

AUDIT REPORT

HUMAN FACTORS ENGINEERING
CONTROL ROOM IN-PROGRESS AUDIT

PERRY NUCLEAR POWER PLANT
UNIT 1
CLEVELAND ELECTRIC ILLUMINATING COMPANY

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AUDIT REPORT

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Introduction

The Cleveland Electric Illuminating Company (CEI) is performing a Detailed Control Room Design Review (DCRDR) at Perry Nuclear Power Plant Unit 1. This audit report is based on the NRC's review of the 7 June 1982 interim DCRDR report prepared by the BWR Owners Group for Perry Unit 1 and on the NRC's 9-13 August 1982 in-progress audit performed on-site. The in-progress audit was carried out by a team from the Human Factors Engineering Branch (HFEB), Division of Human Factors Safety and its consultants from the Lawrence Livermore National Laboratory.

The audit report is divided into four major parts. Part A contains a list of those items that were not available for review during the in-progress audit. Items listed in Part A must be evaluated by CEI. Also, included among the unevaluated items were CEI findings 4.5.2.1, 4.5.2.2, 4.5.2.3, 4.5.2.4, 4.5.2.5, and 4.5.2.6. Those items concern procedures and will be referred to the Procedures and Test Review Branch Division of Human Factors Safety for evaluation. Part B contains Human Engineering Discrepancies (HED's) identified by CEI in the interim DCRDR report or by the HFEB team during the in-progress audit. Part C contains HED's identified by CEI which the HFEB team determined to be either invalid or corrected at the time of the in-progress audit. Part D contains a log of the photographs taken by the HFEB team during the in-progress audit.

Numbering within Parts A-C of this report conforms to that in Section 6 of NUREG-0700. The following notation also applies within Parts A-C.

- o HED's which are marked with an asterisk (*) are verbatim transcripts of HED's reported in CEI's interim DCRDR report. CEI used lower case letters to identify subelements of several of those HED's. The subelements were evaluated separately and thus may not be found together in this report. For ease of tracking, a note concerning the location in this report of other subelements of such HED's is provided. Also, the lower case letter used by CEI to identify subelements is appended to findings numbers in this report. HED's without an asterisk were noted by the HFEB team during the in-progress audit.
- o Numbers in the lower right hand corner of the text (e.g., 4.1.2.1 are the HED identification numbers from CEI's interim DCRDR REPORT).

Photo numbers in Part D correspond to those listed to the left of Finding (HED) numbers in Parts A and B of this report. Photo numbers in the body of HED's correspond to those provided in CEI's interim DCRDR report.

All HED's, including those identified in CEI's evaluation of items listed in Part A, should be corrected prior to licensing. In the event an HED cannot be corrected prior to licensing, the applicant will be required to provide a rationale for deferral, and interim pre-licensing correction, and a reasonable schedule for implementing the long-term correction. Corrections which are deferred beyond licensing will become license conditions, and deferral of a correction beyond restart following the first refueling outage will not be acceptable.

Per SECY-82-111 , CEI should arrange a schedule for completion for the Perry Unit 1 DCRDR with the NRC project manager. Ideally, the applicant should plan to arrange that schedule to allow NRC close-out of Task Action Plan Items I.D.1 and II.K.3.27 prior to licensing.

AUDIT REPORT
Part A

HUMAN FACTORS ENGINEERING
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UNIT 1
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Part A - This section contains a list of those items which were not available for review during the August 9 through August 13, 1982 in-progress audit.

1.0 Control Room Workspace

- A. Control room furnishings and equipment were not installed. Adequacy of furnishings, obstacles to operator movement, and presence of unnecessary furnishings and equipment could not be evaluated.
- B. The control room environment during operations could not be evaluated.
- C. Operator protective equipment and emergency equipment storage facilities could not be evaluated.
- D. Document organization and storage provisions in the control room and at the remote shutdown panel could not be evaluated.
- E. The effect of personal protective equipment on the operator's performance of required tasks could not be evaluated.
- F. The remote shutdown panel environment during operations could not be evaluated.

2.0 - Communications

- A. Communication procedures and instructions were not in place to allow evaluation of:
 - 1. Public address system management use and procedures
 - 2. Emergency response communications procedures
 - 3. Normal operations communications procedures
 - 4. Communication systems management, use and procedures
 - 5. Control room priority interrupts for access to communications systems
- B. The entire control room communication system was unavailable for evaluation

5.0 - Displays

- A. System status panels were inoperative and could not be fully evaluated

7.0 - Process Computers

- A. The operational process computer and CRT display system could not be evaluated because new software and hardware is to be installed in August 1983
- B. The sequence of events recorder was not operational and could not be evaluated

8.0 - Panel Layout

- A. Panels 902, 906, and 907 could not be evaluated as most of the equipment for these panels had not been installed

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Audit Report
Part A

The following list of items are specific HEDs from the CEI's interim DCRDR report as provided by CEI which could not be evaluated.

FINDING

- 1.1* Operator pathways between panel 680 and other benchboards may be obstructed by the centrally located panel 805 (Photo #24).
(4.1.1.4)
- 1.2* Emergency lighting levels are below the recommended 20 footcandles minimum at panel surfaces
(4.6.3)
- 1.3* Some indicators and recorders were found for which alternate process units may provide useful information to the operator:
(4.2.2.4)
- 1.3d* The hotwell level controller on panel 870-2 is scaled as 0-100, corresponding to dump/makeup (Photo #54).
(4.2.2.4.d)
- HFEB NOTE: Finding B5.13 and C5.1 contain the other parts of this CEI finding.
- 1.4* A color code is in effect at Perry, specifying color applications for mimic lines and indicating lights. However, not all systems have assigned colors.
(4.1.4.1)
- 1.5* The computer output is very difficult to modify and it is not anticipated that output will be periodically reviewed and updated.
(4.4.7)

AUDIT REPORT
Part B

HUMAN FACTORS ENGINEERING
CONTROL ROOM IN-PROGRESS AUDIT

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Part B - This section contains a list of valid HED's identified by CEI in their 7 June 1982 interim DCRDR report or by the HFEB team during the 9 August through 13 August 1982 in-progress audit.

B-1 CONTROL ROOM WORKSPACE

PHOTO FINDING

- 1.1 The operator at the remote shutdown panel manually controls Division I equipment after transfer to the remote shutdown panel is completed. Division II and Division III remain in automatic mode in the control room and may automatically initiate ECCS, but the remote shutdown panel operator has no direct source of information as to this event. Neither does he have a direct indication of scram.
- 1.2 Off-normal instructions for the remote shutdown panel are still being developed. Confirmation is needed that all instrumentation and controls needed to satisfy those instructions are supplied.
- 1.3 The remote shutdown panel uses Division I power. However, there is no provision to start Division I on-site power at the remote shutdown panel.
- I1 1.4* No discharge pressure indication is available for LPCS or RHR pumps. (5.5)

Perry Unit 1
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Part B

B-1 CONTROL ROOM WORKSPACE, (cont.)

PHOTO FINDING

- 1.5* Some limits discussed in the guidelines are "two dimensional", i.e., the operator must correlate two different parameters and plot the resulting operating point on a graph defining the permissible operating regions. In one case he must relate three different parameters, utilizing two separate graphs. In a time critical situation this severely compounds the operator's workload and requires careful design of both control room layout and procedures. The parameters involved should at least be situated in close proximity to each other with the associated graph provided nearby. However, a more innovative approach may prove more satisfactory, perhaps involving two dimensional CRT plots or X-Y recorders. This area of the guidelines must be given extremely close attention as actual plant specific procedures are prepared. Limits involving correlation of multiple parameters include suppression pool heat capacity, RPV saturation, suppression pool spray, pressure suppression, suppression pool load, and heater capacity level limits. Potentially of most concern in this respect are limits involving suppression pool temperature and level, as these parameters are located on a backpanel. Specific recommendations for display formatting are contingent upon the final form of the plant specific procedures and the philosophy utilized in development of emergency response system addressed by NUREG 0696. (5.29)
- 13 1.6* No wide range reactor pressure recorder is available on panel 650.(unnumbered - p5.3 interim DCRDR report)
- HFEB NOTE: The panel was indentified as panel 680 during the in-progress audit.
- 1.7* No indication of reactor temperature is available in the main control area,(unnumbered - p5.3 interim DCRDR report)
- 1.8* The suppression pool level recorder has not been mounted in the main control area. (5.10)
- 1.9* No indication of containment water level is available. (5.25)
- 1.10* The off gas and radiation monitoring panels cannot be seen from the normal operating area (Photo #23) (4.1.1.6)

B-1 CONTROL ROOM WORKSPACE, (cont.)

