SNUPPS
Standardized Nuclear Unit
Power Plant System

5 Choke Cherry Road
Rockville, Maryland 20850
(301) 869-8010

Nicholas A. Petrick
Executive Director

March 16, 1982

SLNRC 82-016 FILE: 0671.1.2
SUBJ: NUREG-0737, Item I.D.1

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Docket Nos. STN 50-482 and STN 50-483

Ref: 1) SLNRC 82-04, dated January 19, 1982: Same Subject.

2) NRC Summary of meeting held on February 9, 1982 concerning Control Room Design, dated February 16, 1982.

Dear Mr. Denton:

Reference 1 forwarded the SNUPPS responses to the NRC human engineering findings. On February 9, 1982, a meeting was held to discuss the findings and responses. Reference 2 reported on the meeting.

Attached to this letter is a revised set of responses to the NRC findings. Changes are indicated by revision bars in the right margin. The following responses have been revised in accordance with the meetirg discussion and reference 2:

3.1, 3.14, 5.18, 5.27, 6.3, 6.23, 6.26, 6.32, 6.39, 6.40, 6.43, 6.61, 9.6, and 9.13

The following are comments on reference 2. There are two findings (1.1 and 6.15) in which only the first portion of the responses are Callaway-specific (panels RL013 and RL014). The second portion of these responses apply to both SNUPPS units. It was understood that the response to item 6.33 was acceptable. However, reference 2 did not note item 6.33 as resolved. Subsequent to the meeting it was learned that item 8.19 had been changes to Category 3.

Very truly yours,

Nicholas A. Petrick

RLS/bds/1b30
Enclosure

cc: G. L. Koester KGE
D. T. McPhee KCPL
D. F. Schnell UE
J. H. Neisler NRC/CAL
T. E. Vandel NRC/WC

B001
S 1/1

1.0 Control Room Workspace

Finding 1 (1) Some controls are located too high to be accessible to a 5th percentile operator. One J-handle switch is located 73" above the floor. Some emergency controls for the BORON INJ RECIRC PUMP are located 66" above the floor. The maximum recommended height for controls is 56".

Response On panel RL014 at Callaway, the switchyard breaker control switches are located above the recommended height in order to retain their proper relationship to the switchyard mimic which is arranged to show the correct association of the transmission lines, busses and circuit breakers. Manual operation of these control switches is infrequent and is performed only after discussion with and at the direction of the Union Electric system dispatcher so that the operator action is deliberate and unhurried. These control switches can be operated by a 5th percentile operator as the attached picture illustrates.

The referenced control (Boron Inj. Recirc. Pump) which is in panel RL017 is not an emergency control. With its present location (66" above the floor) a 5th percentile operator can perform any necessary functions required as the attached picture illustrates.

Finding 2 (3) Controls on the test and maintenance operations panels have not been placed in the vertical area between 34" and 70" above the floor. Controls on these back panels are located significantly above and below the recommended range.

Response The controls on the panels behind the main control boards are not used on any kind of routine basis by the operator. They are, in fact, exactly as described, for test or maintenance functions. This creates no problems for the reactor operator because the operator will be aware of test or maintenance activities on these panels and can take appropriate actions without undue or adverse effects.

Finding 3 (1) There are several J-handle control switches that are located closer to the front edge of the panels than the recommended 3". These switches can be inadvertently actuated. These switches are located on RL001, RL013, RL015, RL019, RL021, RL023, and RL025.

Response Metal guardrails will be installed on all outer-ring control board consoles and on the RL001 inner-ring console. This will maintain approximately 2-1/2" of

1.0 Control Room Workspace, continued

free space between the operator body and the front edge of the console benchboard.

Finding 4 This finding has been resolved to the satisfaction of the NRC.

Finding 5 (1) The critical TD AUX FW PUMP TRIP/RESET control is located in a position where it can be inadvertently actuated.

Response This trip/reset control switch has been deleted and will be removed from the panel.

Finding 6 (1) The annunciator response controls are located on the fronts of the benchboards and can be easily activated by leaning against the panels.

Response The test and first-out annunciator reset controls will be guarded to prevent accidental actuation. The acknowledge buttons will be equipped with mushroom type actuators and will remain on the front of the benchboards. This location is highly desirable because its uniqueness allows the operator to operate it by feel with no danger of actuating any other type of control, while devoting his visual attention to the annunciator. There are no adverse consequences of accidentally activating the acknowledge button.

Finding 7 (3) Some controls are located further in from the front edge of the inner ring consoles than the recommended 24". These controls will not be accessible to a 5th percentile operator.

Response All controls located on the inner ring consoles can be operated by 5th percentile operators as the attached pictures illustrate.

Finding 8 (1) Some vertical and horizontal meters are located higher than the recommended 70" above the floor. These displays will not be readable or accessible to a 5th percentile operator. Most of these meters are located between 75" and 84" from the floor. Some meters are located as high as 92", and the top rows of the annunciator panels are all located 117" above the floor. This problem exists on all of the main control room outer ring panels and on the Remote Shutdown panel.

Response A study is being conducted to determine the feasibility of changing to larger meter scales with increased letter size to enhance visibility of those meters located higher than the recommended 70" above the floor.

1.0 Control Room Workspace, continued

The engraving size on the annunciator tiles is being increased to improve legibility. See 1.9 and 1.10 for further discussion of annunciators.

Finding 9 (3) The annunciators are mounted out of the visual field of the 5th percentile operator (recommended maximum = 75° above the horizontal line of sight). The viewing angle was measured to be approximately 80°.

Response The intent of the 75° guideline is to avoid placement of indicators where uncomfortable neck strain would result from prolonged observation. The annunciators are legible to a 5th percentile operator. By their nature, annunciators do not require more than a few seconds of scrutiny before the operator would move on to other tasks. In this time it is unlikely that any adverse physiological problems would develop from looking up at an 80° angle. Additionally, the operators will usually acknowledge and read the annunciators from the consoles instead of the main board, where the viewing angle is less than 75°.

Finding 10 (3) The annunciator tiles are mounted with less than the recommended minimum 45° viewing angle from the tile plane to the 5th percentile operator's line of sight at the acknowledge controls. The viewing angle was measured to be approximately 33°.

Response Enlargement of the annunciator engravings, as described in 3.12, will alleviate this finding. Additionally, the operators will usually acknowledge alarms from the consoles instead of the main control boards. The viewing angle from console is not strongly dependent on the operators' height, and is greater than 45°.

2.0 Communications

To be the subject of a future review.

3.0 Annunciator Warning System

Finding 1 (1) A reflash capability is not provided that allows subsequent alarms to activate the auditory alert mechanism and reflash the visual tile even though the first alarm may not have been cleared.

Response This statement is incorrect, with the exception of the auditory alert mechanism. If the time delay relay associated with an annunciator group times out before an alarm is acknowledged (adjustable from 0 to 60 seconds), that auditory device is silenced automatically and will not reset until the acknowledge button is pressed. This feature has no affect on the visual indications, which do have reflash capability on all windows with multiple inputs. The annunciator time-out feature is desirable in that it eliminates a distracting and repetitive chore during conditions of high stress, i.e. a time when several alarms are being generated in rapid sequence as during a trip. The initial auditory signal alerts the operator of a problem. Allowing the timer to run out and silence its initial and subsequent auditory signals will reduce the need for extraneous activity (repetitivly acknowledging alarms) and allow the operators to concentrate on assessing the situation and taking corrective action. Once the immediate actions have been taken, the operator resets the auditory alarm simply by pressing the acknowledge button.

Administrative Controls will be established to prevent adjusting the alarm to time out in less than 10 seconds. Operators will be required to reset the alarms at the earliest reasonable time after response to previous alarms.

Finding 2 (3) The "first out" alarms that are provided for the reactor system and the turbine-generator system are not located on physically separate panels from the remainder of the annunciators. The proposed prioritization scheme for the annunciators will further interfere with easy recognition of the first out alarms.

Response The "first out" alarms that are provided for the reactor system and the turbine-generator system are each grouped separately on the annunciator window panels. In addition, a black demarcation line will be used to separate the "first out" annunciator windows.

Finding 3 (3) There is no prioritization of annunciator alarms by location, color, or other coding scheme.

Response Operating personnel are performing a study to prioritize and logically arrange the annunciator windows. It is planned to use window location, not color, as an indication of priority. This work is scheduled to be completed in February of 1982.

3.0 Annunciator Warning System, continued

Finding 4 (1) The annunciator indicating breaker trip is on RL014 while the associated breaker control is on RL006.

Response The referenced annunciator window will be moved to the matrix on panel RK026. This is the closest annunciator matrix to the breaker control location.

Finding 5 (1) The tile coordinate labels and panel identification labels for the annunciators have not yet been engraved or otherwise permanently attached. Also, annunciator response procedures are not indexed by panel identification and tile coordinates.

Response The annunciator matrices will be indexed by means of a coordinate system utilizing letters to denote rows and numbers to denote columns. In order to facilitate rapid location of a tile, each column will have its own unique number (1 through 134). Labels for each row and for every other column will be attached to the panels. After the final position of each tile has been established (see action to finding 3.3), the annunciator response procedures will be revised to include tile coordinates.

Finding 6 (3) Annunciator windows are not keyed or coded to prevent inadvertent interchange.

Response Tile locations will be engraved into each tile when the tiles are revised to solve the prioritization and abbreviation problems. (see finding 3.3 and 6.33).

Finding 7 (2) The flash rates of the annunciators are not the recommended three to five flashes per second with approximately equal on and off times. The rates are approximately one flash per second, or slightly less.

Response The Finding is incorrect. During the "alert" portion of the annunciator sequence, the flash rate is rapid, about 3 flashes per second. The slow flash rate referred to occurs during the "return to normal" phase of the sequence for first out annunciators and those other annunciators equipped with the ringback feature.

Finding 8 (3) There is no distinctive coding to indicate annunciator tiles that are illuminated for extended periods of time.

3.0 Annunciator Warning System, continued

Response The dark board concept while at normal power operation will be supported. Lights to be lit for extended periods of time while at power operation and that are due to maintenance related activites will be identified administratively to the operator.

Finding 9 (3) The annunciator panel matrix density is too high on some panels. For example RL026 is a 23 x 6 matrix with 138 tiles. The recommended maximum is 50 tiles per matrix.

Response The major problem with large matrices is one of rapid location. This difficulty will be alleviated by identifying each row and every other column (see action for finding 3.5).

Finding 10 (1) Some annunciator tiles do not adequately specify the alarm condition (e.g., "RHR PUMP TROUBLE" and "ACCUM TANK - LEVEL HI/LO").

Response All annunciator legends are being reviewed as part of our annunciator prioritization study in an attempt to shorten the legends to permit larger lettering, and to improve clarity. The examples given above however, are not deficient in our view. The use of a high level "Trouble" alarm reduces the total number of annunciators in the control room. Amplifying information is available from the computer and from local control panels. HI-LO alarms also reduce the number of annunciators needed in the control room. This type of alarm alerts the operator to a level problem. Instrumentation in the control will then be used to identify the exact nature of the problem, i.e. whether the level is HI or LO.

Finding 11 (3[1]) The annunciator legend character height-to-width ratio was measured to be approximately 7:3. It should be no more than 5:3.

Response The annunciators are being reevaluated for prioritization. As a part of this program, an attempt is being made to reduce the number of words per annunciator tile so that letter dimensions consistent with this finding can be used.

