A SUPPLEMENTAL REPORT
TO THE
DETAILED CONTROL ROOM DESIGN REVIEW
FINAL SUMMARY REPORT

FOR

WATERFORD SES UNIT NO. 3

Submitted by:

Louisiana Power and Light

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1.0 INTRODUCTION

A Supplemental Safety Evaluation Report (SSER) for Waterford-3, dated 30 October 1985, requested that Lousiana Power and Light (LP&L) submit a supplemental Detailed Control Room Design Review (DCRDR) Summary Report to the Nuclear Regulatory Commission (NRC) by 1 April 1986. The contents of the SSER were based on the reviews of the Program Plan and Summary Report, the Pre-Implementation Audit during 3-6 June 1985, and the review of the additional DCRDR information forwarded to the NRC in a letter dated 17 July 1985. As outlined in the SSER, three issues remain to be resolved:

(a) Control Room Inventory. Three potential human engineering concerns were identified during the Pre-Implementation Audit that appeared to the NRC team to have not been identified during the comparison of operator needs to the control room inventory. This was not the case. The validity of these potential HEDs will be discussed individually in this report.

(b) Conduct of the Task Analysis. The question that was raised by the audit team's isolation of these three potential concerns was: "Are they (the three potential concerns) symptomatic of a deficiency with the process used for the identification of required display and control characteristics and/or comparison to the control room inventory?" This question and its related concerns are discussed in the text of this report, as well as the integrity of the task analytic process is defended.

(c) Selection of Design Improvements. The following areas of design improvements, modifications and implementation schedules were outlined as needing further clarification: (1) complete the process for selecting design improvements and proposing modifications; (2) provide an evaluation of the present labeling scheme; (3) justify the delay for completing the color shading enhancements until the second refueling outage; and (4) determine whether the annunciator system has reflash capability. The necessary information pertaining to these four areas is presented in this report.

2.0 CONTROL ROOM INVENTORY

During the Detailed Control Room Design Review, a control room inventory was prepared that contained a complete list of controls and displays, their characteristics, and panel locations. This information was stored in the computer through data coding and depicted on control panel drawings. The purpose of the inventory was to determine the suitability and/or availability of information within the present control room by determining operator display and control requirements through the performance of a task analysis.

Human Factors Specialists (HFSs) and Subject Matter Experts (SMEs) used these panel drawings to determine operator requirements. The SME walked through the various steps within each task. He then specified the location of each meter or display or the need for an additional meter or display that would be used in the performance of each step within a task. A set of structured questions, which had two goals, was then presented to the SME. These goals were: (1) to have the SME defend the existing information in the control room, as a part of each safety-related task scenario; and (2) to redesign the present control panels, if necessary, either by changing the present boards or by adding new components.

During the Pre-Implementation Audit, the NRC team walked through this process using the emergency operating procedures to address a Station Blackout scenario. The following

potential HEDs (that appeared to have not been isolated during the comparison of operator needs to the control room inventory) were identified by the audit team:

(a) An indicator giving only valve position demand indication was identified for use in verifying secondary steam dump valve position.

(b) Indication of emergency power sequencer relay status was identified as the means of verifying start of emergency loads instead of a direct indication of the load status (e.g., breaker position, motor current, or related process variable reading).

(c) A meter with a 0-100% scale that is readable to no more than $\pm$ 0.5% discrimination was referenced to determine Condensate Storage Pond level within $\pm$ 0.1% accuracy.

The first potential HED refers to the Atmospheric Steam Dump Controller on Control Panel 8, line 5, component 9 and 33 (CP08-05-09/33). The problem outlined is generic to most vendor boards of controllers in that the valve position demand indication is not an index of valve position. During the task analysis, this potential problem was isolated under the task "Provide makeup to SGs using Condensate Pump" (Condenser task #14) and task element "Open the Atmospheric Dump Valve for SG 1 & 2" (task element #9). The following statement was written in the Notes column of the Task Description Form: "It should be made clear in training that the demand meter is only a signal output and not a valve position." However, this item was not considered a potential HED during further analysis with other SMEs for the following reasons:

(a) This concept is adequately covered in the existing training program.

(b) There are limit switches on the individual steam bypass valves that provide indication of valve position in the control room.

(c) Actual valve position is immaterial, but Steam Generator pressure and Reactor Coolant System temperature and their overall effects upon maintaining plant cooldown are important. In the task analysis, "Scan SG pressure", "Monitor RCS hot and cold leg temperatures . . .", and "Read RCS Tave temperature" are utilized as task elements immediately following the task element that contains the Atmospheric Steam Dump controller. In other words, the combination of decreasing Steam Generator pressure, valve demand indication and valve travel limit indication are reasonable approximations of valve position. Increased accuracy is not necessary to plant safety.

The second potential HED refers to the Emergency Power Sequence on Control Panel 1, line 3, items 1 to 12 and 19 to 29. The purpose of the sequencer is to assist the operator in determining that the emergency loads have timed out. The sequencer is not used to verify the emergency load status. This task is performed by control operators using a checklist and visually verifying equipment status. In other words, the sequencer gives the control room operator a quick check that the timing relays are operating, and that there is a high probability of their having started. The actual determination of emergency load status is performed using visual on-site checks. Therefore, since the sequencer was performing its job the way it was intended and required, no HEDs were written concerning the sequences during the comparison of operator needs to the control room inventory.

The third potential HED concerns the Condensate Storage Pool Level meter on Control Panel 8, line 1, items 1 and 53. The meter is read in percent level with a range of 0-100%, numbered

intervals of 10%, and divisions of 2% (four divisions between numbered intervals). The potential HED states that the meter is readable to no more than ± 0.5%, but that the referenced accuracy is written ± 0.1%. Control room operations and safety-related emergencies do not require accuracy of 0.1% from this meter. The present meter's scaling of range, intervals and divisions is sufficient for its designed purpose of reading approximate values of condensate level. Therefore, this item is not considered to be an HED. However, this narrative does not explain why the audit team believed this amount of accuracy was required during the performance of the Station Blackout scenario.

In the Emergency Operating Procedure (OP-902-005) for Degraded Electrical Distribution Recovery Procedure Revision 0 on page 39 of 58, statement number 19 states "When Condensate Storage Pool level ≤ 97.7%, verify Condensate Storage Pool manual makeup". This emergency procedure was analyzed during the task analysis (task statement Condenser 5) and compared to the inventory in order to determine operator needs and requirements. This meter was considered sufficient for its purpose. However, the procedural statement indicates that 97.7% is needed to perform the next step in the scenario. Throughout the Emergency Operating Procedures (EOPs), there are many more statements outlining accuracies greater than required for operator performance. These highly accurate numbers were placed in the EOPs for purposes of reference setpoints, and not for control room operator readability and human performance requirements.