PHOTO FINDING

- | | | | |
|-----|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| | 1.11 | There are no furnishings (e.g., chairs) at the remote shutdown panel. | |
| | 1.12* | View of panels 870 and 877 are partially blocked from some positions in the control room by a centrally located support column (Photos #21 & 22). | (4.1.1.5) |
| | 1.13* | Storage space has not yet been allotted for procedures and reference materials. When space is designated, care should be taken that bookshelves do not obstruct walking paths in the control room. | (4.5.1.1) |
| | 1.14 | There is no provision for storage of documents (e.g., off-normal instructions and drawings) at the remote shutdown panel. | |
| | 1.15 | There are presently no provisions for storage of spare parts (e.g., light bulbs and expendables) within the control room. | |
| | 1.16 | At this time there is not a dedicated communications link between the primary operating area and the shift supervisor's office. | |
| 16 | 1.17* | The corners of panel inserts and the edges of the guardrail on panel 680 are somewhat sharp (Photos #9-12) | (4.1.1.3) |
| 124 | 1.18* | The following controllers were not easily reached from a normal operating position: | (4.2.1.1) |
| | 1.18a* | RCIC controllers on panel 001 are mounted high. | (4.2.1.1.a) |
| | | HFEB NOTE: Finding C1.4 contains the other part of this CEI finding. | |
| 125 | 1.19* | Controllers are clearly marked to show manual and automatic control options. However, on panel 001, the MANUAL/AUTO designations are obscured by the controller lever due to the high placement of the controller. | (4.2.1.3) |

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B-1 CONTROL ROOM WORKSPACE, (cont.)

PHOTO FINDING

- 1.20* Switches on the following panels have been placed above or below recommended heights and are not easily reachable from a normal operating position:
- | | | |
|-------------|---------|-----|
| 001 | 632 | 865 |
| 601 | 669-672 | 970 |
| 604/803/804 | | 800 |
- (4.2.5.6)
- 1.21* Many backpanels have controls and indicators mounted both above and below recommended heights. (4.1.3.6)
- 1.22* The emergency shutdown panel contains controls and displays placed above and below recommended limits. (4.1.3.10)
- P2,P3
P4,I7 1.23* While the computer keyboard is appropriately located for a seated operator at panel 680, the CRT above the keyboard is placed too high and the other two CRTs offer unfavorable viewing angles. The operators indicate that the computer will probably be operated from a standing position. (4.4.1)
- 1.24* Laydown space for use of procedures at the panels has not been provided (see Figure 6-1). This is especially important for panel 680 (see Figure 6-2). During startup, the operator must refer to the startup procedure and the rod sequence list. Operators reported that while practicing start-ups at the simulator, they found it necessary to hold the rod sequence list on their knees. (4.5.1.2)
- I8 1.25* Glare or parallax were observed on the following panels, usually on the upper most displays:
- | | | |
|-----|-----|-----|
| 001 | 623 | 803 |
| 601 | 632 | 804 |
| 604 | 642 | 870 |
| 619 | 680 | 904 |
| 622 | 800 | 970 |
- (4.2.2.2)
- I9 1.26* Glare or parallax were observed on recorder faces located on panels 600, 680, 907, 642, 800. (4.2.3.9)
- I25 1.27* Glare was observed on the remote shutdown panel, particularly on the upper most indicator faces (Photos #25, #26). (4.6.1)

B-1 CONTROL ROOM WORKSPACE, (cont.)

PHOTO FINDING

- 1.28 There does not appear to be any way that operators in the kitchen can be contacted by personnel in the control room.

Part B

B-3 ANNUNCIATORS

PHOTO FINDING

- I10 3.1* The following annunciators may be actuated from multiple inputs (high/low, etc.):
601-16-A2, E5
601-19-G4, H4
601-17-G3, G4
601-20-D5, G4
601-21-66
680-1-A1, A2, A3, A6
680-2-B1, B2, B3
680-3-A9
680-4-A1, D8, E8, A10
680-5-B5
845-A4, B2, B4, B7, B8, C1, C2, C7,
D1, E5, E8
870-3-E3
870-7-F2, G2
870-9-C2, C3, F1, F2
877-A2 (4.3.10)
- 3.2 The LPCS Pump Discharge Press HI/LO annunciator on panel 601-21A may be actuated from multiple inputs.
- 3.3* Entry conditions into the guidelines may involve action level not currently addressed by procedures or alarmed in the annunciator system. As plant-specific limits are defined, the available annunciators should be evaluated to determine if entry conditions are adequately alarmed. (5.31)
- 3.4* A first-out feature has not been provided. (4.3.17)
- 3.5* While some attempt has been made at prioritizing annunciators with color coded windows, application of this technique does not appear to be well defined or consistent on all control panels. (4.3.11)
- I12 3.6* Annunciator audible alarms are not directionalized or prioritized. (4.3.13)

B-3 ANNUNCIATORS, cont.

PHOTO FINDING

- I13 3.7* The following annunciators are not located above related controls and displays:
870-1-H1
870-5-D1
680-7-C9, C10, C11, C12, D9, D11, D12, E11, E12
680-15-B1 (4.3.3)
- M1 3.8 Annunciator panels in the control room are not identified with labels.
- 3.9* While most annunciators are grouped together by system within panel inserts, a few alarms were identified which could be better arranged:
- 601-17-E4 and D5 are separated
 - 601-20-P3 and E4 are separated
 - All scram signals are not grouped together on panel 680
 - RHR pump room cooling for alarms are not grouped together on panel 800-R400
 - Containment vacuum relief alarms for A and B trains are separated on panel 800-R405
 - Combined gas mix system compressor alarms are separated on panel 800-R405
 - Windows 904-R655-A3 and B3 are inverted (reversed)¹ relative to the surrounding windows
 - 904-R655-B3 and E3 are separated
 - Other alarms are interspersed with low flow alarms on the left side of panel 904-R655
 - Arrangements for RHR A and B alarms are not identical on panels 601-17 and 601-20 (4.3.1)
- I15 3.10* Within system groupings, some inconsistency in arrangements of annunciator windows was apparent. Some related windows, such as 601-16-A3 and B3 are arranged vertically. Others, such as 877-A3 and A4 are arranged horizontally. Other examples of this variation in placement may be found on panels 845, 870, 904 and 680. (4.3.2)

¹ NRC review team clarification note.

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Part B

B-3 ANNUNCIATORS, cont.

PHOTO FINDING

- 3.11* Annunciator windows have not been grouped by type; i.e., informational and diagnostic alarms are not segregated from trips and warnings. (4.3.4)
- I16 3.12* There is currently no procedure or window markings to assure that annunciator legend plates are replaced in their correct locations when removed for maintenance. (4.3.19)
- 3.13* No administrative procedure is in effect specifying a method of identifying out-of-service annunciators. (4.3.20)
- M3 3.14 Several annunciator panels contain blank tiles which are illuminated.
- I17 3.15* Wording for the following legends could more clearly define the purpose of the alarm.
- 601-17-H6 (indicates a particular valve lineup)
- 601-29-H2 (indicates a particular valve lineup)
- 601-18-A1, A2, B2, B2 ("identified" means equipment drain, "unidentified" means floor drain)
- 601-21-C6 (unclear whether this is associated with RCIC or LPCS)
- 680-4-A5, A14 ("needs maintenance" is unclear)
- Electrical designations on annunciators on panel 870 are somewhat abstruse (4.3.8)
- I18 3.16* The following alarms annunciate abnormal conditions for parameters which may have more than one trip, alarm or action level. For example, "DRYWELL PRESS A HIGH" could be an alarm, a scram, an isolation or a safety system initiation signal. In such cases, the annunciator legend should clearly specify the intent of the alarm.
680-5-85
870-3-H1
601-20-G2, H2, E6
601-17-G1, H1, E2, E5 (4.3.9)

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B-3 ANNUNCIATORS, cont.

PHOTO FINDING

- I19 3.17* More succinct wording would enhance the readability of the following annunciator legends:
601-21-H1
601-20-A3, B3, C3, D5, E5
601-17-A3, B3, C3, D3
601-17-B1 (delete "B")
601-20-B2 (delete "A")
601-19-A2, B2
680-1-C3, D3, B4
680-4-C1, D1, E1, D1, D2, A6, C10, D10, E10
800-R405-E5, F5
870-7-D2 (4.3.7)
- 3.18* The following inconsistent abbreviations were found on annunciator windows:
ST LN (680-1-C3) vs MSL (680-3-A8)
CNDR (680-1-A6) vs COND (680-3-A6, A7)
ATWB (680-4-E12)
D/W (680-4-D6, D15) vs DW on other panels
RX vs RPV (680-5-C5)
CIRW PUMP (870-3-E1)
TB (870-3-H2) vs TURBINE BLDG (870-3-H1)
Periods are used in abbreviations on windows:
870-4-A1, A2
CND STRG TK (870-7-A2) vs CST (601-16-F5) (4.3.5)
- I21 3.19* Annunciator panels are not marked with an alpha-numeric location code. (4.3.12)
- I20 3.20* Annunciator legends on panel 680 are not easily readable from a normal operating distance due to the small lettering size (Photos #5, #31). (4.3.6)
- M4 3.21 There are three different type fonts used on annunciator tiles on panel 680.
- M2 3.22 The annunciator panel on 870-1A contains tiles which have temporary handwritten legends.
- I22 3.23* Separate acknowledge and reset buttons have not been provided. (4.3.15)
- I22 3.24* Silence buttons are only available on panel 680. (4.3.14)

B-3 ANNUNCIATORS, cont.

