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September 24, 1984

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

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Subject: McGuire Nuclear Station
Docket Nos. 50-369 and 50-370

Dear Mr. Denton:

By letter dated August 15, 1984, the NRC provided the results of a review of the Detailed Control Room Design Review Evaluation of McGuire Nuclear Station. The NRC has requested that Duke respond to several items identified during the review. The Duke response for McGuire is contained in the attachments to this letter.

Very truly yours,

H.B. Tucker /RO

Hal B. Tucker

RLG/mjf

Attachments

cc: Mr. James P. O'Reilly
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U. S. Nuclear Regulatory Commission
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Mr. W. T. Orders
NRC Resident Inspector
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Mr. Ralph Birkel
Division of Project Management
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Washington, D. C. 20555

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Attachment 1

DUKE POWER COMPANY

McGuire Nuclear Station

Response to NRC Request for Information
Control Room Design Review Evaluation
Human Engineering Deficiencies

Provide additional information and/or justification for those Human Engineering Deficiencies (HED's) identified in the TER.

Specifically, of the 165HEDs identified by Duke Power to be resolved by surface enhancements or physical change, 37 HEDs were found to be too brief, general, ambiguous or only partially allowed a valid assessment.

In addition, of the 15 HEDs that Duke Power proposed to leave uncorrected, the staff believes that 10 of those HEDs should and can be corrected. The TER (Appendix A) identifies the specific HEDs that require additional information or justification (pages 20-26).

RESPONSE:

TER, page 22, Section 1 (a)

M-1-0066
M-1-0068

Device IF4a and IF4c are meters which display 1A CA Pump Suction Flow and 1B CA Pump Suction Flow respectively. The word Suction (abbreviated Suct). was not included on the device nameplate. The flow could have been mistaken for discharge flow. The nameplates were corrected by adding Suction to the description.

M-1-0070

The scale for this meter was graduated in increments of 15 making it inconvenient to read. The scale was corrected by graduating in increments of 10.

M-1-0106

Valve 1NV-241 is used to control seal injection flow by increasing or decreasing back pressure in the line to the regenerative heat exchanger. The nameplate was changed to SEAL INJ FLOW CONTROL from REGEN HX TUBE SIDE INLT CNTRL to reflect the operational usage.

M-1-0127

Due to a change in design, this switch now controls a pressurizer heater group through a contactor rather than the original supply breaker. The supply breaker is controlled by another switch. The nameplate was changed from 1A PZR HTR GRP SUP BKR to 1A PZR HTR GROUP to reflect this change.

M-1-0198

This meter displays the level of the Standby Nuclear Service Water Pond. The scale was changed to have major intervals of one half foot and minor intervals of one inch over the scale range of 739 feet to 741 feet to provide a more convenient scale to read.

M-1-0258

The recommended solution for this HED corrected the color of indicator lamp lenses and or control switch push-button colors for several devices which did not meet the established Duke color code. The proper color of lens or push-button was specifed for each of these devices in the recommended solution.

M-1-0288

This HED covered several groups of meters where the lettering size, or graduation interval differed between the scales of meters within a group displaying the same parameter. These differences were corrected by providing identical scales for each meter within a related group.

M-1-0322

This HED covered several nameplates and/or switch escutcheon plates with errors in spelling, confusing wording, or incomplete descriptions.

Examples:

1. STEAM CHEAST PRESSURE should be STEAM CHEST PRESSURE

2. CF PUMP TURBINE should be CF PUMP TURBINE SPEED

3. BLOCKING (or switch button) should be BLOCK

M-1-0359

The HED covered several rotary switches where the escutcheon engravings were not in the most convenient or logical arrangement for ease of readibility. To prevent confusion and aid readability, new escutcheon plates were engraved.

M-1-0374

Several Republic V5 meters were provided with small meter-mounted nameplates which were difficult to read. A standard control board-mounted nameplate was already provided for these meters, so the redundant, hard to read, meter-mounted nameplates were removed.

TER, page 22, Section 1 (b)

M-1-0172

This recorder is located on a vertical panel directly behind the benchboard-mounted controls for this system. The nameplate in question is for a switch, mounted on the benchboard, which controls the input signals monitored by the recorder. The existing label was changed from REC LOOP SELECT to OVERPWR OVERTEMP D/T REC LOOP SELECT to distinguish which recorder was controlled by the selector switch.