3.0 TASK ANALYSIS

The audit team stated that "Because required control and display characteristics were not documented a priori, the audit team cannot verify whether these are potential discrepancies that were not identified by the LP&L task analysis and control room comparison, or whether the analysis of operator needs indicated that the controls and displays provided were sufficient for the operator's needs." The three potential concerns that were identified by the NRC audit team were forwarded to LP&L for review and "to determine whether they are indeed concerns and whether they are symptomatic of a generic deficiency with the process . . ."

The three potential concerns were reviewed in the preceding section, Control Room Inventory. The conclusions drawn from this effort were that the three items were considered not to be legitimate concerns. The validity of the task analytic process and the comparison with the control room inventory and the determination of required display and control characteristics should not be questioned further.

4.0 DESIGN IMPROVEMENTS

4.1 Background

The selection of design improvements had not been completed prior to the Pre-Implementation Audit. In the SSER, the audit team outlined 23 HEDs that have to be discussed in this supplemental report in order to "complete the process for selection of design improvements and provide proposed modifications for those HEDs for which a correction has not yet been selected." These HEDs, which are contained in Appendix A, can be categorized as follows:

(a) Lighting analysis - HEDs 138, 139, 140, 141, 283, 284 and 399
(b) Computer review - HEDs 335, 365, 377, 383, 386, 390 398 and 402
(c) Annunciator evaluation - HED 107
(d) Investigation into noise reduction - HED 277
(e) Engineering analysis of instrumentation - HEDs 182, 227, 228 and 270
(f) Review of radio communication - HEDs 185 and 281

In addition, this section of the report evaluates the present labeling system with recommended improvements, outlines a surface enhancements program, and explains the reflash capability of annunciators.

4.2 Lighting Analysis (Appendix A-1)

The lighting analysis has been completed and recommended solutions have been determined. These recommendations should reduce glare and shadowing, increase readability of instruments and the illumination levels on the control panels, and implement a more uniform lighting scheme throughout the control room. One of these recommendations is to replace the existing diffusers with low brightness parabolic louvers. The proposed solutions will first be utilized and evaluated within the simulator room at the training center. Using the simulator area as a test bed, the final recommendations will be determined and implemented in the control room no later than the second refueling outage. Through the implementation of these control room modifications, the difficulties identified during the Control Room Design Review will be successfully addressed.

4.3 Computer Analysis (Appendix A-2)

The corrective actions on the computer have been initiated. Three separate activities are involved in these corrective actions. One of these activities involves the computer alarms (HED 335) which are being modified to optimize the system. There are approximately 13,000 parameter points in the system with several thousand presently having been studied and several hundred changes having been initiated. The process considers the alarm limits of those parameters and if they are critical to operations. When it is decided by the Plant Operations Department that a point's parameters have to be rectified, a Condition Identification Work Authorization (CIWA) is originated and given to Plant Engineering for review and concurrence. If all parties agree, the CIWA is sent to the Reactor Engineering and Performance Department for incorporation into the Plant Monitoring Computer and completion of the CIWA.

The second activity involves computer input point ranges. Several thousand of the 13,000 total input points have been studied and several hundred changes have been initiated. The process considers the range limits of those parameters which appear to have calibration problems or sensory errors. When it is decided by the Plant Instrumentation Maintenance Department that a point's parameters have to be rectified, a condition Identification Work Authorization (CIWA) is originated and given to Plant Engineering for review and concurrence. If all parties agree, the CIWA is sent to the Reactor Engineering and Performance Department for incorporation of the CIWA. Both of these activities are ongoing processes of detection, analysis, review and change.

The third modification process is the evaluation of the various computer screens (HEDs 365, 377, 383, 386, 390, 398, 402) containing data, labels, mimics and color coding. Guidelines for screen design have been developed, reviewed and are presently being implemented to standardize and create well human factored screens. For example, data lists are now vertically aligned and left justified, mimics are being evaluated with 15 mimics having been sent to Reactor Engineering for review prior to implementation, and standarized color coding is being initiated. A portion of these guidelines is contained in Appendix B.

4.4 Annunciator Evaluation of the Dark Board Concept (Appendix A-3)

A third continuing evaluation is that of conforming the annunciators (HED 107) to a dark board concept. The criterion being used to identify problem or nuisance windows is whether they are illuminated one-half the time. Each annunciator is investigated as to its validity or reason for being illuminated. Some of the remedies being used are to change setpoints, to fix malfunctioning equipment or wiring, to

initiate station modifications, and to keep specified tiles actuated. Presently, 76 annunciators are outstanding with an average of 5-10 problem tiles being cleared every week. However, additional nuisance tiles are still being found and investigated.

4.5 Noise Reduction (Appendix A-4)

Various methods of noise reduction (HED 277) which could lower the background noise levels between the control desk and the back panels are presently being investigated. A significant portion of this noise is attributed to the highspeed CPC ventilation fans on CP21 and CP22. This fan noise interrupts verbal communication between the front and the back panels, but will not pose any problems to health or cause any potential hearing loss. In addition, the working environment in the front panel area is relatively quiet. A station modification request has been initiated to add sound deadening material around CP-21 and CP-22 to lower the fan noise. Other Combustion Engineering plants also are being contacted to determine the arrangement of their CPC ventilation fans.

4.6 Engineering Analyses of Instrumentation (Appendix A-5)

The following four engineering analyses have been initiated: (1) determine radiation instrumentation needs during a Steam Generator Tube Rupture (SGTR), (2) modify the setpoint meters on the Pressurizer Pressure controller and on the Steam Bypass Master controller, and (3) evaluate the optimum method of presenting low flow information on the Feedwater Flow Rate meter. The progress and initial results of each of these analyses will be described in the following paragraphs.

4.6.1 Radiation Instrumentation Needs During an SGTR Event (HED 182)

Several elements of this activity have already begun. These include discussions with plant operations and reviews of installed plant equipment. The determination of radiation detection needs also includes reviews of emergency operating procedures, analyses of regulatory and design documents, FSAR reviews and industry experience. This analysis of installed radiation detection instrumentation is specific to those devices that would perform the required detection actions during an SGTR event. The variables considered in this analysis are the location, range, sensitivity and flexibility of the devices. At present, a station modification request is being prepared to enhance the existing main steam line radiation monitors. This enhancement is based on the expected radioactive material routing (especially noble gas releases) following an SGTR event, the presently installed equipment arrangement and the probable detection response time. Implementation will occur by the first refueling outage.

