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DAEC Plant Support Center
Operated by Nuclear Management Company, LLC

April 9, 2001
NG-01-0459

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station 0-P1-17
Washington, DC 20555-0001

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Response to Request for Additional Information (RAI) to Request for Operating License Change (TSCR-040) – Revised Thermal-Hydraulic Analysis for the Spent Fuel Pool. (TAC # MB0596)

References:
1) NG-00-1904, "Request for Operating License Change (TSCR-040) – Revised Thermal-Hydraulic Analysis for the Spent Fuel Pool," November 17, 2000.
2) NG-00-1900, "Technical Specification Change Request (TSCR-042): 'Extended Power Uprate'," dated November 16, 2000.

File: A-117, SPF-189

Dear Sir(s):

On March 27, 2001, a conference call was held with the NRC Staff to review a draft of a Request For Additional Information (RAI) on our Reference 1 amendment request. The proposed RAI had been provided to us electronically on March 8, 2001. As a result of this conference call, no clarifications or modifications were made to the electronic version of the draft RAI. Consequently, Attachments to this letter contain that RAI and our Responses.

The Enclosures to this letter are provided "For Information Only" and have been denoted on the documents as such. This information is current as of this letter, and does not preclude any potential future changes pursuant to 10 CFR 50.59.

A timely review of this application is requested, as it is a supporting evaluation to our application for the Extended Power Uprate (Reference 2).

No new commitments are being made in this letter.

A001

3313 DAEC Road • Palo, Iowa 52324-9646
Telephone: 319.851.7611

Please contact this office should you require additional information regarding this matter.

Sincerely yours,

Kenneth S. Putnam
Manager, Nuclear Licensing

Attachments: 1) DAEC's Response to NRC Staff's Request for Additional Information Regarding the Thermal-Hydraulic Evaluation of the DAEC Spent Fuel Pool
2) Decay Heat Curves

Enclosures: 1) Drawings of DAEC Spent Fuel Pool (M453-006, BECH-C492[Annotated]), Drawings of DAEC Fuel Pool Cooling and Cleanup System (BECH-M134, BECH-M263, BECH-M270, and BECH-M271), ESW P&ID (BECH-M113)
2) DAEC Procedures: RFP-109 (Spent Fuel Pool and Cask Pool Gate Removal) and RFP-201 (Spent Fuel Pool and Cask Pool Gate Installation), OI-454 (Emergency Service Water)
3) System Description SD-435 (Fuel Pool and Fuel Pool Cooling and Cleanup System) and OI-435 (Fuel Pool Cooling System).
4) Excerpted pages from DAEC "Outage Management Guidelines" OMG-7, Abnormal Operating Procedure (AOP) #149, "Loss of Decay Heat Removal" and OI-149 (Residual Heat Removal System).

cc: T. Browning (w/o Enclosures)
M. Wadley (w/o Enclosures)
D. Hood (NRC-NRR) (w/all)
J. Dyer (Region III) (w/all)
D. McGhee (State of Iowa) (w/o Enclosures)
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Docu (w/o Enclosures)

DAEC's Response to
NRC Staff's Request for Additional Information
Regarding the Thermal-Hydraulic Evaluation of the DAEC Spent Fuel Pool

1. Please provide the following information regarding the layout of spent fuel pool (SFP). This information is needed to accurately understand the water flow paths between these structures.

   a. Provide a brief description of the layout of the reactor vessel cavity, spent fuel pool and cask pit (where 323 cells are planned to be placed) after the final campaign.

   DAEC Response:

   See enclosed drawing M453-006 (Enclosure 1) that shows the rack layout in the spent fuel pool and cask pool. See enclosed drawing BECH-C492 (Enclosure 1) which shows the layout of the refueling floor at DAEC which includes the spent fuel pool, reactor cavity, and cask pool.

   b. Locations of the transfer canal gate, and cask pit isolation gates. The open-close status of these gates during the core discharge operation, impact of failure of these gates, and operating procedures that control these gates.

   DAEC Response:

   See enclosed drawing BECH-C492 (Enclosure 1) which shows the layout of the refueling floor at DAEC which includes the spent fuel pool, reactor cavity, and cask pool.

   The SFP to reactor cavity gates are normally open during core discharge operations. The cask pit isolation gates are also normally open. Refueling procedures RFP-109 (Spent Fuel Pool and Cask Pool Gate Removal) and RFP-201 (Spent Fuel Pool and Cask Pool Gate Installation) are provided as a reference (Enclosure 2).

   The most severe impact of failure of the SFP gates would be during normal operation because of the limited means of makeup available to the SFP. The failure of the SFP gates would result in loss of level in SFP to reactor cavity and equipment pool. The resultant drop in SFP level will not be down to the bottom of the transfer slot since most of the volume of the reactor cavity is occupied with the drywell head. A failure of the SFP gates during the draindown evolution is mitigated by initiation of the Residual Heat Removal (RHR) and/or Core Spray systems (total nominal flow of 25,400 gpm) to restore level in the reactor cavity.

The failure of the cask pool gate with the cask pool initially empty would conservatively result in a loss of 4 feet of water in the SFP (36 ft to 32 ft) to equalize between the SFP and cask pool.

c. Intake and return points of the FPCCU and RHR flows (hot sides) during the core discharge operation.

DAEC Response:

The Fuel Pool Cooling and Cleanup (FPCCU) system takes a suction on the fuel pool from the skimmer surge tanks or from the scupper drains located in the perimeter of fuel pool, reactor cavity, and dryer/separator pit liner. The return of the FPCCU system can be directed back to the SFP via two return points located in the NW and NE corners of the SFP or to the reactor cavity via two diffusers located in the lower region of the reactor cavity.

Drawing BECH-M134 (Fuel Pool Cooling and Cleanup) is provided to show flow paths for the FPCCU system and the interties with the RHR system (Enclosure 1). Drawings BECH-M263, BECH-M270, and BECH-M271 are provided which show the piping arrangement of the FPCCU system (except for the demineralizer portion) (Enclosure 1). System Description SD-435 (Fuel Pool and Fuel Pool Cooling and Cleanup System) and Operating Instruction (OI) #435 (Fuel Pool Cooling System) are also provided for reference (Enclosure 3).

2. Please provide the heat removal rates, or alternatively the temperature effectiveness values, of the FPCCU and RHR heat exchangers as functions of the SFP water temperature. If the temperature effectiveness values are constants, please provide those values. (The Holtec report stated in Section 6.1, Page 13, that this information is available in Appendix B, which was not provided since it contains Holtec proprietary material.)

DAEC Response:

Both the RHR and FPCCU heat exchangers were modeled using constant temperature effectiveness values. The RHR heat exchanger temperature effectiveness used was 0.223 and the FPCCU heat exchanger temperature effectiveness used was 0.339, both extracted from the Proprietary Appendix B. These effectiveness values correspond to a hot water inlet temperature of 120 °F. As temperature effectiveness will rise with increasing hot water temperature, the use of this low temperature to calculate effectiveness is conservative.

3. The licensee stated in Section 1 that the plant has the ability to provide cooling to the SFP by diverting a portion of the flow discharged from RHR system heat exchangers to the SFP. The input data in Section 5.1 indicates that 2,000 GPM is directed to SFP out of 4,800 GPM of RHR flow in its calculations of the SFP bulk temperatures.

a. Is this flow rate fixed, while the decay heat in the reactor vessel cavity decreases and decay heat in the SFP increases during the core discharge operations?

DAEC Response:

The flow rate is fixed in the analysis at 2000 gpm. The suction of the RHR system is from the Shutdown Cooling (SDC) mode of operation. With the SFP gates removed, the flow of 2000 gpm from the RHR system to the SFP flows back to the reactor cavity through the open gates, then back to the suction of SDC, thus completing the cycle.

b. Are there any operating procedures or technical specifications to control this flow rate?

DAEC Response:

OI-149 (RHR system) directs that the flow be established back to the SFP by opening isolation valves. Flow is established to the SFP by using the injection valves to control the amount of back pressure in the RHR system. There is no direct indication for the flow to the SFP. The Operators adjust the valves, as needed to maintain the SFP temperature. OI-149 governs the flows that are required to maintain forced circulation in the reactor vessel and that Plant Management approvals are required to reduce flow below these minimum requirements. Outage Management Guideline – 7, "Outage Risk Management Guidelines" and Abnormal Operating Procedure (AOP) #149, "Loss of Decay Heat Removal," provide additional guidelines on the FPCCU and RHR systems during a refueling outage (see Enclosure 4 for copy of applicable pages).

4. With regard to the decay heat in the reactor cavity vessel, please provide the following additional information.
   a. The decay heat in the reactor vessel cavity as functions of time (similar to Figures 4-6) for all scenarios analyzed. This information is needed since the RHR removes the heat from both reactor vessel cavity and SFP.
   b. The decay heat in the reactor cavity vessel of the same cases for Revision 2 for comparison.

DAEC Response:

See Attachment 2, Figures 1 and 2 for reactor decay heat curves from Revision 4 and Figure 3 for the reactor decay heat curve from Revision 2.

5. The licensee provided equations governing the transient thermal response of the SFP, reactor vessel cavity and RHR in Section 2.1 (Maximum Spent Fuel Pool Temperature). The reviewer could not duplicate these equations. For example, when these equations are added (which represents the overall energy balance), it appears that the RHR heat removal is counted twice in the resultant equation (below); the

Q_{RHR} term and the last term in the equation both represent the RHR heat removal.

$$C_{RXW} \times dT_{RXW}/dt + C_{SFP} \times dT_{SFP}/dt = Q_{RXW}(t) + Q_{SFP}(t) - Q_{RHR}(T_{RXW}) - Q_{ENV}(T_{SFP}) - W \times C_p \times (T_{RXW} - T_{RHR})$$

a. Please indicate whether these equations are correct, or contain typographical errors.

DAEC Response:

The two differential equations presented in Section 2.1 of Revision 4 of HI-971746 are not the exact equations solved by the MULPOOLD computer code, but rather simplified energy equations for each water mass intended to simplify the discussion slightly. Adding the two equations together does not yield the correct overall energy balance equation. This attempt to "simplify" the discussion has unintentionally complicated it instead. The actual governing equations are slightly different than the "simplified" ones presented in HI-971746. These actual governing equations are:

$$C_{SFP} \frac{\partial T_{SFP}}{\partial \tau} = Q_{SFP}(\tau) - W \times Cp \times (T_{SFP} - T_{RHR}) - Q_{ENV}(T_{SFP})$$

$$C_{RXW} \frac{\partial T_{RXW}}{\partial \tau} = Q_{RXW}(\tau) + W \times Cp \times (T_{SFP} - T_{RXW}) - W_2 \times Cp \times (T_{RXW} - T_{RHR})$$

W_2 in the second of these two equations is the mass flow rate exiting the RHR heat exchangers that is directed back towards the reactor vessel, all other terms are as defined in Revision 4 of HI-971746. Adding these two equations together to obtain a total energy balance yields:

$$C_{SFP} \frac{\partial T_{SFP}}{\partial \tau} + C_{RXW} \frac{\partial T_{RXW}}{\partial \tau} = Q_{SFP}(\tau) + Q_{RXW}(\tau) - W \times Cp \times (T_{RXW} - T_{RHR}) - W_2 \times Cp \times (T_{RXW} - T_{RHR}) - Q_{ENV}(T_{SFP})$$

$$\therefore C_{SFP} \frac{\partial T_{SFP}}{\partial \tau} + C_{RXW} \frac{\partial T_{RXW}}{\partial \tau} = Q_{SFP}(\tau) + Q_{RXW}(\tau) - (W + W_2) \times Cp \times (T_{RXW} - T_{RHR}) - Q_{ENV}(T_{SFP})$$

This total energy balance correctly accounts for all energy sources and sinks and is the governing equation actually solved by the MULPOOLD computer code. The calculations and corresponding results in Revision 4 of HI-971746 are, therefore, correct.

b. If these equations are in error, please discuss the impact on the SFP temperature calculation; they appear to over-estimate the heat removal capability of RHR and, thus, under-estimate the SFP temperature.

DAEC Response:

See response to 5.a.

6. In Section 7.1, the maximum SFP bulk temp for Case 3 (C) is slightly lower than Case 2(B), although the decay heat for Case 3 (C) is slightly higher than Case 2 (B). This appears to be inconsistent. Please explain this seeming inconsistency.

DAEC Response:

The lower temperature of bulk fuel pool temperature in Case C (Emergency offload after 45 days of operation) is the result of placing the RHR heat exchanger in service earlier. The efficiency of the RHR heat exchanger increases as the ΔT between fuel pool/reactor cavity and RHRSW increases. With the emergency offload occurring at only 45 days following a refueling outage, the decay heat load from the previous cycle's discharge is still high. Thus, the SFP/reactor cavity water temperature rises faster and consequently, reaches the criterion for establishing RHR in the fuel pool cooling assist mode (i.e., 120 °F) at an earlier time, when the pool temperature is still rising. By placing the RHR heat exchanger into service earlier, which has a greater heat removal capacity than the FPCCU system, the peak bulk temperature of the SFP is reduced by 0.04 °F.

7. The maximum bulk SFP temperatures presented in Section 7.1 for this submittal (Revision 4) are lower than those submitted in Revision 2 for all cases, although decay heats are higher.

   a. Is this due to the improved versions of computer codes, as stated in Page 3 of Attachment 2 to NG-00-1904?

   DAEC Response:

   As discussed in Reference 1, during the preparation of this submittal, a review of the previously-used inputs into the calculation found several to be discrepant with the formal design documents. When corrected, these changes resulted in the slightly lower bulk pool temperatures. This is more fully explained in our response to 7.b below.

   b. If so, please explain what specific improvements contributed to these lower temperatures. (It is estimated that the additional decay heat for Revision 4 would increase the SFP bulk temperature by more than 5 °F compared to Revision 2 if everything else remains the same.)

DAEC Response:

Of the six input discrepancies found, two have the most impact on the results; they are the flowrates for RHR-Supplemental Fuel Pool Cooling mode and RHR Service Water (RHRSW).

The Functional Control Diagrams of both the FPCCU and RHR systems show 2000 gpm flowrate for RHR Supplemental Fuel Pool Cooling mode. As discussed in our response to Question 3.b above, this flowrate (and level control) can be easily established when RHR-SDC mode is in service and the SFP to reactor cavity gates are removed. However, if the SFP to reactor cavity gates are installed, then the suction for the RHR Supplemental Fuel Pool Cooling is from the FPCCU skimmer surge tanks, not the reactor vessel. In this lineup, the flowrate is limited to 1300 gpm in order to prevent overflowing the skimmer surge tank into other plant areas. To match the scenario being modelled, the 2000 gpm flowrate, corresponding to having the gates removed, should have been used in the analysis.

The flow of the RHRSW was also incorrect in that the Technical Specification flowrate of 2040 gpm per pump (or 4080 gpm per loop) should have been used versus the original system design flowrate of 4800 gpm, which had been previously used in this analysis.

Revision 3 of the calculation was performed with the new decay heat values, but before the input discrepancies were identified. (Note: Revision 3 was never used and thus, not provided to the Staff.) This analysis showed that SFP bulk temperature did increase by almost 9 °F. Factoring in the corrections for the cooling flowrates to the Revision 2 analysis would have shown a corresponding temperature drop of 10 °F in maximum SFP bulk temperature (154 °F to 144 °F).

The other discrepancy that had a minor effect on bulk SFP temperature was reactor cavity volume. Actual reactor cavity volume to the physical top is 157,000 gallons and was used in the original analysis. The calculation should have been performed with the SFP level at 36 feet (Technical Specification minimum), then the corresponding level in the reactor cavity (gates removed) would contain only 136,000 gallons. This results in a slightly lower thermal heat capacity of the reactor cavity and an estimated increase in bulk SFP temperature of 1 °F.

Combining the effects of correcting all the identified discrepancies with the increases due to the higher decay heat loads from GE14 at Extended Power Uprate conditions, results in almost a zero net effect.

8. With respect to the coincident net SFP heat load in Section 7.1,
   a. Please explain the coincident "*net*" SFP heat load. Is this different from the decay heat at the peak SFP temperature?

DAEC Response:

Coincident "Net" SFP heat load is equal to Total Decay Heat from the spent fuel minus losses to environment through evaporation.

b. The coincident net SFP heat load for Case C is approximately same to those of Case A or B in Revision 4, while it is about 8% higher in Revision 2. Is this significant difference mainly due to the different assumptions regarding fuel exposure time (i.e., 18 months in Revision 2 vs. 45 days in Revision 4)?

DAEC Response:

The significant difference is the change in the exposure of the fuel at the 45 day offload point. In the previous analyses, the offloaded fuel had been conservatively assumed to have been exposed for an entire operating cycle (i.e., 18 months) to get the maximum decay heat. This analysis removed that additional conservatism to get a more reasonable decay heat input into the calculation of maximum bulk SFP temperature.

9. Please provide following additional information regarding the makeup water. This information is necessary to assure sufficient makeup water is available, and sufficient time is available to align the makeup water.

   a. The licensee states in Section 7.2 that the calculated maximum boiling water loss is 53 GPM, and in Section 5.2 that the maximum makeup water flow rate is 59.5 GPM. The licensee also states in Page 4 of Attachment 2 to NG-00-1904 that Emergency Service Water (ESW), a Seismic Category I system, will be used to provide makeup to the SFP in the event of a loss of forced cooling and that it is estimated to take less than 2 hours to provide ESW. Is the 59.5 GPM solely from ESW? What is the basis of this estimation of 2 hours, test or analysis? In view that the calculated time-to-provide-makeup-water is reduced from 4.5 hours in Revision 2 to 3.9 hours in Revision 4, please describe the operating procedures or technical specifications to assure the ESW availability and the time to take for this alignment. Please describe what actions would be taken by operators to align this makeup water to the SFP.

DAEC Response:

The flowrate of 59.5 gpm is entirely from the ESW system. A Special Test (SpTP-198) was performed in September 1996 that demonstrated that the flowrate of 59.5 gpm could be established in a timely manner. The time for performance of the complete steps of SpTP-198 to demonstrate the required flow was approximately 2½ hours from the time the test was initiated by the Operations Shift Supervisor to completion by the in-plant operator. Because this SpTP was evaluating three different alternatives, this 2½ hours includes those additional actions that were later determined to not be required. Consequently, this time *estimate is judged to be very conservative. The 2 hours used in the analysis is a bounding estimate for performing the current procedural steps developed from this SpTP. OI-454 (ESW Operating Instructions) is provided (Enclosure 2) to show the steps required to initiate the makeup flow to the SFP. ESW P&ID (BECH-M113)(Enclosure 1) shows the emergency makeup flowpath to the SFP.*

b. In view that the margin between this makeup water flow rate and boiling rate is relatively small, are there any other emergency makeup water sources? If there are, please list the sources, their makeup flow rates, and how long it takes to align them to SFP.

DAEC Response:

If the loss of fuel pool level accident were to occur during a refueling outage and the gates were removed, then RHR Low Pressure Coolant Injection mode, Core Spray, Control Rod Drive and Standby Liquid Control systems could be used for makeup. Basically, anything that can inject into the vessel to raise cavity level can be used to provide makeup water to the SFP.

If the loss of fuel pool level accident were to occur when the gates are installed, RHR could be used to provide makeup flow to the SFP provided the piping in the FPCCU system that provides the flow path to the SFP was intact and could be isolated from the remaining portion of the FPCCU system. Other systems available to provide water include the condensate service water and demineralized water systems via hoses. See the following tables for systems and system flowrates.