PHOTO FINDING

- 122 3.25* One set of annunciator response buttons on panel 680 is of a different style and configuration from all others (Photos #59, #60). (4.3.16)
- 3.26* The "cause" section of annunciator response procedures is somewhat long, including sensor identity, setpoint, reset point and possible contributing factors. This section should be much more concise. Toward this end, listing sensor identity and setpoint separately may help and also make this information easier to locate. (4.3.18)

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Part B

Part B

B-4 CONTROLS

PHOTO FINDING

- 4.1 The DG-3 voltage regulator control switch for panel 879 is not installed.
- P33 4.2 The Reactor Mode Switch for panel 680 has not been installed.
- 4.3 J-handle transfer switches on the remote shutdown panel are subject to inadvertent actuation.
- C7 4.4 The turbine trip pushbutton on panel 680 is near the edge of the benchboard and is not protected from possible inadvertent actuation.
- P28 4.5 On panel 680 Inboard Manual Scram Buttons S3C and S3B are separated from Outboard Manual Scram Buttons S3A and S3D. Buttons S3C and S3B are located in close proximity to the Manual Isolation Div. 1 and Div. 4 pushbuttons which are of the same type of guarded pushbuttons. Since one scram button on each side of the isolation pushbuttons must be depressed to initiate a scram, there is a possibility that the Manual Isolation pushbutton may be depressed inadvertently when a manual scram is desired.
- 4.6* The direction of thumbwheel motion in automatic controllers is opposite to the resulting motion of the moving scale. (4.2.2.8)
- P15 4.7* The direction of switch motions on the following panel 601
P16 controls is not in accordance with accepted conventions:
P17 MAIN STEAM LINE INBD and OUTBD MSIVs close to the right and open to the left. (4.2.5.1)
- 4.8* Switch handles have not been shape-coded to distinguish switch functions. (4.2.5.8)

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B-4 CONTROLS, cont.

PHOTO FINDING

- | | | |
|----------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P18 | 4.9* | While red pushbuttons are usually provided for manual trip functions, similar distinctive marking is not used to highlight manual initiation pushbuttons for automatic systems.
(4.2.5.9) |
| C5
C6 | 4.10 | The three annunciator acknowledge controls on panel 680 are very near to an identical-feeling set of RFPT trip controls that are unguarded. These identical controls could be confused resulting in an inadvertent RFPT trip. |

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Part B

B-5 DISPLAYS

PHOTO FINDING

- C12 5.1 The RCIC Pump Suction Pressure Meter on panel 601-21B is incorrectly labeled showing vacuum adjacent to the positive pressure side of zero.
- 5.2 The watts and VARS meters for DG3 have circular scales. While DG1 and DG2 use vertical scales for these same parameters.
- 5.3 A diesel RPM meter for DG3 has not been provided as there is for DG1 and DG2.
- 5.4* If reactor water level has dropped below the top of the fuel, the operator is left with only one water level indicator on scale, which may not be calibrated for the existing conditions. (5.1)
- 5.5* Suppression pool water level is referenced to normal, but technical specification limits are referenced to the bottom of the suppression pool. (5.4)
- 5.6 The RX water level recorder at the remote shutdown panel provides only limited range and is not appropriately referenced as required by II.K.3.27. Range of water level indication does not cover top end of vessel; i.e., water solid operation. Operator decisions regarding RCIC operations may be required when water level is outside the limited range of the available display.
- 5.7 A task analysis to determine operator information requirements at the remote shutdown panel has not been conducted.
- I1 5.8 The LPCS and HPCS systems do not have pump suction pressure gauges. Since neither LPCS nor HPCS has a pump suction valve interlock to prevent pump start with the suction valve closed, the operator needs pump suction pressure information.
- 5.9 On the remote shutdown panel five systems (RCIC, RHR, PRV, ESW, ECC) are without system status indication.

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 Part B

B-5 DISPLAYS, cont.

PHOTO FINDING

- P24 5.10 There are PSIA meters without labels or scales on panel 680-7D Steam Bypass Panel.
- P22 5.11 The blank meters installed on panel 680-1B may be unnecessary instrumentation.
- 5.12* No direct indication of safety-relief valve position is provided. (5.3)
- 5.13* Some indicators and recorders were found for which alternate process units may provide useful information to the operator: (4.2.2.4)
- P6 5.13b* HEATER 1 PRESSURE and MAIN CONDENSER SHELL PRESSURES on panel 870 are scaled in psi vac, whereas in Hg-vac would be more common. (4.2.2.4.b)
- P8 5.13e* The condensate storage tank level indicator on panel 870-2 is scaled 0-100%, but procedure references specify level in gallons (Photo #55). (4.2.2.4.e)
- HFEB NOTE: Finding A1.3 and C5.1 contain the other parts of this CEI finding.
- I26 5.14* Some indicating devices are not scaled in subdivisions consistent with the accuracy required by the operator. Suppression pool level instruments provide indication to only + 2 ft; a wider range may be required. On the remote shutdown panel, wider ranges may also be desirable for reactor level and drywell pressure indications. (4.2.2.12)
- P9 5.15* A reactor pressure indicator on panel 680 has no scale (Photo #6). (4.2.2.13)
- 5.16* Drywell and containment pressure instruments are calibrated in psia, whereas trips and alarm points are specified in psig. (5.2)
- I4 5.17 On the Suppression Pool Level meter on panel 601 the zero is not centered and the range is too narrow.
- P34 5.18 RFP and MFP flow indicators on panel 680-3 use different scale multipliers (x 100 and x 1000).

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B-5 DISPLAYS, cont.

PHOTO FINDING

- 5.19 Operation at low RHR flows may be required, but RHR flow indication at the remote shutdown panel is not valid at less than approximately 30% of the meter scale.
- 5.20 At the remote shutdown panel the range of the reactor pressure meter is 0 to 1500 psig, but indicator reading is invalid at approximately 20% meter range and below. Operator decisions to stop, start and transfer equipment (RHR, RCIC) are based on readings in the invalid range.
- 5.21* The guidelines require the use of bulk suppression pool water temperature and average drywell atmosphere temperature. No provision has yet been made to obtain these "average" temperatures. (5.27)
- P30 5.22 The logarithmic CPM scales of the Rad Monitoring Recorders on panel 907 have major markings at numbered 10^x values. There are nine intermediate scale markings between 10^x values, and single minor marking between intermediate markings. Values between numbered 10^x values are difficult to read because of the large number of undifferentiated intermediate scale markings.
- P10 5.23* Small indicators such as those used on
P11 panel 680 are not easily read. The control band on the SRM period meters subtends a very small visual arc when viewed from a normal operating position (Photos #5, #6, #29). (4.2.2.5)
- 5.24* Process units are not specified on labels for the following indicators and recorders:
- IRM/APRM recorders, panel 680
 - LOOP A/B Flow, panel 680
 - TOTAL RECIRC FLOW, panel 680
 - PRESSURE, panel 680
 - REACTOR LEVEL, panel 680
 - Bailey recorders on panel 001
 - Indicators on panel 619
 - Hydrogen analyzer and glycol pump temperature displays, panel 845
 - Indicators on panel 811
- The label for the drywell pressure recorder on the emergency shutdown panel does not specify whether the pressure is displayed in psig or psia. (4.2.2.3)

B-5 DISPLAYS, cont.

PHOTO FINDING

5.25* Scales on panel 823/842 are not identified clearly. Units are small and often obscured from view. Sometimes the scales are not marked at all. (4.2.2.6)

5.26* On panel 001, references used for water level indications are at variance from those used in the control room. Also, the SUPPRESSION POOL LEVEL display is not clear since the zero point is not specified. (4.2.2.10)

5.27* Different zero references are used for reactor water level instruments. This may complicate comparing readings from multiple indications. (5.19)

5.28* The following indicators possess greater than 9 intermediate graduations between numbered scale divisions (Photos #27, #28).

- Panel 601: C11R100 B/A CRD PUMPS A/B
- E51-R601 RCIC PUMP DISCH PRESS
- E51-R602 MST TO RCIC TURBINE PRESS
- E22-R601 HPCS PUMP DISCHARGE PRESS
- Panel 001: SUPPR POOL LEVEL
- Panel 622/623: All meters
- Panel 632: EQUIPMENT AREA AMBIENT TEMP
- Panel 642: SUMP LEVEL
- Panel 669-672: EQUIPMENT AREA AMBIENT TEMP
- Panel 823/842: APRM indicators
- Panel 845: Several discrepant indicators
- Panel 970: FPCC SURGE TANK LEVEL A NCC PUMP A and B
- Panel 811: Several discrepant indicators
- Panel 821: Several discrepant indicators (4.2.2.14)

5.29* Numbered scale divisions that were not in decimal multiples of 1, 2 or 5 were observed on the following panels (Photos #27 and 28).

001	680	870
601	800	904
622	821	970
669/672	823-842	(4.2.2.15)

C11 5.30 These pressure meters on panel 870-4B are in different units which are hard to reference to each other.

- N36-R401A, B Heater 3 Pressure Meters
- N36-R201A, B, C Heater 2 Pressure Meters
- N36-R341A, B C Heater 1 Pressure Meters

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Part B

B-5 DISPLAYS, cont.