4.6.2 Setpoint Meter on the Pressurizer Pressure Controller (HED 227)

The setpoint meter on this controller (PIC100) will be modified to have the same scale as the process meter. The range of the setpoint meter will be 1500-2500 psia.

4.6.3 Setpoint Meter on the Steam Bypass Master Controller (HED 228)

The setpoint meter on this controller (PIC1010) will be modified to have the same scale as the process meter. The range of the setpoint meter will be 850-1050 psia.

4.6.4 Presentation of Low Flow Information on the Feedwater Flow Rate Meter (HED 270)

As a result of the recent operator interviews, it was determined that the presently installed Feedwater Flow Rate indication is adequate. Therefore, this meter will not be modified. The ability of the operator to read .378 x 10^6 lbs/hr is not critical to safety operations. This value is approximately 10% feedwater flow rate to each steam generator. This is the flow rate the Start-up Feedwater Valves will deliver automatically following a trip. Flow indication is available from the following sources: Main Feedwater Flow, Emergency Feedwater Flow (from Emergency Feedwater System) and Auxiliary Feedwater Flow (from Start-Up Feedwater Control valve). The Auxiliary Feedwater Flow indication has acceptable readability for the range outlined in the OP-902-006 Emergency Operating Procedures. Following a trip, normal feedwater would pass through the Start-Up Feedwater valves, and the critical trend parameter of Steam Generator Level would be available to the operators.

4.7 Radio Communication Analysis (Appendix A-6)

The Motorola Communications personnel have recently conducted a test of the two-way radio systems for Operations, Maintenance and Security frequencies. The purpose of the test procedure was to determine if any equipment problems exist with LP&L's transmitter and combiner network that could cause the interference problems that presently exist (HEDs 185 and 281). The following procedural tasks were performed during the test:

(a) Check power output of all three repeaters to insure that they are within specifications, and adjust as needed.

(b) Check transmitter frequency of all three repeaters to confirm that they are on frequency and within specifications, and adjust as needed.

(c) Check bandwidth of transmit frequency of all three repeaters to insure that they are within specifications, and adjust as needed.

(d) Check modulation and repeat levels of all three repeaters to insure that they are within specifications, and adjust as needed.

(e) Check all line levels to and from all remote consoles to confirm that they are within specifications, and adjust as needed.

(f) Check receiver frequency of all three repeaters to confirm that they are on frequency and are within specifications, and adjust as needed.

(g) Check bandwidth of receiver frequency of all three repeaters to confirm that they are within specifications, and adjust as needed.

(h) Check transmit combiners with spectrum analyzer for spurs, and adjust as needed.

(i) Check receiver combiner for selectivity according to specifications, and adjust as needed.

(j) Check overall system with spectrum analyzer for spurs or intermod.

(k) Check all interconnecting cables and connectors for proper shielding and terminations.

The results of the above analysis disclosed no major equipment problems. It was determined that the actual system output is approximately 1 watt.

A follow-up to this test was an application to the Federal Communications Commission (FCC) to change radio frequencies at Waterford-3 at a power level of 75 watts. This application received an unfavorable review by the Utilities Communications Commission. Based on the overall results of the system analysis, Waterford-3 is in the process of submitting a new application to the FCC for frequency changes at the power level of 1 watt. This application is expected to be approved. The submittal is expected prior to May 1, 1986.

4.8 Labeling Study and Evaluation (Appendix C)

Waterford-3 has initiated a study to examine control room labeling and to recommend the changes necessary to correct the cited HEDs. It has been determined that the Kroy lettering applied directly to the control panels may not be permanent enough and is difficult to maintain. All control room labels are being reviewed by Human Factors Specialists and Subject Matter Experts from operations, to ensure proper nomenclature, placement and unambiguous identification of every instrument. The hierarchical labeling currently employed in the control room is satisfactory. However, the Kroy labeling will be replaced by permanent lamacoid labels. The design of permanent labels for the control panels has been initiated.

4.9 Surface Enhancement Program (Appendix C)

Several systems on the Waterford-3 control panels will be background shaded to enhance system demarcation. Control panels cited on the 38 HEDs contained in Appendix C will be closely examined. Several different enhancement techniques will be integrated with the labeling program implemented or improved in a systematic fashion. Lines of demarcation will be used to separate groups of systems. System components also will be highlighted through the implementation of background shading. Mimics will be used to model the relationship of the components where necessary. Existing tape demarcation lines will be replaced by permanent plastic demarcation lines. The selection of the areas to be shaded and the colors to be used will be determined by Human Factors Specialists working with Subject Matter Experts from operations and engineering. A mock-up of the control panels will be used to show the selected background shading scheme. The proposed enhancements will be presented to operations personnel for review. Modifications will be made based upon operations input. As suggested by the NRC team during the Pre-Implementation Audit, the control panel

background shading will be applied to the simulator prior to being installed in the control room. This will be accomplished to ensure proper placement and operator acceptance. Data collection for construction of the mock-up and enhancements is currently underway. The analysis and evaluation will not be completed in the time prior to the completion of the first refueling outage because the simulator's construction will not be complete. Therefore, to perform the desired steps prior to implementation in the control room, these modifications are scheduled for completion by the end of the second refueling outage.

4.10 Reflash Capability of Annunciators

The visible and auditory operation of the annunciator system is as follows:

(a) Annunciator tile is dark when no alarm is present.

(b) When an alarm setpoint is violated, the annunciator fast flashes. The audible alarm sounds for three seconds and silences automatically.

(c) When the annunciator is acknowledged, the tile becomes a steady light.

(d) When the alarm setpoint clears, the tile slow flashes. When the CLEAR button is pressed, the tile becomes dark.

(e) For multiple-input alarms when the tile is in a solidly lighted state, and a subsequent alarm setpoint is violated, the tile remains solidly lighted.

(f) When the tile is in slow flash and the alarm setpoint is again violated, the tile returns to fast flash with an audible alarm.