With SFP gates removed

System	*Nominal System Flowrate (gpm)*	*Time to Establish Flow*
RHR	*4800 per pump (4 total)*	*< 1 minute*
Core Spray	*3100 per pump (2 total)*	*< 1 minute*
CRD	*64 per pump (2 total)*	*< 1 minute*
SBLC	*28 per pump (2 total)*	*< 1 minute*
Condensate Service Water	*600 per pump (2 total)*	*< 2 hours since there are 15 connections in service pits on the refuel floor that would feed a hose with chicago fittings.*
Demineralized Water	*100 per pump (2 total)*	*< 2 hours from one demineralized water station located on the floor below the refuel floor that would feed a hose with chicago fittings.*

With SFP gates installed

System	*Nominal System Flowrate (gpm)*	*Time to Establish Flow*
RHR	*2000 (restricted)*	*< 2 hours to align three valves to allow flow from Torus to SFP.*
Condensate Service Water	*600 per pump (2 total)*	*< 2 hours since there are 15 connections in service pits on the refuel floor that would feed a hose with chicago fittings.*
Demineralized Water	*100 per pump (2 total)*	*< 2 hours from one demineralized water station located on the floor below refuel floor that would feed a hose with chicago fittings.*
Well Water	*1500*	*< 2 hours to align valves that would normally be used by the ESW lineup to the SFP.*

Figure 1 - Reactor Heat Generation for Cases 1 and 2 from Revision 4

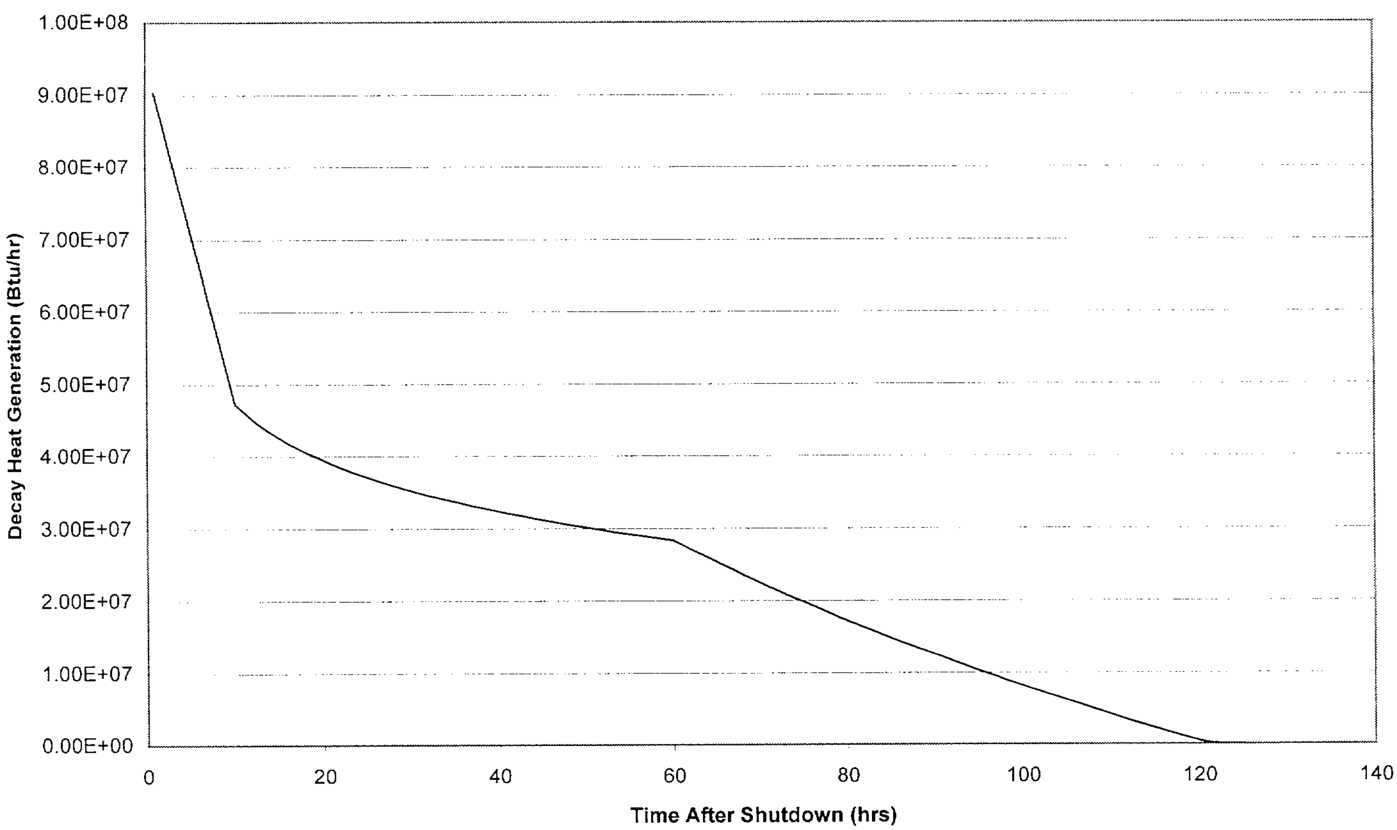


Figure 2 - Reactor Heat Generation for Case 3 from Revision 4

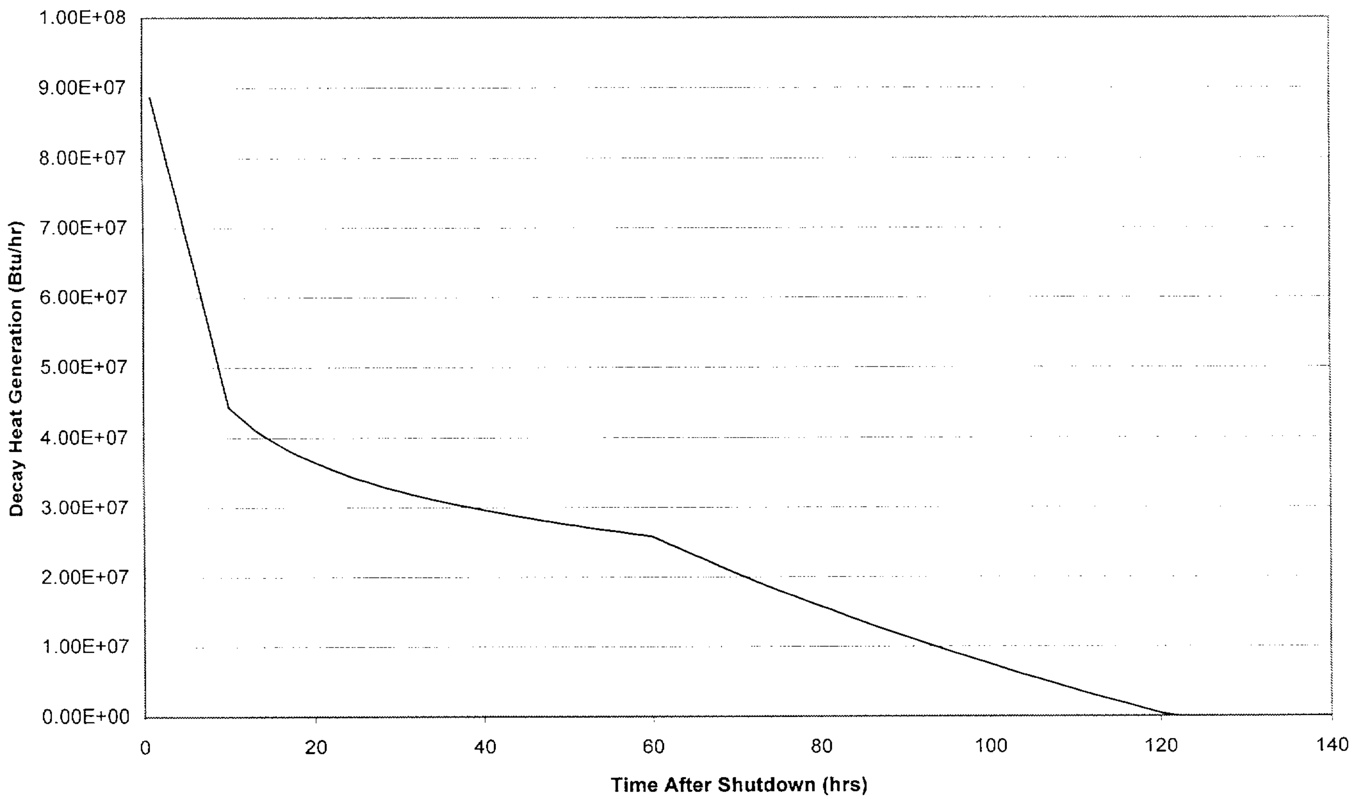
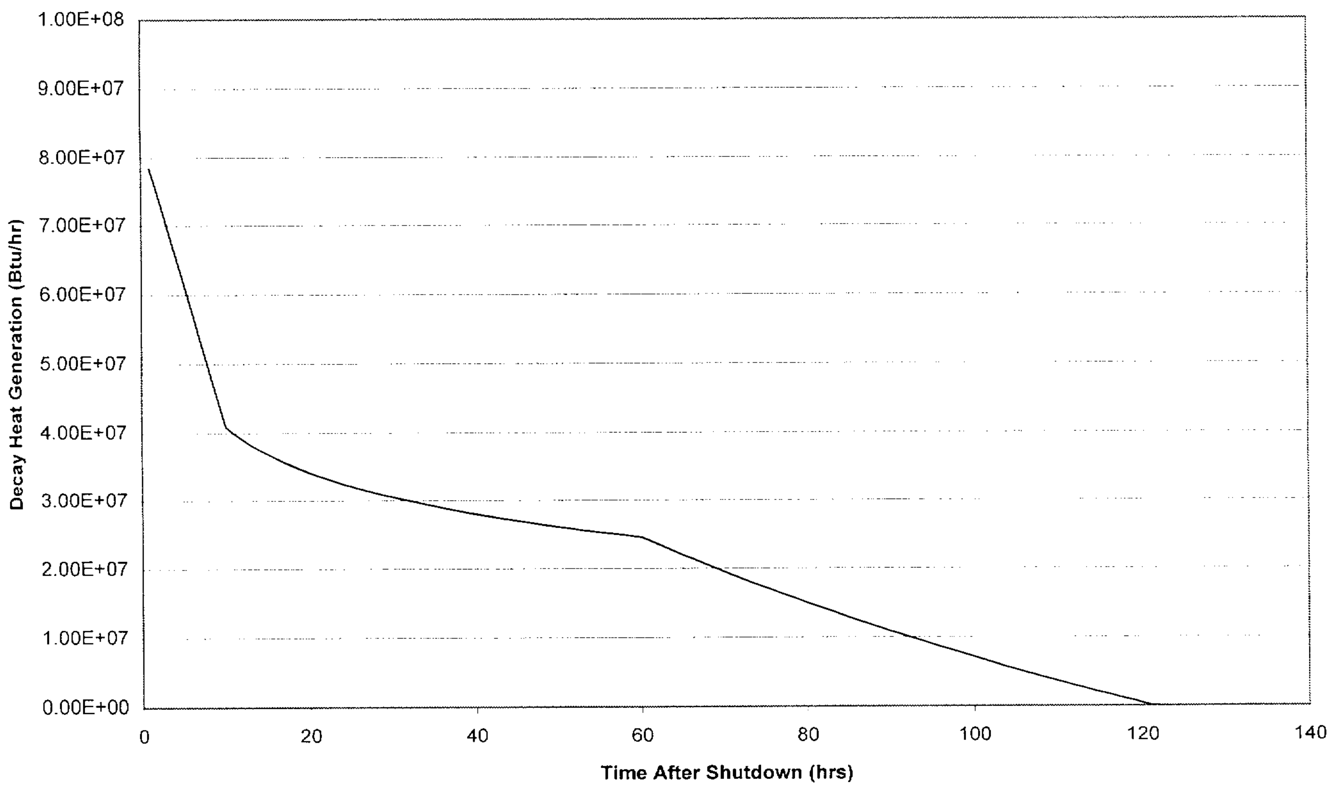


Figure 3 - Reactor Heat Generation for Cases 1, 2 and 3 from Revision 2



Enclosure 1 to

NG-01-0459

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

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P.&I.C. R-R SERVICE WATER AND EMERGENCY SERVICE WATER SYSTEMS BECH-M113-WIP

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D1

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AREA-5 PIPING PLAN BELOW ELEV. 855'-0"

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AREA-5 PIPING PLAN BELOW ELEV. 833'-6"

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AREA 4 & 5 - PIPING MISC. SECTIONS

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P&ID FUEL POOL COOLING & CLEANUP SYSTEM

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REACTOR BUILDING

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POOL LAYOUT - CAMPAIGN III SPENT FUEL STORAGE RACKS

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D7

Enclosure 2 to

NG-01-0459

REFUELING PROCEDURE

RFP 109

SPENT FUEL POOL & CASK POOL GATE REMOVAL

Effective Date:

TECHNICAL REVIEW			
Prepared by:	____________________	Date:	__________
Technical Review by:	____________________ Mechanical Maintenance Staff	Date:	__________
Technical Review by:	____________________ Radiation Protection ~~Supervisor~~Staff	Date:	__________
Reviewed by:	____________________ Operations Committee	Date:	__________

PROCEDURE APPROVAL			
I am responsible for the technical content of this procedure.			
Approved by Procedure Owner:	____________________ Principal Engineer - Refueling & Fuel Storage	Date:	__________
Approved by:	____________________ Plant Manager, Nuclear	Date:	__________

Table of Contents

1.0 PURPOSE AND SCOPE

This procedure provides guidelines for the removal of the shipping cask storage pool and spent fuel storage pool gates. Data and verification signatures will be documented in this procedure, as appropriate.

The sections and steps described in this procedure need not be performed in order. The exact sequence of refueling operations and associated system manipulations is determined by the sequence of events identified in the outage schedule, plant conditions or refuel floor configuration.

2.0 PRECAUTIONS AND LIMITATIONS

(1) The shipping cask storage pool and spent fuel storage pool gates are considered heavy loads and the following precautions and limitations apply:

   (a) Movement of a heavy load over the spent fuel pool is prohibited.

   (b) Movement of heavy loads shall be restricted to areas within the safe load path described in this procedure. If this is not possible, the guidelines for the control of generic heavy loads provided in ACP 1408.19 shall be followed.

   (c) When moving a heavy load, one person on the floor shall be responsible for verifying that the safe load path is followed.

   (d) In all cases, the height to which the load is lifted shall be minimized.

(2) Unnecessary crane hook or tool motion over the spent fuel storage pool and open reactor vessel cavity shall be avoided whenever possible.

(3) Housekeeping and work practices shall comply with ACP 1408.12, Refuel Floor Housekeeping Control.

(4) If SFP level drops below 36 feet during SFP gate removal, suspend all irradiated fuel handling activities.

3.0 PREREQUISITE CONDITIONS

(1) Verify that the water levels in the fuel pool and fuel shipping cask storage pool and reactor cavity when applicable, are approximately equal.

Verified by: ______________________ Time/ Date: __________________

> **NOTE**
>
> The slings and associated hardware used to handle specific loads in this procedure have been upgraded (increased in capacity). The rigging used to handle these loads shall be of equal or greater capacity than the rigging specified on Appendices 2 and 3.

(2) Obtain required rigging as specified in Appendices 2 and 3.

(3) Verify that the crane, cables, and other lifting equipment have been inspected and found acceptable per appropriate sections of CRANE-H046-002, GMP-MECH-006, and GMP-MECH-007.

Verified by: ______________________ Time/ Date: __________________

(4) Verify prerequisites complete and obtain permission to commence work from the Control Room Operations Shift Supervisor (OSS).

OSS Name: ______________________ Time/ Date: __________________

Verified by: ______________________ Time/ Date: __________________

4.0 INSTRUCTIONS

4.1 SHIPPING CASK STORAGE POOL GATE REMOVAL

(1) Prepare the gate for removal by deflating the gate seal as follows:

(a) Position the 2-way pressure regulator valves to the deflate position (located under deck plate immediately adjacent to the northeast corner of the cask pool).

(b) Close the manual isolation valve for the pressure regulators.

(c) Disconnect the two hoses from the gate seal.

(2) Move the crane until the Aux Crane Hook is directly west of the cask storage pool gate.

(3) Move the crane hook eastward until the Aux Crane Hook is directly over the cask storage pool gate.

(4) Attach rigging, as specified in Appendix 2, over the Aux Crane Hook and to the gate attachment lug. Slowly lift the gate 6" to verify no binding or misalignment. The gate must lift freely.

(5) Lift the gate vertically until it is clear of the cask storage pool.

(6) Move the crane along the Safe Load Path shown in Appendix 1 until the gate is east of its storage lug.

(7) Move the gate west until it is just north of its storage lug.

(8) Slowly lower the gate onto its storage lug.

(9) Disconnect the shackle from the gate attachment lug. Move the crane westward until the aux. crane hook is west of the removable handrail.

(10) Verify that Shipping Cask Storage Pool Gate removal is complete.

Verified by: ____________________ Time/ Date: ____________________

4.2 SPENT FUEL POOL GATES REMOVAL

> **NOTE**
>
> When fuel is to be moved between the spent fuel pool and the reactor cavity, the spent fuel gates shall be moved to their storage positions shown on Appendix 1.

(1) Verify that the rigging is set up as specified on Appendix 3. Loosen and disengage the two hold down bolts on the gate.

South Gate Verified by: ____________________ Time/ Date: ________________

North Gate Verified by: ____________________ Time/ Date: ________________

(2) Lift the South Gate about one foot (1') to unseat it. Move it south a short distance. Move the gate westward over its holding slots and lower it into position on the north face of the fuel pool.

(3) Repeat for the north gate, except that it is to be moved eastward over its holding slots and lowered into position.

South Gate Removed (Initial):_____ Time/ Date: ________________

North Gate Removed (Initial): _____ Time/ Date: ________________

(4) Notify the OSS that the transition from RHR Low Water Level to the RHR High Water Level Tec Spec can occur (T.S. 3.9.8 to 3.9.7).

OSS Name: ______________________________ Time/ Date: ________________

Notified by: ______________________________ Time/ Date: ________________

FOR INFORMATION ONLY

5.0 REFERENCES

(1) NUREG-0612, Control of Heavy Loads, USNRC, July 1980

(2) Response to NRC request for information on control of heavy loads, Iowa Electric Light and Power, Dec. 15, 1981

(3) ACP 1408.12, Refuel Floor Housekeeping Control

(4) ACP 1408.19, Control of Generic Heavy Loads

(5) Installation, Operation and Maintenance Instructions Shipping Cask Pool Slot Gate PS055 (MDL 7884-C45-12) Presray Drawing No. PR3396 (MDL 7884-C45-7)

(6) Installation, Operation and Maintenance Instructions Refueling Slot Gates PS056 (MDL 7884-C45-13), Presray Drawing No. PR3405-1 (MDL 7884-C45-6(1)), PR3405-2 (MDL 7884-C45-6(2)), PR3405-3 (MDL 7884-C45-6(3))

(7) CRANE-H046-002, Harnischfeger Reactor Building Crane & Ederer Trolley Inspections & Lubrication

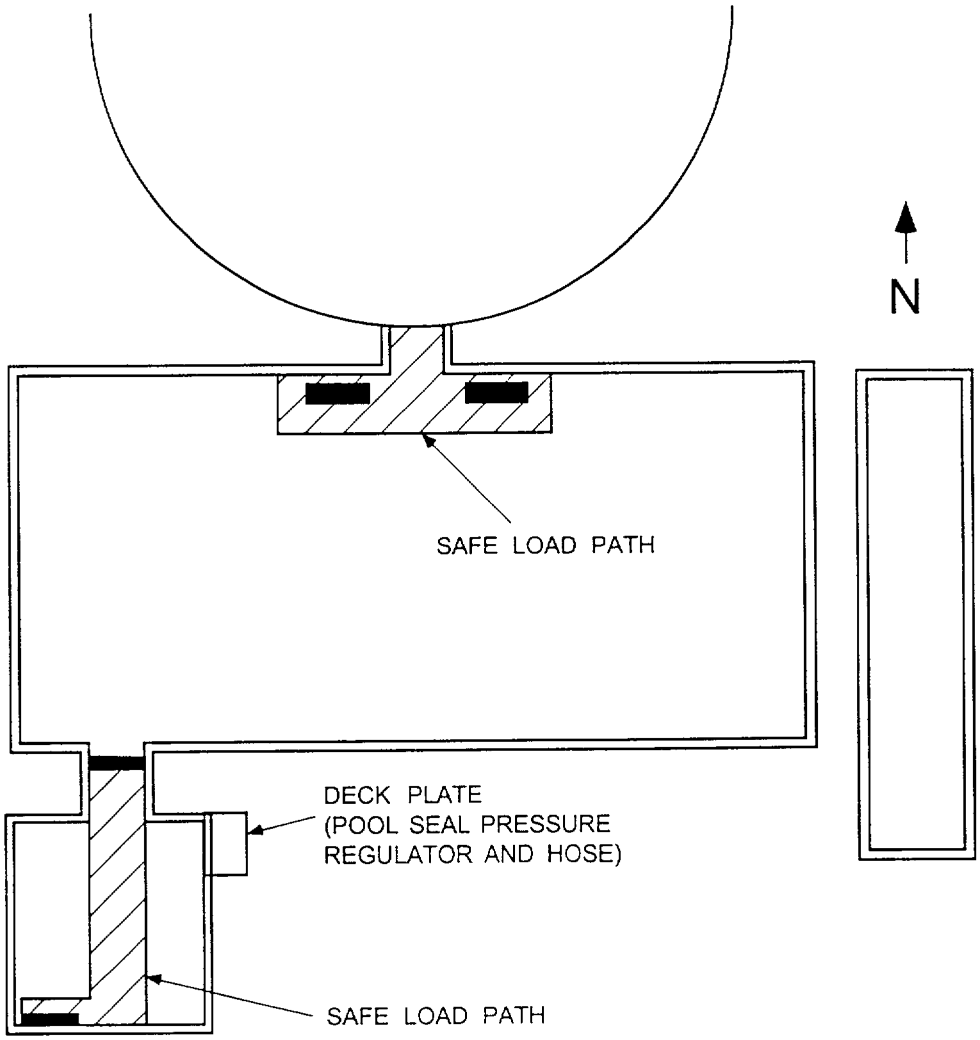
(8) GMP-MECH-006, Inspection, Tagging and Testing of Lifting Devices