M-1-0281

Several meters identified in the HED can have parallex problems if read from extreme angles of vision, however, the operator is not required in operating tasks to read any of these meters from an angle that would cause parallex. The rod position display panel (a bar graph type of display) can be difficult to read when the bars are at full scale. The difficulty is in associating the individual bars with the bar designations which are at the bottom of the display. The recommended solution corrected this difficulty by labeling the bars at the top of the display, as well as the bottom.

M-1-0333

The HED concerns several controllers with rotary set point knobs. Directional arrows were added to these knobs to indicate the valve open or increase parameter direction, as applicable. In addition open/close or increase/decrease labels were added to the position indicators on these controllers.

M-1-0361

Several switches and/or indicating lamps were identified in the HED which (1) had buttons or lamp lenses where the engraving had worn in use to a poorly readable state, (2) had dymo tape rather than permanent escutcheons, or (3) had lenses or buttons that were not engraved. The corrective action replaced worn items or provided new items as applicable.

M-1-0671

The HED concerns a switch which disables the recording function of the undervoltage recorder. This recorder is located on the Generator Relaying Board adjacent to the Control Board and is used to record transient conditions for historical analysis. The switch is located properly with the recorder, is used infrequently (such as during startup), and is never used under time-constraints. This location was not considered a deficiency; however, the nameplate for the switch could be improved so a new nameplate was recommended.

M-1-0683

The HED concerns the lack of a narrow range steam generator level meter at the Aux. Shutdown Panel. Wide range meters are available at this panel and a narrow range meter is not needed for operating tasks; however, to provide a reference for the operator, the portion of the wide range scale corresponding to the Control Room narrow-range instrumentation was indicated with an additional scale placed beside the existing meters. This recommended solution provided a reference to the scale range used by the operator during normal power operation.

M-1-0095

This HED was not recommended for correction. The justification appears in Appendix C, page C-2 of the Supplement to Final Report.

TER, page 23, Section 2 (a)

M-1-0108

This HED concerned the layout of components for the ND (Residual Heat Removal) System. The position of components, primarily valves, was not arranged conveniently for operating task sequences and, in addition, the layout between trains was somewhat different. The recommended solution rearranged 13 components, moved 8 components from the adjacent panel area, and moved 4 components to another panel area to provide a logical arrangement of necessary controls for operation of the ND system.

M-1-0128

Power to the Accumulator Discharge Isolation Valves is required to be removed during power operation. Power to these valves is now restored from local circuit breakers. The recommended solution adds switches in the control room to remove or restore power for operation of these valves.

M-1-0188

Existing circular meters on the HVAC control board have partial arc scales with small lettering size, making the scales difficult to read. The recommended solution replaces these meters with vertical edgewise VX252 meters. This type of meter is used extensively on the main control boards and presents an easily readible display,familiar to operators and compatible with other instrumentation.

M-1-C268C

The SPILLOVER BYPASS valve control switch was located beside the HIGH PRESSURE STEAM SEAL SHUTOFF control. Likewise, the HIGH PRESSURE STEAM SEAL BYPASS control was located next to the SPILLOVER SHUTOFF control. These controls were rearranged in the recommended solution to group the SPILLOVER control together and the HIGH PRESSURE STEAM SEAL controls together.

M-1-0679

The D/G PANEL TROUBLE alarm alerts the operator when there is an alarm at either Diesel Generator's local alarm panel. An auxiliary operator is then dispatched to the local control panel. There is no indication of which Diesel Generator is in alarm. The recommended solution adds a selected group of alarms from each local alarm panel to the computer alarm video in the Control Room. Thus, the operator would not only know which Diesel Generator was in alarm but also what the trouble was before dispatching the auxiliary operator.

M-1-0681

The transfer switches for transferring control of valves from the Control Room to the Auxiliary Shutdown Panel have either three positions (REMOTE - STATUS - LOCAL) or two positions (REMOTE - LOCAL). Valve transfer switches have three positions so that the current valve position (STATUS) may be determined and the corresponding valve control switch placed in the proper position before transfer of control to avoid system upsets. The HED concerned the difference in transfer procedure for pumps and equipment whose status does not change during control transfer, and valves whose position would change if current status was not determined and control switches placed in the proper positions before transfer. This difference in procedure is unavoidable due to system design; however, it was noted that the current switch position order and engravings did not conform to Duke conventions. Switches and engravings were changed in the recommended solution to LOCAL - C/R (2 position) and LOCAL - STATUS - C/R (3 position).