Finding 12 (1) The annunciator legends are difficult to read from the inner ring of control consoles due to inadequate character size, stroke width, and spacing; but they can be acknowledged from that location. For viewing the annunciators from the 12' distance within the inner

ring of control consoles, the character stroke width should be at least .058 inch and the height-to-stroke width ratio should be 6:1.

Response Using a stroke width of .058", a 6:1 height-to-stroke ratio, and a 4:3 height-to-width ratio will permit 3 lines of 8 characters per tile. This finding is being investigated as part of the annunciator prioritization project.

Finding 13 (1) The annunciator response controls do not include all of the following: silence, acknowledge, reset, and test controls. There is no separate silence control. The acknowledge control will silence the alarm before 10 seconds have elapsed from the time of alarm initiation. The auto silence function will silence the alarm after 10 seconds from initiation. Only the first out alarm panels have reset capability. The remainder of the annunciator alarms are automatically reset.

Response (1) The silence function is incorporated in the acknowledge control. This is desirable because it reduces the number and complexity of controls associated with the annunciators without any function loss or ambiguity. This feature reduces the visual search time and memory requirements for the operator, enhancing overall performance.

(2) The auto-silence function is adjustable from 0 to 60 seconds. A discussion of the merits of this system is included in the position statement on NRC item 3.01.

(3) The statement concerning reset capability is incorrect. First of all, the terminology that applies is "Ring back." This means that an auditory and visual signal (slow flash rate) are generated when the alarm condition clears on annunciators with the ring-back feature. All "First Out" annunciators have ring-back, and the others may be converted to ring-back by changing a card in the logic cabinet. We are using the ring-back feature only for annunciators that convey important information to the operator by clearing. This group of annunciators is being evaluated in the prioritization program.

Finding 14 (1) The location order of the annunciator controls is inconsistent from one panel to another (e.g., Test, Acknowledge on RL015; Acknowledge, Test on RL019 & RL023;

3.0 Annunciator Warning System, continued

Acknowledge, Reset, Test on RL019; Acknowledge, Test, Reset on RL025; First Out Acknowledge, First Out Reset and Annunciator Acknowledge on RL005).

Response The annunciator controls will be repositioned so that they are consistent. In addition, all controls, except the acknowledge buttons, will be recessed to prevent inadvertent operation. These controls (test and First-out reset) will require deliberate attention to activate, thereby minimizing inadvertent actuation of the test function, and preventing loss of the First-out information. Labels will be placed immediately above each button on the gently-sloped portion of the control panel.

4.0 Controls

Finding 1 (3) Some of the Cutler-Hammer pushbuttons will be difficult to operate while wearing protective equipment gloves.

Response An operator can operate the Cutler-Hammer pushbuttons without difficulty while wearing switching gloves. These gloves consist of a heavy rubber liner and an outer leather glove. As the attached picture illustrates, wearing protective gloves even as bulky as switching gloves, does not cause any diffuculty for the operator.

Finding 2 (1) The guarding mechanism for several controls on RL018 consists of a red plastic cover with a sliding plastic plate that is removed to operate. Some of the red covers are not permanently attached and will be easily lost. The sliding plates will also be easy to misplace.

Response The red plastic collars will be attached permanently to the switch bezels. The transparent sliding plate is not necessary for the guarding device to perform its function. The transparent plate will be eliminated.

Finding 3 (2) The intentional or accidental tripping of the two unguarded 480V BREAKER J-handle switches on RL016 (Rod Drive Power Supplies) would result in a reactor trip if both are tripped at the same time. Some guarding mechanism is needed for these controls.

Response These J-handles (Breakers: 52PG1901, 52PG2001; Switches: PGH1516, PGH1518) will be replaced with red J-handles and labels will be added to identify these breakers as the power supply to the rod drive motor-generator sets.

Finding 4 (1) The OPEN and CLOSE pushbuttons on some Cutler-Hammer switch arrays can be actuated and latched simultaneously.

Response These pushbutton switches are used in 11 applications on the main control board. They are not available from the supplier with mechanical interlocks between the OPEN and CLOSE pushbuttons. These 11 switches are used in non-IE solenoid valve circuits designed such that the valve will travel to the safe position should both the OPEN and CLOSE pushbuttons be actuated and latched simultaneously. The OPEN and CLOSE pushbuttons on these switches are separated by indicating lights eliminating the possibility of an operator inadvertently actuating both functions simultaneously. A more likely occurrence would be operator error in forgetting to unlatch a position before actuating the other position. In

this case the valve stays IN or travels to the safe position and the actual valve position is reflected by the pushbutton indicating lights thus alerting the operator if this is not the desired valve position. In addition the operator would notice that both OPEN and CLOSE pushbuttons are depressed particularly if the indicated valve position is not the desired valve position.

In the design of the main control board, Cutler-Hammer type E-30 switches have been utilized for valves and dampers and electroswitch type 20 for pump, fan, and breaker controls. This practice was followed to aid the operator in quick recognition of devices by switch type. In order to maintain this standardization some few cases exist where credit must be taken for operator training and procedures. In these few cases we believe maintaining the recognition and standardization of function has greater merit than introducing new manufacturers or types of switches. In addition, the schematic design has been accomplished to nullify improper operator actions for these switches by design of predictable valve travel. Based on the switch and schematic design described herein and the main control board switch standardization concept, we conclude that the switches are adequate and proper for their intended use.

Finding 5 (2) Some of the Cutler-Hammer pushbutton arrays are arranged so that they violate plant convention and population stereotypes for the position of the OPEN and CLOSE functions. Some arrays are arranged OPEN/CLOSE rather than the conventional CLOSE/OPEN. Some arrays are arranged with CLOSE on the top row of the array, rather than the conventional OPEN=top and CLOSE=bottom.

Response The plant convention for the Cutler-Hammer pushbutton switches is CLOSE=left, OPEN=right; OPEN=top and CLOSE=bottom. Switches with only OPEN-CLOSE pushbuttons will be inspected. Any found not conforming to this convention will be corrected.

However, there are other switch arrangements. For example: CLOSE-norm on the upper row with the bottom row left blank. While it confirms the CLOSE-left convention, it does not follow the CLOSE-bottom convention. If this switch is reversed, it will satisfy the CLOSE-bottom convention but in so doing will violate the CLOSE-left convention. Since the "norm" is only a release of the main switch, the CLOSE-left

convention is maintained. It should be noted, there will be no adverse effect if the wrong button is actuated. Operator will look for feedback indication after actuation. Errors can be quickly detected and corrected.

Finding 6 (2) The SYNC CHECK RELAY BYPASS J-handle control violates direction-of-movement stereotypes. The ON function is at the center, upright position, and the OFF function is at the right-hand position.

Response The SYNC CHECK BYPASS control switch will be replaced with a new switch having the correct direction of movement; off at center, upright position and on at right-hand position. Handle will be removable only when it is in the center off position.

Finding 7 (1) The BTRS CONTROL SW has an unconventional arrangement of functions. The DILUTE function is located on the left, the BORATE function is located in the center, and the OFF position is located on the right. This implies that the control, when leaving the OFF position, must actuate the BORATE function before it can actuate the DILUTE function.

Response This BTRS CONTROL switch will be changed to a type similar to the one on the simulator. The new switch will have the OFF position located in the center with BORATE and DILUTE functions located on the left and right, respectively.

Finding 8 (2) The TURBINE TRIP and OVERSPEED controls are placed adjacent to each other. The controls are extremely similar in appearance and could be easily confused.

Response Red plastic collar-type guards will be placed on the MFWP Turbine Trip/Reset controls FCHIS-18 and FCHIS-118.

Finding 9 (2) The two 4.16 kV Bus NB02 Breaker 152 J-handle controls on RL015 are alternate breakers that are not differentiated from the adjacent normal breakers. These controls could be easily confused and incorrectly activated.

Response The alternate breaker to feed Bus NB02 and the alternate breaker to feed Bus NB01 (152 NB0212 and 152 NB0109, respectively) will have their nameplate engravings changed to indicate they are the alternate feeds. The normal and alternate feeds are also electrically interlocked to prevent both breakers from being closed and causing incorrect activation. The nameplate engravings will have ALT. engraved in front of the word BREAKER on the second line.

4.0 Controls, continued

Finding 10 This finding has been resolved to the satisfaction of the NRC.

Finding 11 This finding has been resolved to the satisfaction of the NRC.

Finding 12 This finding has been resolved to the satisfaction of the NRC.

Finding 13 (1) Some J-handle controls have excessive spring tension for their return to center function. When an operator releases the handle from a function activation position, the handle can spring back with such force that the activation of the opposite function occurs. In less extreme cases when the opposite function is not activated, a mechanical indicator flag incorporated into the control is sometimes thrown to the opposite function indication, creating a position/indication mismatch.

Response The vendor will be requested to review specific examples in January 1982 and provide recommendations to alleviate the finding.

Finding 14 (3) On some of the J-handle switches it is possible to mistake the handle of the switch for the position indicator, since there are no other position pointers used.

Response An engraved arrow will be added on to the J-handle of all applicable J-handle switches. The engraved arrows will be filled with white paint and clear filler for easy identification.

Finding 15 (3^1) The pointer for the AUDIBLE COUNT RATE CONTROL-AUDIO MULTIPLIER partially obscures the position labels associated with the control. In addition, the pointer is not always visible from the normal position of the operator.

Response An engraved line will be added on to the knob for this selector switch. The line will be filled with white paint and clear filler for easy identification.

Finding 16 (3^1) The handle on the MAIN GEN VOLTMETER PHASE SELECT switch obstructs both the position labels associated with the control and the switch pointer.

Response The MAIN GEN VOLTMETER PHASE SELECT switch handle will be replaced with an oval handle which will offer less obstruction of the pointer and position labels.

5.0 Displays

Finding 1 (3)	There is no indication of PRESSURIZER PRESSURE in the range between 700-1700 psig on RL002.
Response	A new pressure indicating channel will be provided for the reactor coolant system. This new instrument channel will have a range of 0 - 2,500 psig. It will be located on RL002 in the area where other pressurizer instruments are located.
Finding 2 (2)	When displays fail or become inoperative, the failure is not always apparent to the operator.
Response	All safety-related displays have a redundant display and/or display of diverse variable(s). Therefore, if any safety-related display fails in a manner that is not obvious (e.g., other than failure off-scale low or high), the operator(s) will have no difficulty identifying the failure or operating the plant in accordance with approved procedures.
Finding 3 (3^1)	The scales for the COOLING TOWERS BASIN LEVEL meters are indexed in feet above sea level rather than actual basin level.
Response	The scales for the COOLING TOWERS BASIN LEVEL meters will be changed to reflect actual basin level in feet of water.
Finding 4	This finding has been resolved to the satisfaction of the NRC.
Finding 5 (3)	The measurement variable labeling on the scale face of the displays is oriented vertically from top-to-bottom, rather than horizontally, from left-to-right. The vertical label on the face of the TRANSFER VOLTMETER on RL006 is especially difficult to read because of the length of the legend.
Response	The transfer voltmeter on RL006 has more information than necessary and is difficult to read. The scale legend will be changed to read D.C. VOLTS from top to bottom. A review of the remainder of the meters on the control boards has produced no other meters with legends containing excess information.
Finding 6 (3^1)	The process controller scales (0-100) are not labeled to indicate which is full open and which is full closed.
Response	The scales on the controllers are not position indicators, they are controller output meters. Labeling

5.0 Displays, continued

them with "open" and "closed" could result in an operator assuming that the meter is a position indicator and thereby make an incorrect judgement.