The policy of LP&L (refer to POM Operating Procedures, Section 10, Annunciator Response Procedures) is to dispatch an operator to the local panel for evaluation and corrective action at the first indication of an alarm to a multiple-input window. In general, the multiple-input windows require local action to address the malfunction. If the item is directly pertinent to control room activities, and individual alarm is used.

It should be stressed that these procedures and the annunciator evaluation of Section 4.4 are part of an ongoing effort at LP&L. The purposes of this effort are to eliminate continuous alarm windows, and to provide reasonable assurances that all alarms are identified and responded to by the operators.

APPENDIX A

HUMAN ENGINEERING DEFICIENCIES RELATED TO PROPOSED MODIFICATION STUDIES

APPENDIX A-1

LIGHTING ANALYSIS

CORRECTIVE ACTIONS

HED NO.: 0138

GUIDE NO.: 1.5.3.E.2

CATEGORY: X

FINDING:

Labels, instructions, and other written information are shadowed.

RESPONSE:

Lighting experts will further review the lighting situation. A thorough investigation and implementation of recommendations will be complete by the second refueling outage.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/114

CORRECTIVE ACTIONS

HED NO.: 0139

GUIDE NO.: 1.5.3.D, F, G, 1.5.7.A.2

CATEGORY: X

FINDING:

There is excessive glare in the control room which interferes with the readability of displays, labels, and indicators.

RESPONSE:

Lighting experts will further review the lighting situation. A thorough investigation and implementation of recommendations will be complete by the second refueling outage.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/113

CORRECTIVE ACTIONS

HED NO.: 0140

GUIDE NO.: 1.5.3.B

CATEGORY: X

FINDING:

The lighting levels at given work stations vary greatly between the vertical and horizontal slants of the benchboards.

RESPONSE:

Lighting experts will further review the lighting situation. A thorough investigation and implementation of recommendations will be complete by the second refueling outage.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/112

CORRECTIVE ACTIONS

HED NO.: 0141

GUIDE NO.: 1.5.3.A

CATEGORY: X

FINDING:

The illumination levels in the control room do not meet the recommended values of NUREG-0700. At the panels, the lighting levels range from 5-27 footcandles. NUREG-0700 recommends levels between 20-50 footcandles. This lighting level, in conjunction with glare, causes shadowing and operator difficulties in reading meters.

RESPONSE:

Lighting experts will further review the lighting situation. A thorough investigation and implementation of recommendations will be complete by the second refueling outage.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/111

CORRECTIVE ACTIONS

HED NO.: 0283

GUIDE NO.: Op Survey A7.01

CATEGORY: X

FINDING:

In areas of the panel with bright overhead lighting the glare on meters and CRTs is extreme, especially on the top vertical sections. Glare is intense unless you are standing directly in front of the indication. Computer CRTs are prone to glare.

RESPONSE:

Lighting experts will further review the lighting situation. A thorough investigation/recommendations will be complete by the second refueling outage.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/10

CORRECTIVE ACTIONS

HED NO.: 0284

GUIDE NO.: Op Survey A7.02

CATEGORY: X

FINDING:

Lighting over the panels needs to be more diffused and maintained at a low level. Some glare on main control panel indicators during normal and emergency lighting is caused by the refusal to use soft flourescent lights. Lighting is adequate to see all boards and indicators, but the light is not diffused or soft enough to prevent glare on computer CRTs and board indicators.

RESPONSE:

Lighting experts will further review the lighting situation. A thorough investigation/recommendations will be complete by the second refueling outage.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/11

CORRECTIVE ACTIONS

HED NO.: 0399

GUIDE NO.: 7.2.1.B

CATEGORY: X

FINDING:

The HERCO displays are situated at such an angle that they reflect light from the overhead lamps causing glare, and making them difficult to read.

RESPONSE:

Lighting experts will further review the lighting situation. A thorough investigation/recommendations will be completed by the second fuel outage.

IMPLEMENTATION:

By the completion of the second refueling outage.

4336/1/65

APPENDIX A-2

COMPUTER ANALYSIS

CORRECTIVE ACTIONS

HED NO.: 0335

GUIDE NO.: Oper. Survey E5.03

CATEGORY: X

FINDING:

There are numerous computer alarms not critical to operations (doors, etc.). In many cases, these alarms will backlog the printer.

RESPONSE:

An engineering study will be performed to evaluate the optimum method to speed up and/or prioritize the alarms to eliminate the backlog.

IMPLEMENTATION:

By the completion of the second refueling outage.

4336/1/40

CORRECTIVE ACTIONS

HED NO.: 0365

GUIDE NO.: 7.2.4.G.1

CATEGORY: X

FINDING:

Some lists are not vertically aligned and left justified.

RESPONSE:

The finding is valid. Due to the complexity of the PMC and the need to integrate various computer changes, a review will be conducted to identify and implement the means of correction.

IMPLEMENTATION:

By the completion of the second refueling outage.

4331/1/90

CORRECTIVE ACTIONS

HED NO.: 0377

GUIDE NO.: 7.2.4.A.1

CATEGORY: X

FINDING:

Data are not presented in a readily usable format on the PMC. Mimic designations are inconsistent and unrecognizable. Mimic names are used, which are not descriptive of the mimics. Number codes are also used which are not descriptive of t. mimics.

RESPONSE:

The finding is valid. Due to the complexity of the PMC and the need to integrate various computer changes, a review will be conducted to identify and implement the means of correction.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/43

CORRECTIVE ACTIONS

HED NO.: 0383

GUIDE NO.: 7.2.5.B

CATEGORY: X

FINDING:

There is an inconsistency of location for physical data groups on the PMC. Legends to explain the symbols used for components on mimics are rarely used. When they are used, they are placed haphazardly wherever space is available.

RESPONSE:

The finding is valid. Due to the complexity of the PMC and the need to integrate various computer changes, a review will be conducted to identify and implement the means of correction.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/54

CORRECTIVE ACTIONS

HED NO.: 0386

GUIDE NO.: 7.2.4.D

CATEGORY: X

FINDING:

Some labels on mimics for the PMC are vertically oriented making them difficult to read. Mimic CCW01.4 illustrates this problem.

RESPONSE:

The finding is valid. Due to the complexity of the PMC and the need to integrate various computer changes, a review will be conducted to identify and implement the means of correction.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/52

CORRECTIVE ACTIONS

HED NO.: 0390

GUIDE NO.: 7.2.7.H

CATEGORY: X

FINDING:

Graphic codes on the PMC do not have the same meaning in all applications. There is inconsistency in the use of symbols (e.g., different valve symbols which have the same meaning).