PHOTO FINDING

- C4 5.31 Black and red colors are used to code pushbuttons in an inconsistent manner in the Control Room.
- 5.32 Yellow and green colors on the CRT displays cannot be discriminated from each other by a red-green color blind person.
- 5.33* Indicator scales are generally not marked or color coded to indicate normal, marginal and abnormal ranges. (4.2.2.1)
- 5.34* There currently exists no positive means for testing or detecting failed indicating lights. (4.2.4.2)
- 5.35 There is no lamp test capability provided for normally unlit indicators in the control room, at the remote shutdown panel, containment isolation status indicator panel and all other system status indication panels.
- 5.36 On panel 877, the DG-2 out-of-service status indicator panel does not have its tile labels etched.
- ~~5.37~~ 5.37 Bulb replacement for backlit indicators on system status panels is not convenient.
- 5.38 All system status panels, except isolation status panels, indicate normal condition by means of unlit tiles. This exaggerates the no-lamp test problem.
- 5.39* Relief valve position indications on panels 001 and 601 display only the condition of the actuating solenoid, rather than the actual valve position. (4.2.4.3)
- 5.40* Green lights on panels 680, 800 and 881/882 were relatively dim. However, normal operational room illumination conditions have not been established. (4.2.4.1)
- P20 5.41 Backlit indicator tile locations in indicator matrices are not identified on each tile. Tiles can be removed, interchanged and reinstalled in incorrect locations (i.e, turbine control panel).
- P25 5.42 On panel 680-8C, backlit pushbuttons and backlit indicators on the turbine control panel cannot be readily distinguished from one another.

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Part B

B-5 DISPLAYS, cont.

PHOTO FINDING

- 5.43 Strip chart recorders do not have paper installed on panels 601, 680, 870.
- 5.44* Printed values on recorder charts may be difficult to read on the following panels: (4.2.3.1)
- 5.44a* Panel 601 has minitrend recorders with very small numerals. (4.2.3.1.a)
- 5.44b* On Panel 865, a "frosted" cover causes "haziness" in reading the numbers (Photo #30). (4.2.3.1.b)
- 5.45* Some chart recorders are provided with dual speed capability while others are not. The operator is given no indication from the front of the panel to distinguish between single and dual speed capabilities. More widespread application of dual speed capability may be desirable, particularly for those parameters closely monitored during transient conditions and the instruments on the emergency shutdown panel. (4.2.3.4)
- 5.46* Point select capability is not provided for most multipoint recorders. (4.2.3.5)
- 5.47* Recorders are not generally marked to indicate proper size and type of chart paper. (4.2.3.6)
- P13 5.48* Nuclear instrumentation bypass switches could be disturbed
P14 when paper is replaced in IRM/APRM recorders (Photo #56). (4.2.3.7)
- 5.49* Recorder scales are generally not marked to indicate normal and abnormal range. (4.2.3.10)
- P12 5.50* The wide range level recorder on panel 680 has been supplied with an incorrect scale. (5.22)
- 5.51* A given parameter covered by the guidelines may possess several action levels: Suppression pool water level, for example, has at least eight limits of concern to the operator. Limits or action levels of immediate concern to the operator should be marked in fashion on the indicator or recorder. They may include such points as the top of active fuel for reactor water level, normal operating limits and vacuum breaker elevation for suppression pool level, and low pressure injection system shutoff head for reactor pressure. (5.30)¹

¹ Note that items 5.30 and 5.6 are identical discrepancies as taken from the CEI interim DCRDR report.

9-5 DISPLAYS, cont.

PHOTO FINDING

- 5.52* A given parameter covered by the guidelines may possess several action levels. Suppression pool water level, for example, has at least eight limits of concern to the operator. Limits or action levels of immediate concern to the operator should be marked in some fashion on the indicator or recorder. This may include such points as the top of active fuel for reactor water level, normal operating limits and vacuum breaker elevation for suppression pool level, and low pressure injection system shutoff head for reactor pressure. (5.6)¹
- 5.53 Some trend recorders do not have correctly scaled paper.
- Examples.
- panel 845 N64-R614 Adsorber Vault Temp
 - panel 845 N64-R617 Adsorber Outlet Flow
 - panel 842 N11-R050 Mainsteam A&C Pressure
 - panel 600 D17-R601 Process Rad Monitor
- P26 5.54 Bailey strip chart recorders must be pulled out of the panel to view the time history record on the chart (i.e., on panels 601, 608, 870).
- 5.55* Alarm points are generally not identified on recorder scales. (4.2.3.2)
- M6 5.56* The left hand wing of panel 680 has a very high density of
S37 instrumentation (Photos #5, #6). In the midst of these inserts
S38 are some of the operator's most important indications - water
S40 level and reactor pressure. These use either very small
C3 indicators which are difficult to read from normal operating
distances, or are on recorders, which are more appropriately
used for trend indication. Larger, more clearly labeled
indications would be much easier to locate and use when
evaluating plant conditions during major transients. (5.23)
- C1 5.57* Pointers partially obscure scale markings or numerals on round
C2 indicators located on panel 680 and four indicators on panel
632. (4.2.2.7)
- 5.58 On panels 691, 694, 672, and 669 pointers partially obscure
scale markings or numerals on round indicators.

¹ Note that items 5.30 and 5.6 are identical discrepancies as taken from the CEI interim DCRDR report.

Part B

B-6 LABELS & AIDS

PHOTO FINDING

- S2 6.1* Unlabeled white indicating lights are used on panels 669
S3 and 672 for both LPRM downscale and LPRM bypassed
S4 indications. Similarly, red hydrogen purge lights and amber
high/low vacuum lights on panel 845 are not individually
labeled (Photos #44, #45). (4.1.4.3)
- S5 6.2* The following components are missing
function labels:
- Four indicators on panel 680-3 (Photo #6)
 - Indicating lights on panels 622 and 623 (photo #46)
 - Two meters on panel 870-1
 - Ten switches on panels 881 and 882
 - Four indicating lights on panel 632
 - One pushbutton on panel 654
 - Numerous components on panel 845 (Photo #47)
 - One switch on panel 870-5 (Photo #48)
 - Indicators on the right wing of panel 680 (Photos #49,
#50) (4.1.5.1)
- S6 6.3* System labels, seen on panels 601 and 870, are not used on most
other panels. (4.1.5.2)
- HFEB NOTE: The HFEB team believes panel 877, rather than panel
601, contains the referenced labels
- 6.4* Panels are generally not identified by both number and function.
(4.1.5.3)
- 6.5* On panel 601, RX LEVEL recorders cannot easily be correlated
with the REACTOR FUEL ZONE LEVEL indicator since the latter is
not labeled or provided units. (4.2.2.9)
- 6.6* The association of pen color to input parameter is generally
not specified on recorder labels, except for those on panel 680.
(4.2.3.8)

Perry Unit 1
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Part B

B-6 LABELS & AIDS, cont.

PHOTO FINDING

- 6.7* Several switches on panel 001 have escutcheons incorrectly listing position options as "OFF-1-2" (Photo #57). (4.2.5.2)
- 6.8* Status lights for containment isolation valves are labeled by number only. (5.15)
- 6.9* The wide range/narrow range level recorder on panel 680 is missing its label. Another level instrument on panel 680 is unlabeled; its purpose is unclear. (5.21)
- C14 6.10 Identifying labels on panel 805 are missing from three controls (i.e., two red pushbuttons, one rotary switch).
- C14 6.11 The label "Radiation Emergency" on panel 805 is not descriptive of the function of the control it is associated with.
- C15 6.12 A pushbutton next to the Instrument Volume Isolation Test Pushbutton, C71AS2B, on panel 680-6C is not labeled.
- 6.13 There are four unlabeled selector control switches on panel 883, the Post Accident Monitoring Panel.
- 6.14 There are missing labels on the outboard and inboard isolation valve controls on panel 881 and panel 882.
- M5 6.15 One of the annunciator controls on panel 604 is not labeled.
- P31 6.16 Turbine Trip and Turbine Trip Reset pushbuttons are not labeled on panel 680-8C.
- 6.17 Functionally grouped controls or displays are not identified by hierarchical labels.
- S9 6.18* Many instances of repetitive labeling were found
S42 (Photo #15). Institution of an hierarchical system
S46 should be considered to shorten device descriptions and accentuate functional groupings of panel components. (4.1.5.7)
- S10 6.19* Labels above controls on the "C" inserts of panel 680 are
S11 obscured by the projecting switches and cannot be read from a seated operating position (Photos #2, #3). Labels below components on the lower surfaces of some vertical panels are difficult to see from a normal operating position. These include panels 600, 632, 655, 800, 823, 842, 845, 883, 902, 906, 904, 907 and 970 (Photos #17-20). (4.1.5.8)

B-6 LABELS & AIDS, cont.