Finding 7 (3) Several display scales begin with an unnumbered major graduation mark.

Response Some display scales do begin with an unnumbered major graduation, but the scales on these meters have ranges of such magnitude that during operations the reading will be above the first numbered graduation. This makes the magnitude of the meter reading readily apparent to the operator.

Finding 8 (2) The lengths of the graduation marks on some of the display scales are not large enough to be read from the required distances.

Response The vital information is mostly on the front panels where the graduations can be easily read from the required distance. The back panel and front panel scales will have tolerance ranges marked on them as soon as these tolerances are defined, therefore, being able to read each graduation is not required from any required distance, only that the readings are within tolerance. We also have annunciators to alert the operators of conditions out of tolerance.

Finding 9 (2) The size and contrast of the scale markings and numerals on many of the outer ring displays are inadequate to be read from the inner ring consoles.

Response With the tolerance zones marked on the scales, the numerals and scale markings will not need to be read, only that the meters are reading within the tolerance zones which will be easily determined from the inner ring console.

Finding 10 (1) Some vertical displays use scales which contain both positive and negative numbers. However, no positive (+) or negative (-) markings appear on the scale face.

Response Five vertical meters have been identified which contain both positive and negative numbers and do not readily identify which are positive and negative. These meters are: SE N1-41C, 42C, 43C, 44C on RL004 and SC TI-412A on RL003. The scales on these meters will be changed to identify that positive (+) is towards the top and negative (-) is towards the bottom.

5.0 Displays, continued

Finding 11 (3) The indicator lights for the ROD DIRECTION and the ROD DIRECT DEMAND violate the plant color-coding convention. The IN indicator lights are green and the OUT indicator lights are red.

Response This statement is incorrect. Green is used on the reactor trip breaker indication to show that the breakers are open and the rods tripped into the core. This is in accordance with industry color convention for breaker position indication. The effect of rod insertion on power (i.e. decreases power) corresponds to the "cold" - green, "hot" - red convention for breakers. For this reason, the current application of green for rods in and red for rods out should be retained.

Finding 12 This finding has been resolved to the satisfaction of the NRC.

Finding 13 (2) The movement of the scale pointers on the Hagan process controllers violates the left-to-right increase convention. The magnitude of the scale reading increases as the pointer moves from right-to-left. The CLOSE/OPEN position convention is also violated. The OPEN position is to the left of the center, and the CLOSE position is to the right.

Response Westinghouse, the manufacturer of this instrument, has been contacted. This finding will be corrected through modification of these controllers to reverse-acting mode of operations.

Finding 14 (3[1]) The pointers obscure the shortest graduation marks on the scales of the trend recorders on RL018. The pointers on some of the recorders on RL022 totally obscure all graduation marks along with the numerals.

Response The supporting arms for pointers located on RL018 and RL022 recorders will be bent to allow maximum visibility of its associated scale.

Finding 15 (3) The numerals on the MFW PUMP TURBINE SPEED circular meters on RL005 are placed on the same side of the meter graduations as the pointer. This causes the pointer to obscure the indicated value.

Response The MFW Pump Turbine Speed meters are not used for precise control of the feed pump turbine. They are used primarily during startup of the turbine to give the operator an indication of how fast the turbine is accelerating. The numerals are large enough that they are not totally obscured.

5.0 Displays, continued

Finding 16 (3) The long hand of the potentiometer dial on the Hagen "Full Station" process controllers obscures the dial numerals.

Response The potentiometer dials on process controllers are very similar to a clock face, with the short hand indicating major divisions of the pot range and the long hand indicating fractions of the major division much as the long hand on a watch indicates minutes. As on a wristwatch, the presence of numerals is not necessary for accurate interpretation of the long hand's position, provided the major divisions are clearly visible, which they are. Mistakes in setting these pots are therefore unlikely. Should a mistake occur, that fact will be readily apparent from other control room indicators and annunciators, and such a mistake would be easily correctible.

Finding 17 This finding has been resolved to the satisfaction of the NRC.

Finding 18 (1) Single filament incandescent lamps are used without the means of test for bulb or circuit failure.

Response Single filament incandescent lamps are used for position and status indication. It is preferred to neon bulbs since neon bulbs provide lower level of illumination in a well lighted control room environment. The single filament bulbs being used have an estimated 20,000 hours life span. This is a result of the fact that the voltage supplied to the bulbs has been reduced approximately 7% to increase bulb life. A burnt bulb can be traced by observation alone. Each switch or a group of lights for a component contains at least two status lights, one for OPEN (RUN, ON) and the other for CLOSE (STOP, OFF). At any given time during normal operation, at least one of the two lamps is lit, otherwise bulb or circuitry problem is indicated. This can be remedied by either replacing both bulbs or repairing circuit failure. Verification that the lights are energized will be made at shift turnover.

Finding 19 (2) The legend lights for STEAM DUMP VALVE POSITION violate the OPEN=top and CLOSE=bottom convention. The CLOSED (green) indicators are located above the OPEN (red) indicators.

Response These legend lights will be rearranged so that the OPEN (red) is on top and CLOSED (green) is on the bottom.

Finding 20 (3) The legend plates for the DEMINERALIZER TRAIN "A" and "B" legend lights are not keyed or coded to prevent inadvertent interchange during bulb replacement.

5.0 Displays, continued

Response There are two identical demineralizer trains located next to each other. The likelihood of inadvertently interchanging legend lights is very remote if not inconceivable. The one demineralizer train will act as a pattern for the other train if more than one lens cover is removed for multiple bulb replacement. These lights are strictly indication and interchange of lens covers would be apparent to the operator when he initiated a function on the controls.

Finding 21 (2) The redundant ESF SYSTEM STATUS INDICATION legend lights lack identical layout between the matrices. They also make inconsistent use of abbreviations. In addition, inconsistent logic is used in the NSSS monitoring system that interfaces with these two display matrices.

Response The ESF Status Indication System is currently under design-revision. The redundant legend lights will be arranged consistently. NSSS logic will be revised to be consistent with the logic of balance of plant components and to maintain a dark board concept. Abbreviations will be made consistent to those used in the annunciator prioritization study.

Finding 22 (3[1]) The bottom scale on each of the RCP A,B,C, and D SEAL LEAKOFF trend recorders obscures the top of the recorder paper. In addition, the pointer for the bottom scale of each recorder is located behind the scale, prohibiting the reading of current information.

Response Westinghouse, the manufacturer of this instrument, has been contacted for clarification and/or solution.

Finding 23 (1) The top of the NIS RECORDER window obscures the exponential values at the top of the recorder scale when the scale is viewed from a normal standing position.

5.0 Displays, continued

Response The recorder window will be modified so that it will not obscure the exponential values at the top of the recorder scale.

Finding 24 (2) Many of the two- and three-pen recorders have one pen that is mounted below and/or behind the scale. This location creates parallax which will make the reading of trend information difficult.

Response The "trending information" is obtained by comparison of data over some period of time; not at the exact moment it is printed on the chart paper. Therefore, the area of focus is the larger picture presented by the lines on the chart paper in the large viewing area provided. In addition, the scale printed on the chart paper provides reference to orders of magnitude.

"Current information" is obtained from the individual parameter indicator and not from recorders.

Finding 25 (2) The recorded data on the MAIN TURBINE VIBRATION AC and MAIN TURBINE TEMP + EXPAN impact recorders is printed on top of other data, making the information totally illegible. The graph lines on these recorders are a light blue color which provides poor legibility and contrast. In addition, the scaling on the graph paper does not correspond to the horizontal scale on the impact recorders. The data is recorded in the form of a number (1-16 or 1-20) of very small size that is difficult to read.

Response The turbine recorders will print points that touch each other when all points have the same value. The operator uses the information on the recorder to determine points that vary from the norm. When a point varies from the remainder of the points, it will be obvious to the operator. The color of the graph lines and the scaling on the graph paper will be changed to improve legibility and correspond to the horizontal scale on the recorder. When a single point prints by itself on the paper, the number is legible and the print wheel also has a larger number on it to identify which point is printing. More detailed information can be obtained from the plant computer whenever the operator suspects a point is trending out of its normal range.

5.0 Displays, continued

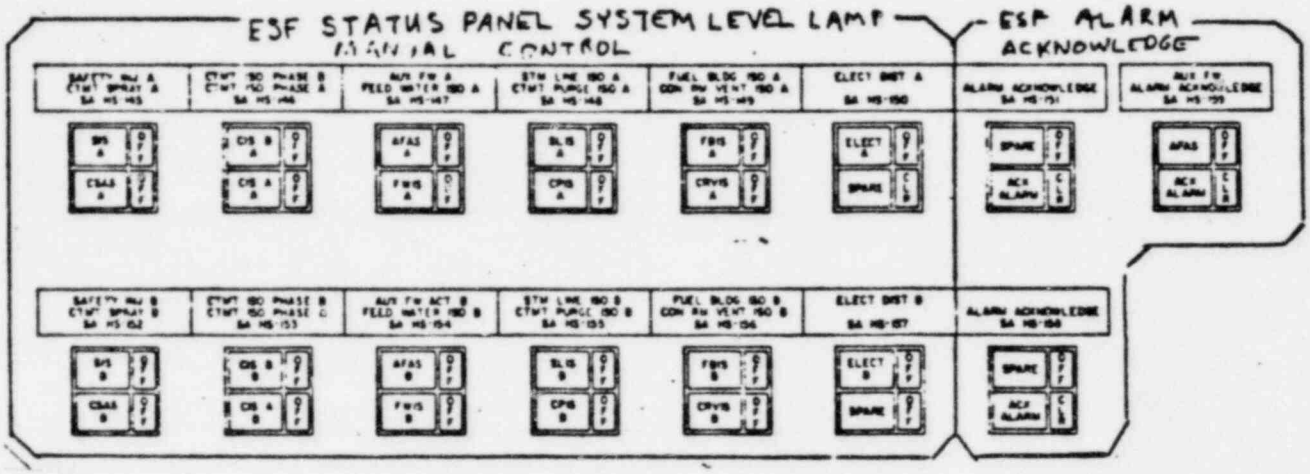
Finding 26 (3[1])	There are no units of measurement provided for the counters on RL002.
Resonse	Nameplates with GALS. engraved on them will be installed directly to the right of the flow counters on BG-FY-111BB, BG-FY-111B, BG-FY-110BB and BG-FY-110B.
Finding 27 (1)	The red covers installed over the counter numbers obscures the numbers from view. To read the counter accurately, the cover must be raised.
Response	The covers indicated will be changed from "red " to "clear".
Finding 28	This finding has been resolved to the satisfaction of the NRC.