RESPONSE:

The finding is valid. Due to the complexity of the PMC and the need to integrate various computer changes, a review will be conducted to identify and implement the means of correction.

IMPLEMENTATION:

By the completion of the second refueling outage.

4336/1/62

CORRECTIVE ACTIONS

HED NO.: 0398

GUIDE NO.: 7.2.7.M.1

CATEGORY: X

FINDING:

Red and green colors are sometimes used on CRT displays as background colors or to represent unchanging information. This diminishes the attention getting value of these colors when they are used to code important values.

RESPONSE:

The finding is valid. Due to the complexity of the PMC and the need to integrate various computer changes, a review will be conducted to identify and implement the means of correction.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/118

CORRECTIVE ACTIONS

HED NO.: 0402

GUIDE NO.: 7.2.7.K.1, 7.2.7.K.2

CATEGORY: X

FINDING:

Colors used on PMC displays are not always consistent with the use of color elsewhere in the control room. For example, red, green, amber are used to code status of a component, but do not always convey the same meaning with regard to that component (e.g., breaker closed or open). On many mimic displays, pumps, breakers, and dampers are represented in an unchanging color, regardless of their status.

RESPONSE:

The finding is valid. Due to the complexity of the PMC and the need to integrate various computer changes, a review will be conducted to identify and implement the means of correction.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/117

APPENDIX A-3

ANNUNCIATOR EVALUATION OF THE DARK BOARD CONCEPT

CORRECTIVE ACTIONS

HED NO.: 0107

GUIDE NO.: 3.3.2.C

CATEGORY: X

FINDING:

Under normal operating conditions, no annunciators should be illuminated. A "dark" panel concept is not used on the Waterford-3 control room. Specifically, three high-radiation alarms (CP33) are lit due to the lack of flow to the monitor (as opposed to actual high activity).

RESPONSE:

After operational experience has been obtained, an evaluation of all annunciators to conform to dark board concept will be performed. The circuitry and annunciator engraving for the rad monitoring on CP33 will be investigated for the most appropriate modification.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/17

APPENDIX A-4

NOISE REDUCTION

CORRECTIVE ACTIONS

HED NO.: 0277

GUIDE NO.: Op Survey A5.01, C1.01

CATEGORY: X

FINDING:

Communication between the control desk and the protection panel area in the back is impossible due to unnecessarily high background noise levels from CPC ventilation fans on CP21 and CP22. This fan noise bleeds over into front panel area and creates background noise. The RPS noise is a consistent high problem concerning normal verbal control room communication.

RESPONSE:

Various methods of noise reduction will be investigated. Sound surveys, however, in the control room, are acceptable and operators do not have problems communicating with each in the control room.

IMPLEMENTATION:

By the completion of the first refueling outage.

4332/1/7

APPENDIX A-5

ENGINEERING ANALYSES OF INSTRUMENTATION

CORRECTIVE ACTIONS

HED NO.: 0182

GUIDE NO.: Validation

CATEGORY: X

FINDING:

Presently the system is not sensitive enough in measuring tube leaks and isolation steam tube rupture isolations. There should be an improvement oi the steam line radiation monitor for detection of low level radioactivity during tube rupture.

RESPONSE:

An engineering analysis will be performed to determine radiation instrumentation needs during a SGTR. The needs will be compared with current instrumentation to determine deficiencies.

IMPLEMENTATION:

By the completion of the first refueling outage.

43361/1/2

CORRECTIVE ACTIONS

HED NO.: 0227

GUIDE NO.: T.A. HT5

CATEGORY: X

FINDING:

The setpoint meter on the pressurizer pressure controller should be modified so that it is identical to the process meter on the same controller.

RESPONSE:

This will be investigated and modified if product availability allows. If no other meter scale can be added it will be reevaluated.

IMPLEMENTATION:

By the completion of the second refueling outage.

4336/1/16

CORRECTIVE ACTIONS

HED NO.: 0228

GUIDE NO.: T.A. DI7

CATEGORY: X

FINDING:

The setpoint meter on the steam bypass master controller (CP1) should be identical to the process meter on the same controller.

RESPONSE:

This will be investigated and modified if product availability allows. If no other meter scale can be added it will be reevaluated.

IMPLEMENTATION:

By the completion of the first refueling outage.

4336/1/17

CORRECTIVE ACTIONS

HED NO.: 0270

GUIDE NO.: Op Survey A3.07

CATEGORY: 1

FINDING:

Response to the operator survey indicated that low range flow indication is needed to comply with the requirements of the emergency procedures to be able to read .378 x 10^6 lbs./hr. feedwater flow rate. Our present indication will not indicate this flow, which is in the emergency procedure, to that accuracy.

RESPONSE:

An engineering study will be performed to evaluate the most optimum method of providing this reading to the operators.

IMPLEMENTATION:

By the completion of the first refueling outage.

4332/1/2

APPENDIX A-6

RADIO COMMUNICATION ANALYSIS

CORRECTIVE ACTIONS

HED NO.: 0123

GUIDE NO.: 8.2.3.B/8.3.3

CATEGORY: X

FINDING:

CP33 is mirror imaged for some instruments.

RESPONSE:

Background shading will be added to CP33 to clearly define similar components and functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4331/1/41

CORRECTIVE ACTIONS

HED NO.: 0142

GUIDE NO.: 9.2.1.A, 9.2.2.A.1

CATEGORY: X

FINDING:

Reactor drain tank displays (CP4) are not located directly above the related controls.

RESPONSE:

Background shading will be added to CP4 to clarify the functional relationships.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/32

CORRECTIVE ACTIONS

HED NO.: 0143

GUIDE NO.: 9.2.1.A, 9.2.2.A.1

CATEGORY: X

FINDING:

The RCP bleed off header meter (CP4) is not located directly above the related controls.

RESPONSE:

Background shading will be added to CP4 to clarify the functional relationships.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/33

CORRECTIVE ACTIONS

HED NO.: 0144

GUIDE NO.: 9.2.1.A, 9.2.2.A.1

CATEGORY: X

FINDING:

The quench tank valve displays (CP2) are not located directly above the related controls.

RESPONSE:

Background shading will be added to CP2 to emphasize functional relationships.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/34

CORRECTIVE ACTIONS

HED NO.: 0145

GUIDE NO.: 9.2.1.A, 9.2.2.A.1

CATEGORY: X

FINDING:

The make-up mode switch (CP4) is not located directly next to its related components (boric acid pumps).