M-2-0325

During the Unit 1/Unit 2 Difference evaluation, several switch escutcheon plates were identified where the engravings (wording, letter size, font, etc.) differed between Unit 1 and Unit 2. The recommended solution replaced the escutcheon on Unit 2 which differed from Unit 1, with ones identical to Unit 1 escutcheons.

M-1-0139
M-1-0141
M-1-0513
M-1-0514
M-1-0516
M-1-0517
M-1-0520
M-1-0587
M-1-0691
M-2-0319

These HEDs originated in the Task Analysis, Operating Experience Review, or the Unit 1/Unit 2 Difference evaluation and concerned problems with the physical arrangement of switches, meters, and components in several areas of the main control board, HVAC Control Board, or Auxiliary Shutdown Panel. The recommended solution in each case rearranged the components or a portion of the components in each identified area to provide a more logical and consistent arrangement for the operator; and to eliminate problems where (1) related components were not grouped together, (2) minor differences in arrangement existed between safety trains or between Unit 1 and Unit 2, and/or (3) functional grouping, flow path, sequence arrangement and/or mimic representation was needed but not used.

As an example, HED M-1-0139 involves the RN (Nuclear Service Water) system. During the preliminary Control Room Review, an alpha-numeric matrix with identifying markers along the left and lower edge of this area was installed to aid the operator in searching for a particular valve. The matrix coordinates of each valve were also added to the procedure for operation (line up) of this system. The Task Analysis, however, demonstrated that for operations of this system other than line-up, a flow path arrangement with mimic would be more useful.

To provide such an arrangement the following changes are required:

1. Remove 8 switches from the RN panel and relocate on Containment Vent and Cooling panel.

2. Relocate low level intake control to RN panel.

3. Add 2 new controllers (design change to be incorporated with this arrangement).

4. Rearrange 61 our of 64 remaining switches into a flow path arrangement.

5. Remove existing matrix identification markers.

6. Add mimic to panel.

7. Rework train separation barriers to support new arrangement.

Each of the above HEDs involved a considerable amount of physical rearrangement similar to this example to group related components, eliminate minor differences between areas of similar function, and/or aid the operator in component and system function identification.

TER, page 23, Section 2 (b)

M-1-0610C

The computer program for calculating T-Average was changed to show asterisks rather than a value in the value column of the CRT display whenever T-Average is below 530°F. The problem identified by the HED is that the computer calculated range for this variable has a lower limit of 530°F. This value is displayed even when T-Average is below this value, giving a misrepresentative reading. The asterisks indicate to the Operator that the variable is out of range and alert him to use other instrumentation.

M-1-0652

A wide range level indicator is needed to monitor increasing level when filling the cold leg accumulators. This instrumentation is not needed in the Control Room, but should be located outside the containment for ALARA considerations. Present instrumentation is provided for monitoring operating range (upper 10%) level only and is only provided in the Control Room. The current instrumentation is adequate for normal operating needs, but not for filling (start-up) operations. The recommended solution adds wide range level instrumentation as needed in the plant outside of the containment.

M-1-0152

NUREG-0700, Guideline 6.4.4.3(a) states "If key-operated controls cannot be justified in terms of security, they are probably not necessary and should not be used". This HED concerns switches "under direct control of the control room operator". Since these switches are under operator control and access to the control boards is restricted there is no need for key-operated switches in this area.

TER, pages 24-26, Section 3

M-1-0028

Several components, principally 2 small annunciator panels and 2 groups of 3 meters each are arranged in two separate groupings on a panel. Train B components are on the left and Train A components are on the right. The B-A arrangement is not inconformance with the population stereotype A-B. Assessment of this problem determined that the operator is not concerned with which train he is reading, since they are redundant, but with consistency (or confirmation) between the channels. However, each instrument is labeled as to its train and each label is color-coded by train (red background - train A, yellow background - train B) in case train identification is needed, such as during testing activities. The Operator cannot mistake Train A instruments for Train B instruments with the existing labelling and color-coding.

M-1-0038

Physical panel space dictates that each Steam Generator control area has room for 12 meters which are arranged in 4 groups of 3 meters each. Redundant channels measuring Steam Generator parameters are grouped together to allow the operator to easily compare all readings for a single parameter. However, Narrow Range Level has 4 rather than 3 channels of instrumentation. Three NR Level channels are grouped together with the forth channel grouped with SM (Main Steam) Flow which has only two instrument channels. The forth NR Level meter is immediately above and approximately 4 inches to the right of the other NR Level meters. There is no physical space to add this meter next the the other NR Level meters except by rearranging existing meters to provide an open space in the adjacent 3-meter group. This rearrangement would separate the CF (Feedwater) Flow and SM Flow meters in the two 3-meter groups above. Since the comparison and balance of Feedwater and Steam Flow is the primary task in operating the Steam Generator, this change would be unacceptable. In addition three NR Level meters are grouped together for easy comparison and the forth, if needed, is very near. These meters are also well labelled and are color-coded as level instruments (the only such instruments in this panel area) for easy identification.