6.0 Labels and Location Aids

Finding 1 (1)	There are several horizontal meters on RL013 that are missing their associated component labels.
Response	Ammeters located in the feeder circuits are positioned above the associated circuit breaker control switch. These meters are adequately identified due to location in mimic and proximity to associated circuit breaker control switch nameplate.
Finding 2 (1)	Two CIRCUIT/LAMP TEST pushbutton arrays on RL017 are not labeled. This makes it impossible to determine which of the buttons serves each function (circuit test or lamp test).
Response	The engravings on the two CIRCUIT/LAMP TEST pushbutton switches will be changed. The upper pushbutton will read "VLV TEST" and the lower pushbutton, "INTLK TEST".
Finding 3 (2)	There is no label with the REACTOR TRIP BREAKER A and B indicator lights to indicate that the red and green mean closed and open, respectively.
Response	Red for closed and green for open is a color convention used throughout the control room for breaker position indication. Since the reactor trip breakers do not differ from this convention, no special labeling will be used. The indicator lights will not be labeled "open/closed" because those that are labeled are push-buttons.
Finding 4 (3[1])	There are no permanent panel number identification labels. Temporary labels made of dark gray duct tape that are very hard to read have been put on some of the higher numbered panels.
Response	Labels with the panel numbers will be added to the control boards.
Finding 5 (3[1])	The SAFEGUARD SYSTEM switches on RL003, which illuminate to acknowledge/clear status indicators on RL018, have no labeling to indicate their function.
Response	Demarcation lines and a summary label will be added to clarify the purpose of this group of buttons. (See sketch)

6.0 Labels and Location Aids, continued

Sketch to Finding 5:



Finding 6 (1) The label on RL002 that reads BORIC ACID TO VCT INLET is incorrent. Boric acid is not sent to the VCT because of possible fouling of the VCT spray system.

Response The label for BG HIS 111B will be changed to read: MAKEUP TO VCT INLET.

Finding 7 (1) There is an incorrect label for the TRAIN A RETURN VALVE. This label should indicate that this is a SUPPLY/RETURN VALVE.

Response This label will be changed to read "SUPPLY/RETURN VALVE".

Finding 8 This finding has been resolved to the satisfaction of the NRC.

Finding 9 This finding has been resolved to the satisfaction of the NRC.

Finding 10 This finding has been resolved to the satisfaction of the NRC.

Finding 11 (3) There are no functional or system summary labels.

Response Panel numbers are being added. The close functional relationships that exist on each panel segment are well understood by trained operators. Addition of summary labels is unnecessary and would add visual clutter.

6.0 Labels and Location Aids, continued

Finding 12 (3^1) The heirarchical labels for the PZR RELIEF TANK indications and the REACTOR COOLANT LOOP FLOW indications do not clearly fulfill their purpose. The system portion of each label is engraved with the same size type face as the indication identifier portions of the label. Since the system portion of each label is engraved over the center indication identifier, it appears only to apply to that indication identifier rather than to the whole group.

Response The labels for Reactor Coolant Loop Flow and PZR Relief Tank will be changed as below to make it apparent that the system portion refers to the group of indicators rather than just to a specific indicator.

REACTOR COOLANT FLOW LOOP -		
BB FI-____	BB FI-____	BB FI-____

PZR RELIEF TANK		
TEMPERATURE	PRESSURE	LEVEL
BB TI-468	BB PI-469	BB LI-470

Finding 13 (3^1) The EXCESS LETDOWN OUTLET TEMPERATURE and PRESSURE display labels on RL002 do not follow the recommended guidelines for hierarchical labeling. The group label for the pair of meters does not include the word OUTLET, which is, therefore, engraved before PRESSURE and before TEMPERATURE. Labels on displays directly adjacent to this group do follow the hierarchical labeling guidelines.

Response The label for Excess Letdown Temperature and Pressure will be changed to follow the hierarchical labeling guidelines as shown below.

EXCESS LETDOWN OUTLET	
TEMPERATURE	PRESSURE
BG TI-122	BG PI-124

Finding 14 (3^1) The size of the lettering on the component labels for controls is not 25% larger than the lettering on the control position labels, as recommended. The position label lettering for all of the J-handle controls is the same size or larger than the associated component label lettering.

Response Component labels have a distinctive shape and lettering and are always located above the device to be operated. After locating the correct device, the operator then

determines the desired position by the labeling on device escutcheon. Due to this serial operating activity, adequate emphasis is provided by the labeling distinctions now provided.

Finding 15 (2) The labels for some indicator lights on RL013, RL014, and RL018 are located below the lights. Labels are conventionally placed above their associated components elsewhere in the control room.

Response On panels RL013 and RL014, the nameplates for some indicator lights are located below the lights in order to provide needed information while maintaining the mimic to a reasonable size. On RL013, pump dischage valve position lights are located at the bottom of the panel and due to the specific arrangement, the identification of these lights is positive and unambiguous. On panel RL014, the 345kV circuit breaker controls consists of time-proven control switches and indicating lights. This arrangement provides the most compact arrangement possible for these devices considering back panel wiring. Operation of these controls is infrequent and does not require rapid component identification. In some cases control switches are only shown by the mimic, these nameplates are also located below the lights for consistency within the switchyard mimic.

Generally, all controls and indicators located on panels RL013 and RL014 are related to systems and equipment which are ancilliary to the main unit operation and do not serve safety related systems. Operation of the controls on these panels is infrequent and requires unhurried responses. Additionally, these panels are located at the left extremity of the control board and will have minor effect to the operation of the other control panels.

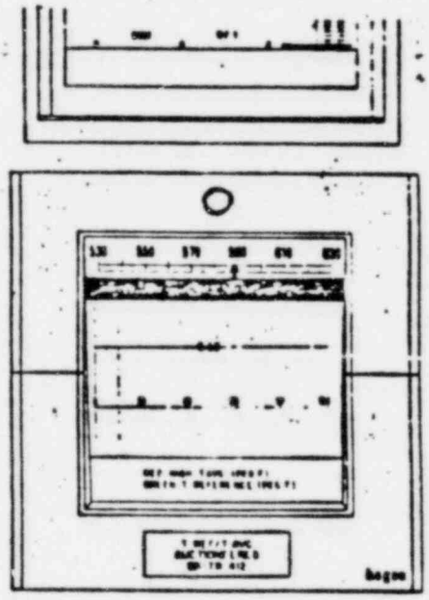
The following labels on RL017 and RL018 will be relocated above their associated components on the control board.

RL018
EPZL-8808CA
EPZL-8808AA
EPZL-8808DA
EPZL-8808BA

RL017
EJZL-8840A
EJZL-8809BA
EMZL-8802AA
EJZL-8809AA
EMZL-8835A

Finding 16 (3[1]) The label for the T REF/T AVG AUCTIONEERED trend recorder is located at the bottom of the recorder, rather than above as is the plant convention.

Response The location of the label is such that there is no question at all as to which device it refers to. There is inadequate room to locate the label above the recorder. See sketch



Finding 17 (1) The labels for the displays that are located at high positions on the outer ring panels are not readable by an operator at the front edge of the panel. These labels are obscured from this position by their associated displays.

6.0 Labels and Location Aids, continued

Response	In those high locations where the labels are not readable due to obstruction of associated display devices, the labels will be moved or installed with adequate spacers underneath the labels so that the labels are readable by any operator at the front edge of the panel.
Finding 18 (3[1])	The central annunciator response control labels are not visible from a standing position at the benchboard edge.
Response	All labels for annunciator response pushbutton switches will be relocated to the top of console benchboard. These labels will be situated on the edge of the console benchboard directly lined up with corresponding pushbutton switches.
Finding 19 (3[1])	The STM GEN A through D DUMP CTRL AT SHUTDOWN PNL labels are placed such that they can be associated with indicator lights that they do not apply to. These labels apply only to the white light in each group of one red, one green, and one white indicator light. The red and green lights in each group are associated with the STM GEN A through D STM DUMP TO ATMOS VLV POS labels.
Response	The labels will be rearranged. The one bearing "STM DUMP TO ATMOS VLV PCS" will be centered above the red and green lights. The label bearing "STM GEN DUMP CTRL AT SHUTDOWN PNL" will be made shorter and centered on top of the white light.
Finding 20 (2)	The ESF XFMR XNB01 UNIT 2 and the XFMR SPB 218 AND MISCELLANEOUS TRANSFORMERS labels are located side by side in association with an indicator light. It is not clear from this label arrangement what the associated indicator light refers to.
Response	One nameplate (ESF XFMR XNB01 UNIT 2) will be removed.
Finding 21 (3[1])	The DG NE01 REGULATOR NULL INDICATION label ON RL015 is not attached to the panel. The screw holes in the label are drilled in the wrong places to fit the holes drilled in the panel.
Response	A new label for the "DG NE01 REGULATOR NULL INDICATION" will be made and affixed to the RL015 benchboard.
Finding 22 (3[1])	Some labels in the control room have come loose. Most of the loose labels were glued to the painted panel surface rather than screwed on.

6.0 Labels and Location Aids, continued

Response	All labels will be inspected for proper installation. Those which became loose will be secured.
Finding 23 (1)	The label relating pen color to displayed parameter on some recorders is located in the recorder window. This label location obscures part of the chart paper when the recorder door is closed, and the information provided by the label is not available when the door is open.
Response	The label relating pen color to displayed parameter will be relocated from the window to the bottom part of the door.
Finding 24 (2)	In addition to the standard component labels, there are one or two labels incorporated into the top and/or bottom edges of some of the Hagan process controllers. These labels generally provide either redundant or confusing information. In some cases, the incorporated labels which use small print, contain the information that is necessary to differentiate between adjacent controllers.
Response	A study of Control Panel labels will be performed and redundant information will be deleted. Along with this all necessary information to differentiate between controllers will be included on nameplate labels.
Finding 25 (3)	Several J-handle controls on RL015 are designed with the numeral "1" occupying the central position between OFF and ON. The numeral "1" is used as a procedure step to enable synchronization of offsite power sources with the diesel generators, but as presently labeled does not convey any meaningful information to the operators.
Response	The "1" occupying the center position between OFF and ON J-handle controls on RL015 will be changed to "I". The "I" stands for indication.
Finding 26 (3[1])	The J-handles on RL006 that are labeled STEAM FLOW SELECT SW, FW FLOW SELECT SW, and STEAM GENERATOR LEVEL SELECT SW do not select flow or level, as the labels indicate. They select the channel from a flow or level sensor that will be used as an input to the Reactor Protection System.

6.0 Labels and Location Aids, continued

Response This statement is incorrect. These switches select the channels of each of the three parameters, steam flow, feed flow, and steam generator level that are to be displayed on the associated trend recorder, and that are input to the steam generator level control system and main feed pump speed control. These switches have no control over inputs to the Reactor Protection System. The word "channel" will be added to each applicable nameplate to show selection of channels.

Finding 27 (3^1) Five valve control switches in a group of eight on RL024 do not have component labels that indicate that they actuate valves. This problem also occurs other places in the control room.

Response A study on Control Panel labels will be performed to insure consistent labeling is used to denote what a switch is actuating.

Finding 28 (1) The TD AUX FW PUMP TRIP/RESET pushbutton has an integral label that reads TRIP. This integral label makes it unclear whether the button can also perform a reseting function, as the component label implies.

Response This switch is being eliminated from the main control board.

Finding 29 This finding has been resolved to the satisfaction of the NRC.

Finding 30 (3^1) A label on RL002 which refers to the emergency boration system imprecisely reads IMMEDIATE BORATE TO CHARGING PUMP SUCTION.

Response The label for the emergency boration system will be changed to read - "EMERGENCY BORATE TO CHARGING PUMP SUCTION".

Finding 31 (2) The labels for the MAIN TUBINE LIFT PUMPS J-handles and indicator lights do not clearly imply the association between the components.