(9) GMP-MECH-007, Inspection, Tagging and Testing of General Usage Hoists

(10) AR 15390, ITS Enhancements

APPENDIX 1

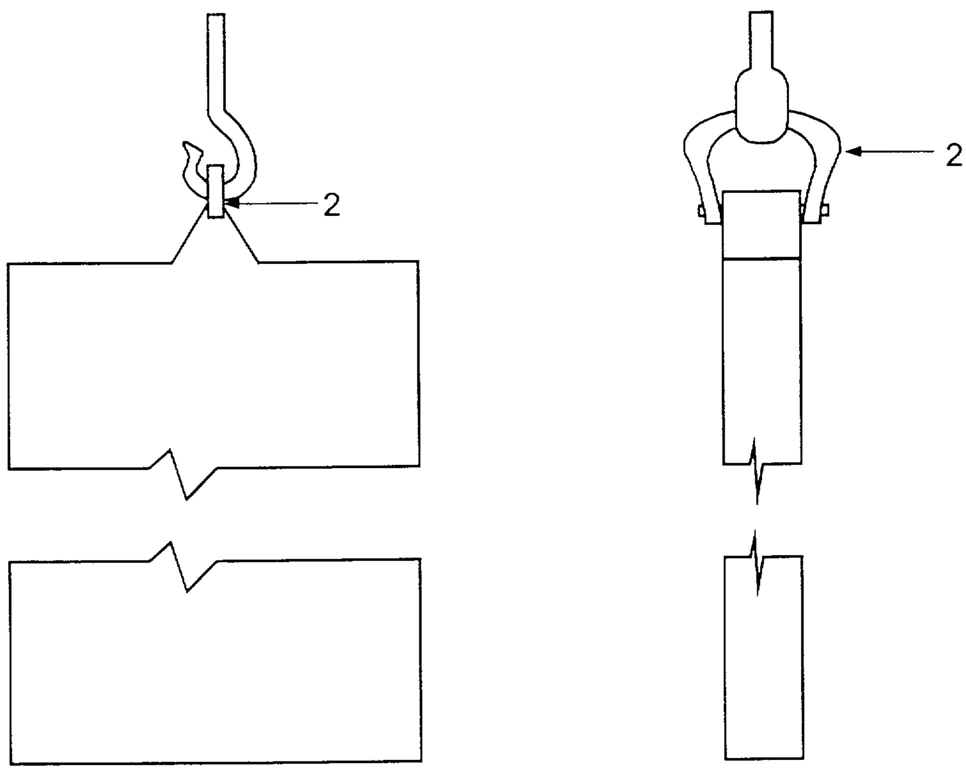
REFUELING EQUIPMENT STORAGE LOCATIONS



APPENDIX 2

SPENT FUEL SHIPPING CASK POOL SLOT GATE RIGGING

ITEM NO.	QTY.	RATED CAPACITY	DESCRIPTION
2	1	12T-V	Shackle, 1-1/4" nominal size



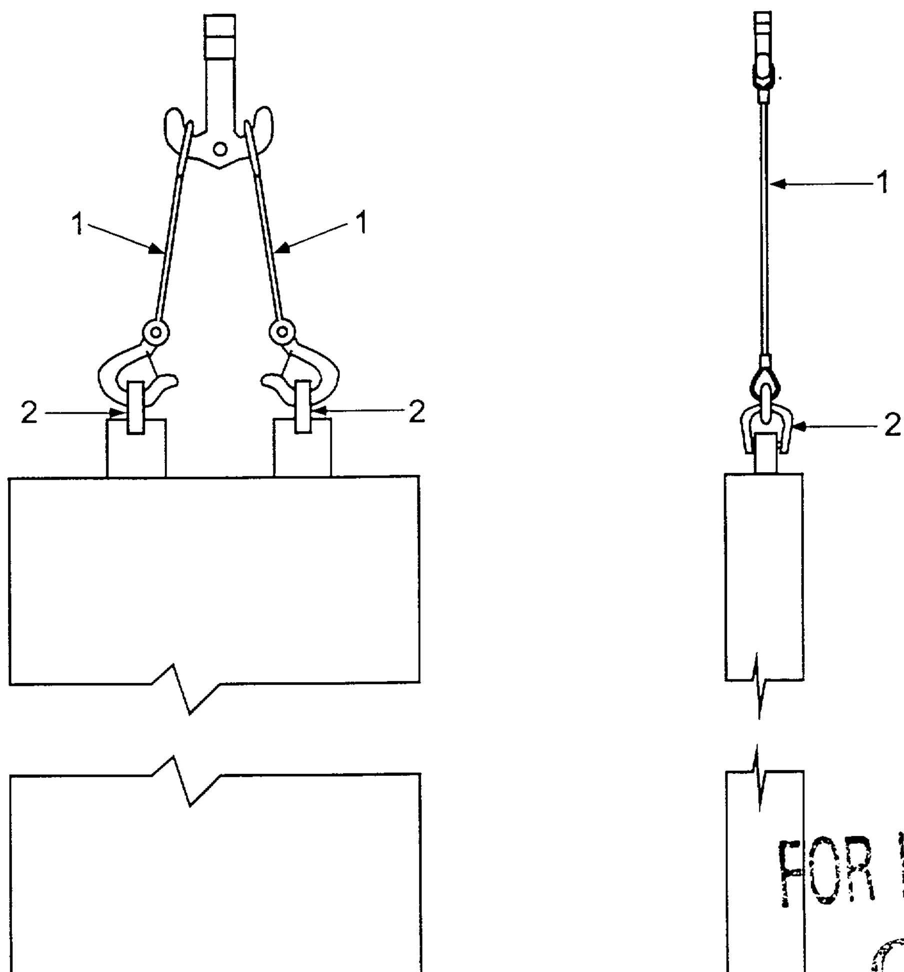
APPENDIX 3

SPENT FUEL POOL REFUELING SLOT GATE RIGGING

ITEM NO.	QTY.	RATED CAPACITY	DESCRIPTION
1	2	10T-V	Eye and hook rope, 1-1/8" IPS, 6 x 19 IWRC, 7'-0" long.
2	2	12T-V	Shackles: 1-1/4" nominal size.

NOTES

Install the shackle pin with entry from the South or they will not be able to be removed when disconnecting rigging at the storage location.



FOR INFORMATION ONLY

REFUELING PROCEDURE

RFP 201

SPENT FUEL POOL & CASK POOL GATE INSTALLATION

Effective Date:

TECHNICAL REVIEW

Prepared by: ______________________ Date: __________

Technical Review by: ______________________ Date: __________
Mechanical Maintenance Staff

Technical Review by: ______________________ Date: __________
Radiation Protection Staff

Reviewed by: ______________________ Date: __________
Operations Committee

PROCEDURE APPROVAL

I am responsible for the technical content of this procedure.

Approved by Procedure Owner: ______________________ Date: __________
Principal Engineer - Refueling & Fuel Storage

Approved by: ______________________ Date: __________
Plant Manager, Nuclear

FOR INFORMATION ONLY

Table of Contents

1.0 PURPOSE AND SCOPE

This procedure provides guidelines for the installation of the shipping cask storage pool and spent fuel storage pool gates. Data and verification signatures will be documented in this procedure, as appropriate.

The sections and steps described in this procedure need not be performed in order. The exact sequence of refueling operations and associated system manipulations is determined by the sequence of events identified in the outage schedule, plant conditions or refuel floor configuration.

2.0 PRECAUTIONS AND LIMITATIONS

(1) The shipping cask storage pool and spent fuel storage pool gates are considered heavy loads and the following precautions and limitations apply:

(a) Movement of a heavy load over the spent fuel pool is prohibited.

(b) Movement of heavy loads shall be restricted to areas within the safe load path described in this procedure. If this is not possible, the guidelines for the control of generic heavy loads provided in ACP 1408.19 shall be followed.

(c) When moving a heavy load, one person on the floor shall be responsible for verifying that the safe load path is followed.

(d) In all cases, the height to which the load is lifted shall be minimized.

(2) Unnecessary crane hook or tool motion over the spent fuel storage pool and open reactor vessel cavity shall be avoided whenever possible.

(3) Housekeeping and work practices shall comply with ACP 1408.12, Refuel Floor Housekeeping Control.

(4) If SFP level drops below 36 feet during SFP gate installation, suspend all irradiated fuel handling activities.

3.0 PRERELQUISITE CONDITIONS

NOTE

The slings and associated hardware used to handle specific loads in this procedure have been upgraded (increased in capacity). The rigging used to handle these loads shall be of equal or greater capacity than the rigging specified on Appendices 2 and 3.

(1) Obtain required rigging as specified in Appendices 2 and 3.

(2) Verify that the crane, cables, and other lifting equipment have been inspected and found acceptable per appropriate sections of CRANE-H046-002, GMP-MECH-006, and GMP-MECH-007.

Verified by: ____________________ Time/ Date: ________________

(3) Prior to installing the Spent Fuel Pool (SFP) gates, verify that decay heat removal systems for the reactor and SFP are available to support decay heat removal requirements of Tech Specs (Spent Fuel Pool Temperature <150 °F).

OSS Name: ____________________ Time/ Date: ________________

Verified by: ____________________ Time/ Date: ________________

(4) Verify prerequisites complete and obtain permission to commence work from the Control Room Operations Shift Supervisor (OSS).

OSS Name: ____________________ Time/ Date: ________________

Verified by: ____________________ Time/ Date: ________________

4.0 INSTRUCTIONS

4.1 SHIPPING CASK STORAGE POOL GATE INSTALLATION

(1) Move the crane until the Aux Hook is directly over the cask storage pool gate storage lug.

(2) Attach rigging, as noted in Figure 2, over the Aux Hook and to the gate attachment lug.

(3) Slowly raise the gate 1"-2" while pushing the gate northwards until it is clear of its storage lug.

(4) Lift the gate vertically until it is clear of the fuel pool / cask storage pool slot.

(5) Move the gate along the safe load path identified in Appendix 1 until it is over the gate guide slots.

(6) Slowly lower the gate into its holding slots.

(7) Disconnect the shackle from the gate attachment lug. Move the crane until the Aux Hook is west of the spent fuel pool handrail.

(8) With the gate seated in the bottom of the slot, inflate the gate seals as follows:

  (a) Connect the 2 hoses to the gate seals (located under deck plate immediately adjacent to the northeast corner of the cask pool).

  (b) Open the manual isolation valve for the pressure regulators.

  (c) Position the 2-way pressure regulators to the inflate position.

  (d) Verify pressure on downstream gauge is 25-30 psig. Adjust regulator as necessary.

  Verified by: ____________________ Time/ Date: ________________

NOTE

Steps (9) and (10) may be omitted if pool seal effectiveness can be determined by observing that the cask pool level decreases below the weir and stops decreasing when level is below the weir. If the level in the cask pool does not decrease below the weir the seal may not be holding.

(9) Open valves V-34-22 and V-34-23 and lower the cask pool water level to test the effectiveness of the gate seal. Valves V-34-25, V-34-26, and V-34-27 shall remain closed for this step.

(10) Close valves V-34-22 and V-34-23.

(11) Verify that the gate is sealed by confirming that there is no change in pool water level.

(12) If the level increases, equalize water levels, deflate the gate seals, and adjust the gate position.

(13) Repeat Section 4.1, Steps (9) and (12) until the gate is leak tight.

(14) Verify that Shipping Cask Storage Pool Gate installation is complete.

Verified by: ____________________ Time/ Date: ________________

4.2 SPENT FUEL POOL GATES INSTALLATION

(1) Verify that the rigging is set up as specified on Appendix 3.

North Gate Verified by: ____________________ Time/ Date: ________________

South Gate Verified by: ____________________ Time/ Date: ________________

(2) Lift the North Gate (on the East Side of the opening) about one foot (1') to unseat it. Move the gate into the channel opening connecting the spent fuel pool and reactor cavity and lower it into position.

(3) Engage and tighten the swing bolts on each side of the spent fuel pool gate.

(4) Repeat for the South Gate (on the West Side of the opening).

North Gate Installed (Initial):_____ Time/ Date: ________________

South Gate Installed (Initial): _____ Time/ Date: ________________

(5) After both gates have been installed, drain the reactor cavity as directed by Refuel Floor Supervisor.

NOTE

While lowering reactor cavity level, monitor fuel pool level for decreases. The spent fuel gates require approximately 4 feet of differential level between the reactor cavity and the spent fuel pool to create enough pressure to seat the gates properly.

CAUTION

After reactor cavity level has dropped 4-6 feet, there should be sufficient DP to seat the gates. At that level, if makeup to the Skimmer Surge Tanks is still required, the SFP gates may not be seated.

(6) Verify that there is no leakage past the South Gate after lowering the water level in the reactor cavity by verifying that fuel pool level does not decrease.

Verified by: ____________________ Time/ Date: ________________

(7) If it is determined that the SFP gates are not seated, performed the following:

(a) Obtain a pumping system capable of pumping out the area between the SFP gates (~200 gpm pump recommended).

(b) Place the pump suction between the SFP gates and discharge the water back to the SFP.

(c) Station an operator at the Skimmer Surge Tank makeup valve. Start the pump.

(d) Drain the area between the gates until level between the gates is even with reactor cavity level.

(e) Verify that condensate service water makeup to the Skimmer Surge Tanks is no longer required. This is an indication that the gates are seated.

(f) When it is confirmed that the gates are seated, secure drain operations and verify that level between the SFP gates does not increase.

(8) Notify the OSS that the transition from RHR High Water Level to the RHR Low Water Level Tec Spec can occur (T.S. 3.9.7 to 3.9.8).

OSS Name: ____________________ Time/ Date: ____________________

Notified by: ____________________ Time/ Date: ____________________

5.0 REFERENCES

(1) NUREG-0612, Control of Heavy Loads, USNRC, July 1980

(2) Response to NRC request for information on control of heavy loads, Iowa Electric Light and Power, Dec. 15, 1981

(3) ACP 1408.12, Refuel Floor Housekeeping Control

(4) ACP 1408.19, Control of Generic Heavy Loads

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(6) Installation, Operation and Maintenance Instructions Refueling Slot Gates PS056 (MDL 7884-C45-13), Presray Drawing No. PR3405-1 (MDL 7884-C45-6(1)), PR3405-2 (MDL 7884-C45-6(2)), PR3405-3 (MDL 7884-C45-6(3))

(7) CRANE-H046-002, Harnischfeger Reactor Building Crane & Ederer Trolley Inspections & Lubrication

(8) GMP-MECH-006, Inspection, Tagging and Testing of Special Lifting Devices

(9) GMP-MECH-007, Inspection, Tagging and Testing of General Usage Hoists

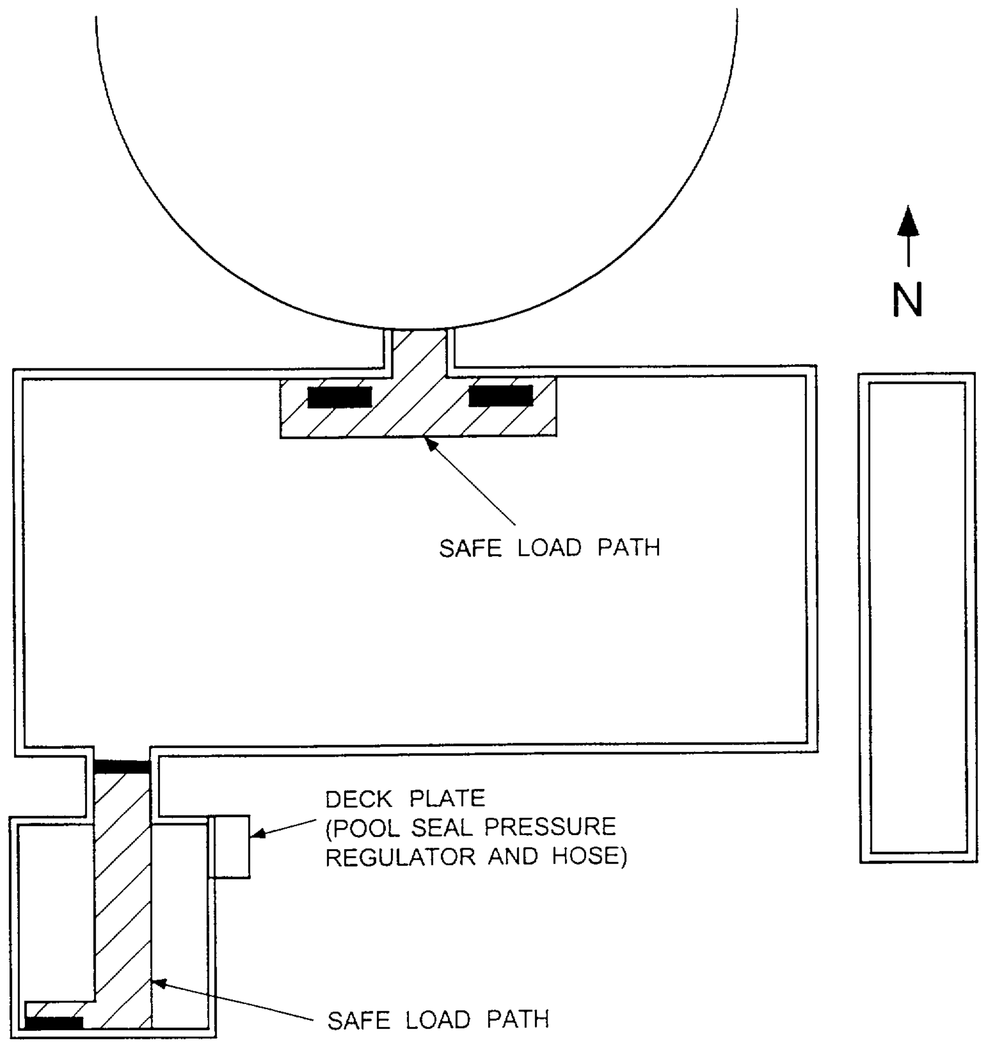
(10) AR 98-0097, Rx & SFP Decay Heat Removal Requirements

(11) AR 15390, ITS Enhancements

(12) AR 17343, Add Additional Guidance on Methods to Seal the SFP Gates

APPENDIX 1

REFUELING EQUIPMENT STORAGE LOCATIONS

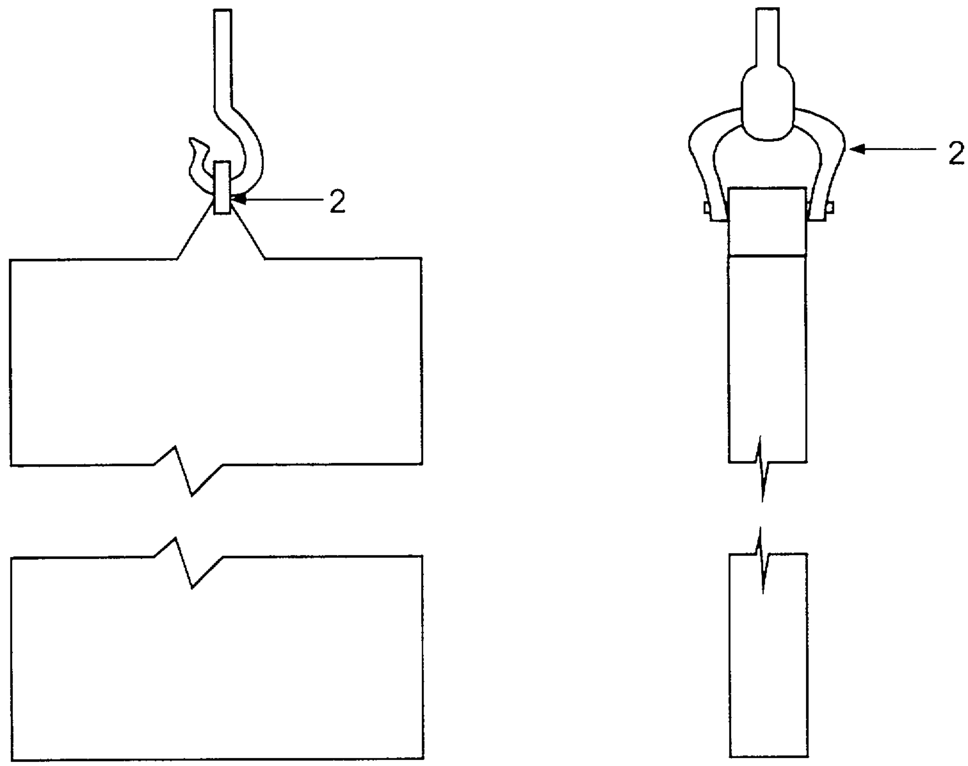


FOR INFORMATION ONLY

APPENDIX 2

SPENT FUEL SHIPPING CASK POOL SLOT GATE RIGGING

ITEM NO.	QTY.	RATED CAPACITY	DESCRIPTION
2	1	12T-V	Shackle, 1-1/4" nominal size



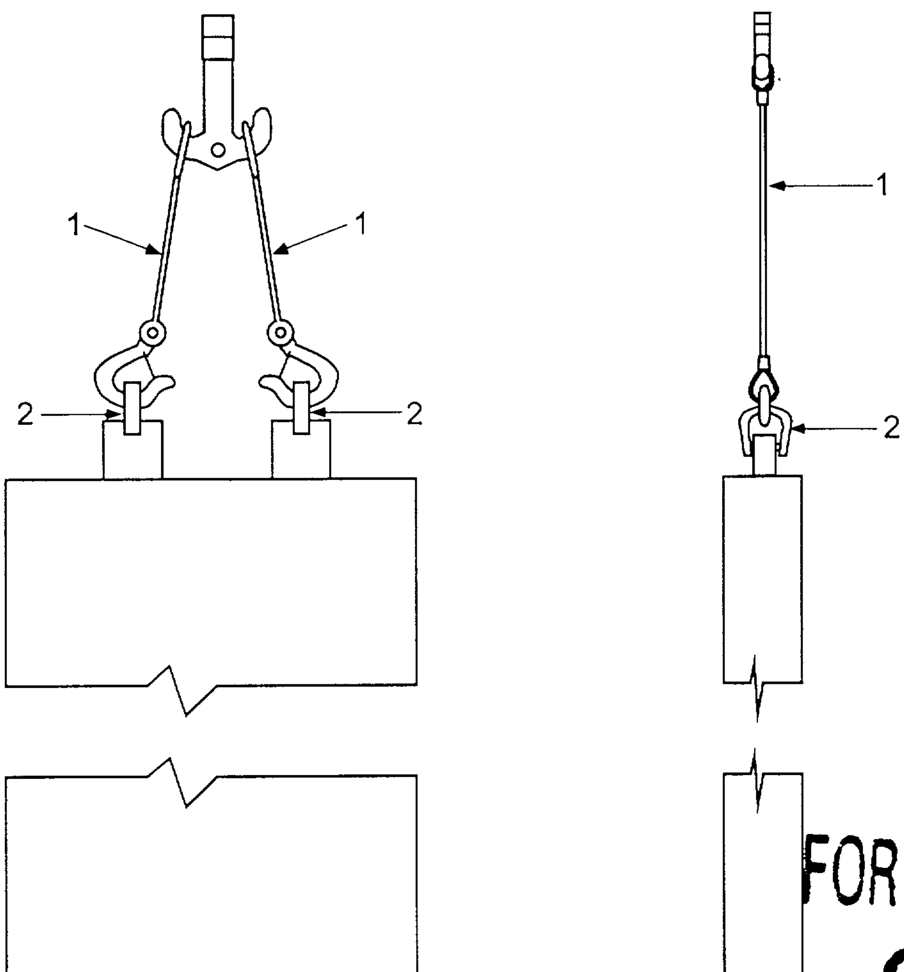
APPENDIX 3

SPENT FUEL POOL REFUELING SLOT GATE RIGGING

ITEM NO.	QTY.	RATED CAPACITY	DESCRIPTION
1	2	10T-V	Eye and hook rope, 1-1/8" IPS, 6 x 19 IWRC, 7'-0" long.
2	2	12T-V	Shackles: 1-1/4" nominal size.

NOTES

Install the shackle pin with entry from the South or they will not be able to be removed when disconnecting rigging at the storage location.



OPERATING INSTRUCTION

OI 454

EMERGENCY SERVICE WATER SYSTEM

Effective Date:

TECHNICAL REVIEW

Prepared by: ______________________ Date: ____________

Validated by : ______________________ Date: ____________
Operations Staff

Verified by: ______________________ Date: ____________
System Engineer

Reviewed by: ______________________ Date: ____________
Operations Committee

PROCEDURE APPROVAL

I am responsible for the technical content of this procedure.

Approved by
Procedure Owner: ______________________ Date: ____________
Operations

Approved by: ______________________ Date: ____________
Plant Manager, Nuclear

FOR INFORMATION ONLY

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1.0 PURPOSE

To provide detailed instructions to the plant operating personnel for proper operation of the Emergency Service Water (ESW) System.

2.0 PRECAUTIONS AND LIMITATIONS

(1) Do not attempt to supply both ESW loops from one ESW pump. Operation of both loops from one pump results in reduced cooling capacity.