PHOTO FINDING

- 6.20* Labels are mounted below most indicators, but have been placed above controllers. (4.1.5.10)
- P23 6.21 In the Control Room, some labels are located below panel elements and many are obscured by the instrument or control when standing close,
 Example: RECIRC flow controllers on panel 680.
- 6.22 Some position indicating labels are obscured by the operators hand when its associated control is operated.
- 6.23 At the remote shutdown panel the labels below the amber light do not indicate "RCIC Trip".
- 6.24 Control switch labels are inconsistent between P-601 and P-631 e.g.,
- | Valve | Label | Panel |
|-----------|---------------------------------------------|-------|
| B21-F051G | ADS Valve | P-631 |
| B21-F051G | Main Steam Line
C Safety Relief
Valve | P-601 |
| B21-F051A | Safety Relief
Valve | P-631 |
| B21-F051A | Main Steam Line
A Safety Relief
Valve | P-601 |
- I14 6.25 Two annunciators on panel 601-17A have incorrect labels; e.g., "DW to Containment Diff Press B High" and "Containment to DW Diff. Press B High". The exact terminology should be: "CNTMT TO DW DIFF PRESS HIGH".
- 6.26* The following labels do not clearly describe the function of the associated components. (4.1.5.9)
- 6.26a* Valve controls on panel 865 are identified only by number. (4.1.5.9.a)
- 6.26b* "RCIC" on panel 632 should read RCIRC. (4.1.5.9.b)
- S28 6.26c* "IP" is incorrectly used twice on panel 870-4 instead. (4.1.5.9.c)
 (NRC reviewer comment: instead of "LP" and "IP" twice each.)

B-6 LABELS & AIDS, cont.

PHOTO FINDING

6.26d* The center position marking of switch E31A-513A on panel 632 appears to be part of the function label (Photo #51). (4.1.5.9.d)

HFEB NOTE: The switch was identified as 31A-S13A during the in-progress audit.

6.26e* Valve controls on panel 365 are identified by number only. (4.1.5.9.e)

6.26f* Containment isolation valve indicating lights on panel 601 are labeled by number only. (4.1.5.9.f)

6.26h* The meaning of "PERSONAL EL603 OTBD DRLRT SA ISOL VLV" on panel 881/882 is unclear. A more concise label would be more readable. (4.1.5.9.h)

S33 6.26i* On panel 601-19, the label for switch B21-F015 currently reads "MAIN STEAM LINE B SAFETY/RELIEF VALVE". The correct legend is "MST LOW POINTS DRN SHUTOFF VALVE". (4.1.5.9.i)

6.26j* Reactor water cleanup dump flow indicator G33-R60Z on panel 680-1 is incorrectly labeled "PUMP FLOW". (4.1.5.9.j)

HFEB NOTE: The indicator was identified as G33-R602 during the in-progress audit.

6.26k* The condenser vacuum trip reset button on panel 680-7 is labeled only "COND VACUUM TRIP". (4.1.5.9.k)

S30 6.26l* "UPSTREAM" and "DNSTREAM" designations are reversed on drain valve indications 2N22-F190A, F230A, F180B and F210B on panel 870-5. (4.1.5.9.l)

S29 6.26m* Labels for valves N25-120A (B) and 125A (B) on panel 870-5 incorrectly imply that scavenging steam is sent to the condenser. (4.1.5.9.m)

S31 6.26n* On panel 870-6, identification numbers are reversed on labels for main steam pressure indication upstream of reheater 1B and 2A control valves (N11-R146A and R141B). (4.1.5.9.n)

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Part B

B-6 LABELS & AIDS, cont.

PHOTO FINDING

- 6.26o* On panel 870-8, RFPT vacuum trip override switches are labeled as resets. (4.1.5.9.o)
- 6.26q* Labels for RFPT lube oil test switches and associated indicating lights on panel 870-8 should specify that a pressure test is involved. (4.1.5.9.q)
- 6.26r* "ST SEAL EVAP DRN" on the label for indicator 1N22-F270 on panel 870-7 should read OFF GAS PREHTRS. (4.1.5.9.r)
- 6.26s* The word "fan" should be included on the label for exhaust fan A control switch on panel 870-7 (1N33-C001A). (4.1.5.9.s)
- 6.26t* The label for the low pressure condensor vent valves control switch on panel 870-7 (1N62-F010) should specify that all three valves (A, B and C) are actuated. (4.1.5.9.t)
- 6.26u* "RFPT A (B) ST SEAL LEAK OFF DRIV VLV" on panel 870-8 (1N22-F260A, B) should read RFPT A (B) FIRST STAGE DRN VLV. (4.1.5.9.u)
- S32 6.26v* The stator water cooling pump reserve cut off switch on panel 870-9 is labeled only "CUTOFF". Its numerical designation incorrectly implies that it operates stator water cooling pump A. (4.1.5.9.v)
- S29 6.26w* Escutcheons are provided for "MST TO 2ND STAGE RHTR B DRAIN VLV" control switch on panel 870-5 and for "S/V V POSIT" indication on panel 680-3, but no associated components are installed (Photos #6, #53). (4.1.5.9.w)

HFEB NOTE: Finding C6.2 contains the other parts of this CEI finding.

- 6.27* Label syntax is not always consistent. For example, most valve labels include a "VLV" designation, but this designation is missing on a panel 970 label reading "NCC TO/FROM FPCC HEAT EXCHANGERS". (4.1.5.5.)
- 6.28* The terminology used on panel 001 relief valve control switch labels does not correspond to that used on panel 601. (4.1.5.6.)

B-6 LABELS & AIDS, cont.

PHOTO FINDING

- 6.29* The following inconsistent abbreviations were noted:
SUPPR/SUPR
V/VLV
SUP/SUPP
CST/STRG TANK
MOTOR FDW PUMP/MFP
SUPR POOL/SUPPR POOL/SP
SVCE AIR/SA
INST AIR/IA
CIRC WATER/CIRW
CNTM/CNTMT
DG/DIESEL GEN
MANUAL BLOW/SRV
PP/PMP
VV/VLV
LKD/LD
COND/CNDS
OT BD/OTB
DR (door)/DR (Drain) (4.1.5.4)
- 6.30* Wording of component labels is generally very wordy and repetitive. (5.14)
- 6.31* Switch positions were not always clearly marked. Panel 669 has controls with missing nameplates. Panel 800 lacks markings for:
AEGT A/B CHAN FLTR DELUGE
DW Keylock Switch
OG BLDG EXIT A/B CHAR FLTR DELUGE
CNTMT AND DW EXH A/B FLTR DELUGE
AB EXH CHAN FLTR DELUGE (4.2.5.3)
- S7 6.32 There is inconsistent use of "NORMAL", "AUTO"
S8 and "STANDBY" labels for the center positions of control switches. The description does not truly match the switch or circuit function (e.g., Left-Right momentary, and Left-Off-Right momentary).
- 6.33* Center positions for the following switches are labeled "AUTO" but should be labeled "NORMAL":
1N27-F140, panel 680-3
1N11-F115B, panel 870-6
1N33-F110, panel 870-7
The center position of switch 1N27-C005A on panel 870-8 is labeled "NORMAL" but should be "AUTO". (4.2.5.5)
- S42 6.34 Labels have white letters on a black background.

B-6 LABELS & AIDS, cont.

PHOTO FINDING

- S14 6.35 These panels have closely spaced matrices of valve controls
S15 as follows:
 panel 865 5 x 6
 panel 881 6 x 7
 panel 882 6 x 6
 Some labels on panel 865 have identical functions described.
 All other labels on the 3 panels have similar functions
 identified. Specific valve controls are difficult to find.
- I25 6.36 Location aids (i.e., demarcation, hierarchical labeling, color
padding) are not provided at the remote shutdown panel to aid
the operator in identifying systems.
- S42 6.37 There is little use of demarcation of any kind on panels in the
control room.
- M7 6.38* Controls and displays on the main benchboards are
S12 generally divided into system groupings by the panel
S13 inserts themselves. However, there are occasions in
S14 which controls for two systems are present within one insert.
S15 In these cases, use of demarcation lines and system
S42 summary labels should be considered to delineate operating
 areas and accentuate system groupings. These techniques might
 be applied in the following instances:
 - Divide main and auxiliary steam to reheater controls on
 panel 870-7 (Photo #34).
 - Separate RCIC and LPCS controls on panel 601 (Photo #35).
 - Distinguish relief valve controls from main steam line
 valves on panel 601-19 (Photo #36).
 - Delineate standby liquid control system operating areas
 within panels 601-18 and 601-19.
 Similarly, use of demarcation lines may be beneficial on some
 backpanels to divide system groups and demarcate
 undifferentiated matrices of controls.
 The following examples were identified:
 Remote shutdown panel (Photo #25)
 Panel 970 (Photo #37)
 Panel 904 (Photo #38)
 Panel 845 (Photo #41)
 Panel 632
 Panel 654
 Panel 655
 Panel 865 (Photo #40)
 Panel 881 (Photo #39)
 Panel 882

(4.1.2.2)

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B-6 LABELS & AIDS, cont.