Response Overlay type labels will be used to make clear the association between indicator and label.

Finding 32 (3^1) The labels do not consistently use terminology or abbreviations even in directly adjacent applications. There is no consistent application of abbreviations in place of complete words. This is a wide-spread problem throughout the control room. For example, adjacent display groups on RL001 use VCT and VOLUME CONTROL TANK. There is no space constraint that would require the use of the abbreviation VCT on the one label.

6.0 Labels and Location Aids, continued

Response — Some components are recognized as readily by their abbreviation as they are by their whole name (for example, RCP, or RWST). For these items, only the abbreviation will be used on labels. For all other components, the entire name will be used where there is room on the label to do this. Where there isn't room an abbreviation will be used. A study on Control Panels is underway to ensure that abbreviations, when used, will be uniquely defined and consistently applied for each component.

Finding 33 (3^1) — There is no standard abbreviations list for the control room. Abbreviations are used inconsistently throughout the control room.

Response — The group of operations personnel that is reviewing annunciator prioritization will also establish a standardized set of abbreviations that will be used for all labels (see action for finding 32)

Finding 34 — This finding has been resolved to the satisfaction of the NRC.

Finding 35 — This finding has been resolved to the satisfaction of the NRC.

Finding 36 (1) — The label on RL004 for RCLP 1 has an "A" instead of a delta symbol.

Response — A new label with the correct "Delta" symbol will be made and affixed to the RL004 panel.

Finding 37 (3^1) — The engraved lettering on the small red pushbuttons on the Cutler-Hammer switch arrays is too small to be easily read. The letters are filled with white paint that has become dirty, which has further degraded their legibility.

Response — The referenced Cutler-Hammer switch is comprised of main pushbutton (PB) switches and corresponding small red PB switches integrated in one switch assembly. These switches are situated right next to each other and bear the following engraved lettering:

MAIN SWITCH	SMALL RED PB SWITCH
OPEN	CLS
CLOSE	NORM
NON-ISO	150

It is therefore evident, the small red PB switch serves only one function - to negate the main switch function. It deactivates, or releases, the main switch.

Operating personnel executing a switching operation will observe the main switch function - to open, close, or non-isolate. When he wishes to perform the opposite function, he will actuate the small red PB and has no real need to refer to the lettering on the PB. The lettering is merely provided as a backup reminder to assure him of its function. Improperly engraved/finished engraving will be replaced.

Finding 38 (3) All of the labels in the control room appear crowded. The inclusion of the engineering number on the component labels in the same size lettering as the primary identification information contributes to this crowded appearance.

Response A study on the Control Panel labels will be perfomed to alleviate the crowded appearance.

Finding 39 (3^1) The character height of the position labels on J-handle controls is under the recommended minimum size for the normal viewing distance of 28 inches.

Response The existing circular label engraving will be changed to horizontal format. Larger letters/numbers will be engraved on the escutcheon.

Finding 40 (3^1) The contrast of a majority of the colored labels is poor Some of the combinations of background/lettering colors are: black/white, white/black, red/yellow, yellow/black, etc. Only the white/black are optimally legible. The red/yellow labels are especially hard to read.

Response The use of colored labels to identify controls and indications by separation group is an exceptionally useful tool during many plant transients. It is particularly useful when responding to a loss of power in a specific train, including AC power and DC or AC instrument power. The operator can quickly identify degraded controls and indicators based on the colored labels. The label engravings are legible at the viewing distance that exists when an operator is operating an associated control. When an operator is at a greater distance (the center of the control room, for example) he can make a rapid review of critical component status on a train basis using the color of the labels, component status lights, and knowledge of panel layout. At this distance (12'-15') engravings of any color combination would not be legible. Replacing the colored labels with black and white ones would eliminate a vital form of information. A yellow border will be provided around red labels and the lettering will be changed to white.

6.0 Labels and Location Aids, continued

Finding 41 (3^1) The engraved legends on the keys of the process computer keyboard are hard to read. The magenta function key legends have especially poor contrast, and some of the other keys have inadequate engraving depth.

Response Lighting levels in the Control Room were not at operating intensity during review due to incomplete construction. Magenta keys will be engraved with black lettering to provide sufficient contrast.

Incorrectly engraved keys will be replaced.

Finding 42 (3^1) The label script on the TEST INTERLOCK LOSS OF PWR PRESS SIGNAL and STEAM DUMP VALVES POSITION engraved indicator lights on RL006 is barely readable due to inadequate engraving depth and lack of script filler pigment of contrasting color.

Response The two indicator light lenses for the TEST INTERLOCK LOSS OF PWR PRESS SIGNAL and STEAM DUMP VALVES POSITION will be replaced with new lenses bearing adequate engraving and proper script filler pigment of contrasting color.

Finding 43 (3^1) The engraved surfaces of the labels have no clear filler to prevent the buildup of dirt. This will result in eventual reduction of legibility.

Response All labels will be inspected for adequacy of engraving and smoothness of label surface finish. Those which are found unsatisfactory for any reason, including susceptibility to accumulation of dirt, will be replaced. Periodic surveillance to review board cleanliness will be performed and boards will be cleaned as required.

Finding 44 (3^1) The label engraving style makes it impossible to differentiate the letter "I" from the numeral "1". Both letter and numeral are represented by a vertical slash.

Response During the label study, engravings will be reviewed and corrected where necessary to allow the letter "I" to be distinguished from the numeral "1". In general,the context informs the operator whether a "1" or "I" is intended.

Finding 45 This finding has been resolved to the satisfaction of the NRC.

Finding 46 (3^3) Several J-handle selector switches on RL005 and RL006 have position labels that are decals that can be easily removed.

6.0 Labels and Location Aids, continued

Response RL005 has no decals on any of the J-handle switches RL006 has four (4) J-handle selector switches with decals. (AE LS/519C, AE LS/529C, AE LS/539C, and AE LS/549C) These decals will be removed, and the required lettering will be engraved on the switch cover.

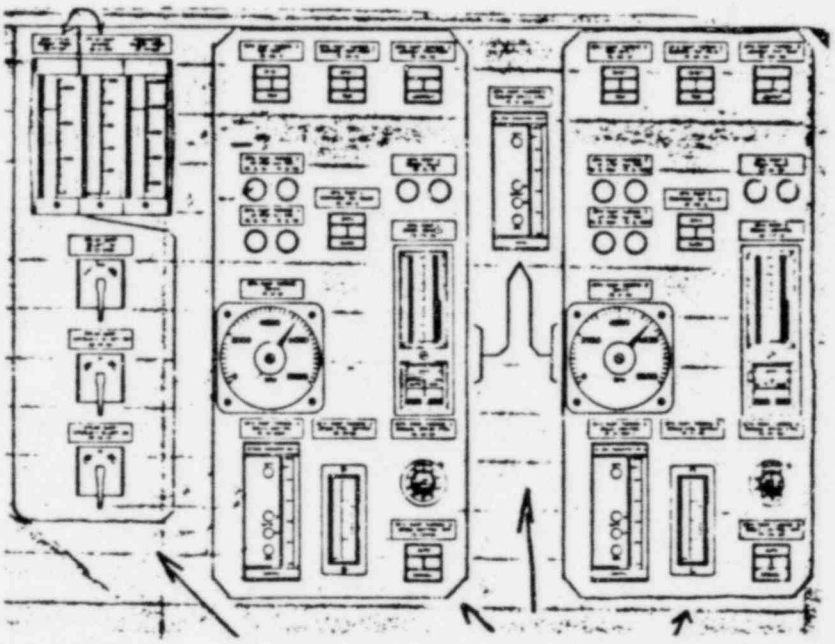
Finding 47 (3^1) Demarcation is not adequately used to visually isolate separate system components or to enhance existing relationships between components contained within the same system.

Response

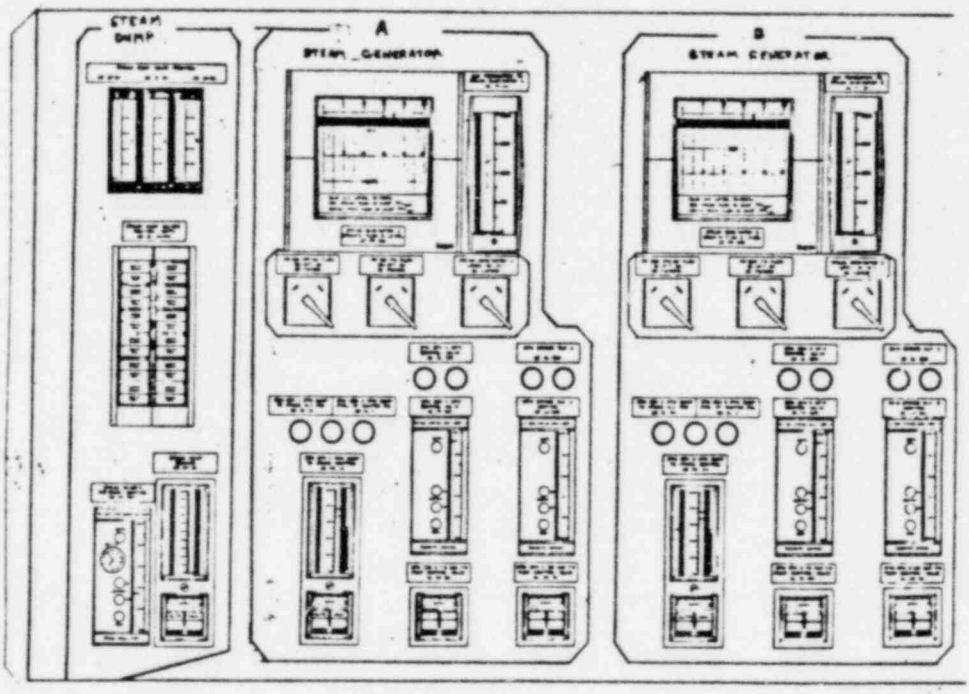
PANEL	DEMARCATION PLAN	REMARKS
RL001	none	panel contains extensive mimic
RL002	on hold	mock-up being constructed to evaluate new instruments and use of demarcation
RL003	see 6.05	
RL004	none	simple panel layout, requires no demarcation
RL005	see sketch	steam dump demarcation continues on RL006
RL006	see sketch	only S/G A&B shown on sketch. Treatment to be same for C&D.
RL013,RL014 RL015,RL016 RL017,RL018 RL019	none	These panels contain extensive mimics. Use of demarcation lines is not needed to improve clarity, and would interfere with mimics.

Proposed demarcation lines for RL005 and RL006 - see sketches on following page.