(2) Minimize the time an ESW strainer is bypassed, to prevent possible fouling of safeguard equipment coolers.

(3) Per Tech. Specs., two ESW Subsystems shall be operable in modes 1, 2, 3.

(4) When "B" SBDG 1G-21 is running, B ESW PUMP 1P-99B will start and/or continue to run regardless of the position of handswitch HS-4928B B ESW PUMP on Panel 1C06 or HS-4928D at Remote Shutdown Panel 1C388 if the associated transfer switch is in the EMER position at Panel 1C388.

(5) At no time while an ESW pump is operating should its flow drop below 300 gpm in order to provide adequate pump cooling.

(6) As soon as possible after A[B] ESW PUMP start, make an inspection of the auto vent/vac breaker for evidence of excessive leakage.

   (a) Occasional leakage is expected due to debris interfering with the valve seat; if that occurs, cycling the pump off, allowing the pump rotation to stop, then turning the pump back on should clear the blockage.

   (b) Actions to be considered if the leak cannot be stopped:

   1. Enter the appropriate LCO action statement for the affected inoperable equipment, and initiate repairs as soon as possible.

   2. If leakage is minor, and well within the capacity of the pumphouse sump pumps, defer maintenance until it can be properly planned.

   3. If the equipment is required for immediate performance of its safety function, run it as needed.

(7) To prevent cavitation, do not run ESW Pump 1P-99A[B] at less than 4 feet of water in the RHR/ESW Pit unless directed by the OSS.

(8) If Cooling Tower(s) are secured or inoperable, ESW/RHRSW return flow should be aligned to the dilution structure.

(9) The ESW System is operable when the strainer backwash function is disabled and the strainer differential pressure is below the operability limit (12.0 psid).

(10) During outage periods with abnormal well water lineups, verify that an adequate flow path exists for well water prior to securing an ESW pump or isolating ESW to the Control Building Chillers.

3.0 PLACING THE ESW SYSTEM IN STANDBY/READINESS CONDITION

(1) Verify that the following systems are operational or able to support the operation of the ESW System: ____________

Instrument and Service Air System, OI 518.1
River Water Supply System, OI 410
Pumphouse HVAC System, OI 711

(2) Verify that water level in the RHRSW/ESW Wet Pits is normal by either of the following methods: ____________

(a) ESW PIT LEVEL RECORDER LR-4935A[B] on Panel 1C29 indicates >20 ft.

(b) The following annunciators are reset:

"A" RHRSW/ESW PIT LO LEVEL (1C06A, D-1)
"B" RHRSW/ESW PIT LO LEVEL (1C06A, D-2)

NOTE

RHRSW/ESW Effluent Rad. Monitor RM-1997 may be inoperable as long as effluent water is sampled every 8 hours in accordance with ODAM Table 6.1-1.

(3) Verify that the RHRSW/ESW Effluent Rad. Monitoring System is operational per OI 879.1. ____________

(4) Verify that the following annunciators are reset: ____________

LIQUID RAD MONITORS DNSCL/INOP (1C03A, D-8)
RHRSW AND ESW EFFLUENT RM-1997 OR RM-4268 HI RAD (1C04B, D-7)

(5) Complete the ESW System Electrical Lineup OI 454A1 (Attachment 1). ____________

(6) Complete the "A" ESW System Valve Lineup and Checklist OI 454A2 (Attachments 2 and 3). ____________

(7) Complete the "B" ESW System Valve Lineup and Checklist OI 454A4 (Attachments 4 and 5). ____________

(8) Complete the ESW System Control Panel Lineup OI 454A6 (Attachment 6). ____________

(9) Verify ESW Pumps 1P-99A[B] have sufficient oil in local bearing sight glass. ____________

(10) Verify one of the following discharge flow paths is available: ____________

(a) Cooling Tower Riser Valves MO-4249, MO-4250, MO-4251, and MO-4252 are open.

(b) Sparging Bypass Valves V-42-42 and V-42-43 are open.

(c) River Discharge Canal V-42-12 is open.

(11) If the RHRSW System is <u>NOT</u> in operation, verify MO-1947 and MO-2046 RHR HX SERVICE WATER OUTLET valves closed on Panel 1C03. ____________

(12) If the Circulating Water System is NOT in operation, verify on Panel 1C06 that motor-operated MO-4208 [MO-4209] HP COND 1E-7B SOUTH and NORTH CIRC WATER OUTLET valves are closed. ________

(13) Verify A[B] ESW PUMP 1P-99A[B] hand switches HS-4928A[B] on Panel 1C06 are in AUTO. ________

(14) Verify that system operability has been established by successful performance NS540002, EMERGENCY SERVICE WATER OPERABILITY TEST, within required surveillance frequency. ________

4.0 AUTOMATIC INITIATION OF THE ESW SYSTEM

> **NOTE**
>
> The ESW System, when lined up per Section 3.0, automatically starts when the associated diesel generator starts.

(1) Verify the automatic start of the associated ESW Subsystem at Panel 1C06 as follows:

(a) A[B] ESW PUMP 1P-99A[B] red indicating light is ON. ________

(b) ESW 1P-99A[B] ammeter indicating approximately 95-115 amps. ________

(2) Verify adequate cooling to ESW Pump 1P-99A[B] motor by observing that FI-4938A[B] A[B] ESW FLOW indicates greater than 300 gpm. ________

> **NOTE**
>
> If desired, Well Water System can be isolated from ESW by closing MO-2039A[B] Well Water to A[B] Chiller by placing HS-2039A[B] on Panel 1C06 to CLOSE, **AND** closing MO-2077[MO-2078] Well Water from A[B] Chiller by placing HS-2077[HS-2078] on Panel 1C06 to CLOSE.

5.0 MANUAL STARTUP OF THE ESW SYSTEM

(1) Manually start either or both ESW pumps by performing either of the following:

(a) Start A[B] ESW PUMP 1P-99A[B] by placing HS-4928A[B] on Panel 1C06 in the START position. ________

(b) Depress the START Pushbutton HS-4927A[B] on MCC-1B32 [1B42]. ________

(2) If A[B] ESW PUMP 1P-99A[B] is started from the MCC, verify the pump running by observing the red indicating light on MCC-1B3214 [1B4207] is ON. ________

(3) Verify A[B] ESW PUMP 1P-99A[B] running by observing the following on Panel 1C06:

(a) A[B] ESW PUMP 1P-99A[B] red indicating light is ON. ________

(b) A[B] ESW PUMP 1P-99A[B] indicates normal running current of approximately 95-115 amps. ________

(4) Verify adequate cooling for ESW Pump 1P-99A[B] by observing that FI-4938A[B] A[B] ESW FLOW indicates greater than 300 gpm. ________

NOTE

ESW auto strainers start in continuous backwash whenever the associated ESW pump starts.

(5) As soon as possible after ESW pump start, perform the following:

(a) Inspect the auto vent/vac breaker for evidence of excessive leakage. ________

(b) If excessive leakage is observed, stop and restart A[B] ESW PUMP 1P-99A[B] per Sections 7.0 and 5.0 respectively; reinspect for leakage. ________

NOTE

If desired, Well Water System can be isolated from ESW by closing MO-2039A[B] Well Water to A[B] Chiller by placing HS-2039A[B] on Panel 1C06 to CLOSE, **AND** closing MO-2077[MO-2078] Well Water from A[B] Chiller by placing HS-2077[HS-2078] on Panel 1C06 to CLOSE.

6.0 NORMAL OPERATION OF THE ESW SYSTEM

> **NOTE**
>
> During normal operation, the ESW System is lined up for automatic initiation per Section 3.0. ESW pumps start automatically when the associated SBDG starts.

(1) Once per shift, the Control Room operator should check the following:

(a) A[B] ESW PUMP 1P-99A[B] hand switch HS-4928A[B] on Panel 1C06 is in the AUTO position. ____________

(b) River Water temperature is less than the maximum established by the latest performance of NS540002, EMERGENCY SERVICE WATER OPERABILITY TEST. ____________

> **NOTE**
>
> The ESW System is operable when the strainer backwash function is disabled and the strainer differential pressure is below the operability limit (12.0 psid).

(2) During operation, periodically monitor and log the following parameters:

Component	Location	Low	Norm	High	High Operability
ESW STRAINER 1S-89A DIFFERENTIAL PRESSURE	PDIS-4921	-	3	4	12
ESW STRAINER 1S-89B DIFFERENTIAL PRESSURE	PDIS-4922	-	3	4	12

(3) The auxiliary operator should perform the following at the frequency noted:

(a) Inspect ESW Pumps once per shift. ____________

(b) When operating, verify that ESW pump discharge pressure is >80 psig on PI-4929A/B during each tour. ____________

(c) Verify that RHRSW/ESW wet pit level is >20 ft on LIS-4935A/B during each tour. ____________

(4) If RHRSW/ESW wet pit level drops below 20 ft, restore pit level per OI 410.

FOR INFORMATION ONLY

7.0 SHUTDOWN OF THE ESW SYSTEM

(1) Prior to shutdown of an ESW loop, verify cooling water flow is not required by any components served by the loop. ____________

(a) Verify the associated Standby Diesel Generator shutdown per OI 324. ____________

(b) Verify the associated RHR pumps shutdown per OI 149. ____________

(c) Verify the associated Core Spray pump shutdown per OI 151. ____________

(d) Verify cooling water is not required by the cooling units in the associated RHR and Core Spray pump room, HPCI or RCIC rooms. ____________

(2) If cooling water will be required for the CB Chillers, verify Well Water System operational per OI 408. ____________

(3) Stop A[B] ESW PUMP 1P-99A[B] by either of the following:

(a) Stop A[B] ESW PUMP 1P-99A[B] by placing HS-4928A[B] on Panel 1C06 in the STOP position. ____________

(b) Stop A[B] ESW PUMP 1P-99A[B] by depressing the STOP pushbutton, HS-4927A[B] on MCC 1B32 [1B42]. ____________

(4) Verify A[B] ESW PUMP 1P-99A[B] is stopped by:

(a) Observing green indicating light on Panel 1C06 is ON. ____________

(b) Observing pump 1P-99A[B] Ammeter indicates "0" amps. ____________

(c) Observing Flow Indicator FI-4938A[B] indicates "0" gpm. ____________

(5) If Well Water is isolated from ESW, restore Well Water flow to Control Building Chillers 1V-CH-1A and 1V-CH-1B and HVAC Instrument Air Compressors 1K-3 and 1K-4 as follows:

(a) Open MO-2039A[B] WELL WATER TO A[B] CHILLER, by placing HS-2039A[B] on Panel 1C06 to the OPEN position, and open MO-2077 [MO-2078] WELL WATER FROM A[B] CHILLER by placing HS-2077 [HS-2078] on Panel 1C06 to the OPEN position. ____________

(b) Verify both valves have opened by observing both red indicating lights are ON and both green indicating lights are OFF. ____________

8.0 CROSS-CONNECTING ESW LOOPS

> **CAUTION**
>
> Do not attempt to supply both ESW loops from one pump, using the spool piece cross-connect. Operation of both loops from one pump results in operation of cooling loads at reduced cooling capacity.
>
> Operation of the ESW System in cross-connect requires bypassing or jumpering power to the ESW Auto-Strainer of the inop pump. Permission of the OSS is required prior to cross-connect mode operation.

(1) Secure any operating ESW Pump per Step (3) in Section 7.0. ____________

(2) Install removable spool piece between V-46-22 and V-46-23. ____________

(3) To use the A[B] ESW Pump to supply the B[A] ESW Loop, perform the following:

(a) Close V-46-103 [V-46-104] ESW STRAINER 1S-89A[B] INLET ISOLATION. ____________

(b) Verify open V-46-104 [V-46-103] ESW STRAINER 1S-89B[A] INLET ISOLATION. ____________

(c) Verify both ESW STRAINER 1S-89A and B BYPASS valves V-46-24 and V-46-19 closed. ____________

(d) Open V-46-22 and V-46-23, SPOOL PIECE ISOLATION valves. ____________

(4) Start ESW Pump 1P-99A[B] per Section 5.0. ____________

> **NOTE**
>
> When cross-connected, flow in the operable loop can be verified by observing Flow Indicator FI-4938A[B].

(5) When directed by the OSS, place the operating strainer in backwash, by jumpering the 1P-99B[A] pump auto strainer interlock contacts 1 and 2 [5 and 6] on relay 97-4207[42-3214] in breaker 1B4207[1B3214]. ____________

9.0 ESW SUPPLY TO FUEL POOL

CAUTION

Use of the ESW System to supply water to the Fuel Pool will result in discharging water to the Fuel Pool that does not meet technical specification or fuel warranty chemistry requirements.

NOTE

Well Water to the 'A' Chiller, and the 'A' Loop are the preferred systems to be in operation during ESW supply to the Fuel Pool. Well Water will provide more flow to the hose station.

(1) If Well Water is not available to the "A" Chiller, then verify an ESW pump is in service per Section 4.0 or 5.0. __________

(2) Open V-13-82 [V-13-81] Fuel Pool Emergency Fill from 1V-CH-1A(B) Outlet. __________

CAUTION

If Spent Fuel Pool level is low, dose rates in the immediate area may go up significantly and appropriate radiological controls have to be taken.

(3) Direct water to Fuel Pool with fire hose from hose connection V-13-83 (ESW Supply for Emergency Fuel Pool Makeup). If dose rates on the Refuel Floor allow, the fire hose should be manned while directing water into the Spent Fuel Pool. __________

NOTE

If Fuel Pool Level is not going up, ESW loads can be isolated or throttled to provide additional makeup flow. With flow through the Fire Hose, an indication of 11 psig on PI-1956C correlates to approximately 59 gpm flow which exceeds the assumed UFSAR makeup flow (SpTP 198). Lower flow may be adequate to raise Spent Fuel Pool level, based upon actual decay heat in the Spent Fuel Pool.

(4) Throttle V-13-83, as necessary to maintain Fuel Pool Level.

CAUTION
Overflow from the Skimmer Surge Tank will flood RB ventilation ductwork and discharge into the Torus Room.

(5) Monitor Skimmer Surge Tank Level while performing emergency makeup to the Spent Fuel Pool. ________

(6) If additional ESW make up flow is needed , the following actions can be taken:

(a) Fail CV-1956A open (1V-CH-1A Discharge to ESW isolation). ________

(b) Close MO-2077 (1V-CH-1A Discharge to Well Water Isolation). ________

(c) Isolate Non-Essential chilled water loads at 1C-26. Then throttle V-13-122, "A" Chiller flow to 28" on PDI-1956A (200 GPM). ________

(7) If additional ESW make flow is needed, the following actions can be taken:

(a) If HPCI and RCIC are not required, isolate HPCI room cooler 1V-AC-14A (close V-13-63) and RCIC room cooler 1V-AC-15A (close V-13-65). ________

(b) Throttle V-13-62 (1V-AC -12 RHR and Core Spray Room Cooling) to 115 GPM (9" wg on PDI-1957A). ________

(c) Isolate non-essential chilled water loads at 1C-26. Then throttle V-13-122 "A" Chiller flow to 28" on PDI-1956A (200 GPM). ________

10.0 REFERENCES

(1) Technical Specifications, Duane Arnold Energy Center

(2) Updated Final Safety Analysis Report, Duane Arnold Energy Center, Section 9.2.3

(3) Operating Instructions 149, 151, 324, 410, 416, 518.1, 730, 734

(4) P and ID No. M-146, M-113, M-144, M-142

(5) Service Water Systems, Bechtel Drawing No. 7884-E-111 (Shts. 8, 8A, 28)

(6) Schematic Diagram Annunciators, Bechtel Drawing No. 7884-E-34

(7) Modifications: DCP 612, DCP 1203, DCP 1408, DCP 1451, MM-132, MM-133

(8) NG-92-3410

(9) Tech Spec Amendment 184

(10) EMA A24000, EMA A38812, EMA A38813

(11) AR 98-0097, Changes to permit Fuel Movement 60 Hrs after Shutdown

(12) AR 21783

(13) SpTP 198, Demonstration of ESW Makeup to the Spent Fuel Pool

Enclosure 3 to

NG-01-0459

DUANE ARNOLD ENERGY CENTER

SYSTEM DESCRIPTION

SD-435

Fuel Pool and Fuel Pool Cooling and Cleanup System

Reviewed by: ______________________________ ____________
Fuel Pool and Fuel Pool Cooling and Cleanup System Engineer — Date

Reviewed by: ______________________________ ____________
Operations — Date

Reviewed by: ______________________________ ____________
Operations Training — Date

FOR INFORMATION ONLY

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PURPOSE

The Fuel Pool provides underwater storage space for temporary storage of spent fuel assemblies or bundles that require shielding, cooling, and criticality control during storage and handling.

The Fuel Pool Cooling and Cleanup System removes the decay heat and radioactivity released from the spent fuel elements. The system maintains a specified fuel pool water temperature, purity, clarity and level. The system also services the dryer-separator storage pool and reactor well during refueling operations.

The New Fuel Storage Vault provides a specially designed dry storage area for the new fuel assemblies or bundles.

DESIGN CAPABILITIES

A. The following design bases are incorporated for spent fuel storage:

   1. Spent fuel storage pool was designed to accommodate General Electric designed racks supplied for 130% of the full core load of fuel assemblies. The use of high density fuel racks has increased storage capacity above the design basis.
   2. Spent fuel storage racks are designed and arranged such that the fuel assemblies can be efficiently handled during refueling operations.
   3. High density spent fuel storage racks are designed to provide maximum storage space in the spent fuel pool.
   4. The fuel array in the fully loaded spent fuel racks will be substantially subcritical and prevent fuel barrier damage caused by overheating. For any operating or accident condition which is a design basis for DAEC, the subcritical multiplication factor (K_{eff}) is maintained below 0.95. This includes the worst case postulation of a dropped fuel element.

5. Each spent fuel storage rack loaded with fuel is designed to withstand earthquake loading to minimize distortion of the spent fuel storage arrangement.

B. The Fuel Pool Cooling and Cleanup System is designed to:

1. Remove decay heat from the fuel assemblies in order to maintain fuel pool water temperature during normal spent fuel storage and refueling operations such that fuel element damage due to overheating is prevented.
2. Minimize corrosion product buildup and control water clarity so that the fuel assemblies can be efficiently handled underwater.
3. Minimize fission product concentration in the water that could be released from the pool to the Reactor Building environment.
4. Monitor fuel pool water level and maintain a water level above the fuel sufficient to provide shielding for normal building occupancy.

C. The following design bases are incorporated for new fuel storage:

1. New fuel storage racks are provided for 30% of the full core load of fuel assemblies.
2. New fuel storage racks are designed and arranged so that the fuel assemblies can be efficiently handled during refueling operations.
3. The new fuel storage racks are designed and maintained with sufficient spacing between the new fuel assemblies to ensure that the array, when racks are fully loaded, shall be substantially subcritical under all conditions.
4. The new fuel storage racks, loaded with fuel assemblies, are designed to withstand earthquake loading; to prevent damage to the structure of the racks, and to minimize distortion of the arrangement of the racks.

SYSTEM DESCRIPTION

The Fuel Pool and Fuel Pool Cooling and Cleanup System consists of the fuel storage pool, two full capacity circulating pumps, two heat exchangers, two filter demineralizers and related equipment, two skimmer surge tanks, and the required piping, valves and instrumentation. The system cools the fuel storage pool by transferring the spent fuel decay heat to the Reactor Building Closed Cooling Water System.

The new fuel storage vault provides a dry location for the storage of new fuel assemblies. It is located adjacent to the spent fuel pool and is constructed of reinforced concrete. Concrete plugs form the top of the vault to keep foreign objects out, thereby preventing any bundle damage.

MAJOR COMPONENTS

The following components are discussed in this section:

- Skimmer Surge Tanks
- Fuel Pool Cooling Water Pumps
- Fuel Pool Heat Exchangers
- Fuel Pool Filter Demineralizers
- Spent Fuel Pool
- New Fuel Storage Vault
- Filter Demineralizer Auxiliaries

A. SKIMMER SURGE TANKS

The skimmer surge tanks are designed to:

1. Remove warmer water from the top of the pools for cooling.
2. Remove surface debris from the pools and prevent large pieces of foreign material from getting into the suction intake of the fuel pool cooling water pumps.
3. Provide a suction head for the fuel pool cooling pumps.
4. Provide a means to monitor system makeup requirements.
5. Provide for level swell when objects are lowered into the pools or reactor well.

The two skimmer surge tanks are constructed of carbon steel and are located on the south end of the spent fuel pool just below floor level (Figure 1). This location allows them to accept surface water flow from skimmers located at the water level of the pool. Water flow through the skimmers to the tanks is controlled by adjustable weirs bolted to the front of the skimmers. Level within the skimmer tanks is equalized by an 8 inch tie line connecting the two tanks at the bottom.

B. FUEL POOL COOLING WATER PUMPS

The fuel pool cooling water pumps take a common suction from the skimmer surge tanks. Each pump discharges to its respective heat exchanger and to a cross-tie line to allow either pump to discharge to either heat exchanger. A check valve is provided in the discharge line of each pump to prevent backflow through an idle pump.

Each fuel pool cooling water pump is of sufficient capacity to provide more than two complete water changes per day of the fuel pool water, or one change per day of the fuel pool, reactor well and dryer-separator storage pit water.

C. FUEL POOL HEAT EXCHANGERS

The fuel pool heat exchangers are of the shell and tube type with Reactor Building Closed Cooling Water flowing on the shell side as the heat sink. Each heat exchanger is equipped with a bypass line and both discharge to a common header.

The heat exchangers are designed with sufficient heat transfer capacity to maintain the fuel pool temperature below 125°F during maximum normal heat load conditions. The maximum normal heat load of the spent fuel stored in the pool is the sum of the decay heat from the average spent fuel batch discharged from a fuel cycle at the earliest closure of the pool gate, plus the heat being released by the fuel discharged at the previous refuelings.

The fuel pool heat exchangers function to maintain fuel pool water temperature less than 150°F with supplemental cooling from the Residual Heat Removal System during maximum possible heat load conditions. The maximum possible heat load is the decay heat of the full core load of fuel at the end of the fuel cycle plus the heat from spent fuel discharged at the previous refuelings.

The temperature at the heat exchanger outlet must be maintained below 130°F to avoid damage to the resin used in the filter demineralizers.