M-1-0118

The controls for this sytem are located on a benchboard in front of vertical panel 1MC9 The HED concerns a meter which is slightly askew to the right from being directly in front of the operator standing at the benchboard controls. The recommended solution was to move this meter approximately 2 feet to the left side of 1MC9, however, this small movement does not materially improve its location which, afterall, is within a reasonable viewing distance. Since the meter is on a separate panel, mimic and/or demarcation lines are not feasible and would not indicate association. In addition, the meter is well labelled and identification and/or association is not a problem.

M-1-0152

This HED was identified in the Operating Experience Review. Operators were concerned about the inconvenience and time delays in using key-lock switches which are under their direct control and need no security provisions. NUREG-0700 states in 6.4.4.3 that "If key-operated controls cannot be justified in terms of security, they are probably not necessary and should not be used".

Justification 2 concerns a switch which controls the Pressurizer Power Operated Relief Valve mode of operation. While this switch needs no protection from use by unauthorized personnel, the key-operated switch does provide a measure of protection from inadvertant operation during plant power operation, and efficiently identifies and distinguishes this switch from the remaining rotary switches on this panel. The change of this switch to a non-key rotary switch and the addition of other coding and protection means is not justified, especially since this switch is not used in a time-critical manner.

M-1-0159

The recorders for hot leg and cold leg temperatures are adjacent. The HED was concerned with placing hot leg and cold leg temperatures on the same recorder. Moving displays is not a valid option.

M-1-0268

The following problems, while minor deficiencies, present no significant impediment to operator performance:

(1) The solution exchanged the positions of the FIRST OUT ANNUNCIATOR RESET and the DC BACKUP VAPOR EXTRACTOR switches to position the DC BACK-UP VAPOR EXTRACTOR switch adjacent to the GENERATOR VAPOR EXTRACTOR switch. The DC BACK-UP VAPOR EXTRACTOR switch is a larger switch than others in this area and is easily identified by its distinctiveness. While it is functionally related to the GENERATOR VAPOR EXTRACTOR switch, it is not used directly with that switch in operation, nor is it in a poor location (2 other switches are between these two switches). Moving this switch would not significantly improve the operation of this switch or its identification.

(2) The position counter for Shutdown Bank E was added later and is not grouped with the counters for the other shutdown banks. However, it is grouped with the rod position bank counters (Shutdown and Control Banks). As stated in the justification, these counters are not used as a group, but individually as each bank is pulled to its raised position. After a shutdown bank is pulled its counter is reset to zero and is not used for further indication. There is no comparison task with the other counters. The counter is also well-labelled and easily identified. Rearrangement of all counters to group Shutdown Bank E with the other shutdown banks would provide no significant operating improvement.

(3) EMF (radiation monitoring) modules are numbered for installation and maintenance activities; however, the number is not of concern to the operator. The operator is concerned with the physical plant area that the radiation monitor covers. Rearrangement of modules in a numerical sequence would not significantly improve the identification or use of these modules.

M-1-0269B

The NC Pump monitor panel is a large equipment cabinet that cannot be located within the horseshoe area. Individual pump vibration readouts are located on this panel which indicate the severity of measured vibration on each pump. A pump vibration alarm and individual indicating lamps were added within the horseshoe area to alert the operator to high vibration and identify the pump in question during an earlier Duke Control Room Review. Normally an operator verifies the amount of vibration at the monitor panel prior to tripping a pump. The panel is in the Control Room approximately 20 feet from the control board area.

The HED concerned the arrangement of the 4 pump vibration readouts on the monitor panel. These readouts are arranged in 2 rows of 2 readouts each, 1B Pump-1C Pump (first row) and 1A Pump - 1D Pump (second row). While this arrangement is not optimum, there are only four readouts, each well identified, and used only for verification of a high reading on a particular pump in alarm.

M-1-0563

The HED concerned the lack of positive position feedback to indicate that the valve is truely open or closed. Existing open/close indicating lights give demand signal indication only. Flow indication is being added as the solution for another HED. Since flow indication is an even more positive indication of whether the spray line to the spray nozzles is open or not, the addition of flow indication sufficiently resolves this HED.