Proposed demarcation lines for RL005



Proposed demarcation lines for RL006



6.0 Labels and Location Aids, continued

Finding 48 (3)	The label color-code used to differentiate between electrical trains is not consistent with the other uses of color in the control room.
Response	Identification of safety-related electrical trains provides the operator with significant information regarding potential train degradation. The essential safety functions provided by these electrical trains during an event requires significant operator awareness regarding train status during all modes of plant operation. Train color coding as now used provides added emphasis consistent with these safety requirements.
Finding 49 (3^1)	The mimic on RL001 incorrectly implies that the CHARGING HDR FLOW control only controls the rate of flow in the flow path, since a single mimic line goes to the control and a single line leaves the control. The mimic does have a second outlet line to indicate the portion of the inlet flow that is used for reactor coolant pump seal injection.
Response	The CVCS mimic is being extensively revised to correct this and other findings.
Finding 50 (2)	The mimic on RL001 does not show flow from the CENTRIFUGAL CHARGING PUMPS through the CHARGING PUMP (mini) FLOW VALVES.
Response	The CVCS mimic is being evaluated for changes that will improve their utility and correct findings such as this.
Finding 51 (3^1)	The mimic lines have warped and come loose from the panel surface in several places. Several mimics are missing portions of mimic because the lines have broken completely off.
Response	All mimic lines will be inspected for correctness in shape and security on board. Defective or missing lines will be replaced. Those that came loose from the panel surface will be secured.
Finding 52 (1)	There is a missing section of gray mimic lines between the 480V XPG20-LCPG20 BREAKER 52PG2001 J-handle control and the 480V LC PG19-PG20 TIE BKR 52PG1416 J-handle control. There is also a missing section of mimic lines between the 13.8KV PA02-XPB04 BREAKER 252PA0208 J-handle control and the 13.8KV BUS TO XFMR XPB04 AMPS vertical meter.

6.0 Labels and Location Aids, continued

Response	All mimic lines will be inspected for completeness. The two missing sections will be replaced.
Finding 53 (1)	The transformer symbol label in the mimic for the 480V XPG25-LC PG25 BREAKER 52 PG2501 J-handle breaker control is upside down. The gray portion of the label which symbolizes the 480V side should be on the bottom, and the black portion of the label which symbolized the 13.8KV side should be on the top.
Response	All mimic symbol labels will be inspected for correctness of orientation. The transformer symbol label for the "480V XPG25-LC PG25 BREAKER 52PG2501" will be reversed so that the gray portion of the label is on the bottom and the black portion of the label is on the top.
Finding 54 (3^1)	There is no consistent color-coding of mimic lines. For example, nine different colors are used for electricity.
Response	The mimics are being reviewed at this time.
Finding 55 (3^1)	The mimic lines are not graduated in size to differentiate primary flow paths from secondary flow paths.
Response	A complete review of the mimic display will be made. Mimic line size for primary flow paths will be clearly differentiated from secondary flow paths.
Finding 56 (1)	Some mimic line flow arrows indicate the wrong direction of flow.
Response	All mimic line flow directions will be inspected. Those showing the wrong direction of flow will be corrected.
Finding 57 (3^1)	Several labels within mimics on RL019 are intersected by mimic lines when no actual connection exists between the components indicated by the labels and the flow paths represented by the mimic.
Response	The mimics on RL019 are being reviewed to correct this finding.
Finding 58	This finding has been resolved to the satisfaction of the NRC.
Finding 59	This finding has been resolved to the satisfaction of the NRC.

6.0 Labels and Location Aids, continued

Finding 60 This finding has been resolved to the satisfaction of the NRC.

Finding 61 (1) The arrangement of valves in the mimic that depicts the flow of boric acid and make-up water to the volume control tank indicates that boric acid can be sent to the volume control tank spray. An operator reported that the valves can even be arranged to accomplish this. If a check valve exists that prevents flow in the indicated direction, an arrow or check valve symbol is needed on the mimic. If there is no such flow restriction in the system, a label is needed to caution the operator not to arrange the valves in this way.

Response There is no check valve that would prevent the flow described. A label will be placed next to the switch with the engraving: CAUTION: DO NOT BORATE VIA BG FC111B This is not a safety concern with the SNUPPS design but merely a delay in the boric acid response.

Finding 62 This finding has been resolved to the satisfaction of the NRC.

7.0 Process Computer

Finding 1 (3[1]) The computer system does not include a file of operator entries. The sequence of events log will include operator entries, but these will not be isolated, grouped or coded in any way.

Response All operator entries are printed on the operator's printer, located in the control room. Each entry is logged as it occurs. This is desirable in that control room personnel are immediately cognizant of the status of computer displays, logs, trends, etc. Operator entries are positively identified by the nature of the printed message. We propose no further coding as it would tend to clutter the printout.

Finding 2 (2) The CRT displays can be affected by each of the keyboards. This means that an operator at one location can disrupt and lose data on a CRT that another operator is using. In addition, there are no signals on the displays or elsewhere to indicate which keyboard is being used to effect a particular display.

Response A software change will be made to inhibit the Engineer's console from controlling CRT displays in the control room. The two keyboards in the control room are in such close proximity as to preclude any problems. A message on the displays indicating the originating keyboard would unnecessarily clutter the screen.

Finding 3 (2) The red, green, and white colored keys on the process computer keyboard are not grouped together and are not in any functional sequence.

Response Software changes will be made and keys physically moved to accommodate this finding. All unused keys will be blank white and will be used to separate the other keys into functional groups where possible.

Finding 4 (2) The dark blue characters on the CRT displays are difficult to read due to poor contrast with the screen background. This color should only be used for non-critical information.

Response The color blue is not used for alphanumeric characters on the CRT's. On Piping and Instrument Diagrams, blue is used for pressurized hydrogen and nitrogen process lines, which is not critical information.

7.0 Process Computer, continued

Finding 5 (3) The two CRT displays on RL020 are located between 76-91 inches above the standing surface. This location exceeds the recommended height for CRT displays.

Response The CRT' on RL020 are 25 inch models rather than the standard 19 inch. This larger size was selected to provide adequate readability.

Finding 6 (3) The colors red and yellow are not used on the CRT displays according to the recommended guidelines applications of danger and caution, respectively. On the alarm list display, red is used to indicate digital points in the alarm and yellow is used to indicate analog alarms.

Response The present arrangement of alarm indications (red indicating digital alarms and yellow indicating analog alarms) is functionally equivalent to the recommended guidelines. A digital alarm such as a breaker trip, equipment failure, partial trip bistable, valve misalignment, etc., would indicate a condition requiring immediate analysis and action. With the use of conservative alarm limits, analog points in alarm would indicate the beginning of an undesirable trend, and allow the operators time to respond to keep parameters within the desired operating limits.

Finding 7 (3) The color-coding of information used on the CRT displays is not consistently applied. One color may be used to convey different types of information. Conversely, the same information type may be presented in different colors on different display pages.

Response The color-coding of information on the CRT displays is applied in the following manner:

I. General Displays
Green - Points in Normal Status
Yellow - Analog Points in Alarm
Red - Digital Points in Alarm
Cyan - Out-of-Service/Failure Messages
White - Message Types (headers, etc.)

II. Piping and Instrument Diagrams
A. Process lines of In-line Equipment:
Cyan - Flowing liquid fluid
Magenta - 1) Pressurized steam
2) Energized Elec. Sys.
White - Operating ventilation air

7.0 Process Computer, continued

Blue - Pressurized hydrogen and nitrogen
Green - 1) Non-flowing liquid fluid
2) Non-pressurized steam
3) De-energized elec. sys.
Yellow - 1) Process line w/undefined status
2) Outline of equipment
B. Alphanumeric Information
White - Current updated values for displayed process parameters w/normal operating conditions
Red - Current updated values for displayed process parameters in alarm conditions
Black w/Yellow background - Static, nonvariable information for titles, equip. labels and other notes

Color coding with the two basic display types is consistent.

Finding 8 (3) Location references are not provided in the viewable portion of the frame when the operator is required to scroll or pan on the point summaries, system index, and other summary type displays. The system displays are referenced acceptably.

Response The only multipage displays beside the system displays are the point summaries and alarm summaries. These are always displayed in alpha-numeric order and convenient page forward and page back functions allow movement among pages. Any further indexing would result in excessive screen clutter.

Finding 9 (3) There is no printer located in the control room for hard copy information, including alarm printouts. This deprives the operator of useful information.

Response There is a control room printer included in the system. It was located in the computer room at the time of the audit for startup purposes.

Finding 10 (3[1]) Although computer feedback messages are generally provided to the operator, there is no message to indicate that a request for a remote printout has been received and confirmed or denied.

Response There is a "function initiated" message which indicates that a request for a remote printout has been accepted. If a printer has failed, is off-line or out of service,

the system will print a message on the operator's printer, display a secondary alarm on the alarm CRT, and switch to an assigned alternate printer. This provides a high degree of assurance that the requested function has actually been performed.

Finding 11 (1) Several functions available on the control room process computer keyboard are for the use of the computer programers, not the reactor operators. For example, operators have the ability to insert values into the system status displays. No indication appears to identify these as inserted values rather than actual values.

Response The inserted values are identified as such on point displays, summaries and alarm displays. However, they are not identified on the system displays. To correct this deficiency, software will be modified to provide positive identification of inserted values on the system displays. Changing the color of the displayed value from white to cyan will be considered.

Finding 12 (2) There are no procedures available to the operator which cover the necessary actions to take in the event the process computer fails.

Response The utilities will develop a procedure and log sheet to be used in case of computer failure.

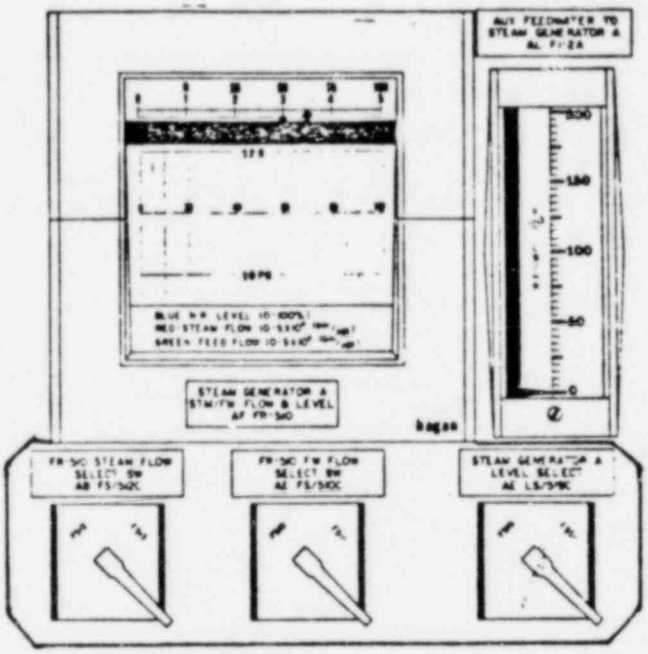
8.0 Panel Layout

Finding 1 (1)	During emergency procedures, the operator is required to compare the REACTOR COOLANT PRESSURE meter on RL002 and the STEAM GENERATOR PRESSURE meter on RL026. These displays are separated by about 25 feet.
Response	The most probable emergency for which RCS pressure and S/G pressure must be compared is Steam Generator Tube Rupture. After taking the immediate actions for safety injection, it is necessary to depressurize the RCS to the pressure of the faulted S/G. If RCP's are still running, the depressurization is performed at RL001 with the spray valves. If RCP's have been stopped, the depressurization is done at RL021 with the PORV('s). For this reason, the depressurization of RCS to S/G pressure is a two man job. At the point in the procedure where two operators are needed, a second reactor operator will be available. All licensed operators will be trained and practiced on a plant specific simulator for the coordination required to perform this procedure. The high level SPDS display for steam generator tube rupture will also be useful in evaluating the depressurization of the RCS.
Finding 2 (3)	The SAFEGUARD SYSTEMS STATUS SELECT switches on RL003 are placed between the CRT and the keyboard, but they are not related to the process computer.
Response	The Safeguards System Status Select switches will be labeled and demarcated. See 6.05 for a sketch.
Finding 3 (3^1)	The two MN STM/FW VLV ACCUM CHARGE TEST and the two MN STM/FW ISO VLV EXERCISE ACTUATE controls are functionally and sequentially related but are not grouped together.
Response	The two cited groups of controls are not functionally related. The two "MN STM/FW VLV ACCUM CHARGE TEST" switches are directly associated with the two Accumulator Charge Test Select switches. The two "MN STM/FW EXERCISE ACTUATE" control switches are directely associated with the exercise select switches. These four switches are grouped together with their respective "Test" and "Actuate" select switches. The grouping is adequate since "Test" or "Actuate" will normally follow "Select."