D. FUEL POOL FILTER DEMINERALIZERS

The filter demineralizers are provided to remove soluble contaminants by ion exchange and insoluble contaminants by filter action in order to maintain high water purity and clarity. Additional functions are to maintain water chemistry to provide a non-corrosive environment and to remove radioactive contaminants.

The filter elements are stainless steel septums mounted vertically in a tube sheet which serve as supports for the filtering and ion exchange material. The filter demineralizer is prepared by a precoating operation which first recirculates a filter aid (Solka-Floc) through the filter demineralizer until it forms a "cake" covering the openings in the filter elements. The ion exchange material consisting of a mixture of powdered strong acid cation and strong base anion resins is then deposited on top of the filter aid. The total thickness of the filter aid and resin layers is approximately three-eighths of an inch.

Effluent strainers are provided after each filter demineralizer to minimize the introduction of filter aid and resin into the fuel pool should the filter media precoat fall from the filter septums.

The filter demineralizers are taken out of service based on poor effluent water quality, filter demineralizer high differential pressure or effluent strainer high differential pressure. The filter media is backwashed to the Solid Radwaste System (Waste Sludge Tank) and the filter demineralizer precoated again prior to being returned to service.

E. SPENT FUEL POOL

The fuel storage pool (Figure 1) is a large rectangular reinforced concrete, stainless steel plate lined tank 24 x 40 feet and approximately 39 feet deep. It is connected on the north side by a narrow channel to the reactor well and on the south side to a smaller separate plate lined pool provided to store shipping casks. Both channels are equipped with steel slot gates. The reactor well channel has two with separate seals to prevent leakage when the reactor well is drained. There are no connections to the fuel storage pool which would allow the fuel pool to be drained below the bottom of the channel between the reactor well and the spent fuel pool. Diffusers in the reactor well, and the shipping cask pool distribute the return water. The fuel pool return lines are equipped with 3/4" vacuum breakers mounted approximately 9" below normal pool surface level. The distribution of return water is such that minimal turbulence is generated, this limits stratification of either temperature or contamination. Another precaution to prevent draining the pool is the installation of eleven liner drains to allow monitoring of the seam welds on the fuel pool liner.

IES Utilities has been authorized by the NRC for a total spent fuel storage pool of 3152 assemblies which include a cask pit storage rack of 352 assemblies. The racks and the pool have been designed such that the effective multiplication factor of the fuel shall be less than or equal to 0.95.

Space for 2411 fuel assemblies is currently provided in high density fuel racks of aluminum construction (older style racks) or stainless steel construction (newer style racks). Currently, approximately 40 percent of the space is provided by the newer style racks. Pockets cast into alternate cavity openings of the fuel rack grids accept poison cans containing boron carbide (B_4C) in an aluminum matrix (Boral) in both styles of fuel racks.

One dual purpose rack has been installed in the Northeast corner of the fuel pool. This dual purpose rack was designed to store 24 control rod blades. However, 12 of the 24 locations have been converted for storing fuel assemblies.

The fuel assemblies are cooled by natural convection flow with inlet cooling water introduced into the warmer pool water in the space above the racks near the pool walls.

F. NEW FUEL STORAGE VAULT

The new fuel storage vault is a rectangular reinforced-concrete tank that provides dry vault storage of new fuel assemblies. The new fuel racks are anchored to the reinforced-concrete walls and have enough storage space for 30% of the reactor core load. (Space can be increased to 43% of full core load by installing additional fuel racks). The new fuel storage vault is designed such that the effective multiplication factor of the fuel is less than 0.90 under the normal dry storage conditions, and less than 0.95 under abnormal flooded conditions.

G. FILTER DEMINERALIZER AUXILIARIES

Each filter demineralizer is equipped with a holding pump and also provided are a resin feed tank, precoat tank and a precoat pump. The purpose of the holding pump is to maintain sufficient flow through the filter media to retain it on the filter element during periods of low or no system flow. The resin feed tank provides for the mixing and storage of ion exchange resins. It is equipped with a slow speed agitator to provide a uniform mix. The precoat tank is used to mix the precoat solution and it also is equipped with an electric agitator. The precoat pump will recirculate the water and precoat through the filter demineralizer while resin is educted into the flow when a controlvalve is opened.

SYSTEM OPERATION

Water is continually recirculated in a closed loop as shown in Figure 2 except when the reactor well and dryer-separator pits are being drained. Water is removed by skimmer weirs from the fuel pool, dryer-separator storage pit and reactor well during refueling operations, and from just the spent fuel pool during normal operations.

The fuel pool cooling water pumps take a suction off an equalizing line on the skimmer surge tanks and circulate water through the heat exchangers and filter demineralizers. Since each cooling pump is rated at the full capacity for a filter demineralizer, both pumps should not be run simultaneously unless both filter demineralizer units are in service.

A connection is provided downstream of the skimmer surge tank equalizing line to allow cross-connection with the Residual Heat Removal System (RHR). The RHR System can be used to supplement the Fuel Pool Cooling and Cleanup System. In order to prevent possible overfilling or draining of the fuel storage pool, the reactor vessel must be open, the reactor well filled and fuel pool gates removed.

Another connection is provided on the pump suction line to allow the fuel pool cooling water pumps to be used to drain the dryer-separator storage pit, reactor well, and fuel pool cask storage area. Normal operating temperature of the fuel pool may be exceeded when circulating water flow is interrupted to drain these pools or when more than average batches are stored in the pool. The dryer-separator storage pit, reactor well, and fuel pool cask storage area can also be gravity drained to the condenser hotwell or the Reactor Building Equipment Drain Sump.

Each pump discharges to its respective heat exchanger, heat exchanger bypass and to a cross-tie line to allow pump and heat exchanger cross-connects. The discharge of the heat exchangers is combined and sent to the filter demineralizers and to a filter demineralizer bypass line. The filter demineralizer influent line divides to allow flow to both units. Each line has a control valve, filter demineralizer, effluent strainer and effluent control valve.

The filter demineralizer effluent lines combine and water is directed back to the fuel storage pool, reactor well or cask storage pool. Water can also be directed to the Condensate Storage Tank or the Liquid Radwaste System (Waste Surge Tank). One of these last two locations is usually used when draining the dryer-separator storage pit or the reactor well.

The return line from the RHR System connects to the return line to the fuel storage pool. A removable spool piece is installed in the RHR cross-connection return line between the RHR and Fuel Pool Cooling and Cleanup Systems.

TABLES

A Plant Water Volumes

Separator & Dryer Storage	112 x 10^3 gal.
Reactor Cavity	157 x 10^3 gal.
Spent Fuel	233 x 10^3 gal.
Cask Storage	26 x 10^3 gal.
Reactor to Head Flange	82 x 10^3 gal.
Reactor to Streamline	72 x 10^3 gal.

CONTROL AND INSTRUMENTATION

A. CONTROL

There are no controls for the Fuel Pool Cooling and Cleanup System located in the Control Room. The only controls for the system are those associated with the fuel pool cooling water pumps, the fuel pool filter demineralizers, and the Fuel Pool Drain Valve.

1. FUEL POOL COOLING PUMPS

   The fuel pool cooling pumps are controlled from two locations in the Reactor Building - locally at Fuel Pool Pump Rack, Panel 1C66, and from Fuel Pool Filter/Demin Control Panel 1C136. The pumps are controlled by STOP - NORMAL - START spring return to NORMAL control switches. The following conditions will trip a running pump or prevent starting an idle pump.

   - Surge Tank low-low level (2'-2")≈60 ft^3 of water
   - Suction low pressure (-10 ft H_2O gage)

2. FUEL POOL FILTER DEMINERALIZERS

   All control and protective devices for automatic and semi-automatic operation are located at Fuel Pool Filter/Demin Control Panel 1C136. The Filter/Hold/Backwash and Precoat modes of operation are pushbutton selected. The ten air operated valves associated with each filter demineralizer, and the four air operated valves used during the precoating operation can also be manually controlled from Panel 1C136.

   The effluent flow rate of each filter demineralizer is controlled by a discharge control valve. Each valve is throttled by an instrument loop consisting of a flow element, a flow transmitter and a flow recorder controller switch. Once the desired flow is manually set at Panel 1C136, the controller will provide a constant flow rate during the time the pressure drop across the filter demineralizer is increasing due to the filtering action.

   The holding pump for each filter demineralizer will start, the holding pump discharge valve open, and the filter demineralizer discharge valve shut under the following conditions:

   - Depressing the HOLD pushbutton

- Filter demineralizer low flow
- Filter demineralizer high differential pressure
- Filter demineralizer effluent strainer high dp

3. FUEL POOL DRAIN VALVE MO 3435

   The Fuel Pool Drain Valve is controlled from Panel 1C66 with a three position (CLOSE-NORMAL-OPEN) handswitch. MO 3435 is used to set the drain rate to the CST or Liquid Radwaste System.

B. INDICATIONS

1. FUEL POOL COOLING PANEL 1C65

   Fuel Pool Cooling Pool water level indication Indication lights (red) are provided for the following:

   - Fuel Pool Cooling Pump A(B) Running
   - Refuel Bellows High Leakage (5 gpm)
   - Reactor Well Seals High Leakage (5 gpm)
   - Reactor Well High Leakage (0.1 gpm)
   - Fuel Pool High/Low Level (+3"/-4" from 37'-5"), ≈ 23' of water above fuel assemblies.
   - Skimmer Surge Tank High Level (8'-4.5")≈250 ft^3 of water
   - Skimmer Surge Tank Low Level (3'-5.5")≈100 ft^3 of water
   - Fuel Pool Cooling Pump A(B) High/Low Discharge Pressure (175 psig/100 psig)

2. FUEL POOL PUMP RACK 1C66

   In addition to the indications described for Panel 1C65 the following indications are provided:

   - Fuel Pool Cooling Pump A(B) Discharge Pressure
   - Fuel Pool Cooling Pump A(B) Suction Pressure
   - Reactor Well Level Indication
   - Fuel Pool Cooling Pump A(B) Stopped (green light)
   - Fuel Pool Drain Valve position (red/green lights)

3. FUEL POOL FILTER/DEMIN CONTROL PANEL 1C136

   Indications are provided for:

   - High Filter/Demin A(B) dp (25 psid)

- High Filter/ Demin A(B) Effluent Strainer dp (5 psid)
- Filter/Demin Low Flow A(B)
- High Filter/Demin Effluent Conductivity A(B)
- Precoat Tank High Level (47") overflow level
- Precoat Tank Low Level (12") trips precoat pump
- AO Valve position (red/green lights)
- Filter Demineralizer Flow Recorder
- Filter Demineralizer Effluent Conductivity Recorder

4. CONTROL ROOM INDICATION

Fuel Pool Water Level LI 3413

Skimmer Surge Tank Level

5. CONTROL ROOM ANNUNCIATORS

   a. Panel 1C04-B FUEL POOL COOLING PANEL 1C65/1C66 TROUBLE is initiated by any of the following conditions:

      - Reactor Well High Leakage
      - Refuel Bellows High Leakage
      - Reactor Well Seals High Leakage
      - Skimmer Surge Tank High/Low Level
      - Fuel Pool Cooling Pump High/Low Discharge Pressure
      - Fuel Pool Gate High Leakage

   b. Panel 1C04-B FUEL POOL HI/LO LEVEL is initiated by Fuel Pool level reaching 37'1" in. (decreasing) or 37'8" (increasing).

6. CONTROL ROOM PANEL 1C21

Temperature elements on the outlet of each heat exchanger and on the common suction to the fuel pool cooling pumps provide temperature indication to recorder TRS 1945. Temperature control is accomplished by manual throttling of the RBCCW through the heat exchangers.

7. SKIMMER SURGE TANK ROOM

Indication of Skimmer Surge Tank level is indicated at the upper level and again on the middle level.

SYSTEM INTERRELATIONS

A. REACTOR BUILDING CLOSED COOLING WATER SYSTEM

RBCCW acts as the heat sink for the decay heat generated by the spent fuel. It passes through the shell side of the fuel pool cooling heat exchangers.

B. CONDENSATE AND DEMINERALIZED WATER SYSTEM

This system provides makeup water to replace evaporative and leakage losses, fill water for the dryer-separator storage pit, fill water for the precoat and resin feed tanks and filter demineralizer backwash water and strainer flush water. The Fuel Pool Cooling and Cleanup System can also return water to the Condensate and Demineralized Water System during draining operations.

C. RESIDUAL HEAT REMOVAL SYSTEM

The RHR system provides additional cooling to the fuel pool cooling system under maximum possible heat load conditions. RHR takes its suction from the skimmer surge tank discharge and its return flow is sent to the fuel pool return line. This return line is equipped with a removable spool piece.

D. MAIN CONDENSER

The dryer-separator storage pit, reactor well, and fuel pool cask storage areas can be gravity drained to the Main Condenser hotwell.

E. LIQUID RADWASTE SYSTEM

The Fuel Pool Cooling and Cleanup System can return water to the Waste Surge Tank. During backwash of the filter demineralizers the backwash water, resin and filter aid are directed to the Waste Sludge Tank.

F. RADWASTE SUMP SYSTEM

The dryer-separator storage pit, reactor well, and fuel pool cask storage areas can be gravity drained to the Reactor Building Equipment Drain Sump (RBEDS). Drains, vents and relief valves are also connected to the RBEDS. Reactor Well and Refuel Bellows leakage or drains are directed to the Drywell Equipment Drain Sump.

G. INSTRUMENT AND SERVICE AIR SYSTEM

Air for air operated valves necessary for filter demineralizer operation and for backwash of the filter demineralizers is supplied from the Instrument and Service Air System.

H. REACTOR BUILDING VENTILATION SYSTEM

The Refueling Pool Exhaust Fan draws air from the fuel pool, reactor well and dryer-separator storage pit areas to control airborne contamination and moisture levels. The air is passed through moisture separators which drain to an air flow moisture separator drain tank. Two small drain transfer pumps automatically pump the water collected to the fuel pool skimmer surge tank.

I. ELECTRICAL POWER SYSTEM

1. 480 VAC MCC 1B35
   - Fuel Pool Cooling Pump A
   - Fuel Pool Filter/Demin A Holding Pump
2. 480 VAC MCC 1B43
   - Fuel Pool Cooling Pump B
   - Fuel Pool Filter/Demin B Holding Pump
   - Fuel Pool Drain Valve MO 3435
3. 480 VAC MCC 1B63
   - Precoat Pump
   - Precoat Tank Agitator
   - Resin Tank Agitator
4. Lighting Centers
   - L40 - Precoat Tank Dust Collector
   - L60 - Panel 1C65
   - L70 - Panel 1C66

J. INSTRUMENT AC CONTROL POWER

- Distribution Panel 1Y11 - Panel 1C136 A (B)

REFERENCES

A. UFSAR/DAEC-1, Section 9.0

B. Specification, Fuel Pool Cooling and Cleanup System, APED-G41-032

C. P&ID, Fuel Pool Cooling and Cleanup Sytem, BECH-M134.

D. P&ID, Fuel Pool Filter Demineralizer System, BECH-M135.

E. OI 435, Fuel Pool Cooling System

F. Minor Mod 114, Fuel Pool Low Level Alarm

G. Minor Mod 133, Panel 1C04 Surface Enhancements

H. DCP 1450, Panel 1C04 Long Term Enhancements

I. DCP 1538, Spent Fuel Pool Rerack

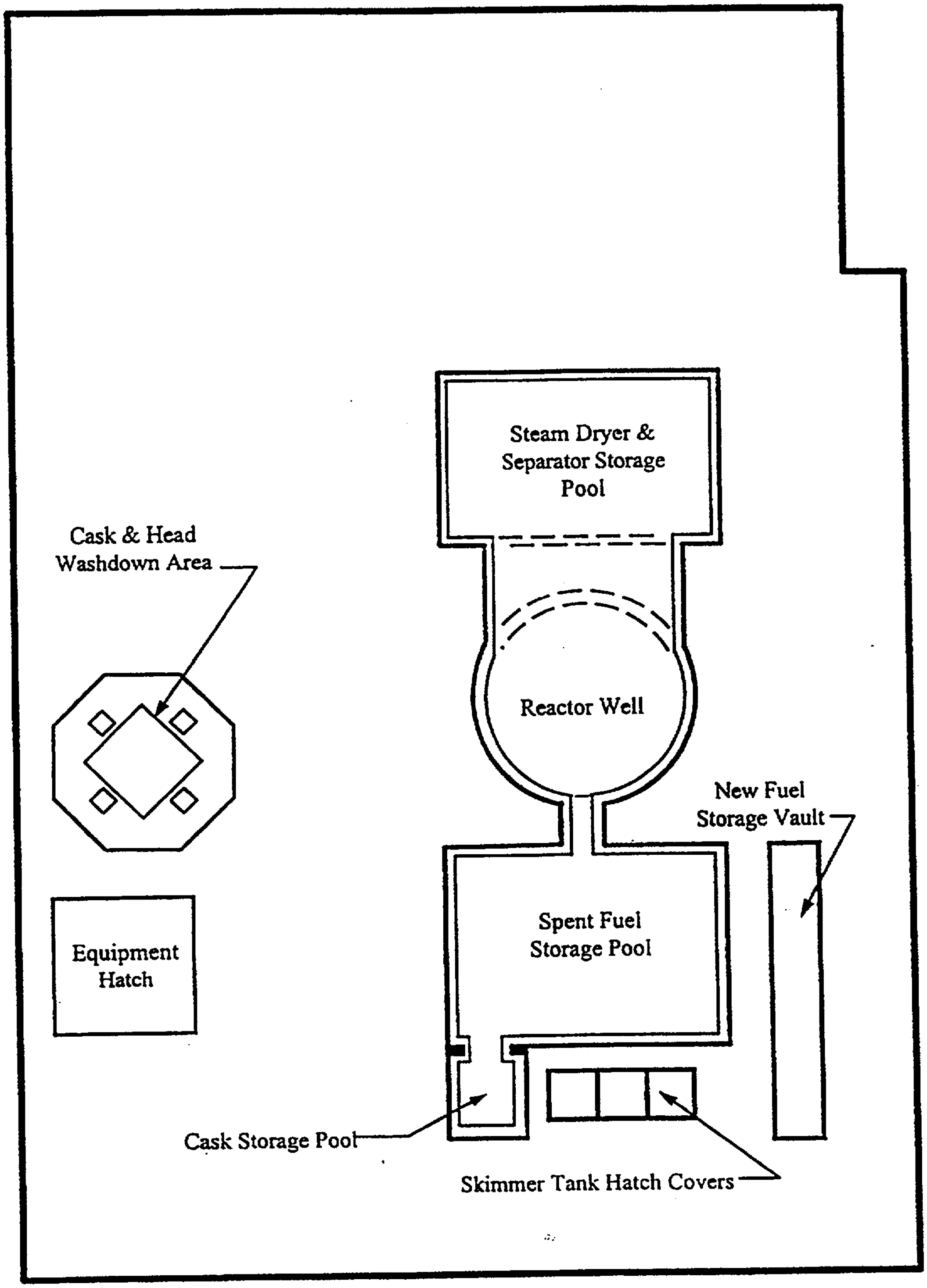

Figure 1. Dryer-Separator Pit, Reactor Well and Fuel Storage Pool Arrangements

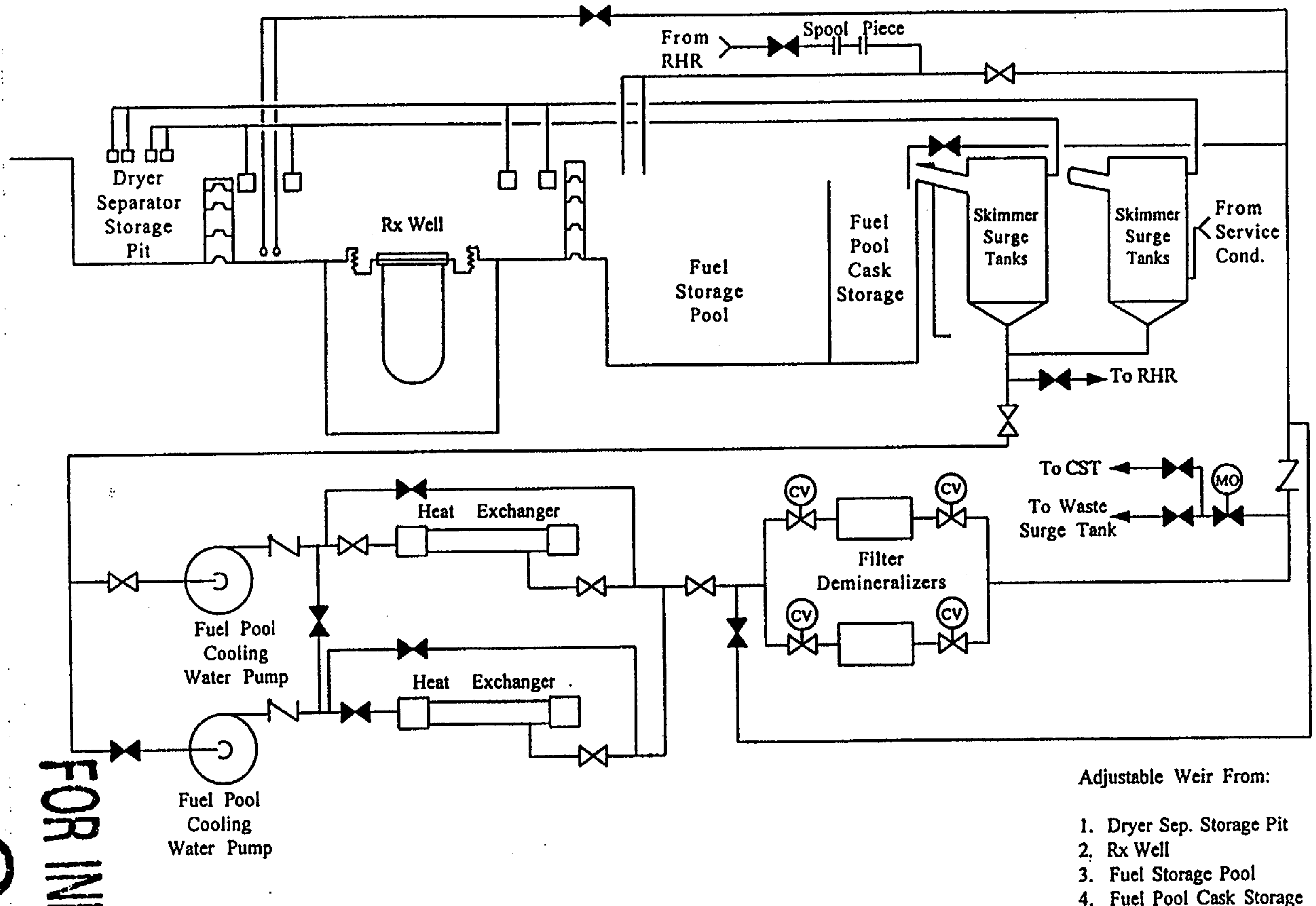

Figure 2. Fuel Pool Cooling and Cleanup System

OPERATING INSTRUCTION

OI 435

FUEL POOL COOLING SYSTEM

Effective Date:

TECHNICAL REVIEW

Prepared by: ______________________________ Date: ______________

Validated by: ______________________________ Date: ______________
Operations Staff

Verified by: ______________________________ Date: ______________
System Engineer

Reviewed by: ______________________________ Date: ______________
Operations Committee

PROCEDURE APPROVAL

I am responsible for the technical content of this procedure.