M-1-0654

The Rod Position Control System is non-safety. The installation of a new process cabinet to provide this indication is economically unfeasible.

M-1-0669

The four SM valves in this HED are not operating SM valves, but, rather, steam-line drain valves for this system, and are grouped and located with all other steam-line drain valves. The location of drain valves together is proper for the infrequent tasks involving these valves; however, the HED solution recommemded providing automatic Main Steam and containment isolation signals to close the four SM drain valves since they were not located with the other SM system valves. Further assessment of this HED and the recommended solution determined that the size of the drain lines did not require automatic isolation.

SER, page 6, Section 7

Though not included in the items requiring a response listed on page 1 of the SER transmittal letter to H. B. Tucker from T. M. Novak, dated August 15, 1984, Section 7 of the SER, Verification That Selected Design Improvements Will Provide the Necessary Corrections states the following:

Duke Power has provided no documentation to assure that all required HED corrective actions are verified and that functional performance of the control room is validated after the HED corrections have been made in the control room. The staff finds the licensee has not met this requirement.

Response:

HED solutions were developed by the Control Room Review Solution Teams, which were comprised of Instrumentation and Control Engineers, Mechanical/Nuclear Engineers, Senior Reactor Operators, and Human Factors Specialists. Proposed physical changes were portrayed on the full scale control board mockups used for the Review. Since the HED solutions were integrated on the mockups, the effect of each solution on the Operator, as well as its relationship to other solutions, could be observed. The mockups were reviewed to ensure that the proposed solutions did not produce additional new HEDs and did provide the improvement desired.

The recommended solutions were then assigned to the Control Complex Group of the Design Engineering Department for implementation. Two members of the Control Room Review Team's "core team" are now assigned to the Control Complex Group. In addition, the remaining personnel of the Control Complex Group served on the Control Room Survey Teams, and the Solution Teams during the Control Room Review. These personnel are familiar with both the Review and the proposed solutions, and are responsible for the implementation of detailed solutions through the Nuclear Station Modification (NSM) process. This process assures the installation of modifications in accordance with the NSM document package.

Attachment 2

DUKE POWER COMPANY

McGuire Nuclear Station

Response to NRC Request for Information
Control Room Design Review Evaluation
Implementation Schedule

Provide an HED solution implementation schedule acceptable to the staff for all identified HEDs requiring corrective action.

Identify which specific HED's are assigned to each of the four implementation categories that are linked to refueling outages.

Reduce the amount of time projected by Duke Power Company to complete the implementation of all HED solutions.

Response

An implementation schedule was developed after an extensive review of the HED solutions recommended for implementation. Following the requirements of Supplement 1 to NUREG-0737, this review carefully considered the significance of each HED including the contribution of the HED solution to the reduction of risk and enhancement in the safety of operation, the difficulty of installing the HED solutions, the need for rewriting operating procedures and retraining of operators, and the coordination of HED solution changes with changes resulting from other post TMI improvement programs such as the SPDS, operator training, new instrumentation from Reg. Guide 1.97, Rev. 2, and upgraded emergency procedures. Implementation of other regulatory requirements such as Reactor Vessel Level Instrumentation (RVLIS) and ATWS must also be considered.

The integration of the changes resulting from each of the NUREG-0737, Supplement 1 improvement efforts, as well as, the scheduling and coordination of individual HED solution changes is a complex and demanding scheduling effort which requires cognizance of the inter-relationships between each of the improvement areas, operator training requirements, resource requirements, and the plant status required for the implementation of each change.

The Duke Control Room Review Team, comprised of engineering personnel, Senior Reactor Operators from each of the three Duke nuclear stations and human factors specialists, carefully assessed the significance of each HED, developed HED solutions, and determined the implementation priority of recommended solutions. The schedule was developed following a policy of scheduling the completion of the more significant HEDs first, consistent with the practical constraints of installation such as design/installation time, material procurement, and the coordination with training and procedures.

Response (continued)

Since most HED solutions must be installed during an outage, and since a considerable amount of planning is necessary to complete the design/engineering and material procurement requirements to install the HED solution, as well as to complete the necessary Operator training and procedure changes, planned periodic refueling outages were chosen as implementation milestones. The Duke Control Room Review Team used these outages to establish a detailed schedule for both the installation of HED solutions and the necessary front end work to support the implementation of each solution.

It is important to note that Operators must be made aware of not only modifications to the Control Room, but all modifications to the plant as they affect operations. Of particular concern to Duke is to not overload the operator with too many plant changes during a single outage.