PHOTO FINDING

- S16 6.39* Within system groupings, additional use of demarcation
S17 lines may be made to divide subgroups of related
M8 components. The following examples are provided:
- Divide A and B recirculation loops on panel 680-4 (Photo
 #33)
- Demarcate inserts on the right wing of panel 680
- Subdivide the remote shutdown panel (Photo #25) and
 panel 845 (Photo #41)
- S14 - Functionally demarcate components on panels 881,
S15 882, 883 and 865 (Photos #39, #40)
- Subdivide quantitative displays on "B" panel inserts
 (4.1.2.3)
- S41 6.40* Locating important indications could be facilitated
S42 by providing visual identification cues, particularly
M6 in areas of high instrument density (See Photo #5). (5.18)
- 6.41 The HPCS shares panels 601-16B and 16C with DIV 3 DG controls
 and displays without separation by demarcation or other means.
- P32 6.42 The significance of the red collar on the Turbine Trip
 Pushbutton and the green collar on the Turbine Trip Reset
 Pushbutton is not known and they are not identified in control
 room color code conventions.
- 6.43* Graphic techniques used in mimic arrangements generally provide
 visual distinction between main and auxiliary flowpaths. Two
 exceptions were noted on panel 970, where the fuel pool cooling
 filter demineralizer and heat exchanger bypasses appear to be
 main flowpaths. (4.1.2.5)
- S20 6.44* Mimic flowpaths generally appear orderly and easily
S18 recognizable. However, the RHR system layout on
S19 panel 601 (Photo #42), the ventilation mimics on panel 904, and
 the containment mimic on panel 800 appear somewhat convoluted.
 (4.1.2.8)
- S21 6.45* The mimic on panel 601-19 incorrectly indicates the
 safety-relief valves in series (Photo #36). (4.1.2.9)
- S20 6.46* Verifying correct operation of emergency system status
S22 could be facilitated if major flowpaths were made more
 distinctive. (5.17)

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B-6 LABELS & AIDS, cont.

PHOTO FINDING

- 6.47* Blue mimics are used for both the nuclear component cooling and the fuel pool cooling system on panel 970. (4.1.4.2)
- S22 6.48 Mimic flowpath ending and start points are temporarily installed on panel 601 inserts 16A, 17A, 20A, and 21A.
- 6.49 Color coding is inconsistent in the control room.
- S22 6.50* The blue mimic lines used on panels 680 and 601
S18 provide poor contrast with the dark brown
S19 panel background (Photo #42). Similarly, the
S23 gray lines on panels 800 and 904 are difficult to
S42 see against the beige background of these panels. (4.1.2.6)
- 6.51 When purple is used for mimic lines on panels with a dark brown background the mimic lines are very difficult to see.
- S20 6.52* Dotted white lines are used to represent both the
S24 containment and feedwater injection lines on panels 601-17 and 601-20 (Photo #42). (4.1.2.7)
- S26 6.53 On panel 800, mimics of air intake symbols at cooler selection valves are blue (air flow suction), but to be consistent, they should be gray.
- S42 6.54 There is poor contrast between the panel board (dark brown) and label background (black).
- S19 6.55* Additional use of flow direction arrows may be beneficial in the mimic on panel 904 (Photo #43). (4.1.2.10)
- S29 6.56 Some mimic lines lack direction of flow indications on panel 870-5.
- S34 6.57 There are temporary mimic sections attached with scotch tape on panel 601-19C.
- S27 6.58* A symbol should be devised which more clearly represents the suppression pool than that currently used on panel 601. The present open "U" shape is rather non-descript and is unlabeled (Photo #42). (4.1.2.12)
- S18 6.59* Starting and ending points are difficult to identify in
S25 the containment and drywell purge mimics on panel 800
S26 and the nuclear component cooling mimic on panel 970. (4.1.2.11)

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Part B

B-7 PROCESS COMPUTERS

PHOTO FINDING

- 7.1 There are no formal authorization procedures or other administrative controls for software changes.
- 7.2 There is presently no provision for secure storage of the current operating software at a remote location.
- 7.3ⁿ When an operator acknowledges alarms on the CRT keyboard, all alarms are acknowledged; e.g., if there are 5 pages of alarms, all 5 pages are acknowledged when operator acknowledges page 1. This feature does not allow a page-by-page acknowledgement of alarms. These are BOP alarms according to operators.
- 7.4 Abbreviations used in computer dialogue are not consistent with plant standard abbreviations; e.g., TH on CRT means "Thrust" but plant standard for thrust is TRST.
- 7.5 The CRT keyboard on panel 680 includes a graphic function which is unnecessary for operators to use.
- P5 7.6^{copy} Computer function keys on the process computer keyboard do not have engraved labels. Some of the keys have only temporary number labels. Functions for some keys are shown on a temporary diagram placed on the panel above the keys.
- 7.7 There are no procedures available to the operator which cover the necessary actions to take in the event the process computer fails.
- 7.8 The computer system data point addresses are not cross-indexed by program name, system/subsystem and functional group. The operator must memorize at least the first 3 digits of point I.D. to get to a nonalphabetized list of components.
- P2 7.9* CRT displays are accessible and easily visible from a
P3 standing operator position but are too high and at
P4 unfavorable viewing angles from a fixed seated position
I7 in front of the keyboard. (4.4.4)

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Part B

B-7 PROCESS COMPUTERS, cont.

PHOTO FINDING

- P1 7.10 It is difficult to distinguish between the characters C, O, 0 (zero), G, D on CRT displays.
- 7.11 The computer system entry formats are confusing. Entry request labels are below the blank entry space instead of above or to the left as recommended in NUREG-0700.
- 7.12 There is insufficient spacing at the top and bottom of CRT pages. The first three lines and last two lines on CRT are "compressed" and so dense that they are hard to read. These are the entry (top) and alarm (bottom) areas of the CRT page.
- 7.13* Color standards for CRT displays are not fully developed but it appears that locally developed standards will be in conflict with vendor supplied display formats. (4.4.5)
- 7.14 There is an inconsistent use of color coding on CRT displays. The colors used do not conform with commonly understood meanings for colors.
- Example: Alarm function includes yellow for unacknowledged alarm and green for acknowledged alarm.
- 7.15* The computer printout is not prioritized. (4.4.6)
- 7.16 The process computer printer used for recording trend data, computer alarms, and critical status information does not have a high-speed printing capability of at least 300 lines per minute to permit printer output to keep up with computer output.
- 7.17 When requested CRT display copies are printed remote from the operator, a print confirmation or denial message is not displayed on the operator CRT.
- 7.18 There is no positive indication of remaining printer paper supply - even if you open cabinet below the printer, you cannot see how much paper is left without pulling out the box.
- 7.19 There is no firm surface for paper to travel over to allow annotation of copy while it is on the printer.
- 7.20 Printers must be turned "off" in order to reload paper. This may result in the loss of hard copy data during paper reloading.
- 7.21 There are no instructions for reloading paper or changing ribbons near or on the printer.

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Part B

B-8 PANEL LAYOUT

PHOTO FINDING

- 8.1* CST level is not available in the HPCS or RCIC operating areas. (5.11)
- 8.2* No level indication is available in the HPCS operating area. (5.12)
- I26 8.3* Water level indication on panel 680 is available
S37 only on recorders and very small indicators
S38 in an area of high instrument density. This
S39 impedes visual location and accurate reading
S40 of this parameter. (5.20)
- 8.4* The operator must be able to determine drywell temperature adjacent to reference leg vertical runs. (5.28)
- 8.5 The controls and displays on the remote shutdown panel have not been grouped by task sequence, importance or system function.
- C9 8.6 Tiles on the Isolation Status Panels are not logically
C10 grouped for easy pattern recognition;
Example: E12CRHR valves are not grouped together.
- P27 8.7 On panel 680-3B, there are inappropriately large, 4" diameter circular dial meters used for RFPT Control Valve Position and RFPT Speed indicators, while small 2" vertical scale meters are used for Reactor Pressure, Reactor Water Level, Main Steam Header Flow and Feedwater Pressure indicators.
- C8 8.8 There appears to be a normal order of use for Main Steam Safety Relief Valve controls on panel 601-19C. The controls are not arranged in left-to-right, top-to-bottom, or other natural sequence.

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B-8 PANEL LAYOUT, cont.

PHOTO FINDING

- S48 8.9 Control-display sequences of ADS valve controls and
C8 displays on panels 601, 631 and 628 are not consistent
R1 with each other.
I28
- 8.10 The configuration of 4 sets of drain line and warm up valve
controls on panel 601 is not consistent from left to right
across the bottom of the panel.
- S43 8.11 On panels 601-17, 18, 19, 20, the Division 1 and 2
S44 power displays are not arranged in a consistent
S45 left-to-right order as they are on the Diesel Generator Panel.
- I28 8.12* The ordering of control-display elements was not always in the
recommended left-to-right or top-to-bottom arrangement.
Examples are: (4.1.3.2)
- 8.12b* CCW chillers on panel 904 are arranged A C B from top-to-bottom.
(4.1.3.2.b)
- 8.12c* Control-display sequences on panel 628 show no correlation to
those of related elements on panel 601-19. No obvious
numerical sequence was observed on panel 628. (4.1.3.2.c)
- 8.12d* On panel 870-4, condensate inlet valves are arranged in a 2A -
2B - 2C - 1A - 1B - 1C top-to-bottom sequence. (4.1.3.2.d)
- HFEB NOTE: Finding C8.3 contains the other part of this CEI
finding.
- P19 8.13 The RCIC out of service backlit indicators for Division 1 and
Division 2 on panel 601-21B are not arranged in the same matrix
layouts.
- 8.14 The layout of redundant controls and displays with identical
systems functions on panel 601 are not consistent for Division
1 and Division 2. Some mirror imaging is involved with display
arrangement.

B-8 PANEL LAYOUT, cont.