Approved by
Procedure Owner: ______________________________ Date: ______________
Operations

Approved by: ______________________________ Date: ______________
Plant Manager, Nuclear

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1.0 PURPOSE

To provide detailed instructions to the plant operating personnel for proper operation of the Fuel Pool Cooling (FPC) System.

2.0 PRECAUTIONS AND LIMITATIONS

(1) When starting the FPC pumps, ensure that the levels in the skimmer surge tanks are close to the high level alarm. When securing the FPC pumps, ensure that the levels in the skimmer surge tanks are close to the low level alarm.

(2) Spent fuel shall only be stored in the spent fuel pool in a vertical orientation in approved storage racks.

(3) Radiological precautions should be observed during all modes of FPC system operation or maintenance.

(4) To prevent exceeding F/D normal design flow (450 gpm), both FPC pumps should not be operated unless both F/Ds are in operation or F/D flow is being bypassed through V-34-29.

(5) Do not stop the Precoat Agitator for any extended period of time while Solka-Floc is in the Precoat Tank since the Solka-Floc may settle around the agitator paddle and prevent its restart.

(6) The RHR System should only be used to assist fuel pool cooling when the vessel is open, the reactor well filled, the fuel pool gates removed, and the spool piece installed.

(7) During cavity drainage:

   (a) Secure the Fuel Pool Cooling 1P-214A[B] pumps and place the F/Ds in a hold condition prior to drawing air into the FPC System.

   (b) Wash down cavity walls to minimize airborne activity.

(8) Do not operate either Fuel Pool Cooling Pump without system flow longer than necessary. (Both F/Ds in HOLD with Bypass Valve V-34-29 closed.)

(9) Any time fuel pool cooling system flow is terminated, verify sufficient holding pump flow to retain the filter media on the septums.

(10) The F/D resin is temperature sensitive. Fuel pool water at the heat exchanger outlet shall be maintained less than 130°F as indicated by the Multi-Point Recorder TRS-1945 RHR Water/HPCI Turb/HPCI Pump Temps on Panel 1C21.

(11) Do not allow spent fuel pool level to drop below 36 ft when irradiated fuel is in the pool. (normal level is 37 ft, 5 inches)

(12) If a F/D has been shutdown or in hold for longer than 48 hours, it should be vented prior to the next precoat cycle.

(13) During F/D programmed operations, ensure that the Solka-Floc filter media is precoated before the resin is educted; otherwise, resin material will not set and will be flushed into the effluent.

(14) When changing RBCCW flow to the FPC Heat Exchangers, flow to other components served by RBCCW will be affected.

(15) The Fuel Pool System cannot be drained through MO-3435 unless at least one Fuel Pool Demineralizer is in service due to check valve V-34-12.

(16) Fuel Pool temperatures at F.P.C. pump suction shall be kept greater than 32°F when the reactor cavity to fuel pool gates are installed, and 68°F during refueling operations when gates are removed, as read on the Multi-point Recorder TRS-1945 RHR WATER/HPCI TURB/HPCI PUMP TEMPS on Panel 1C21 to comply with the analyzed conditions described in the UFSAR.

(17) If Fuel Pool cooling flow is terminated for longer than four hours, a temporary portable temperature monitor shall be used to directly monitor pool temperature. For planned termination of Fuel Pool cooling flow, the temporary temperature monitor shall be in place prior to terminating flow. While temporary temperature monitoring is in place, Fuel Pool temperature shall be logged in the Second Assistant's Logs once per shift.

(18) In order to limit RCIC Room contamination potential during Reactor Building 5th floor draining activities to the Reactor Building Equipment Drain Sump, ensure temporary covering with drainage capability is installed around PSV 2474. Due to its design, PSV-2474 may leak back into the RCIC Room.

3.0 STARTUP OF THE FUEL POOL COOLING SYSTEM

(1) Complete the FPC System Electrical Lineup OI 435A1 (Attachment 1).

(2) Complete the FPC System Valve Lineup OI 435A2 (Attachment 2).

(3) Verify that the following systems are operating or able to support the operation of the Fuel Pool Cooling System:

Instrument and Service Air, OI 518.1
Condensate/Demin. Service Water, OI 537
RBCCW, OI 414

(4) Verify Radwaste capable of accepting FPC System vent/drain water and backwash discharge from the F/Ds.

(5) Verify FPC Pump 1P-214A[B] is operational.

(6) Verify that the shutdown light is ON for each F/D programmer at Panel 1C136.

(7) On Panel 1C136, verify the following switch positions:

Switch No.	Switch Name	Position
HS-3534	Precoat Pump	AUTO
HS-3527A	Holding Pump A	AUTO
HS-3527B	Holding Pump B	AUTO
HS-3410A	Fuel Pool Cooling Pump 1P-214A	NORMAL AFTER STOP
HS-3410B	Fuel Pool Cooling Pump 1P-214B	NORMAL AFTER STOP

(8) On Panel 1C66 in the Skimmer Surge Tank Room, verify the following switch positions:

Switch No.	Switch Name	Position
HS-3409A	Fuel Pool Cooling Pump A	NORMAL AFTER STOP
HS-3409B	Fuel Pool Cooling Pump B	NORMAL AFTER STOP
HS-3435	Fuel Pool Drain Valve	CLOSE

(9) Verify the FPC System filled per Section 6.

(10) Verify that FPC System components have been vented per OI 435A3 (Attachment 3). ___________

(11) Throttle Fuel Pool Filter/Demin System Bypass V-34-29 one-fourth to one-half turn open. ___________

(12) If both heat exchangers are to be used with one FPC Pump, open Fuel Pool Heat Exchangers 1E-211A/B Inlet Cross-Connect V-34-40. ___________

(13) Start FPC Pump 1P-214A[B] by momentarily placing handswitch HS-3409A[B] on Panel 1C66 in START. ___________

(14) Slowly throttle Fuel Pool Filter/Demin System Bypass V-34-29 to obtain a discharge pressure of approximately 140 psig on either PI-3408A[B] in the pump room or PI-3416 in the Fuel Pool Heat Exchanger Room. ___________

CAUTION

The F/D resin is temperature sensitive. Fuel pool water at the heat exchanger outlet shall be maintained less than 130°F.

Fuel Pool temperature shall be kept greater than 32°F when reactor cavity to fuel pool gates are installed, and 68°F during refueling operations when gates are removed, in order to remain within the analysis of the UFSAR.

When changing RBCCW flow to the FPC Heat Exchangers, flow to other components served by RBCCW will be affected.

(15) Line up RBCCW to the Fuel Pool Heat Exchangers as follows:

(a) Throttle open Fuel Pool HX 1E-211A[B] RBCCW Outlet Isolation V-12-33 [V-12-30] on the operating heat exchanger. Close Fuel Pool HX 1E-211B[A] Isolation V-12-30[V-12-33] on the idle heat exchanger. ___________

(b) Adjust Fuel Pool HX 1E-211A[B] RBCCW Outlet Isolations V-12-33[30] to maintain outlet temperatures less than 90°F but >32°F (fuel pool gates installed) or >68°F (gates removed) as indicated by the multi-point recorder TRS-1945 on Panel 1C21. ___________

NOTE

The following step will require coordination between operators at Panel 1C136 and the FPC Heat Exchanger Room, as directed by the Control Room operator.

(16) Shift F/D A[B] to filter per Section 7.4. ____________

(17) Start up the other F/D if desired per Section 7.4. ____________

CAUTION

Do not operate more than one FPC pump with only one F/D in operation when Fuel Pool Filter/Demin System Bypass V-34-29 is closed.

(18) If maximum system flow (900 gpm) is desired, start up the second FPC pump and HX loop per Steps (12) through (17). ____________

4.0 NORMAL OPERATION OF THE FUEL POOL COOLING SYSTEM

NOTE

During normal operation, Fuel Pool Filter/Demin System Bypass V-34-29 is shut and F/D flow is adjusted to maintain system pressure about 140 psig with F/D flow at 450 gpm. The bypass valve may be opened, if preferred, to maintain system pressure.

4.1 OPERATION OF THE FUEL POOL COOLING SYSTEM

(1) As the heat load from stored fuel lowers, the number of fuel pool cooling pumps and heat exchangers in operation may be reduced to reduce wear while maintaining fuel pool temperature less than 150°F (less than 90°F is preferable, if possible), but do not allow temperatures less than 32°F (fuel pool gates installed) or 68°F (gates removed). ____________

NOTE

When performing a flush of the fuel pool heat exchangers per Section 12 of this procedure, it is permissible to have the FPC System operating with 2 pumps, 2 F/Ds and 1 heat exchanger in service.

(2) The following are permissible system component lineups, which will depend on system heat load and water chemistry. ____________

No. of Pumps	No. of Heat Exchangers	No. of F/Ds	Position of Fuel Pool HXs 1E-211A/B Inlet Cross-Connect V-34-40
2	2	2	CLOSED
1	2	1	OPEN
1	1	1	CLOSED

(3) Refer to Section 3 for component startup. ____________

(4) Refer to Section 5 for component shutdown. ____________

CAUTION

When changing RBCCW flow to the FPC Heat Exchangers, flow to other components served by RBCCW will be affected.

(5) Control fuel pool water temperature as indicated on Temperature Recorder TRS-1945 RHR Water/HPCI Turb/HPCI Pump Temps on Panel 1C21 by throttling RBCCW flow from Fuel Pool Heat Exchanger 1E-211A[B] with V-12-33[30]. ____________

CAUTION

The F/D resins are temperature sensitive. Fuel pool water at the heat exchanger outlet shall be maintained below 130°F.

Fuel Pool temperature shall be kept greater than 32°F when reactor cavity to fuel pool gates are installed, and 68°F during refueling operations when gates are removed, in order to remain within the analysis of the UFSAR.

(6) Periodically alternate F/D units to equalize wear and to provide continuous filtering while backwashing and precoating the second unit. ____________

(7) Maintain the volume in the skimmer surge tanks between 41-1/2" and 100-1/2" as indicated by high and low level annunciators on Panels 1C65 and 1C66 or local level indicator LI-3412A, by adding water through Fuel Pool Cooling System Makeup Water Supply Header Downstream Isolation V-34-20. ____________

(8) During operation, periodically monitor and log the following parameters: ____________

Component	Location	Low	Norm	High
SKIMMER SURGE TANK LEVEL (INCHES)	LI-3412A	60	-	90
FUEL POOL FILTER DEMIN ΔP	PDIS-3512A[B]	-	-	10
FUEL POOL F/D EFFLUENT FLOW	FRCS-3511A[B]	400	450	500
FUEL POOL F/D RESIN TRAP ΔP	PDIS-3513A[B]	-	-	5
FUEL POOL F/D EFFLUENT PRESSURE	PI-3513A[B]	-	-	-
FUEL POOL F/D INFLUENT PRESSURE	PI-3512A[B]	-	-	-

4.2 SWITCHING FUEL POOL COOLING PUMPS

(1) Shift the inservice Fuel Pool Filter/Demineralizer to HOLD mode per Section 7.5. ____________

(2) At 1C-66, start the off-service pump 1P-214A[B] by momentarily placing handswitch HS-3409A[B] to START. ____________

(3) At 1C-66, secure 1P-214B[A] by momentarily placing HS-3409B[A] to OFF. ____________

(4) Line up RBCCW to the Fuel Pool Heat Exchangers as follows:

(a) On the operating heat exchanger, Throttle Open Fuel Pool HX 1E-211A[B] RBCCW Outlet Isolation V-12-33 [V-12-30] one-quarter turn. ____________

(b) On the idle heat exchanger, Close Fuel Pool HX 1E-211B[A] RBCCW Isolation V-12-30[V-12-33].

(c) While monitoring RBCCW system pressure on PI4821 (1C06),Throttle Open Fuel Pool HX 1E-211A[B] RBCCW Outlet Isolations V-12-33[30] to maintain outlet temperatures less than 150°F (90°F is preferable) but >32°F (fuel pool gates installed) or >68°F (gates removed) as indicated by the multi-point recorder TRS-1945 on Panel 1C21. ____________

(5) Shift the desired Fuel Pool Filter Demineralizer to FILTER mode per Section 7.4. ____________

5.0 SHUTDOWN OF THE FUEL POOL COOLING SYSTEM

CAUTION

With irradiated fuel stored in the fuel pool, the pool water temperature should not be allowed to exceed 150°F.

NOTE

If fuel pool cooling flow is terminated for longer than four hours, a temporary portable temperature monitor shall be used to directly monitor pool temperature.

During the following evolution, Fuel Pool Level, Skimmer Surge Tank Level, and Fuel Pool Cooling Pump discharge pressure should be continuously monitored and the discharge rate adjusted as required.

(1) If the Fuel Pool Cooling System is expected to be secured for longer than four hours, an alternate means of monitoring fuel pool temperature shall be established prior to securing the Fuel Pool Cooling System. While temporary temperature monitoring is in place, fuel pool temperature shall be logged in the Second Assistant's Logs once per shift. ____________

(2) Reduce skimmer surge tank level to the low level alarm as follows:

(a) Verify at least one filter demineralizer is in service. ____________

(b) Throttle open V-34-15 Fuel Pool Cooling & Cleanup Return to CSTs if water is to be discharged to 1T-5A[B] or V-34-16 Return to Waste Surge Tank if Radwaste is to receive the water. ____________

(c) Manually throttle open MO-3435 to slowly discharge water from the skimmer surge tanks. ____________

(d) When the low level alarm is received:

1. Close MO-3435. ____________

2. Close V-34-15 [V-34-16]. ____________

CAUTION

If the fuel pool gates are removed and the cavity is flooded, it may be necessary to repeat Step (1) before continuing to prevent the ventilation from being flooded.

(3) Place both F/Ds in hold per Section 7.5 ____________

(4) If necessary, backwash F/Ds per Section 7.6. ____________

(5) Stop operating FPC Pump 1P-214A[B] by momentarily placing handswitch HS-3409A[B] on Panel 1C65[66] in the STOP position. ____________

NOTE

Fuel Pool Filter/Demin System Bypass V-34-29 may be left open or shut as desired.

CAUTION

When changing RBCCW flow to the FPC Heat Exchangers, flow to other components serviced by RBCCW will be affected.

(6) If necessary, close Fuel Pool HX 1E-211A[B] RBCCW Inlet Isolation V-12-34[28] to operating FPC Heat Exchanger 1E-211A[B]. ____________

6.0 FILLING THE FUEL POOL COOLING SYSTEM

NOTE

Technical Specifications require that, whenever irradiated fuel is stored or moved in the spent fuel pool, pool water level shall be maintained at or above 36 feet. This portion of the procedure is written with the assumption that normal pool water level (37 ft 5 in.) is established. In the unlikely event that the fuel pool is empty, it may be filled with demineralized water via hose, or by repeating Steps (10) through (16) as necessary to fill the fuel pool.

(1) Ensure the fuel pool gates are in place and sealed. ____________

(2) Verify that the FPC System Electrical Lineup OI 435A1 (Attachment 1) is complete. ____________

(3) Verify that the FPC System Valve Lineup OI 435A2 (Attachment 2) is complete. ____________

(4) Verify that the following systems are operating or able to support the operation of the Fuel Pool Cooling System: ____________

Instrument and Service Air, OI 518.1 ____________
Condensate/Demin. Service Water, OI 537 ____________
RBCCW, OI 414 ____________

(5) Verify the Radwaste Sump System capable of accepting FPC System vent and drain water, and backwash discharge from the F/Ds. ____________

(6) Verify FPC Pump 1P-214A[B] operational. ____________

(7) Crack open Fuel Pool Filter/Demin System Bypass V-34-29. ____________

NOTE

The following steps may require entry into a High Radiation Area. Comply with all Health Physics requirements when entering this area.

(8) Open Fuel Pool Cooling System Makeup Water Supp. Header Downstream Isolation V-34-20 to commence system fill and as necessary to maintain skimmer surge tank level between the low level (41.5") and high level (100.5") annunciator set points. ____________

(9) When level rises in the Skimmer Surge Tank, observe that the SKIMMER SURGE TANK LOW LEVEL (41.5") lights turn OFF at Panel 1C65 and 1C66. ___________

(10) Verify Fuel Pool HX 1E-211A[B] Inlet Isolation V-34-5[9] and Fuel Pool HX 1E-211A[B] Outlet Isolation V-34-6[10] open. ___________

(11) Vent FPC System components per OI 435A3 (Attachment 3). ___________

> **CAUTION**
>
> When starting the FPC pumps, ensure the level in the skimmer surge tank is close to the high level alarm.

(12) Start FPC Pump 1P-214A[B] by momentarily placing handswitch HS-3409A[B] in the START position. ___________

(13) Slowly throttle Fuel Pool Filter/Demin System Bypass V-34-29 to maintain system pressure approximately 140 psig. ___________

(14) If Skimmer Surge Tank drops to the low level alarm point (41.5"), secure the operating FPC Pump, and return to Step (8) as necessary to complete filling of the fuel pool. ___________

(15) Shut Fuel Pool Cooling System Makeup Water Supp. Header Downstream Isolation V-34-20 when Skimmer Surge Tank level approaches the high level alarm point (100.5") or when proper fuel pool and skimmer surge tank levels are established. ___________

> **CAUTION**
>
> When changing RBCCW flow to the FPC Heat Exchangers, flow to other components served by RBCCW will be affected.

(16) Throttle RBCCW flow from the FPC heat exchangers to maintain outlet temperatures less than 150°F (90°F is preferable) but >32°F (fuel pool gates installed) or >68°F (gates removed) as indicated on Panel 1C21 Temperature Recorder TRS-1945 HPCI Water/HPCI Turb/HPCI Pump Temps. ___________

(17) Observe that the FUEL POOL HIGH AND LOW LEVEL lights on Panels 1C65 and 1C66 are OFF.

7.0 FILTER DEMINERALIZER (F/D) OPERATIONS

7.1 SOLKA-FLOC PREPARATION

(1) Remove the lid of the Fuel Pool Precoat Tank 1T-224, located in the RW Bldg. Precoat Room, and inspect the interior for cleanliness. ____________

(2) Fill [drain] the Precoat Tank using the Precoat Tank 1T-224 Fill [Drain] Header Isolation V-35-25[28] until the tank is 1/4 to 1/2 full at a temperature of 100°F or less. ____________

(3) Start Precoat Agitator 1S-246 using local Handswitch HS-3546. ____________

(4) Add Solka-Floc to the Precoat Tank as determined by the Plant Chemistry Coordinator (usually 54 lbs). ____________

(5) Immediately fill the Precoat Tank to a point just above the level control riser pipe using Precoat Tank 1T-224 Fill Header Isolation V-35-25. ____________

> **CAUTION**
>
> Do not stop the Precoat Agitator for any extended time while Solka-Floc is in the tank. Solka-Floc may settle around the agitator paddle and prevent its restart.

(6) Continue agitation for a minimum of 15 min. or until the slurry is homogeneous. ____________

(7) Momentarily stop the agitator. Allow the fluid to still, and then decant the floating particles from the surface using 1T-224 Upper Drain to Waste Sludge Tank Isolation V-35-29. ____________

(8) Refill the Precoat Tank with condensate to a point just above the level control riser pipe. ____________

(9) Restart the agitator and run until the slurry is again homogeneous. ____________

(10) Repeat Steps (7) through (9) above as necessary to obtain a particle-free surface. ____________

(11) Reclose the Precoat Tank lid. The Precoat Tank may remain in this condition with the agitator running until needed. ____________

7.2 RESIN PREPARATION

(1) Remove the lid to the Resin Tank 1T-223, and inspect the interior for cleanliness. ____________

(2) Fill [drain] the resin tank as necessary using the Resin Tank 1T-223 Fill [Drain] Header Isolation V-35-24[26], until the water is 2 inches above second level clip. ____________

CAUTION
The Chemistry Coordinator and OSS shall ensure proper safety precautions are observed when handling resin and filter material.

(3) Start Fuel Pool Resin Agitator 1S-247 using local Handswitch HS-3541. ____________

(4) Add resin to 1T-223 as follows:

(a) Add 2 buckets anion resin. ____________

(b) Agitate for 1 min. ____________

(c) Slowly over 3 minutes, add 1 ½ buckets cation resin. ____________

(d) Complete filling 1T-223 to 3 ½ level clips from bottom (3 clips visible). ____________

(5) Continue agitation until the resin slurry is smooth and homogeneous (between 30 to 45 min). Stop the resin agitation. ____________

(6) Remove the resin tank lid and visually inspect it for proper mixing. ____________

(7) Replace the resin tank lid. ____________

7.3 PRECOATING F/D A[B]

> **CAUTION**
>
> During F/D programmed operations, ensure that the Solka-Floc filter media is precoated before the resin is educted; otherwise resin material will not set up on the septums and will be flushed into the effluent.
>
> If the F/D has been secured or in hold for more than 48 hours, vent the F/D prior to precoating to prevent septum damage.