To ensure the (1) proper introduction of changes into the Control Room with adequate time provided for Operator training and procedure modifications, (2) reduction or elimination of impact on plant availability and power generation and (3) the responsible use of company resources, HED solutions were prioritized.

Attached Table 1 provides the current status of completed HED modifications and those planned for installation during the forthcoming refueling outages. This schedule is our goal and will be adjusted as appropriate as detailed planning is completed prior to each refueling outage. Duke Power would be able to update this status on an annual basis, following completion of the refueling outages and after installation plans for the next succeeding refueling outage of each Unit are established.

Duke is unable at this point to provide a firm commitment to complete a given HED modification for future outages beyond 1985. Too many variables are subject to change. We believe that the schedule as previously proposed and the status as provided in the attached Table provide reasonable assurance that the identified HED solutions will be implemented in as short a time frame as is reasonably practical.

TABLE 1

MCGUIRE NUCLEAR STATION

HED IMPLEMENTATION SCHEDULE

SEPTEMBER 6, 1984

Unit 1 HED solutions that were completed by the end of fuel cycle 1 (May 4, 1984):

M-1-0001	M-1-0176	M-1-0492
M-1-0016	M-1-0269A	M-1-0493
M-1-0075	M-1-0286	M-1-0494
M-1-0104	M-1-0356	M-1-0512
M-1-0107	M-1-0407	M-1-0564
M-1-0114	M-1-0415	M-1-0666
M-1-0129	M-1-0486	M-1-0672
M-1-0139		

Unit 1 HED solutions planned for completion by the end of fuel cycle 2, (expected May, 1985):

M-1-0020	M-1-0149	M-1-0361
M-1-0054	M-1-0172	M-1-0375
M-1-0066	M-1-0183	M-1-0488
M-1-0068	M-1-0184	M-1-0491
M-1-0077	M-1-0189	M-1-0513
M-1-0078	M-1-0192	M-1-0514
M-1-0096	M-1-0219	M-1-0516
M-1-0097	M-1-0258	M-1-0565
M-1-0102	M-1-0268C	M-1-0580
M-1-0103	M-1-0307	M-1-0610C
M-1-0105	M-1-0308	M-1-0616
M-1-0106	M-1-0309	M-1-0656
M-1-0108	M-1-0311	M-1-0671
M-1-0117	M-1-0322	M-1-0681
M-1-0121	M-1-0331	M-1-0683
M-1-0124	M-1-0333	M-1-0687
M-1-0127	M-1-0337	M-1-0691
M-1-0128	M-1-0343B	M-1-0695
M-1-0132	M-1-0343C	M-1-0700
M-1-0141	M-1-0344	M-1-0714
M-1-0142	M-1-0359	

Unit 2 HED solutions planned for completion by the end of fuel cycle 1, (expected April, 1985):

M-1-0001	M-1-0139	M-1-0494
M-1-0016	M-1-0141	M-1-0514
M-1-0020	M-1-0149	M-1-0565
M-1-0066	M-1-0172	M-1-0610C
M-1-0068	M-1-0176	M-1-0616
M-1-0075	M-1-0184	M-1-0666
M-1-0077	M-1-0189	M-1-0671
M-1-0078	M-1-0268C	M-1-0672
M-1-0096	M-1-0269A	M-1-0700
M-1-0097	M-1-0308	M-1-0714
M-1-0102	M-1-0311	M-2-0222
M-1-0103	M-1-0322	M-2-0308
M-1-0106	M-1-0356	M-2-0318
M-1-0114	M-1-0375	M-2-0319
M-1-0117	M-1-0407	M-2-0322
M-1-0127	M-1-0415	M-2-0323
M-1-0129	M-1-0486	M-2-0325
M-1-0132	M-1-0488	M-2-0336

NOTES:

1) The order of HED solutions listed for a particular Fuel Cycle does not imply priority for that Fuel Cycle.

2) The total number of HED solutions to be implemented is as follows:
Unit 1: 149
Unit 2: 158

3) The 22 HED solutions completed by the end of Unit 1 - Fuel cycle 1 satisfy the 15% commitment for that refueling outage.

4) 45 HED solutions out of the group planned for Unit 1 Fuel Cycle 2 will satisfy the 30% commitment for the 2nd refueling outage.

5) 47 HED solutions out of the group planned for Unit 2 Fuel Cycle 1 will satisfy the 30% commitment for the 1st refueling outage.