8.0 Panel Layout, continued

Finding 4 (3[1]) The STM GEN A through D LVL SEL SW controls are not located directly below their associated trend recorders. These switches may be inadvertently associated with the AUX FEEDWATER display that they are located directly beneath.

Response Demarcation lines will be added to clearly group these three switches (see sketch).



Finding 5 (3[1]) The ACCUMULATOR TANK FILL LINE ISO VALVE pushbutton on RL018 is located where it is only clearly associated with the B and D accumulator tanks although it is actually associated with all of the trains.

Response Due to the distance between the two mimic groups, it is impractical to associate the two groups with a mimic line. Labels will be provided to clearly show the connection. The label on B & D accumulator tanks will read "To Accumulator A & C" the label on A & C accumulator tanks will read "Accumulator Fill Line From S.I. Pump."

8.0 Panel Layout, continued

Finding 6 (3[1]) The two RC DRAIN TANK HX DISCHARGE ISO VALVE controls and the two RC DRAIN TANK VENT CONTAINMENT ISO VALVE controls on RL022 are not sufficiently separated or demarcated from the unassociated RELIEF TANK valves to their left.

Response Demarcation will be used to indicate the separation of these components.

Finding 7 This finding has been resolved to the satisfaction of the NRC.

Finding 8 (3) The STEAM DUMP SELECT SW AB US-500Z on RL005 selects the mode for the STEAM HEADER PRESSURE CONTROL, but the select switch and process controller are not located adjacent to one another.

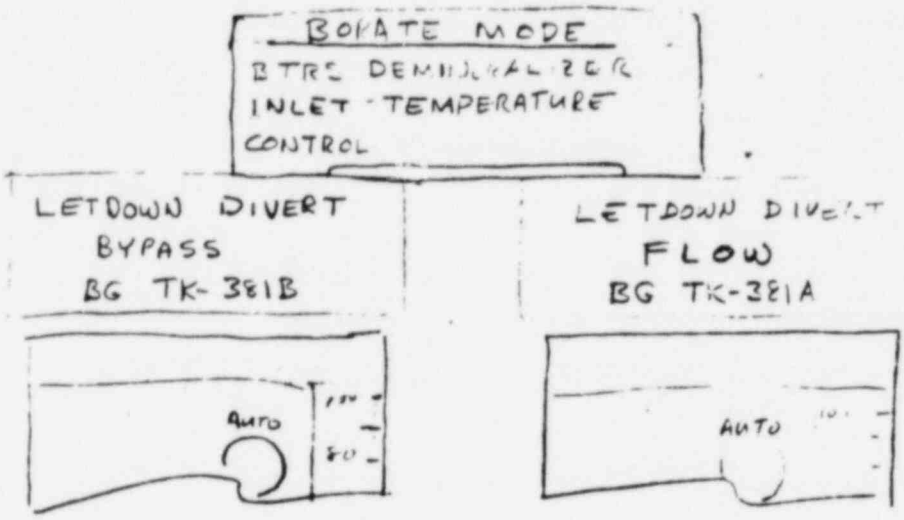
Response Switch AB US-500Z and Steam Header Pressure Controller AB PK-507 are located together in a compact section of the Balance of Plant console (RL005 & RL006). ABUS 500Z is located in a cluster of 3 switches that control the status of the steam dump system. AB US500Z is located directly below an important related indication, Steam Dump Demand. The Steam Header Pressure Controller is located above the instrument cluster containing Steam Dump Demand and Main Steam Pressure and below the Steam Dump valve position indication. Moving any one component to improve a control-display relationship will result in loss of desirable relationship that now exists.

Finding 9 (2) It is not clear from the panel layout of the BTRS DEMINERALIZER INLET TEMP controllers and the associated BTRS TEMPERATURE display at what point in the flow path the displayed temperature is sensed. The B controller is located below the display and to the left of the A controller. The actual flow path is through the B heat exchanger then through the A heat exchanger. The temperature sensor for the display is located at the outlet of the A heat exchanger.

Response The BG TK381B and BGTK381A controllers work together to control BTRS demineralizer inlet temperature during the borate mode by controlling letdown divert flow through the tube side of the Letdown Reheat Heat Exchanger. To clarify this, the labeling will be changed as follows:

8.0 Panel Layout, continued

Finding 9 Sketches



Finding 10 (3) The STEAM GENERATOR A & B and C & D WIDE RANGE LEVEL and the STEAM GENERATOR A & B and C & D PRESSURE trend recorders are not grouped according to the different steam generators. For example, the STEAM GENERATOR A trend information is not grouped with the other STEAM GENERATOR A information.

Response The hook-up for the four steam generator level and pressure trend recorders will be rearranged such that the recorder immediately below the instrumentation group pertaining to a particular steam generator will record both the steam pressure and water level of that particular steam generator.

Finding 11 (2) The two BTRS DEMINERALIZER INLET TEMP controllers on RL002 appear to be located in an unconventional alphabetical sequence. The B controller is located to the left of the A controller. However, the plant drawings indicate that the associated equipment is also arranged with the B heat exchanger before the A heat exchanger in the flow path.

Response Both controllers work together to control flow to a single heat exchanger, the Letdown Reheat Heat Exchanger. The label changes suggested for 809 should resolve this finding.

8.0 Panel Layout, continued

Finding 12 (1) The pushbutton orientations of two switches on the RL001 mimic do not match their positions in the mimic. Switch BG-HIS-112A has HUT on the top pushbutton of the switch, with VCT on the bottom. These pushbutton locations should be reversed. Switch BG-HIS-129 has DEMIN on the top pushbutton of the switch, with VCT on the bottom. These locations should also be reversed.

Response Evaluation and upgrading of the CVCS mimic should solve this finding. If it does not, then the pushbutton locations will be changed.

Finding 13 (2) The RCP A SEAL LEAKOFF & INJ FLOW chart recorders on RL022 are arranged in an unconventional numerical sequence - 2, 4, 1, and 3.

Response Instrumentation for the four reactor coolant loops are arranged in the order of, from left to right, A, B, C, and D (or Loop 1, 2, 3, and 4). The RCP SEAL LEAKOFF & INJECTION FLOW Chart Recorders are presently arranged in that order. The Loop Hot & Cold Leg Temperature Recorders will be rearranged such that they will correspond to the order of the RCP Seal Leakoff & Injection Flow Recorder located immediately above these temperature recorders.

Finding 14 This finding has been resolved to the satisfaction of the NRC.

Finding 15 (2) The BLOWDOWN VALVE #1 CONDUCTIVITY RATIO/AUTO-MAN CONTROLLER and the BLOWDOWN VALVE #2 CONDUCTIVITY RATIO/AUTO-MAN CONTROLLER are located in an unconventional left to right numerical sequence. The #2 controller is located to the left of the #1 controller.

Response Unit 1 and 2 controllers will be interchanged and Unit 2 controller will be marked future.

Finding 16 (2) The RHR PUMP ROOM SUMP PUMP A through D controls are arranged in an unconventional alphabetical sequence. The controls are arranged in two rows with B in the top left location, A in the top right location, D in the bottom left location, and C in the bottom right location.

The CENTRIFUGAL CHARGING PUMP A and B controls on RL001 and the DEMINERALIZER TRAIN A and B AUTO-MAN FLOW controls on RL014 are also located in an unconventional B = left, A = right arrangement.

8.0 Panel Layout, continued

Response The controls for the four RHR pump room sump pumps, A through D, will be rearranged in the following manner:

Pump A - Top left
Pump B - Top right
Pump C - Bottom left
Pump D - Bottom right

The controls for the centrifugal charging pumps A and B are enwrapped in mimics on RL001. Reversing these controls would require not only additional separation barriers at the back of the board which would be extremely difficult to accommodate due to limited space but would also result in poorly defined mimic displays. Controls on RL014 are currently being reviewed.

Finding 17 (1) The indicator lights for the INTAKE PUMP C DISCHARGE VALVE control are located in an unconventional red = left and green = right arrangement. The related A and B indicator lights are arranged conventionally with green = left and red = right.

Response The lens covers for the Intake Pump C Discharge Valve were inadvertently reversed. This condition has now been corrected to agree with convention of green = left and red = right.

Finding 18 (3) The CONTROL BANK and SHUTDOWN BANK STEP counters are grouped together. Since these counters are identical, an operator could easily read a count from the wrong group, especially since the same numbering system is used on the labels of each (e.g., A-1, A-2, etc.)

Response These step counters are grouped and sequenced in order of withdrawal, with the first rods to be withdrawn on the lower left and the last to be withdrawn on the upper right of the matrix. The operator compares these step counters with the digital rod position indication. Any erroneously perceived differences would be quickly detected. The step counters are also clearly labeled as either control bank or shutdown bank, including the group identification.

Finding 19 (3) Several component groups on RL005, RL006, RL014, RL015, RL017, RL018, and RL019 are mirror imaged. In some of these groups the mirror imaging is not exact. The ESF CONTROL PANEL (RL017 and RL018), in particular, exhibits significant problems in mirror imaging and mixed mirror imaging. These arrangements will create transference of training problems for the operator.

8.0 Panel Layout, continued

Response The mimics are being reviewed for upgrading to enhance the visual grouping of controls. On RL014 the mimic layout represents the actual physical arrangement as much as feasible. Many of the redundant systems have portions common to both making a quasi-symmetrical layout desirable. This is particularly true of panels RL017 and RL018. A full-scale mockup of those panels was recently constructed and revisions to the mimics, labels and the locations of some indicators were made to improve the clarity to the operator. A representative of our Human Factors consultant (Essex Corporation) participated in the review of the final arrangement of RL017 and RL018.

9.0 Control-Display Integration

Finding 1 This finding has been resolved to the satisfaction of the NRC.

Finding 2 (3) Related controls, displays, and indicator lights throughout the control room are often located on both the inner and outer rings of panels. These rings are separated by approximately 8 feet. This arrangement prevents close visual association between the associated displays and controls. For example, the SEAL WATER OUTLET ISOLATION VALVE controls are located on RL001, while the associated LEAKAGE FLOW indicators are located on RL021.

Response The design objective is to maintain close association between instruments/controls located on the inner-ring and outer-ring control boards. However, due to factors such as split system association and mimic display arrangement, it is not always possible to accommodate one close visual association without sacrificing some other aspects of association. The cited seal water outlet isolation valve controls are part of the reactor coolant & support system and are shown in the mimics on RL001. The RCP Seal Leakage Flow indicators which are a part of the RCP instrumentation system are grouped together with other RCP indications on RL021.

Finding 3 This finding has been resolved to the satisfaction of the NRC.

