact where only 1 position actually initiates a specific action.

The response to item 9 has been combined with the response to 6.4.I.

(9) The meaning of "Pull to ---" labels associated with some "J-handles" is not always clear with regard to their rotary position. 1

6.4.I. The function (i.e., use of pull out/in feature) of some J-handle switches are not clearly labeled. 1

Response: Operator training is such that the operators understand the operation of the J-handle switches. Also, the switches are labeled as to the function of this feature.

(10) Annunciator panels are not functionally labeled and individual tiles are not matrix number coded to assist in locations. 1

Response: Functional nametags will be added to the annunciator panels prior to fuel loading. Windows will be numbered by placing an engraved tag outside the upper left hand corner of the window. The numbers will correspond to the numbering system already in use in the SOI's and on the drawings.

The responses to items 11 and 14 have been combined.

(11) Some controls have more than two status lights associated with them, with no labeling to indicate the purpose or meaning of the lights. 1

(14) No labels - Turbine pump indicators have two red lights but no label for either. 2

Response: Status lights are color coded per TVA standards. Red denotes the active or inservice state of a circuit, green denotes the inactive or out-of-service state of a circuit, and white denotes an abnormal or disagreement condition. Switches which have two sets or more of identically colored indicator lights (for example, turbine pump indicators) have been identified (see list below) and descriptive labels will be installed (where room permits) prior to fuel loading.

Panel 1-M-2

HS-47-61A - Seal oil backup pump and turning gear oil pump

HS-47-111A - Turning gear and bearing lift pumps

Panel 1-M-3

HS-3-116A - HPFP HDRA isolation valve

HS-3-126A - HPFP HDRB isolation valve

HS-3-136 - HPFP HDRA isolation valve

HS-3-179A - HPFP HDRB isolation valve

Panel 1-M-5

HS-68-8A - RC pump 1

HS-68-31A - RC pump 2 normal feeder breaker and oil pump

HS-68-50A - RC pump 3 normal feeder breaker and oil pump

HS-68-73A - RC pump 4 normal feeder breaker and oil pump

HS-62-108A - Charging pump A-A motor control

HS-62-104A - Charging pump B-B motor control

Panel 1-M-15

HS-27-9A - CCW pump 1A motor and valve control

HS-27-19A - CCW pump 1B motor and valve control

HS-27-29A - CCW pump 1C motor and valve control

HS-27-39A - CCW pump 1D motor and valve control

Panel 0-M-27A

HS-67-146A - CC HTXA DISCH control valve

HS-67-151A - CC HTXC DISCH valve to HDR A

HS-67-152A - CC HTXC DISCH valve to HDR B

Panel 0-M-27B

HS-65-81 - Shield building vent and containment annulus isolation

HS-65-83 - Shield building vent and containment annulus isolation

Panel 1-M-9

HS-30-1A - Purge air supply unit A

HS-30-4A - Purge air supply unit B

HS-30-11A - Instrument room supply and exhaust fans

6.7.N. Variation of Stereotype - Amps display for feedwater pump B is mounted over a vertical string of pump A related switches. 2

Response: This has been corrected. On panel 1-M-4, Pump A-A motor current indicator (EI-3-119A) is located above pump A-A motor control (HS-3-118A). Pump B-B motor current indicator (EI-3-129A) is located above pump B-B motor control (HS-3-128A).

(12) Some labels contain erroneous information. 1

Response: A continuing effort exists to correct erroneous labeling as it is identified.

(13) Labeling - Font was too small, contrast poor, and information inconsistently placed on specific lines. 1

Response: Nametags have been changed to black lettering on white background to improve contrast and legibility (per ECN 2604). Font size has also been increased. Density of information does not permit line standardization.

B. Demarcation

No demarcation is used to delineate systems, subsystems, or functional grouping on controls and displays. 2

Response: Demarcation lines will be added prior to fuel loading (per ECN 2604).

C. Mimicing

(1) Most mimics are temporarily affixed to panels and are sometimes confusing. 1

Response: The temporary mimics on panel 1-M-1 have been removed or replaced with permanent mimics.

(2) The electrical distribution panel mimic is incomplete. 2

Response: The auxiliary power mimics on panel 1-H-1 are complete as designed. The switchyard panel is not part of the reactor operators area of responsibility.

D. Coding

(1) The number of colors used for switch backplates is excessive and shading differences are sometimes difficult to discriminate. 1

Response: Color coding is applied to the backplates on a system basis, hence the large number of colors. To aid in distinguishing between systems, functional nametags and demarcation lines will be added prior to fuel loading (per ECN 2604).