RESPONSE:

Background shading will be added to CP4 to clarify the functional relationships.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/35

CORRECTIVE ACTIONS

HED NO.: 0146

GUIDE NO.: 6.3.7.A, 9.2.1.A

CATEGORY: X

FINDING:

The "Oil sump drain valve" control on CP1 should not be functionally grouped with the turbine-generator instrumentation.

RESPONSE:

Background shading will be added to CP1 to help perceptually group and differentiate instruments.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/36

CORRECTIVE ACTIONS

HED NO.: 0148

GUIDE NO.: 9.2.2.A.1

CATEGORY: X

FINDING:

The turbine-generator temperature displays (CP1) are not located directly above their related controls.

RESPONSE:

Background shading will be used to emphasize the functional groupings on CP1.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/38

CORRECTIVE ACTIONS

HED NO.: 0149

GUIDE NO.: 9.2.2.A.1

CATEGORY: X

FINDING:

The main feedwater regulating isolation and startup feedwater regulating isolation displays are not located directly above their related controls.

RESPONSE:

Background shading will be used to emphasize the functional groupings on CP1.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/39

CORRECTIVE ACTIONS

HED NO.: 0150

GUIDE NO.: 9.2.2.A.1

CATEGORY: X

FINDING:

Displays (CP1) are not directly above related controls.

RESPONSE:

Background shading will be used to emphasize the functional groupings on CP1.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/40

CORRECTIVE ACTIONS

HED NO.: 0151

GUIDE NO.: 9.2.2.A.1

CATEGORY: X

FINDING:

The auxiliary feedwater displays (CP1) are not located directly above related controls.

RESPONSE:

Background shading will be used to emphasize the functional groupings on CP1.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/41

CORRECTIVE ACTIONS

HED NO.: 0152

GUIDE NO.: 9.2.1.A, Op Survey B3.3

CATEGORY: X

FINDING:

The blowdown system is divided into two groups on Panel CP1.

RESPONSE:

Background shading will be used to emphasize the functional groupings on CP1.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/12

CORRECTIVE ACTIONS

HED NO.: 0153

GUIDE NO.: 9.2.1.A

CATEGORY: X

FINDING:

The circ. water vacuum breakers (CP1) are not grouped with the rest of the circ. water system (5 controls, 16 legend lights).

RESPONSE:

Background shading will be used to emphasize the functional groupings on CP1.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/42

CORRECTIVE ACTIONS

HED NO.: 0156

GUIDE NO.: 8.3.2.C.1

CATEGORY: X

FINDING:

The six steam bypass condenser components on CP1 are labeled in an unbroken row. According to NUREG-0700, no more than five similar components should be laid out in an unbroken row or column.

RESPONSE:

Background shading will be added on CP1 to clearly define similar components and functional groupings. In addition, hierarchical labeling and demarcation is present to perceptually break-up the six components.

IMPLEMENTATION:

By the completion of the second refueling outage.

4331/1/42

CORRECTIVE ACTIONS

HED NO.: 0162

GUIDE NO.: 8.3.2.C.1

CATEGORY: X

FINDING:

Ten meters (Train B) are laid out on CPB in an unbroken row. According to NUREG-0700, no more than five similar components should be laid out in an unbroken row or columns.

RESPONSE:

Hierarchical labeling and demarcation provide a perceptual "break" in this row of meters. In addition, background shading will be added to CPB to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/45

CORRECTIVE ACTIONS

HED NO.: 0163

GUIDE NO.: 8.3.2.C.1

CATEGORY: X

FINDING:

There are nine meters associated with the turbine system on CP1 laid out in an unbroken row. According to NUREG-0700, no more than five similar components should be laid out in an unbroken row or column.

RESPONSE:

Hierarchical labeling and demarcation provide a perceptual "break" in this row of meters. In addition, background shading will be added to CP1 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/46

CORRECTIVE ACTIONS

HED NO.: 0164

GUIDE NO.: 8.3.2.C.1

CATEGORY: X

FINDING:

There are six meters (Chiller B) on CP18 laid out in an unbroken row. According to NUREG-0700, no more than five similar components should be laid out in an unbroken row or column.

RESPONSE:

Hierarchical labeling and demarcation provide a perceptual "break" in this row of meters. In addition, background shading will be added to CP18 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/47

CORRECTIVE ACTIONS

HED NO.: 0165

GUIDE NO.: 8.3.2.C.1

CATEGORY: X

FINDING:

There are six meters (Chiller AB) on CP18 laid out in an unbroken row. According to NUREG-0700, no more than five similar components should be laid out in an unbroken row or column.

RESPONSE:

Hierarchical labeling and demarcation provide a perceptual "break" in this row of meters. In addition, background shading will be added to CP18 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/48

CORRECTIVE ACTIONS

HED NO.: 0166

GUIDE NO.: 8.3.2.C.1

CATEGORY: X

FINDING:

Ten meters (Train A) on CP8 are laid out in an unbroken row. According to NUREG-0700, no more than five similar components should be laid out in an unbroken row or column.

RESPONSE:

Hierarchical labeling and demarcation provide a perceptual "break" in this row of meters. In addition, background shading will be added to CP8 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/49

CORRECTIVE ACTIONS

HED NO.: 0167

GUIDE NO.: 8.3.2.C.1

CATEGORY: X

FINDING:

There are six meters (Chiller A components) on CP18 which are laid out in an unbroken row. According to NUREG-0700, no more than five similar components should be laid out in an unbroken row or column.

RESPONSE:

Hierarchical labeling and demarcation provide a perceptual "break" in this row of meters. In addition, background shading will be added to CP18 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/50

CORRECTIVE ACTIONS

HED NO.: 0169

GUIDE NO.: 6.1.1.1., 6.2.1.B, 6.3.7
8.1.1.B, 8.2.1.C

CATEGORY: X

FINDING:

The shutdown heat exchanger B Shutdown Inlet Pressure meter (CP8) is located under the hierarchical label "Component Cooling Water". It actually belongs under the grouping of meters labeled "Shutdown Cooling".

RESPONSE:

CP8 will be thoroughly reviewed for functional groupings. Background shading will be added as needed to clarify functional groupings. In addition, the hierarchical labels will be modified on these instruments.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/52

CORRECTIVE ACTIONS

HED NO.: 0170

GUIDE NO.: 9.2.2.A

CATEGORY: X

FINDING:

The five "Train B CVAS Isol Valve" legend lights on CP18 are not located directly above the related control.