PHOTO FINDING

- S48 R1 8.15* Controls and displays are generally grouped by system with identical layouts for repetitive groups. Examples of exceptions include: (4.1.3.1)
- 8.15a* The arrangements of relief valve indicating lights differs on panels 601-19, 628 and 631. (4.1.3.1.a)
- 8.15b* Equipment drain system components are interspersed with floor drain system components on panel 881/882. (4.1.3.1.b)
- 8.15c* Standby liquid control system components are divided between panels 601-18 and 601-19. (4.1.3.1.c)
- 8.15d* Drywell pressure and temperature indications are not placed adjacent to each other on panel 601, but are interspersed with containment pressure and temperature. (4.1.3.1.d)
- 8.15e* The RHR controls on panel 001 are separated into left-center-right panel segments. The RCIC controls are distributed across center and right panel segments. Relief valves controls are not aligned. (4.1.3.1.e)
- P21 8.16 On panel 601-16B, meters are grouped in long unbroken strings of 10 meters and 7 meters.
- I28 8.17* Some panels contain undivided strings or matrices of related components. These groupings should be differentiated from adjacent controls with demarcation lines, hierarchical labeling, spacing or color coding. The following examples were noted:
- VALVE STM LEAK-OFF switches on panel 865 (Photo #40)
 - Matrix of ARMs on Panel 902/906
 - Meters on Panel 970 (Photo #37)
 - Control-display elements on Panel 628/631
 - Control-display elements on Panel 881/882 (Photo #39)
- (4.1.3.5)

Perry Unit 1
Audit Report
Part B

Part B

B-9 C/D INTEGRATION

PHOTO FINDING

- C13 9.1 The RX Pressure Meter and Turbine Steam Chest Pressure Meter are used in coordination when bringing the turbine on line. However, the RX Pressure Meter is too small to be read from the turbine control area. (They are 11 feet apart.)
- 9.2* The association between transfer switches and related controls is not evident on panel 001. (4.1.3.3)
- 9.3* The association of selector switches to recorders on panel 883 is not obvious. (4.1.3.4)
- 9.4* No reactor pressure indication is available immediately adjacent to safety relief valve controls. (unnumbered - p5.3 interim DCRDR report)

AUDIT REPORT
Part C

HUMAN FACTORS ENGINEERING
CONTROL ROOM IN-PROGRESS AUDIT

PERRY NUCLEAR POWER PLANT
UNIT 1
CLEVELAND ELECTRIC ILLUMINATING COMPANY

Part C - This section contains a list of items identified by CEI which the HFEB team determined either to be invalid or corrected at the time of the in-progress audit.

C-1 CONTROL ROOM WORKSPACE

PHOTO FINDING

- 1.1* No indication of suppression chamber pressure has been provided. (5.26)
 - 1.2* Panel 680 is four inches deeper than recommended. (4.1.1.1)
 - 1.3* The uppermost indicators on panel 680 are higher than recommended. (4.1.3.9)
 - 1.4* The following controllers were not easily reached from a normal operating position: (4.2.1.1)
 - 1.4b* Four controllers on panel 800 are mounted low. (4.2.1.1b)
- HFEB NOTE: Finding B1.18 contains the other part of this CEI finding.
- 1.5* Out-of-service switches on panels 601, 870 and 877 are higher than recommended. (4.1.3.8)

C-1 CONTROL ROOM WORKSPACE, cont.

PHOTO FINDING

- 1.6* The top rows of indicators on panels 601, 870 and 877 are above recommended heights. (4.1.3.7)
- 1.7* The kitchen and toilets are outside the controlroom and relatively inaccessible. (4.6.2)

C-4 CONTROLS

PHOTO FINDING

- 4.1* Based on experience at the simulator, an operator reported that the RCIC PUMP FLOW controller on panel 601 is too sensitive in the manual mode. (4.2.1.2)
- 4.2* Operators report that the annunciator pushbutton controls sometimes trap fingernails when depressed. (4.2.5.7)

Perry Unit 1
Audit Report
Part C

C-5 DISPLAYS

PHOTO FINDING

5.1* Some indicators and recorders were found for which alternate process units may provide useful information to the operator: (4.2.2.4)

5.1a* HEATER 1 LEVEL (N26-R042A) on panel 870-4 is incorrectly scaled in lbm/hr. (4.2.2.4.a)

P7 5.1c* The feedwater check valve indicator on panel 612 is inappropriately scaled in amps. (4.2.2.4.c)

HFEB NOTE: Finding A1.3 and B5.13 contain the other parts of this CEI finding.

5.3* On panel 845, the RECOMBINER A and B DIFF PRESS scales are different thereby rendering comparative reading more difficult. (4.2.2.11)

5.4* The full core display contains a large matrix of multicolored lights. When under stress, it is conceivable that the operator might miss one or two non-illuminated red bottom lights. (5.16)

5.5* Printed values on recorder charts may be difficult to read on the following panels: (4.2.3.1)

5.5c* The lower recorder scales on panel 883 are not visible from a normal operating position. (4.2.3.1.c)

HFEB NOTE: Finding B5.47 contains the other parts of this CEI finding.

5.6* The multi-pen recorder on panel 845 does not provide adequate distinction between markings. (4.2.3.3)

C-6 LABELS AND LOCATION AIDS

PHOTO FINDING

- 6.1* Pushbutton switch N22-F3008 on panel 870-8 is incorrectly provided with a rotary switch escutcheon (Photo #58).
(4.2.5.4)
- 6.2* The following labels do not clearly describe the function of the associated components.
(4.1.5.9)
- 6.2g* Two physically similar, adjacent switches on panels 691 and 694 also have very similar designations - STEAM LINE DRN VLS ISOL LOGIC TEST and MAIN STEAM DRAIN LOGIC TEST (Photo #52). The possibility of confusion should be reduced by more distinctive labels.
(4.1.5.9.g)
- 6.2p* RFPT high pressure stop valve before and after seat drain control switches have incorrect numerical designations on panel 870-8.
(4.1.5.9.p)
- HFEB NOTE: Finding B6.26 contains the other parts of this CEI finding.
- 6.3* Identifying labels on the SRM/IRM drawers on panels 669 and 672 are not distinctive against the panel background. (4.1.5.11)
- 6.4* Mimic layouts have been utilized on most inserts of the main benchboards. However, a few opportunities still exist for which this technique may be appropriate. These include the recirculation system on panel 680 (Photo #33) and the air removal system on panel 870-7, which are currently not mimicked.
(4.1.2.1)
- 6.5* While quantitative displays on the "B" inserts of the main benchboards are generally grouped by system above related controls, these arrangements could be accentuated through use of demarcation lines to define system operating areas (Photo #13).
(4.1.2.4)

C-7 PROCESS COMPUTERS

PHOTO FINDING

- 7.1* The computer is capable of displaying selected input information; however, the C91 has a limited number of inputs (about 800). (4.4.2)
- 7.2* The computer is not capable of automatic or manual switchover for processor failure since there is only one processor. (4.4.3)
- 7.3* Ribbon replacement on the computer printer is difficult. (4.4.8)

C-8 PANEL LAYOUT

PHOTO FINDING

- 8.1* Emergency diesel controls and indications are located on panel 877, but controls and indications for the remainder of the electrical systems are located at the opposite end of the control room on panels 680 and 870. (5.13)
- 8.2* The relative positions of Division I and Division II controls on panels 622 and 623 differs between units. (4.1.1.2)
- 8.3* The ordering of control-display elements was not always in the recommended left-to-right or top-to-bottom arrangement. Examples are: (4.1.3.2)
- 8.3a* Steam lines on panel 601 (18 and 19) are arranged B D A C. (4.1.3.2.a)

HFEB NOTE: Finding B8.12 contains the other parts of this CEI finding.

AUDIT REPORT
Part D

HUMAN FACTORS ENGINEERING
CONTROL ROOM IN PROGRESS AUDIT

PERRY NUCLEAR POWER PLANT
UNIT 1
CLEVELAND ELECTRIC ILLUMINATING COMPANY

Part D - Perry Photo Summary

	<u>No.</u>	<u>ID #</u>	<u>Photo Description</u>
1-1	25	C1	Pointer covers numerals on meter scale
1-2	26	C2	Pointer obscures scale divisions on meter
1-3	24	C3	Dense array of small meters
1-4	3	C4	Inconsistent color coding on pushbuttons
1-5	35	C5	<u>Annunciator</u> and <u>RFPT</u> pushbuttons are similar
1-6	36	C6	<u>Annunciator</u> and <u>RFPT</u> pushbuttons are similar
1-7	37	C5/6	Similar arrangement of controls
1-8	4	C5/6	Similar arrangement of controls
1-9	34	C7	Turbine Trip button not guarded
1-10	1	C8	Controls not arranged in sequence of operation
1-11	5	C9	Backlit indicator matrices (Div 1)
1-12	7	C9	Backlit indicator matrices (Div 1)
1-13	9	C9	Backlit indicator matrices (Div 1)
1-14	6	C10	Backlit indicator matrices (Div 2)
1-15	8	C10	Backlit indicator matrices (Div 2)
1-16	10	C10	Backlit indicator matrices (Div 2)
1-17	23	C11	Different references vacuum/pressure meters
1-18	24	C11	
1-19	25	C11	
1-20	26	C12	VAC scale level adjacent to pressure pportion of scale
1-21	27	C13	Separation of RX Press and Turbine Press indicators
1-22	28	C13	
1-23	29	C13	
1-24	30	C13	
1-25	31	C13	Wide angle shot
1-26	32	C13	Wide angle shot
1-27	33	C14	Missing labels
1-28	34	C15	Unlabeled pushbutton