(2) A color coding scheme has not been applied to displays. 2

Response. This will not be a problem since functional nametags and demarcation lines will be added prior to fuel loading (per ECN 2604).

6.9 PROCESS COMPUTER, KEYBOARDS, AND CRTS

Items A and B have been combined with the same response.

	Category
A. To initiate a computer function requires a series of complex operator actions.	
B. Poor I/O indexing, operator must search through complete document list to find specific data point address information.	1

Response: Operator actions and documentation required to initiate a function via the computer interface console is described below. TVA feels that the procedures will not be complex after the operator has been trained and becomes familiar with the system.

1. Reference computer systems operator's manual for desired function.

2. Key in function and computer point I.D. via operator's console.

The operator will have the following references listings to determine the appropriate computer point I.D. These listings will be available prior to fuel load.

(a) System Index which alphabetically lists the systems and the computer input and outputs associated with each system.

(b) Computer Point I.D. Alphabetical Index which lists the computer

inputs and outputs in alphabetical order of the Computer Point I.D.

(c) A Character Description Alphabetical Index which lists the computer inputs and outputs in alphabetical order of the 24 character description for each computer point.

C. The process computer and the IBM Selectric typewriters are very limited in their ability to present pertinent real time information. 2

Response: The IBM Selectric typers (15 characters per second) will be replaced prior to fuel load with General Electric Terminet Model 1200 typers. These typers are faster (120 characters per second) and more reliable than the IBM Selectrics. Additionally, there is a Mohawk line printer capable of printing 300 lines per minute located in the main control room. It has a noise suppressing hood. The Terminet typers will be mounted in consoles which are designed for noise suppression.

D. Filing of process computer documents not systematic or clearly identified. 1

Response: This will be corrected prior to fuel loading.

E. Could not find any procedures covering the necessary actions to take in the event the computer failed. 1

Response: The status of the plant process computer does not affect either normal operating or emergency operating procedures. Therefore, a procedure for use during periods when the computer system is not operational is not required.

The primary purpose of the plant computer system is to present information to the operator to assist him in the operation of the Nuclear Steam Supply System and inform him of any off-normal conditions.

The computer system performs the following functions: obtains data by scanning analog and digital sensors; performs limit supervision; alarms off-normal conditions; logs various information on hard copy devices; performs trending on analog recorders; reactor control and protection system operation monitoring and nuclear calculation monitoring.

F. The CRT color coding display required some refinement for clearer status monitoring. 3

Response: The color CRT is equipped with contrast, brightness, and degauss controls which are located on the front panel. The operator makes adjustments to these controls as needed to improve display clarity. Also, the color CRT's will be converged prior to system operation and will be checked periodically for proper convergence, resolution, etc.

G. Status monitoring system was not functional. 1

Response: The status monitoring system will be operational before second cycle of operation.

In addition to the concerns just addressed, TVA has also committed to correct eight previously documented deficiencies (reference memorandum from L. M. Mills to NRC dated January 13, 1981 (Q27 810113 012), prior to fuel loading and to respond to twelve others. Some of these are identical to the concerns just addressed and will be noted accordingly.

The eight concerns and the corrective action to be taken are as follows:

1. Control room communications between operators is inadequate.

Response: This will be corrected by the installation of dedicated panel telephones (per ECN 2776).

2. Controls located near front edge of sloping console creates a potential for inadvertent actuation if not guarded. (This concern is also documented in section 6.4 as item C and section 6.4 as item K.)

Response: Panel guardrails will be installed prior to fuel loading. Red carpet will be installed prior to fuel loading to designate off-limit areas to personnel not performing a required task.

3. Operating procedures are not maintained in a specific location and are not indexed to assist operators in locating specific emergency procedures. Also, immediate action steps in the emergency procedures contain references to external documents.

Response: Arrangements will be made to maintain procedures in a specific location in the control room, and an index will be added to assist operators in locating specific emergency procedures. Also, immediate action steps in emergency procedures will be revised to eliminate references made to external documents.

4) Alarms are not prioritized.

(This concern is also documented in Section 6.3 as item E.)

Response: The alarms will be prioritized by implementing a priority alarm system which is presently being developed. Each priority will have its own unique color for identification purposes. Annunciator windows will be color coded according to their priority. Two colors will be utilized - red for high priority alarms and white for all others. This will be done prior to fuel loading.

(5) Demarcation between units 1 and 2 and common controls and displays are not clearly understood. (This concern is also documented in Section 6.6 as item B.)

Response: Common panels containing controls and displays from both units will be modified by adding color coding and specific unit numbering to provide unique identification of each control and display. This will be done prior to fuel loading.