RESPONSE:

Background shading will be added to CP18 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/53

CORRECTIVE ACTIONS

HED NO.: 0171

GUIDE NO.: 9.2.2.A

CATEGORY: X

FINDING:

The five "Train A CVAS Isol Valve" legend lights on CP18 are not located directly above the related control.

RESPONSE:

Background shading will be added to CP18 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/54

CORRECTIVE ACTIONS

HED NO.: 0172

GUIDE NO.: 8.2.2.A

CATEGORY: X

FINDING:

The safety injection tank components on CP8 are laid out in a sequence other than alphabetic and numeric.

RESPONSE:

These components are laid out the way they are due to separation criteria. Background shading will be added to CP8 to further define functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4331/1/38

CORRECTIVE ACTIONS

HED NO.: 0173

GUIDE NO.: 8.2.2.A

CATEGORY: X

FINDING:

The systems associated with the A and C trains are located on one side of the panel, while the systems associated with B and D trains are located on the other side (CP18).

RESPONSE:

These components are laid out the way they are due to separation criteria. Background shading will be added to CP18 to further define functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4331/1/39

CORRECTIVE ACTIONS

HED NO.: 0178

GUIDE NO.: 8.1.1.B, 9.2.1.A

CATEGORY: X

FINDING:

The pressurizer level meter is not related to the other components on CP8.

RESPONSE:

The meter will be additionally labeled with a hierarchical label. Also, background shading will be added to CP8 to clearly define functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4331/1/37

CORRECTIVE ACTIONS

HED NO.: 0179

GUIDE NO.: 8.2.2.A, 9.2.1.B, T.A. SG3

CATEGORY: X

FINDING:

The components associated with the SMA, SMB, SMC and SMD systems are not arranged in the logical left-to-right and/or top-to-bottom sequence, and are not identified in alphabetic sequence.

RESPONSE:

These components are laid out the way they are due to separation criteria. Background shading will be added to CP8 to further define functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/92

CORRECTIVE ACTIONS

HED NO.: 0230

GUIDE NO.: T.A. TB8

CATEGORY: X

FINDING:

The "Turb-Gen Temp Control Valves" section of CP1 is confusing in its present layout.

RESPONSE:

Background shading will be added to CP1 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/99

CORRECTIVE ACTIONS

HED NO.: 0232

GUIDE NO.: T.A. PWR14

CATEGORY: X

FINDING:

The containment spray A Pressure/Flow meter (CP8) should be separated from the cluster of meters as to be similar to containment spray B Pressure/Flow. The present arrangement could cause confusion.

RESPONSE:

Background shading will be added to CP8 to help emphasize functional groupings and clarify the relationship between Train A instruments and Train B instruments.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/24

CORRECTIVE ACTIONS

HED NO.: 0251

GUIDE NO.: 1.2.2.F

CATEGORY: X

FINDING:

The lateral spread of controls and displays on LCP43 is 96 inches. The maximum lateral spread recommended by NUREG-0700 is 72 inches at a given work station.

RESPONSE:

Demarcation and hierarchical labeling is currently presently on all control boards. This provides functional groupings and perceptually breaks up the large panels into instrument groupings that are less than 72 inches. Background shading will also be added to the boards to help better define groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4336/1/25

CORRECTIVE ACTIONS

HED NO.: 0288

GUIDE NO.: Op Survey B3.01

CATEGORY: X

FINDING:

Response to the operator survey stated that Panel CP8 is not laid out well. The controls are laid out as a safety train instead of a total grouping of function. While controls are grouped in some ways, the groups are split up in safety trains, e.g. the sampling isolations on CP8 are not functionally grouped.

RESPONSE:

Background shading will be added to CP8 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/13

CORRECTIVE ACTIONS

HED NO.: 0289

GUIDE NO.: Op Survey B3.02

CATEGORY: X

FINDING:

Condensate and feedwater controls (particularly EFW, Safety Injection indicators) and positions of CP18 (control switches grouped and indicators grouped, but groups widely separated) are not properly functionally grouped. EFW low controls are confusing.

RESPONSE:

Background shading will be added to CP18 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/14

CORRECTIVE ACTIONS

HED NO.: 0291

GUIDE NO.: Op Survey B3.05

CATEGORY: X

FINDING:

The main steam reheater drains are poorly grouped on CP13.

RESPONSE:

Background shading will be added to CP13 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/15

CORRECTIVE ACTIONS

HED NO.: 0293

GUIDE NO.: Op Survey B4.05

CATEGORY: X

FINDING:

Response to the operator survey indicated that on CP18 there is reverse mirror image from A to B side while all other boards have mirror image from B to A side.

RESPONSE:

Background shading will be added to CP18 to emphasize functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/17

CORRECTIVE ACTIONS

HED NO.: 0294

GUIDE NO.: Op Survey B4.06

CATEGORY: X

FINDING:

On CP1 the condensor off gas switch (atmosphere or filter) is on one side of panel while condensor vacuum pumps and instrumentation are on the opposite side.

RESPONSE:

Background shading will be added to CP1 to improve functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/18

CORRECTIVE ACTIONS

HED NO.: 0297

GUIDE NO.: B5.03

CATEGORY: X

FINDING:

Placement of a CCW pump in respect to a CCW makeup pump is poor and controls are identical so occasionally the CCW pump control switch is operated instead of the CCW makeup pump.

RESPONSE:

Background shading will be added to CP8 to improve functional groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4331/1/1

CORRECTIVE ACTIONS

HED NO.: 0298

GUIDE NO.: B 5.4

CATEGORY: X

FINDING:

The B CC Pump and B CC Makeup pump are identical and occasionally the CCW pump control switch is operated instead of the CCW makeup pump.

RESPONSE:

Background shading will be added to help differentiate between the controls.

IMPLEMENTATION:

By the completion of the second refueling outage.

4338/1/58

CORRECTIVE ACTIONS

HED NO.: 0404

GUIDE NO.: 9.1.1.1

CATEGORY: X

FINDING:

LCP43 is partially mirror imaged.

RESPONSE:

Background shading will be added to LCP43 to enhance functional groupings. This panel has already been modified to minimize mirror imaging within instrument groupings.

IMPLEMENTATION:

By the completion of the second refueling outage.