(1) Verify that F/D A[B] has been backwashed and is in the Shutdown Mode, per Section 7.6. ____________

(2) Verify Solka-Floc preparation per Section 7.1 and that the preparation has been agitated a minimum of 15 min. ____________

(3) Verify resin has been prepared per Section 7.2. ____________

(4) Start the resin agitator by placing local Handswitch HS-3541 in the RUN position. Run agitator 15 min prior to precoating. ____________

(5) Verify the Programmer A[B] Precoat Selector Switch in RESIN/SF position at Panel 1C136. ____________

(6) Verify the Resin Timer is set at 30 min in the back of Panel 1C136 to allow complete injection of all the resin. ____________

(7) Depress the Programmer A[B] PRECOAT START pushbutton at Panel 1C136 and hold for at least 10 seconds or until the red PRECOAT light turns ON. (The system will automatically go into the open recirculation mode.) ____________

> **NOTE**
>
> The precoat sequence is a timed operation, unaffected by flow rates, percentage of vessel volume discharged, etc. During the following programmer verifications, the valve number in () corresponds to the White Block valve labels on Panel 1C136. The corresponding P and ID valve number immediately follows.

(8) Monitor the programmer operation at Panel 1C136 by observing the following sequence of events: ________

(a) The precoat lockout relay energizes, preventing backwashing and precoating operations on the other F/D. ________

(b) The Fill Valve (12) CV-3515A[B] and Dome Vent Valve (16) CV-3508 [CV-3503] OPEN to fill and vent the F/D. ________

(c) The Fill Valve (12) CV-3515A[B] CLOSES when water replaces all of the air in the vessel, and then the Dome Vent (16) CV-3508 [CV-3503] CLOSES. ________

(d) The precoat pump starts and the following valves open: ________

Precoat Supply Valve (22) CV-3530A[B]
Precoat Return Valve (19) CV-3526A[B]
Precoat Flow Control Valve (13) CV-3542
Precoat Suction Valve (26) CV-3540

(e) The flow rate increases to 400 gpm as Flow Control Valve (13) CV-3542 OPENS. ________

NOTE

The Solka-Floc should be deposited in about 7 to 10 min.

(f) The resins are educted onto the filter cake as the following valves OPEN: ________

Eductor Suction Valve (24) CV-3539
Eductor Discharge Valve (25) CV-3535

(g) Observe the level of the resin mixture in the Resin Tank, 1T-223 is lowering during the resin coating cycle. ________

NOTE

Should the Resin Tank level become low enough to allow air to enter the eductor suction, immediately close the suction valve and notify the OSS/Chemistry Department of the problem. Do not place the bed in service until approved by the OSS/Chemistry. If necessary, initiate a WRC to adjust the Resin Feed Timer or the eductor supply pressure to prevent air entrapment.

(h) When approaching the time-out of the Resin Feed cycle, verify that sufficient volume remains in the Resin Tank to provide adequate suction to the eductor. __________

(i) Eductor Suction Valve (24) CV-3539 CLOSES. __________

(j) Eductor Discharge Valve (25) CV-3535 CLOSES. __________

(k) The precoat pump rate drops to 267 gpm. __________

(l) Hold Pump 1P-240A[B] starts (red run light). __________

(m) Hold Valve (23) CV-3520A[B] OPENS. __________

(n) Precoat Return Valve (19) CV-3526A[B] and Precoat Flow Control Valve (13) CV-3542 CLOSE. __________

(o) Precoat Discharge Valve (22) CV-3530A[B] CLOSES. __________

(p) Precoat Pump 1P-241 STOPS. __________

(q) Influent Valve (20) CV-3518 [CV-3517] OPENS and the F/D remains in HOLD until ready to be placed in service. __________

(9) Verify the following indications on Panel 1C136: __________

Component	Indication
Influent Valve	Red (open) - ON
Filter Light	Red - OFF
Hold Light	Red - ON
Effluent Flow Control Valve	Green (closed) - ON
Hold Valve	Red (open) - ON

Holding Pump	Red (running) - ON
Low Flow Annunciator	Activated

(10) Check Precoat Tank contents are free from Solka-Floc or resin. __________

(11) Stop 1T-224 agitator 1S-246 using HS-3546. __________

(12) Stop 1T-223 agitator 1S-247 using HS-3541. __________

(13) With OSS concurrence, once fuel pool bed A[B] has been placed into Hold, backwash filter demin outlet strainer YS3514A[B] per section 14.0. __________

7.4 SHIFTING F/D A[B] TO FILTER MODE

(1) Verify that F/D A[B] has been precoated per Section 7.3 and is in hold. __________

(2) Verify the setpoint knob on Indicating Flow controller FRCS-3511A[B] is set at "0". __________

(3) At Panel 1C136, momentarily depress the FILTER START A[B] pushbutton and observe that the red FILTER indicating light illuminates. __________

(4) Slowly adjust FRCS-3511A[B] to 450 gpm while slowly closing Fuel Pool Filter/Demin System Bypass V-34-29 to maintain system pressure about 140 psig as read on PI-3416 in the FPC Heat Exchanger Room. __________

NOTE
During normal operation, Fuel Pool Filter/Demin System Bypass V-34-29 is shut and F/D flow is adjusted to maintain system pressure approximately 140 psig with F/D flow at 450 gpm. The Bypass Valve may be opened, if preferred, to maintain system pressure.

(5) Verify proper F/D status by observing the following indications on Panel 1C136: ____________

Component	Indication
Influent Valve	Red (open) - ON
Effluent Flow Control Valve	Red (open) - ON
Filter Light	Red - ON
Hold Pump	Green (stopped) - ON
Hold Valve	Green (closed) - ON

7.5 SHIFTING F/D A[B] TO HOLD MODE

(1) Verify that F/D A[B] is operating in the filter mode per Section 7.4. ____________

(2) Slowly reduce F/D flow to zero with FRCS-3511A[B] on Panel 1C136 while throttling open Fuel Pool Filter/Demin System Bypass V-34-29 to maintain system pressure approximately 140 psig as read on PI-3416 in the FPC Heat Exchanger Room. ____________

(3) Verify Hold Pump 1P-240A[B] starts and Hold Valve CV-3520A[B] opens when F/D flow reduces to approximately 140 gpm. ____________

(4) Momentarily depress the HOLD A[B] pushbutton for the appropriate F/D on Panel 1C136. ____________

(5) Verify HOLD status of F/D A[B] at Panel 1C136 as follows: ____________

Component	Indication
Filter Light	Red - OFF
Hold Light	Red - ON
Effluent Flow Control Valve	Green (closed) - ON
Influent Valve	Red (open) - ON
Holding Pump	Red (running) - ON
Hold Valve	Red (open) – ON

7.6 BACKWASHING F/D A[B]

NOTE

A F/D shall be backwashed prior to precoating.

(1) Verify that Radwaste is ready to receive backwash. ____________

CAUTION

The HP Shift Technician may restrict access to the Jungle Room during Fuel Pool bed backwashes.

(2) Contact the HP Shift Technician prior to a Fuel Pool bed being backwashed. ____________

(3) Verify that F/D A[B] is in hold per Section 7.5. ____________

(4) Depress the Programmer A[B] BACKWASH Pushbutton on Panel 1C136 for 10 seconds or until the red BACKWASH indicator light turns ON. ____________

NOTE

During the following programmer verifications, the valve number in ( ) corresponds to the White Block valve labels on Panel 1C136.

(5) Monitor the following steps in sequence at Panel 1C136:

(a) The backwash lockout relay energizes, preventing backwash or precoat of the other F/D. __________

(b) Influent Valve (20) CV-3518 [CV-3517] CLOSES. __________

(c) Dome Drain Valve (17) CV-3506 [CV-3502] OPENS. __________

(d) The hold pump remains running with Hold Valve (23) CV-3520A[B] OPEN to maintain the cake on the septums. __________

(e) The Air Inlet Valve (18) CV-3507 [CV-3501] is OPENED and the liquid is ejected through the Dome Drain Valve (17) CV-3506 [CV-3502] by compressed air. __________

(f) When the excess liquid has been ejected, the Dome Drain Valve (17) CV-3506 [CV-3502] CLOSES, and the compressed air pressurizes the vessel to 85 psig minimum. __________

(g) Hold Valve (23) CV-3520A[B] closes and the holding pump stops. __________

(h) Main Drain Valve (21) CV-3504A[B] opens, forcing the contents of the Filter-Demineralizer to the waste sludge tank. __________

(i) The Air Inlet Valve (18) CV-3507 [CV-3501] closes and Vent Valve (16) CV-3508 [CV-3503] opens. __________

(j) After the F/D is drained, the Backwash and Fill Valve (12) CV-3515A[B] opens to flood the vessel for 40 sec. __________

(k) Upon completion of the rinse, the Main Drain Valve (21) CV-3504A[B] closes. __________

(l) The Backwash and Fill Valve (12) CV-3515A[B] cycles open and closed to fill the vessel. __________

(m) The Vent Valve (16) CV3508 [CV-3503] and Backwash and Fill Valve (12) CV-3515A [CV-3515B] CLOSE.

(6) Verify the following indication on Panel 1C136: ____________

Component	Indication
Influent Valve	Green (closed) - ON
Effluent Flow Control Valve	Green (closed) - ON
Shutdown Light	Amber - ON
Hold Valve	Green (closed) - ON
Holding Pump	Green (off) - ON

NOTE

The F/D is in a shutdown condition and ready for precoating per Section 7.3.

(7) Contact the HP Shift Technician when the backwash is complete. ____________

8.0 REACTOR WELL/DRYER SEPARATOR PIT COOLING AND CLEANUP

(1) Verify that the Fuel Pool Cooling System is operating per Sections 3 and 4. ____________

(2) Verify that the fuel pool gates are installed and sealed. ____________

(3) Verify that Reactor Seal Cavity & Fuel Pool Gate Drain Line Isolation V-34-49 is closed. ____________

CAUTION

Failure to install seals will cause water to enter the ventilation system upon filling.

(4) Verify that all Drywell/Torus to Reactor Well vent duct flange seals are installed. ____________

NOTE

If filling the Reactor Well following dry cavity or in-vessel maintenance, skip Steps (5) through (8). Proceed to Step (9).

(5) Verify that the Dryer Separator-Reactor Well shield plugs are removed.

CAUTION

The walls of the Reactor Well and Dryer Separator Pit, along with the dryer and separator should be continuously sprayed down during transfer until both pits are covered to reduce the airborne contamination hazard.

(6) Verify that the Steam Dryer has been transferred to the Dryer Separator pit. ____________

(7) If dry in-vessel or cavity maintenance is scheduled, proceed as follows, otherwise proceed to Step (9). ____________

(a) Adjust the water level to approximately four (4) feet above the bottom of the Dryer Separator canal (or the top of an already installed Dryer Separator-Reactor Well shield plug), with either Condensate Pump 1P-8A[B] per OI 644, Section 6.2, or with an alternate supply such as Core Spray. ____________

(b) Complete transfer of the separator per RFP 108. ____________

NOTE

At this point the transfer of the Separator should have been completed per RFP 108.

(c) Install a Dryer Separator-Reactor Well shield plug per RFP 208. ____________

(d) Raise water level approximately four (4) feet and install the next shield plug. ____________

(e) Repeat Steps (7)(a) through (7)(b) as necessary until all four (4) shield plugs are installed. ____________

NOTE

Water in the Dryer/Separator Pit and/or Reactor Cavity cannot go over the weirs until the Fuel Pool gates are removed or the skimmers will overflow.

(f) Fill the Dryer Separator Pit and Reactor Cavity to just below the weirs and secure the condensate pump (or alternate supply).

(8) Proceed to Section 9 for draining of the Reactor Well. __________

(9) Insure the cavity between the fuel pool gates is flooded (due to leakage past the seals from the Reactor Well) and secure the condensate pump per OI 644, Section 5.4 (or alternate supply). __________

(10) Remove the fuel pool gates, per RFP 109. __________

(11) Move the pool seal from its storage position to its installed position per RFP 304, if required. __________

(12) Open Reactor Well Fuel Pool Cooling Recirculation Line Isolation V-34-14. __________

(13) Throttle pool cleanup return valve(s) CV-3510A[B] by adjusting FRCS-3511[B] on Panel 1C136 to achieve desired refueling volume flow distribution. Dryer/Separator Pit, Reactor Cavity and Spent Fuel Pool level should be established at approx. 37'5", using condensate makeup to the skimmer surge tanks or an alternate supply. __________

> **NOTE**
>
> If water within the reactor vessel is excessively dirty, the reactor water cleanup system may be operated per OI 261 to provide additional filtration.

9.0 REACTOR WELL/DRYER SEPARATOR PIT DRAINING

> **NOTE**
>
> Contact the Plant Chemistry and Radwaste Coordinators before performing this operation.

(1) Verify that adequate room for Reactor Well/Dryer Seperator pit draining exists in Condensate Storage Tanks 1T-5A/B as indicated on Level Indicators LI-5216A CST 1T-5A LEVEL and LI-5217A CST 1T-5B LEVEL on Panel 1C06 or in Radwaste. Inform Radwaste of approximate amount of water to be drained. __________

(2) Verify that the fuel pool gates are in place and the pool seal is in the appropriate mode per RFP 201 and RFP 304. ______

(3) Verify at least one Fuel Pool Demineralizer is in service. ______

(4) Lower level in the reactor well/dryer separator pit and the spent fuel pool by the following steps: ______

> **NOTE**
>
> The Fuel Pool level shall remain above 36 ft.

(a) Station personnel in the following areas: ______

Refuel Floor (to monitor level)
Jungle Room
Skimmer Surge Tank Room

(b) In the Jungle Room, align the drain path to either the CSTs or the Radwaste Surge Tank by opening V-34-15 or V-34-16, respectively. ______

> **NOTE**
>
> When draining, throttle MO-3435 to maintain Skimmer Surge Tank level greater than the low level alarm.

(c) Commence and control draining by throttling open MO-3435 (Fuel Pool Drain) via HS-3435 located at 1C-66 in the Skimmer Surge Tank Room. ______

> **NOTE**
>
> When the level in the Dryer/Separator pit and the Reactor Well drops below the overflow weirs, the drain rate will have to be reduced.

(d) Monitor level at the Refuel Floor. When the level is below the Reactor Well or the Dryer/Separator pit weirs, slowly lower the Surge Tank level to just above the low level alarm and secure draining. ______

(e) Allow the Spent Fuel pool level to stabilize.

CAUTION

When securing the FPC Pumps, ensure the level in the Skimmer Surge Tank is close to the low level alarm to prevent flooding the heating and ventilation ducting.

(5) If the Fuel Pool Cooling System is expected to be secured for longer than four hours, an alternate means of monitoring fuel pool temperature shall be established prior to securing the Fuel Pool Cooling System. While temporary monitoring is in place, fuel pool temperature shall be logged in the Second Assistant's Logs once per shift. ____________

(6) Place filter demineralizers in hold per Section 7.5. ____________

(7) Stop any operating cooling pumps by placing FPC pump 1P-214A[B] Handswitch HS-3409A[B] on Panel 1C66 in the STOP position. ____________

(8) Line up per OI 435A4 (Attachment 4) to drain the reactor well or separator storage pit to the condensate storage tank or waste surge tank. ____________

NOTE

V-34-0013, Fuel Storage Pool FPC RECIRC LINE ISOLATION, may be throttled open to allow return to the fuel pool if needed to control fuel pool level. Additional attention to skimmer level is warranted if this valve is opened to avoid skimmer high level.

(9) Restart FPC Pump 1P-214A[B] at Panel 1C66, by momentarily placing handswitch HS-3409A[B] in the START position. ____________

(10) Return one F/D to the Filter Mode per Section 7.4 as directed by the OSS (only 1 F/D and pump should be used if draining only the Dryer Seperator pit). ____________

(11) Commence draining by throttling MO-3435 (Fuel Pool Drain) open as required to control drain rate. ____________

NOTE

Periodically monitor F/D dP and effluent conductivity (as directed by Chemistry) while draining. Backwash and P/C F/Ds as necessary.

If fuel pool temperature reaches 150°F, shift to fuel pool cooling mode by performing step 13 and restoring FPC until Fuel Pool temperature is < 125 °F.

(12) If applicable, remove the Dryer Separator shield plugs as the water level Lowers per RFP 102. ____________

CAUTION

Do not allow air to enter the cooling pump suctions.

(13) Drain the Reactor Well or Separator pit to the level desired or until the level is near the bottom of the Reactor Well or the Separator Pit. Shift the FPC System mode as follows: ____________

(a) Place operating F/D in hold per Section 7.5. ____________

(b) If the Fuel Pool Cooling System is expected to be secured for longer than four hours, a temporary portable temperature monitor shall be used to directly monitor pool temperature. The temporary temperature monitor shall be installed prior to securing the Fuel Pool Cooling System. While temporary temperature monitoring is in place, Fuel Pool temperature shall be logged in the Second Assistant's Logs once per shift. ____________

(c) Stop operating FPC Pump 1P-214A[B] by momentarily placing handswitch HS-3409A[B] on Panel 1C66 in the STOP position. ____________

(d) Line up for fuel pool cooling per OI 435A4 (Attachment 2). ____________

(e) Operate Fuel Pool Cooling per Section 3. ____________

NOTE

Caution should be observed while draining to the Reactor Building Equipment Drain Sump. An operator should be dispatched to the RCIC Room to initially monitor flow to the sump. If flow is not throttled, damage to the RBED Sump Level Probes may result.

Due to radiological conditions in the area of the RBED Sump, it should NOT be necessary to visually determine the magnitude of drainage flow; rather, it should be sufficient to listen for metal-metal contact (i.e., banging and clanging).

(14) To drain the water from between the fuel pool gates:

(a) Open V-34-49. FUEL POOL COOLING PANEL 1C-65/1C-66 TROUBLE (1C04B, D-2) annunciator will activate on Panel 1C04, and the red Fuel Pool Gate High Leakage lights will turn ON at Panels 1C65 and 1C66. ____________

(b) When the space between the gates is dry, close V-34-49 and reset the annunciator. ____________

(15) Final draining of the reactor well is accomplished as follows:

(a) Open the Reactor Well Seal Cavity Drain Line Isolations V-34-37 and V-34-35 and the Reactor Seal Cavity & Fuel Pool Gate Drain Line Isolation V-34-49. ____________

(b) Acknowledge the FUEL POOL COOLING PANEL 1C-65/1C-66 TROUBLE (1C04B, D-2) annunciator. ____________

(c) Verify that the FUEL POOL CLG. SYS. ALARM computer printout occurs. ____________

(d) Open the Reactor Well Drain to Reactor Building Equipment Drain Sump V-34-31. ____________

(e) Open the Reactor Well Flange Drain Upstream and Downstream Isolations V-34-32 and V-34-33. ____________

(f) Upon completion of draining, close Reactor Well Drain to Reactor Building Equipment Drain Sump V-34-31, Reactor Well Flange Drain Upstream and Downstream Isolations V-34-32 and V-34-33, and Reactor Well Seal Cavity Drain Line Isolations V-34-35 and V-34-37. ________

> **NOTE**
>
> Prior to final draining of the Separator Pit, contact Chemistry and Radwaste to determine the best drain path.

(16) Final draining of the separator pit is accomplished as follows:

(a) If the water is pure, drain to the condenser hotwell by using Dryer/Separator Storage Pit Drain Line Isolation V-34-26 and Dryer/Separator Storage Pit Drain to Condenser V-34-27. ________

(b) If contaminated, the water is drained to the Reactor Building equipment drain sump through Dryer/Separator Pit Drain to Radwaste Equipment Drain Sump V-34-28. ________

> **NOTE**
>
> The RWCU System is used to drain the vessel to normal level per OI 261.

10.0 DRAINING/FILLING SHIPPING CASK POOL

> **NOTE**
>
> Prior to flushing or draining the Cask Pool, a screen may be installed over the drain to prevent large items from getting into the system.

10.1 DRAINING SHIPPING CASK POOL

> **NOTE**
>
> Throttling Skimmer Surge Tanks 1T-61A/B Drain Line Isolation V-34-2 may be necessary to maintain the required draining rate.
>
> Skimmer Surge Tank 1T-61A level shall be monitored during draining to maintain level within normal limits.

(1) Verify Cask Pool Gate installed per RFP 201. ____________

(2) Verify at least one Fuel Pool Demineralizer is in service. ____________

(3) Open Fuel Pool Cask Storage Pit Drain Line Isolation V-34-22. ____________

(4) Throttle open either Fuel Pool Cooling & Cleanup Return to CSTs V-34-15 or Fuel Pool Cooling & Cleanup Return to Waste Sludge Tank V-34-16. ____________

(5) Throttle open Fuel Pool Drain MO-3435 using HS-3435 at Panel 1C66. ____________

(6) Throttle open Fuel Pool, Reactor and Dryer/Separator Pit Drain Header Isolation V-34-23. ____________

(7) Drain Cask Pool to desired level. ____________

(8) Close Fuel Pool, Reactor and Dryer/Separator Pit Drain Header Isolation V-34-23. ____________

(9) Close Fuel Pool Drain MO-3435. ____________

(10) Close Fuel Pool Cooling & Cleanup Return to CSTs V-34-15 if draining to CSTs, or close Fuel Pool Cooling & Cleanup Return to Waste Sludge Tank V-34-16 if draining to waste surge tank. ____________

(11) Close Fuel Pool Cask Storage Pit Drain Line Isolation V-34-22. ____________

(12) Verify open Skimmer Surge Tanks 1T-61A/B Drain Line Isolation V-34-2. ____________

10.2 ALTERNATE METHOD OF DRAINING THE CASK POOL

(1) Verify Cask Pool Gate is installed per RFP 201. __________

(2) Verify Radwaste can accept water from the Cask Pool to 1T-70, Radwaste Collector Tank. __________

(3) Open Fuel Pool Cask Storage Pit Drain Line Isolation V-34-22. __________

(4) Open RX Well Drain Line Isolation V-34-25 and close Reactor Seal Cavity & Fuel Pool Gate Drain Line Isolation V-34-49. __________

> **NOTE**
>
> Opening the next valve will start the draining process. Extreme care shall be taken not to overflow the Rx. Bldg. Equipment Drain Sump. The draining rate should be established such that one sump pump can handle the drain rate.