(6) Low level of contrast between illuminated and nonilluminated annunciator tiles. (This concern is also documented in Section 6.3 as item G.)

Response: Contrast will be improved by utilizing a reflector surface with a high reflectivity. This will be done prior to fuel loading.

(7) Distance and noise interferes with voice communication between the unit 2 control room operator at the panels, and the operator at the common panels. The problem is particularly acute when a breathing apparatus is worn by both. (This concern is also documented in Section 6.1 as item 3.)

Response: To help reduce the background noise level carpet will be installed prior to fuel loading. Noisy equipment which interferes with voice communication will be identified and modified to reduce noise output.

Additional noise measurements will be made after the above improvements have been made and further corrective action taken if necessary.

Results will be submitted to the NRC 120 days prior to the issuance of an operating license.

A proposed modification to the emergency breathing apparatus face mask involves equipping the masks with standard telephone transmitter-receiver units mounted in such a way as to not jeopardize the integrity of the face seal. Each device would have a transmitter transfer unit which would permit the operator to switch between the telephone and paging systems.

Headsets will be provided for common and back panels.

(8) Status Monitoring-Engineering Safety -

In the matrix of indicator lights, failure to achieve a proper system status is often given by a light "off". No check is made during EP for failed lights. This could lead the operator to assume that an operating sytem had failed. (This concern is also documented in Section 6.5 as item 6).

Response: This will be corrected by revising control room procedures to instruct operators to use the lamp test feature on the status monitoring panels to verify that a lamp is burned out. This will be done prior to fuel loading.

The twelve additional concerns which TVA has identified and committed to respond to are listed below:

(1) The radiation monitor equipment noise is excessive.

Response: The radiation monitoring equipment has been moved to an area behind the horseshoe.

(2) The operating range of indicators are not readily discernible.

Response: The indicator scales will be color coded before fuel loading to indicate normal and abnormal operating ranges on indicators where it is a benefit to operators.

(3) The pointer on indicating meters is difficult to discern against the background scale.

Response: TVA will investigate the possibility of replacing the present pointers with pointers painted with fluorescent paint.

(4) Some nametags contain erroneous information. Nametags do not identify the power source for the particular device.

Response: Nametags are replaced when found to contain erroneous information. The power source for particular devices will be identified on the devices.

(5) Some systems lack functional grouping of devices.

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

Additionally, approximately 62 devices will be moved (prior to fuel loading) to improve functional grouping (per ECN 2710).

(6) Devices lack functional nametags.

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

(7) The computer trend recorders are located on panel 1-M-10 and are not readily available to the operator.

Response: Three computer trend recorders have been moved to panel 1-M-1 (per ECN 2710).

(8) The identification of a single meter in a string of meters is difficult. (Also noted in section 6.5 as item 8.)

Response: This will be corrected by the addition of functional nametags and demarcation lines prior to fuel loading (per ECN 2604).

Meter bezels will be painted black.

(9) Test switches which are seldomly used are located inside the horseshoe.

Response: The present location of the test switches on panel 1-M-6 is under review to determine the feasibility of moving them to a backpanel or to local panels.

(10) Meters which are scaled in percent must be converted to other units to be useful.

Response: The following indicators will be modified (prior to fuel loading if possible) to read in units consistent with other devices:

1. The Safety Injection System (SIS) cold leg accumulator tank level indicators - LI-63-60, 81, 82, 89, 99, 109, 119, and 129.
2. The Upper Head Injection (UHI) accumulator surge tank indicators - LI-87-1, 4.
3. The boric acid tank level indicators LI-62-238 and 242.
4. The impulse chamber pressure indicators - PI-1-72, 73.
5. The Reactor Coolant System (RCS) pressurizer relief tank pressure indicator - PI-68-301.
6. The steam generator level indicators - LI-3-148, 156, 164, 171, 172, 173, 174, 175.
7. The SIS reactor water storage tank level indicators - LI-63-50, 51, 52 and 53.
8. The condensate storage tank level indicators - LI-2-230A and 233A.
9. The containment recirculation sump level indicators - LI-63-180, 181, 182 and 183.

(11) The contrast of the nametags is poor:

Response: The nametags are being changed to black lettering on white backgound to improve contrast (per ECN 2604). This will be done prior to fuel loading.

(12) The alarms are not given in priority arrangement.

Comment: The use of additional CRT's for alarm summaries and further alarm arrangement by priority is under study.

The CRT computer system aids the operator in recognizing the effects of a plant safety system bypassed or inoperable components by monitoring the plant safety systems.