Perry Unit 1
 Audit Report
 Part D

	<u>No.</u>	<u>ID #</u>	<u>Photo Description</u>
1-29	2	I1	Missing pressure indicator
1-30	3	I1	LPCS PRESS ann. tile
1-31	4	I1	Vertical LPCS meters amps/flow
1-32	5	I1	Pump controls
1-33	6	I2	LPCS SUPP. POOL suction valve
1-34	7	I3	Pressure recorder
1-35	8	I4	Missing Suppression Pool recorder
1-36	9	I4	Actual location and suggested location
1-37	10	I4	Suppression Pool recorder
1-38	12	I5	Column in control room
1-39	13	I5	
1-40	14	I5	
1-41	15	I6	Sharp corners on guardrail
1-42	16	I7	CRT viewing problem
1-43	17	I7	
1-44	18	I8	Glare problem
1-45	19	I8	
1-46	20	I9	Glare on recorders
1-47	21	I10	Annunciator with multiple inputs
1-48	22	I10	
1-49	23	I11	Annunciator windows priority problem
1-50	24	I12	Alarm windows provide panel location which are alarmed
1-51	25	I12	
1-52	26	I13	Annunciator not located above associated controls
1-53	27	I14	Separated annunciator (P601-17A)
1-54	28	I14	Separated annunciator (P680)
1-55	29	I15	Annunciator arrangement (P877-2A)
1-56	30	I15	Annunciator arrangement (P601-16)
1-57	31	I16	Interchangeable annunciator windows (P877)
1-58	32	I17	Ambiguous annunciator tile legends (P601-18A)
1-59	2	I18	Lack of intent on annunciator tile (P601)
1-60	3	I19	Wordy annunciator (P601-21A)
1-61	4	I20	Annunciator font size (P680-3A)
1-62	5	I21	Axes of annunciator panels not labeled (P877)
1-63	6	I22	No acknowledge control button for annunciators (P877)
1-64	7	I22	Inconsistent annunciator control arrangement(P680-9A)
1-65	8	I22	Inconsistent annunciator control arrangement (P680-10C)
1-66	9	I23	Annunciator Emerg. Response Procedures
1-67	10	I24	Control height problem (C61-001)

Perry Unit 1
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 Part D

	<u>No.</u>	<u>ID #</u>	<u>Photo Description</u>
	1-68	11	I25 RCIC Turbine Flow Control (C61-001)
	1-69	13	I26 Water level indicators on P680 (P680)
	1-70	14	I27 Identical layouts (P622)
	1-71	15	I27 Identical layouts (P623)
	1-72	16	I28 Long string of instruments (P970)
	1-73	17	I29 Controls not labeled - relationship to recorders not clear (P833)
	1-74	3	M1 Annunciator panels not labeled (P870-8A)
	1-75	4	M2 Temporary annunciator legends (P870-1A)
	1-76	5	M3 Illuminated blank annunciator tiles (P601-18A)
	1-77	6	M4 Inconsistent type styles on annunciator panels (P680)
	1-78	7	M4
	1-79	8	M4
	1-80	9	M5 Annunciator controls not labeled (P604)
	1-81	21	M6 Hi density of displays and small labeling
	1-82	22	M7 Demarcation problem
	1-83	23	M8 (P630)
	1-84	24	M9 Long string of meters
	1-85	1	P1 CRT readability - Poor Distinction between letters
	1-86	2	P1
	1-87	3	P2 CRT visibility problem - seated operator
	1-88	4	P2 CRT visibility problem - standing operator
	1-89	5	P3 CRT #2 left edge not visible from seated position
	1-90	6	P3 standing position edge is visible
	1-91	7	P4 CRT #3 view from seated keyboard position
	1-92	8	P4 Standing in front of CRT #3
	1-93	9	P5 Function keys not labeled and temporary labels
	1-94	10	P6 Heater 1 Pressure in PSI VAC
	1-95	11	P6 Heater 2 Pressure in PSIA
	1-96	12	P7 Feedwater Inlet Check valve in AC amps
	1-97	13	P8 CST level 0-100%
	1-98	14	P9 RX PRESS meter - no meter scale
	1-99	15	P10 Small vertical meters difficult to read
	1-100	16	P11 Meters difficult to read
	1-101	17	P11 Long array of small meters difficult to read
	1-102	23	P12 Mislabeled recorder scales

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 Part D

	<u>No.</u>	<u>ID #</u>	<u>Photo Description</u>
1-103	18	P13	Recorders hit bat handle selector switches
1-104	19	P13	
1-105	20	P14	Recorders clear lowered bat handles
1-106	21	P14	Lowered bat handles
1-107	27	P15	Valve controls open left and close right & open right - close left
1-108	28	P15	
1-109	29	P16	Valve controls open left and close right & open right - close left
1-110	30	P16	
1-111	31	P17	Valve controls open left and close right & open right - close left
1-112	32	P18	Red and Black Manual Initiate Pushbuttons
1-113	33	P18	
1-114	11	P19	Backlit Indicator Matrix layouts different
1-115	12	P20	Legend labels matrix location not identified
1-116	13	P21	Long meter strings
1-117	14	P22	Blank meters installed
1-118	15	P23	Obscured flow controller labels
1-119	16	P23	
1-120	17	P24	Unlabeled PSIA meters without scales
1-121	16	P24	
1-122	19	P25	Backlit pushbuttons/indicators
1-123	20	P25	
1-124	21	P26	Strip chart time history recorder
1-125	22	P26	
1-126	2	P27	Panel layout - large and small meters
1-127	3	P27	
1-128	4	P27	
1-129	5	P28	Pushbutton layout - Manual Scram & Man. isolation
1-130	6	P28	
1-131	7	P28	
1-132	8	P28	
1-133	9	P29	Equipment not installed
1-134	10	P29	
1-135	11	P30	Scale markings on log scales of Rad Mon Recorders
1-136	12	P30	
1-137	13	P30	
1-138	14	P30	
2-1	35	P31	Unlabeled Turbine Trip and Reset pushbuttons
2-2	36	P31	
2-3	37	P31	
2-4	1	P32	Pushbutton color coding

Perry Unit 1
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	<u>No.</u>	<u>ID #</u>	<u>Photo Description</u>
2-5	15	P33	Reactor mode switch not installed
2-6	16	P34	Inconsistent scale multipliers on flow meters
2-7	17	P34	Terminet printer
2-8	18	P35	Sequence of Events printer and printout
2-9	19	P35	
2-10	20	P35	
2-11	1	S1	Mimic color code
2-12	2	S2	Label problem on mimic
2-13	3	S3	Unlabeled white lights
2-14	4	S4	Lights not labeled
2-15	5	S5	Unlabeled meters
2-16	6	S6	Missing labels
2-17	7	S7	Inconsistent labeling
2-18	8	S8	Inconsistent labeling
2-19	9	S9	Heirarchical labeling problem
2-20	10	S10	Obscured labels in sitting position
2-21	11	S11	Obscured labels in standing position
2-22	12	S12	Demarcation problem
2-23	13	S13	Demarcation problem
2-24	14	S14	Demarcation
2-25	15	S15	Isolation valve control panel
2-26	16	S16	Lack of labels on meter groups, no demarcation
2-27	17	S17	Demarcation feasible
2-28	18	S18	Mimics
2-29	19	S19	Mimics
2-30	20	S20	Mimics
2-31	21	S21	Incorrect mimic
2-32	22	S22	Unclear mimics
2-33	23	S23	Poor contrast on mimic
2-34	24	S24	Inconsistent use of color
2-35	25	S25	Start point on mimic not easily indentified
2-36	26	S26	Inconsistent use of color in mimic
2-37	27	S27	Unclear symbols in mimic
2-38	28	S28	Incorrect labels
2-39	29	S29	Missing arrows on mimic
2-40	30	S30	Reversed labels
2-41	31	S31	Reversed labels
2-42	32	S32	Confusing labels
2-43	33	S33	Wrong nameplate label
2-44	34	S34	Temporary mimic using tape
2-45	35	S35	People
2-46	36	S36	General CR shot

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	<u>No.</u>	<u>ID #</u>	<u>Photo Description</u>
2-47	1	S37	Density problem with small instruments
2-48	2	S38	Density problem with small instruments
2-49	3	S39	Density problem with small instruments
2-50	4	S40	Density problem with small instruments
2-51	5	S41	Hi instrument density
2-52	6	S41	
2-53	7	S42	Hi instrument density
2-54	8	S42	
2-55	9	S43	C/D integration problem
2-56	10	S44	C/D integration problem
2-57	11	S45	C/D integration problem
2-58	20	S46	No descriptive labels
2-59	21		
2-60	22	S47	Mosaic P601-16
2-61	23		Mosaic P601-21
2-62	24		Mosaic P601-20
2-63	25		Mosaic P601-17
2-64	26		Mosaic P601-18
2-65	27		Mosaic P601-19
2-66	28		Mosaic P601-22
2-67	31	S48	Panel layout problem
2-68	32	R1	Panel layout problem
2-69	1	R2	Left end of P601