4336/1/68

CORRECTIVE ACTIONS

HED NO.: 0405

GUIDE NO.: 1.2.2.F

CATEGORY: 3

FINDING:

The lateral spread of controls and displays on LCP43 is 96 inches. The maximum lateral spread recommended by NUREG-0700 is 72 inches at a given workstation.

RESPONSE:

Background shading will be added to this panel to emphasize functional groupings and perceptually break the panel into smaller sections.

IMPLEMENTATION:

By completion of the second refueling outage.

4338/1/63

CORRECTIVE ACTIONS

HED NO.: 0185
GUIDE NO.: Oper. Survey A5.3, D3.1
2.1.4.B.1, T.A. SI.2

CATEGORY: X

FINDING:

The radio system does not provide adequate communication for the control room operators. The signals from maintenance and security radios bleed into the operations radio.

RESPONSE:

The radio system will be thoroughly reviewed and a recommendation will be available.

IMPLEMENTATION:

By the completion of the first refueling outage.

43361/1/3

CORRECTIVE ACTIONS

HED NO.: 0281

GUIDE NO.: Op Survey A5.06

CATEGORY: X

FINDING:

There is need for a better communication system, such as sound powered phones or another phone system with plug-ins, at all major components and throughout the plant. There is also incompatability between three wire female sockets and two wire male plugs which result in unreliable connections in remote locations.

RESPONSE:

A solution for Radio System problems will be implemented to provide adequate communications. Much of this hinges on FCC approval of a new radio frequency.

IMPLEMENTATION:

By the completion of the second refueling outage.

4332/1/8

APPENDIX B

PORTION OF THE WATERFORD-3
COMPUTER GUIDELINES FOR SCREEN DESIGN

4.3 MIMIC DESIGN

4.3.1 It is highly recommended that the layout of a mimic be prepared on a CRT Display Chart prior to its entry through the AYDIN. This chart is shown in Attachment 8.1.

4.3.2 A mimic is defined on a CRT containing 48 line (Y) and 72 column (X) positions as shown in Attachment 8.3. Each X, Y coordinate pair represents a cursor (or character) position on the CRT. Notice in the CHARACTER DISPLAY (Attachment 8.3) that a large character on the screen occupies two consecutive vertical cursor positions, the first of which must be an even line (Y) position (i.e., in the example large "A" is printed in the X, Y coordinates at 0,0 and 0,1). A regular character occupies one cursor position (i.e., in the example "A" is printed in 0,2).

NOTE: Since CRT uses the top line (i.e., Y=0) of the CRT for command prompts, any "large" letters statically displayed on a mimic must be in the range $2 \leq Y \leq 46$ in increments of 2.

4.3.3 The following colors are available:

Cyan (light blue)
Red
Green
Yellow (amber)
White
Dark Blue
Orange
Magenta

4.3.4 The guidelines for color usage are as follows:

Cyan - flow paths and arrows, mimic names, time and date, analog values not in alarm, informational text

Red - open or not fully closed valve, activated component, closed circuit breaker

NOTE
Not fully closed is the opposite state of a limit switch which detects only the fully closed position of a valve.

Green - closed or not fully open valve, deactivated component, open circuit breaker

NOTE
Not fully open is the opposite state of a limit switch which detects only the fully open position of a valve.

Yellow - analog values or digital status points in alarm

White - major component outline

Dark Blue - building or physical barrier outline

Orange - not used

Magenta - not used

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4.3.5 Valves which are monitored by only one limit switch for the fully open position will have the following color conventions.

permanently RED RED if fully open
GREEN if not fully open

4.3.6 Valves which are monitored by only one limit switch for the fully closed position will have the following color conventions.

permanently GREEN  GREEN if fully closed
RED if not fully closed

4.3.7 Valves which are monitored by two liimt switches, one for the fully open position and one for thefully closed position, will have the following color conventions.

GREEN if fully closed
RED if not fully closed RED if fully open
GREEN if not fully open

NOTE
Valve symbols in which one half of the valve is green and the other half is red are not fully open or fully closed.

4.3.8 The majority of the mimic should be cyan with white being the component outline. This enhances the contrast for the informational colors of red and green and reserves the color yellow for alarm conditions.

4.3.9 Orange is not used since it appears red on most CRTs. Magenta is not used due to its high contrast and its radiological hazard connotation.

W370013B

4.3.10 The high/low intensity or colors may be used to enhance the mimic. This may be necessary for hte white component outlines.

4.3.11 The blinking on/off and reverse/normal background features are not used to insure consistency with other PMC CRT systems.

4.3.12 Mimic Names

4.3.12.1 Mimic names may be a maximum of eight alphanumeric characters.

4.3.12.2 The first portion of the mimic name should be the system abbreviation. This is available from Ref. #3.

4.3.12.3 Successive mimics of a system shall be sequentially numbered (i.e., FW, FW1, FW2, FW3,...).

4.3.12.4 Mimic names are in cyan and are located in the upper left hand corner of the screen of the X=0, Y=0 coordinates.

4.3.12.5 Associated pages to the displayed mimic are located to the immediate right of the currently displayed mimic title.

4.3.13 General Display Guidelines

4.3.13.1 Flow arrow should be used to indicate flows to and from major components and into and out of the mimic.

4.3.13.2 Time and date is located in the upper left hand corner starting at the X=0, Y=1 coordinates.

4.6.13.3 Minimize usage of non-monitored valve symbols.

4.3.13.4 The horizontal format for analog points is preferred over the vertical format.

4.3.13.5 Field variables associated with a component should be located to the right or directly below the component outline.

4.3.13.6 A mimic should use no more than a total of 40% of the total screen area. This includes component outlines, updatable fields, and flow paths.

4.3.13.7 Flow paths into and out of mimic should be labeled with the mimic name which displays the continued flow path or a meaningful component name if an additional mimic is not available.

4.3.13.8 Adequate space should be maintained between background component outlines on mimics to allow discrimination and areas for placement of dynamic field inputs.

4.3.13.9 Use of descriptive names for obvious components outline should be avoided, i.e., steam generator, reactor vessel, pump couplings, turbine, etc.

4.3.13.10 A summary of points displayed on each mimic should be created using attachment 8.6. Each mimic is to have a separate summary sheet.

4.3.14 The rules of drawing a mimic on a graph chart and subsequently on the AYDIN are contained in Attachment 8.2.

4.3.15 A sample of the characters which may be included on a mimic are in Attachment 8.4.

APPENDIX C

HUMAN ENGINEERING DEFICIENCIES RELATED TO SURFACE ENHANCEMENT