Finding 4 (2) The ROD INSERTION LIMIT and NEUTRON FLUX DETECTOR recorders on RL022 that will be monitored during control manipulation on RL003 are not located sufficiently close that an operator can read them clearly and without parallax from a normal operating position.

Response There is an abundance of information on neutron flux on RL003, both recorded and on meters, for the operator to use during normal plant operation. The recorders on RL022 are 0-200% over power recorders used only in post-trip diagnosis. Constant monitoring of the Rod Insertion Limit computer output is not necessary. An annunciator (Rods at Low Limit) sounds when rods are 10 steps from the rod insertion limit, informing the operator of a need for action (boration). A second alarm sounds when the rods reach the insertion limit. Even at this point the operator has two hours to correct the situation before exceeding a limiting condition for operation.

Finding 5 This finding has been resolved to the satisfaction of the NRC.

9.0 Control-Display Integration, continued

Finding 6 (2) The MAIN STM RHTR vertical displays are offset to the left of their associated controls by about 6" to 12". The MAIN STM RHTR indicator lights are offset to the left in a 2x2 matrix rather than being located under their associated vertical displays.

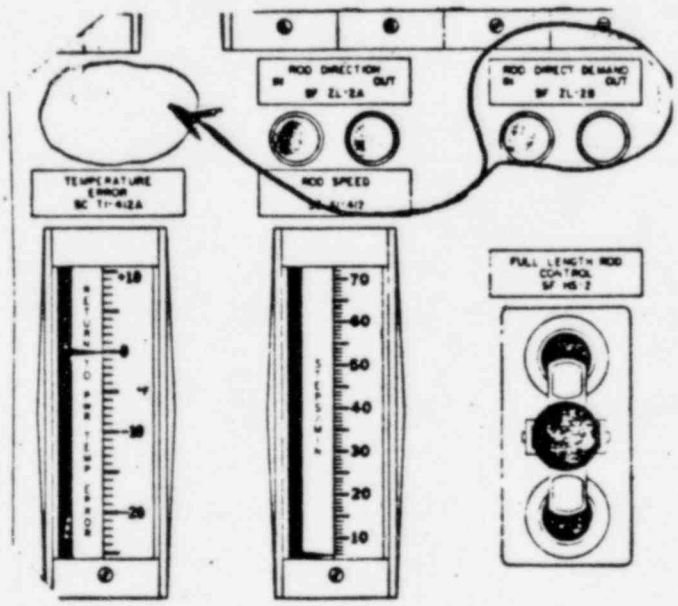
Response The vertical displays located on RL024 are for indication of steam flow to the reheaters. These indicators are provided for indication of tube leakage and are not directly associated with the controls located below. The indicator lights for the second stage low load valves will be relocated to the left.

Finding 7 (2) The FUEL POOL COOLING PUMPS B and A controls are located in an inconsistent order with their associated DISCHARGE displays. The displays are correctly ordered A - B, while the controls are ordered B - A.

The ROD DIRECT DEMAND and ROD DIRECTION indicator lights on RL003 are also located in inconsistent order with their associated controls.

Response The Fuel Pool Cooling Pump controls and the Fuel Pool Heat Exchanger CCW Discharge Isolation Valve controls will be rearranged. Pump A and valve A controls will be located immediately below the A-loop flow indicator and Pump B & valve B controls, immediately below the B-loop flow indicator.

The Rod Direction demand lights will be relocated to above the temperature error meter, SCTI-412A, on RL003, as shown on the following sketch:



9.0 Control-Display Integration, continued

Finding 8 (2) The OVER PWR/OVER TEMP T RECORDER SELECT switch is located beneath its associated trend recorder, but an unrelated trend recorder is located between the associated components.

Response The recorders SETR411 and BGLR102 will be exchanged so that the SETR411 recorder (over pwr/over temp) will be immediately above its select switch.

Finding 9 (2) The association between the PLANT BYPASS VALVE MAN controller and the PLANT BYPASS display is not clear. The display is below and to the left of the controller and two unrelated controllers are between the associated components.

Response The PLANT BYPASS VALVE MAN controller will be relocated or the PLANT BYPASS display will be relocated in such a manner that there is an association between the components.

Finding 10 (3) Related controls and displays are not always easily identified as being associated. For example, the reactor operations controls and displays on RL003 and RL004 are not well arranged by specific functions (e.g. startup).

Response The example given as having poor association between related controls and displays (e.g. reactor controls) follows a very definite pattern. The primary control of the reactor is with the control rods during startup. The operator will be controlling the reactor with the rods while observing the Source Range counts and startup rate meters located above and to the left of the rod control. As reactivity is increased and Source Range counts increase, the Intermediate Range meters located directly to the right of the Source Range meters will begin to indicate. The Power Range meters and recorder are located on the panel (RL004) directly above the rod controls. The reactor coolant average temperature is also located above the Power Range meters so the operator can observe it along with power. To the left of the Power Range and reactor coolant temperature located on RL002, the Pressurizer level and pressure indicators give the operator indication of Reactor coolant water volume and pressure. All of these controls and indications are located on a section of the board approximately 4' x 4' which will require little if any movement of the operator during startup.

9.0 Control-Display Integration, continued

The primary controls and displays necessary to operate the plant are located in a very systematic layout and secondary displays and controls are located directly behind these, on the outer ring of boards, to the highest degree possible.

Finding 11 (2) The arrangement of indicator lights and their associated controls is not consistent from application to application. For example, the CCW PUMP A through D RESET indicator lights are placed to the right or left of their associated control rather than above, as is the convention.

Response The mimic for this panel is being reviewed for improvement. Enhancement will be added to clarify the relationship of these indicators and controls.

Finding 12 N/A

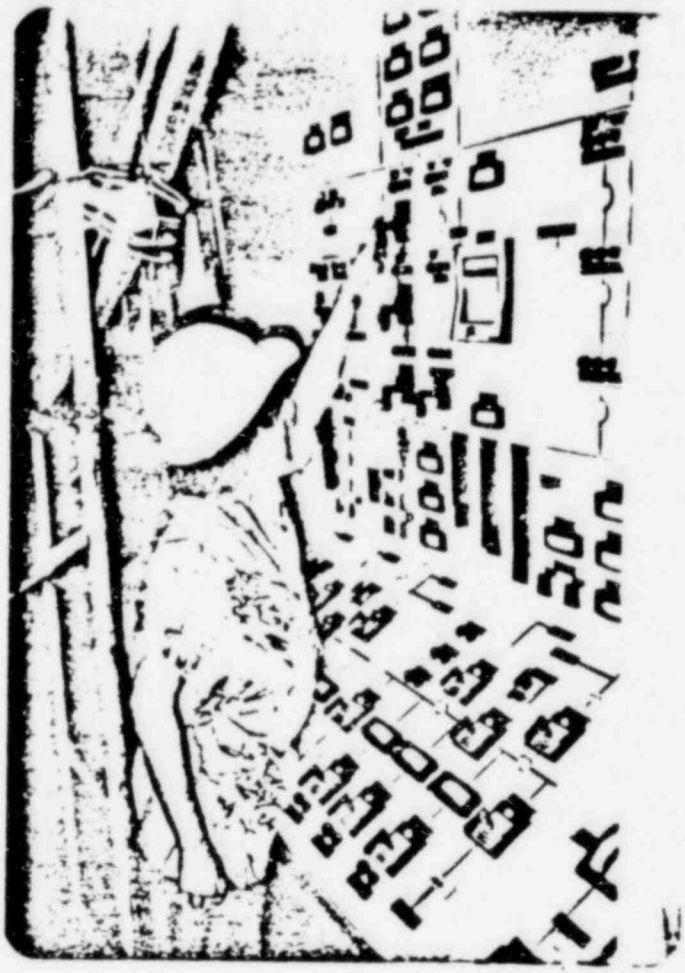
Finding 13 (2) The control groups in the CVCS mimic are in reversed orientation from their associated displays. The LETDOWN HX OUTLET control is located on the left half of RL001. The LETDOWN HX OUTLET display is located on the right half of RL002. The BORIC ACID TO VCT controls are located on the right half of RL001. The BORIC ACID TO VCT display is located on the left half of RL002.

Response The Letdown HX Outlet display is located towards the center of RL002. Pressurizer controls and displays are on the right half of RL002. The existing arrangement places the key displays and controls concerning pressurizer level, and pressure immediately adjacent to the reactivity controls and indications where one person can readily monitor the major reactor system parameters. The controls and indication on RL002 for boric acid constitute a stand alone control station for boration and dilution. The controls on RL001 would be used manually only if those on RL002 malfunction. Automatic controls are located on RL002. The operator has the option of selecting either "manual" or "automatic" functions. Boration and dilution are not fast response actions.

Finding 14 (2) Three PRESSURIZER HEATER controls and three PRESSURIZER PRESSURE and LEVEL controls are reversed with respect to their associated displays.

Response This item will be addressed in the RL002 mockup study.

Attachment to Finding 1.1



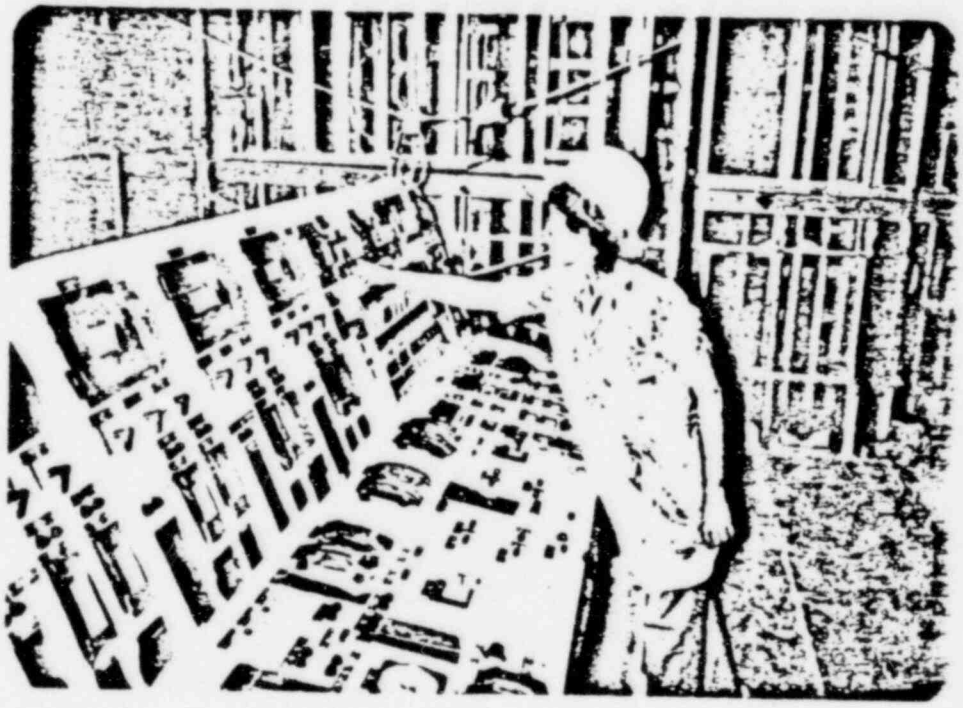
RL014

RL018

NOTE: The person illustrated measures approximately 5'-1" in height, with shoes.

Attachment to Finding 1.7

RL002



RL006

NOTE: The person illustrated measures approximately 5'-1" in height, with shoes.

Attachment to Finding 4.1