(5) Throttle open Reactor Well Drain to Reactor Building Equipment Drain Sump V-34-30 no more than two turns and establish flow to the Rx. Bldg. Equipment Drain Sump to within the capacity of the sump pumps. __________

(6) Close the Reactor Well Drain to Reactor Building Equipment Drain Sump V-34-30 to stop Cask Pool draining. __________

(7) Close Reactor Well Drain Line Isolation V-34-25 and the Fuel Pool Cask Storage Pit Drain Line Isolation V-34-22 and open Reactor Seal Cavity & Fuel Pool Gate Drain Line Isolation V-34-49. __________

10.3 DRAINING SHIPPING CASK POOL WITH FUEL POOL HEAT EXCHANGER BYPASSED

> **NOTE**
>
> Throttling Skimmer Surge Tanks 1T-61A/B Drain Line Isolation V-34-2 may be necessary to maintain the required draining rate.
>
> Skimmer Surge Tank 1T-61A level shall be monitored during draining to maintain level within normal limits.

CAUTION
If, at any time, the fuel pool temperature cannot be maintained above 32°F (fuel pool gates installed) or 68°F (gates removed) and less than 150°F, discontinue this procedure, notify the OSS, and return fuel pool cooling to a normal lineup per Section 4.

(1) Verify Cask Pool Gate installed per RFP 201. ___________

(2) Verify temporary temperature monitor installed in Fuel Pool. Temperature shall be logged by NSPEO once per shift. ___________

(3) Verify at least one Fuel Pool Demineralizer is in service. ___________

(4) Bypass the in service Fuel Pool Heat Exchanger as follows:

(a) Throttle V-34-29 (Fuel Pool Filter Demin Bypass Valve) as necessary to maintain system pressure at approximately 140 psig as read on PI-3416 in the F.P.C. Heat Exchanger room. ___________

(b) Open the in service Fuel Pool Heat Exchanger 1E-211A[B] Bypass valve V-34-34[41]. ___________

(c) Close the in service Fuel Pool Heat Exchanger 1E-211A[B] inlet valve V-34-5[9]. ___________

(d) Close the associated Fuel Pool Heat Exchanger 1E-211A[B] RBCCW outlet valve V-12-33[30]. ___________

(5) Open Fuel Pool Cask Storage Pit Drain Line Isolation V-34-22. ___________

(6) Throttle open either Fuel Pool Cooling & Cleanup Return to CSTs V-34-15 or Fuel Pool Cooling & Cleanup Return to Waste Sludge Tank V-34-16. ___________

(7) Throttle open Fuel Pool Drain MO-3435 using HS-3435 at Panel 1C66. ___________

(8) Throttle open Fuel Pool, Reactor and Dryer/Separator Pit Drain Header Isolation V-34-23. ___________

(9) Drain cask pool to desired level.

(10) Close Fuel Pool, Reactor and Dryer/Separator Pit Drain Header Isolation V-34-23. ____________

(11) Close Fuel Pool Drain MO-3435. ____________

(12) Close Fuel Pool Cooling & Cleanup Return to CSTs V-34-15 if draining to CSTs, or close Fuel Pool Cooling & Cleanup Return to Waste Sludge Tank V-34-16 if draining to waste sludge tank. ____________

(13) Close Fuel Pool Cask Storage Pit Drain Line Isolation V-34-22. ____________

(14) Verify open Skimmer Surge Tanks 1T-61A/B Drain Line Isolation V-34-2. ____________

(15) Restore Fuel Pool Heat Exchanger 1E-211A[B] to service as follows: ____________

(a) While monitoring RBCCW pressure on PI-4821(1C06) throttle open Fuel Pool Heat Exchanger 1E-211A[B] RBCCW outlet isolation V-12-33[30] until desired RBCCW pressure is achieved. ____________

(b) Throttle V-34-29 (Fuel Pool Filter Demin Bypass Valve) as necessary to maintain system pressure at approximately 140 psig as read on PI-3416. ____________

(c) Open Fuel Pool Heat Exchanger 1E-211A[B] Inlet valve V-34-5[9]. ____________

(d) Close Fuel Pool Heat Exchanger 1E-211A[B] Bypass valve V-34-34[41]. ____________

10.4 FILLING SHIPPING CASK POOL

10.4.1 FILLING SHIPPING CASK POOL WITH CONDENSATE SERVICE WATER

(1) Station personnel at cask pool and fill with condensate service water from hose stations located around the reactor well and spent fuel pool. ____________

10.4.2 FILLING SHIPPING CASK POOL FROM FUEL POOL SYSTEM

(1) Station an operator on the Refuel Floor to monitor fuel pool and cask pool levels. ________

(2) Throttle open Fuel Pool Cooling System Makeup Water Supp. Header Downstream Isolation V-34-20 and maintain skimmer surge tank level within normal limits. ________

(3) Throttle open Fuel Pool Cask Storage Pit Fuel Pool Cooling Supply Isolation V-34-17. ________

(4) When desired, close Fuel Pool Cask Storage Pit Fuel Pool Cooling Supply Isolation V-34-17. ________

(5) Close Fuel Pool Cooling System Makeup Water Supp. Header Downstream Isolation V-34-20. ________

11.0 DRAINING THE SKIMMER SURGE TANK

(1) Verify at least one Fuel Pool Demineralizer is in service. ________

(2) Verify that V-34-2 Skimmer Surge Tanks 1T-61A/B Drain Line Isolation is open. ________

(3) Monitor Skimmer Surge Tank level on local indicator LI-3412A or on Panel 1C04 LI-3412 SKIMMER SURGE TNK LVL. ________

(4) Throttle open either Fuel Pool Cooling & Cleanup Return to CSTs V-34-15 or Fuel Pool Cooling & Cleanup to Waste Sludge Tank V-34-16. ________

(5) Throttle open Fuel Pool Drain MO-3435 using HS-3435 at Panel 1C66. ________

NOTE
Skimmer Surge Tank low level alarm is set at 41.5 inches.

(6) Close MO-3435 and V-34-15 or V-34-16 when the desired level is achieved.

12.0 DRAINING THE RPV BELLOWS

(1) Verify that Radwaste is ready to accept water that is drained from the RPV bellows to the RB Equipment Drain Sump. __________

(2) Coordinate with the Refuel Floor to monitor level in the RPV bellows while draining is in progress. __________

> **NOTE**
>
> FIS-3403 will alarm if the drain flow is >5 gpm. This should be considered as an expected alarm during draining. Flow should be throttled as necessary to avoid overfilling the RB Equipment Drain Sump in the RCIC Room.

(3) Verify that V-34-49, Reactor Seal Cavity & Fuel Pool Gate Drain Line Isolation, is OPEN. __________

(4) To commence draining, throttle OPEN V-34-35 and V-34-37, Reactor Well Seal Cavity Drain Line Isolation Valves, in the caged equipment area on the RB 812' level. __________

(5) When the Refuel Floor reports that the bellows is drained sufficiently, CLOSE Reactor Well Seal Cavity Drain Line Isolations V-34-35 and V-34-37. __________

13.0 FUEL POOL COOLING HEAT EXCHANGER FLUSH

> **NOTE**
>
> The following steps direct all fuel pool cooling flow through one FPC heat exchanger at a time with both F/Ds in service to flush the FPC side of each heat exchanger.

> **CAUTION**
>
> If, at any time, the fuel pool temperature cannot be maintained above 32°F (fuel pool gates installed) or 68°F (gates removed) and less than 150°F, discontinue this procedure, notify the OSS, and return fuel pool cooling to a normal lineup per Section 4.

(1) Per Section 7, backwash, precoat and place in filter mode both fuel pool cooling filter demins. ____________

(2) Per Section 3, place Fuel Pool Cooling in service with 2 pumps running, 2 heat exchangers in service and 2 F/Ds in filter mode. ____________

(3) Record Filter Demineralizer A/B ΔP as found on PDIS-3512A[B] on Second Assistant's Logs. ____________

> **CAUTION**
>
> When changing flow to the FPC heat exchangers, flow to other components served by RBCCW will be affected.

(4) Maintain fuel pool temperature above 32°F (fuel pool gates installed) or 68°F (gates removed) and less than 150°F (90°F is preferable) by adjusting RBCCW flow to the in-service heat exchanger(s) 1E-211A[B] with HX Outlet Valves V-12-33[30]. ____________

(5) Verify Fuel Pool Filter/Demin System Bypass V-34-29 open as necessary to maintain system pressure about 140 psig with F/D flow 450 gpm maximum. ____________

(6) Open Fuel Pool HXs 1E-211A/B Inlet Cross-Connect V-34-40. ____________

(7) Close HX 1E-211B[A] Inlet Valve V-34-9[5]. ____________

> **CAUTION**
>
> FPC Filter Demineralizer A/B will isolate at 25 psid.

(8) While flushing either heat exchanger, if either FPC Filter Demineralizer A[B] reaches 10 psid, remove it from service, backwash, precoat and return it to service per Section 7. ____________

(9) Flush the selected heat exchanger 1E-211A[B] for about 8 hours. ____________

(10) Record Filter Demineralizer A/B ΔP as found on PDIS-3512A[B] on Second Assistant's Logs.

(11) Place the other FPC Heat Exchanger 1E-211B[A] in service by opening V-34-9[5]. ____________

(12) Remove the FPC heat exchanger that has been flushed from service by closing V-34-5[9]. ____________

(13) Record Filter Demineralizer A/B ΔP as found on PDIS-3512A[B] on Second Assistant's Logs. ____________

(14) Throttle Fuel Pool Filter/Demin System Bypass V-34-29 as necessary to maintain system pressure about 140 psig with F/D flow at 450 gpm. ____________

(15) Flush the selected heat exchanger 1E-211B[A] for about 8 hours. ____________

(16) Record Filter Demineralizer A/B ΔP as found on PDIS-3512A[B] on Second Assistant's Logs. ____________

(17) Notify Health Physics to survey the Fuel Pool Cooling Heat Exchanger Room to determine if area dose rates have changed. ____________

(18) If necessary, backwash and precoat both F/Ds per Section 7. ____________

(19) Restore FPC to a normal operational status per Section 4. ____________

14.0 BACKWASHING FILTER DEMIN OUTLET STRAINER YS3514A[B]

(1) Place Fuel Pool bed in hold per Section 7.5 ____________

(2) Close V-35-001[2], F/D 1T-206A Outlet Isolation ____________

CAUTION
The following steps will send water to Radwaste. Make sure they are ready to receive the water

(3) Throttle Open V-35-11[30], YS-3514A[B] Flushing Lines Isolation~~ion~~. ____________

(4) Open V-35-3[4], YS-3514A[B] Drain To Waste Sludge Tank f~~e~~or~~r~~ approximately 1-2 minutes~~es~~. ____________

(5) Close V-35-03[4], YS-3514A[B] Drain To Waste Sludge Tan~~ank~~. ____________

(6) Close V-35-11[30], YS-3514A[B] Flushing Lines Isolation~~on~~. ____________

(7) Open V-35-01[2], F/D 1T-206A[B] outlet Isolation~~on~~. ____________

(8) Operate Fuel Pool F/D per OSS. ____________

15.0 REFERENCES

(1) DAEC Tech. Specs.

(2) DAEC UFSAR, Section 9.1

(3) OI 149, OI 261, OI 414, OI 518.1, OI 537, OI 644

(4) ARP 1C04B

(5) RFP 102,108,109,201, 208, 304

(6) BECH-M109, BECH-M112, BECH-M119, BECH-M134, BECH-M135, BECH-M137, BECH-M140

(7) BECH-M404, Sheet 18

(8) BECH-E123, Sheet 2

(9) BECH-E845

(10) APED-G41-006, APED-G41-017

(11) APED-G41-018, Sheet 2

(12) APED-G41-2929-007, APED-G41-2929-019

(13) MM 133, MM 135, MM 149

(14) DCP 1450, DCP 1451

(15) INPO SER 17-90

(16) NG-92-4044

(17) DDC 2174

(18) AR 960470, AR 16672, AR 19179

Enclosure 4 to

NG-01-0459

DAEC OUTAGE MANAGEMENT GUIDELINES	OMG-7
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Effective Date:

TECHNICAL REVIEW

Prepared by: ______________________ Date: ____________

Validated by: ______________________ Date: ____________
Outage Management Staff

Verified by: ______________________ Date: ____________
Operations Staff

Reviewed by: ______________________ Date: ____________
Risk Assessment Staff

PROCEDURE APPROVAL

I am responsible for the technical content of this procedure.

Approved by Procedure Owner: ______________________ Date: ____________
Maintenance Supervisor-Work Management

FOR INFORMATION ONLY

Table of Contents

1.0 PURPOSE

Industry operating experience has shown that plants are susceptible to a variety of abnormal events during shutdown conditions. These events have included problems with reactivity control, inventory control, and decay heat removal. This procedure describes the methods and means utilized for risk assessment and management of DAEC outages.

Furthermore, this procedure defines the roles and responsibilities of nuclear division departments in supporting the process of assessing and managing outage risks during the planning, scheduling, and implementation of outages at DAEC.

2.0 APPLICABILITY

(1) This procedure applies to the planning, scheduling, and implementation of outages.

(2) This procedure applies to Nuclear Generation Division (NGD) personnel tasked with supporting the development of the outage planning, scheduling, and implementation.

(3) This procedure should be used as a guideline, significant deviation from these guidelines should receive the concurrence of the Maintenance Supervisor-Work Management and Plant Manager.

(4) The guidelines established in this procedure provide criteria for maintaining a Defense-In-Depth beyond plant technical specifications, for vital risk management functions. This guideline also supplements existing DAEC Operating Procedures. If conflicts arise between these guidelines and Technical Specifications or DAEC Operating Procedures, Technical Specifications and Operating Procedures take precedence and shall be adhered to until such time that resolution occurs.

3.0 DEFINITIONS

Available - The ability of a system (not required to be operable by Tech Specs) to perform its intended function with the following assumptions:

(a) Credit may be taken for reasonable operator action.

(b) Credit may be taken for temporary equipment (e.g., temporary power supply).

(c) Structural integrity is maintained.

(d) Restrictions/Criteria for Environmental Qualification (EQ), seismic, fire protection, or single failure need not be maintained.

(e) Tech Spec/ASME Section XI surveillances need not be current.

(a) **Cold Shutdown** - Cold Shutdown exists when the Reactor Mode Switch is in the SHUTDOWN position and indicated reactor coolant temperature ≤ 212°F.

6.2.7 NON-REFUELING OUTAGE SAFETY REVIEW

(1) Outage Management will review non-refueling outage work scope and schedules for assessing shutdown risk in the areas of decay heat removal, vessel inventory control, electrical support systems, and containment control per Section 6.3 of these guidelines.

~~(3)~~ (2) Outage Management will ensure that shutdown risk is reviewed and monitored. Considerations may include:

(a) ~~Outage Management should~~ performing an assessment of the area of risk and provide a risk management plan of ensuring Defense-In-Depth via alternate system availability or contingency planning.

(b) reviewing and approving the risk management plan by the Operations Manager, and distribution with the forced/planned outage schedules.

(c) an independent review of the risk management plan may be performed by the Risk Assessment Group of Long-Term Program Engineering.

6.3 SHUTDOWN SAFETY ISSUES

NOTE

The issues that are described in this section have been identified through the review of industry experience, analytical insights of conditions during plant shutdown and through discussions with experienced individuals from several utilities, industry organizations, and NRC staff. The issues are categorized into 5 main sections that represent key safety functions during shutdown. These functions are decay heat removal capability, inventory control, electrical power availability, reactivity control, and containment. The following sections discuss the relationship of each to safety and provide guidelines to ensure that they are addressed.

6.3.1 DECAY HEAT REMOVAL CAPABILITY

(1) Maintaining decay heat removal capability is a principal safety function during shutdown conditions. During refueling outages, the RHR System is the primary means of removing decay heat under normal conditions. Upon loss of the RHR System, many other systems and components may be used to remove decay heat depending on the following:

- Plant configuration
- Availability of other key systems and components

- Ability of operators to diagnose and respond properly to the event.

(2) Providing a Defense-In-Depth for decay heat removal capability, commensurate with the plant conditions as called for in IPOI-8, can effectively enhance shutdown safety. An extended loss of the RHR System can result in depletion of reactor coolant and uncovering of the core. Proper outage planning and scheduling can reduce the likelihood of a loss of RHR event and can also aid in effective mitigation of the event.

> **NOTE**
>
> To reach the refueling condition nominally requires 3 days from the time of achieving cold shutdown. Therefore, decay heat levels will be significantly reduced. Additionally, due to the cavity being flooded the water volume increase results in a heat sink of much greater magnitude than in the cold shutdown mode.

(3) AOP 149, "Loss of Decay Heat Removal", provides guidelines to plant operators on recovery from the loss of RHR capability during shutdown conditions. The procedure provides the alternate cooling methods that may be employed for a given set of conditions during an outage. This procedure has been developed from a technical basis considering: initial level of decay heat, Time-To-Boiling, Initial RPV Water Inventory Condition (Normal Vessel Level or RPV Flooded), and Contingency plans for decay heat removal via relief valves to support the overall loss of RHR system strategy.

~~(5)~~ (4) AOP 149, "Loss of Decay Heat Removal", also provides guidelines to plant operators if the fuel pool is to be isolated from the reactor cavity (i.e., fuel pool gates installed) during a complete core off-load. In this event the following actions will be taken:

(a) Both loops of Fuel Pool Cooling should be maintained AVAILABLE.

(b) RHR should be maintained AVAILABLE and lined up in the Fuel Pool Cooling Mode per OI-149, RHR System, to provide backup decay heat removal capability.

(c) If Step (b) cannot be performed then a temporary backup cooling system should be available as a backup to the normal Fuel Pool Cooling System.

~~(6)~~ (5) When outage activities require securing RBCCW or GSW, the following actions should be taken:

(a) The scheduled out-of-service period should be during low decay heat levels in the fuel pool. (e.g., prior to core off-load or late in the outage after core re-load.)

(b) Fuel pool heatup rate verses out-of-service time should be evaluated to ensure that fuel pool temperature can be maintained within the desired limits.

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(c) If Step (b) cannot be performed then a temporary backup cooling system should be provided for fuel pool heat rejection.

6.3.2 INVENTORY CONTROL

> **NOTE**
>
> Control of reactor coolant system inventory is essential to maintaining the overall decay heat removal function. During reduced inventory operations boiling and potential fuel damage may occur in a relatively short period of time. The reactor coolant pressure boundary expands during shutdown periods to include the decay heat removal piping, spent fuel pool, refueling cavity and other connected support systems. This presents a significant number of potential inventory loss flow paths that are normally isolated during power operation.

(1) During Cold Shutdown Conditions the following scheduling criteria should be utilized:

(a) A CRD pump should be maintained in an AVAILABLE condition for normal vessel level control.

(b) A Core Spray Subsystem should be maintained in an AVAILABLE condition for emergency vessel makeup.

(c) If normal vessel inventory control systems cannot be maintained AVAILABLE then an alternate inventory control system should be maintained AVAILABLE.

(2) During refueling conditions with the cavity flooded the following scheduling criteria should be utilized for vessel inventory control:

(a) The normal vessel inventory control systems (CRD pump & Core Spray Pump) should be maintained in an AVAILABLE condition.

(b) If a CRD Pump is not required to be operating for rod movement during core alterations, then the normal inventory control may be changed to condensate service water via the CRD System for control rod drive seal flushing.

(c) With the cavity flooded, inventory control is accomplished by maintaining level in the fuel pool and skimmer surge tanks using the Fuel Pool Cooling System. Therefore, two drain paths should be AVAILABLE.

(d) If the CRD cooling/flush water is to be removed from service, then at least one alternate means of injection should be AVAILABLE for makeup to the refueling cavity or fuel pool. Alternate systems are listed in IPOI-8.

ABNORMAL OPERATING PROCEDURE

AOP 149

LOSS OF DECAY HEAT REMOVAL

Enter the following as applicable:

LOSS OF FUEL POOL COOLING

LOSS OF FUEL POOL COOLING

IMMEDIATE ACTIONS

None

AUTOMATIC ACTIONS

- None.

FOLLOW-UP ACTIONS

1. During periods when the core is off loaded and the fuel pool gates are installed, the primary decay heat removal system is Fuel Pool Cooling. Upon loss of the system, attempt to return at least one loop to service. _______

> **NOTE**
>
> Calculated Spent Fuel Pool (SFP) heatup rates and decay heat generation curves should be used when determining when to place the Fuel Pool Cooling Mode of RHR in service. When decay heat is high, consideration should be given to placing the Fuel Pool Cooling Mode of RHR in service when SFP temperature approaches 120 °F to preclude exceeding the operating limit of 150 °F. {C002}

2.	**IF**	the plant is in Mode 4 or Mode 5, and the Fuel Pool Cooling System cannot be returned to service before SFP temperature reaches 150 °F	**THEN**	stop fuel transfer to the SFP if in progress and initiate the temporary cooling system, if installed _______ **OR** initiate the fuel pool cooling mode of RHR. _______
3.	**IF**	no cooling system can be reestablished for the SFP	**THEN**	perform the following: a. Take hourly local SFP temperature readings to monitor the pool and heatup rate. This may be relaxed to once per shift once a heatup rate is established. _______ b. Use the curve in Appendix 3 to estimate the maximum heatup rate for the fuel pool and perform a time-to-boil calculation per IPOI 8. Ensure ESW is lined up and available for SFP makeup prior to exceeding 200 °F. _______ c. Notify Health Physics to begin increased monitoring of the Refuel Floor for airborne radiation. _______ d. Verify ventilation is lined up to the fuel pool by opening AV-7604V and operating refuel pool exhaust fan 1V-EF-10. _______

LOSS OF FUEL POOL COOLING

FOLLOW-UP ACTIONS (continued)

e. Notify maintenance to expedite repairs to the Fuel Pool Cooling System. _______

4. **IF** SFP temperature reaches 212 °F AND inventory is being lost due to local boiling **THEN** initiate makeup from Condensate Service Water and/or ESW. _______

CAUTION

Overflow from the Skimmer Surge Tank will flood RB ventilation ductwork and discharge into the Torus Room.

5. Monitor Skimmer Surge Tank Level while performing emergency makeup to the Spent Fuel Pool. _______

6. **WHEN** the FUEL POOL HI/LO LEVEL ALARM, 1C04B (A-4) clears **THEN** Secure SFP makeup from Condensate Service Water and/or ESW. _______

7. **WHEN** repairs are completed on the Fuel Pool Cooling System **THEN** return the system to service per OI 435 _______

PROBABLE ANNUNCIATORS

1C04B, D-2 FUEL POOL COOLING PANEL 1C-65/1C-66 TROUBLE

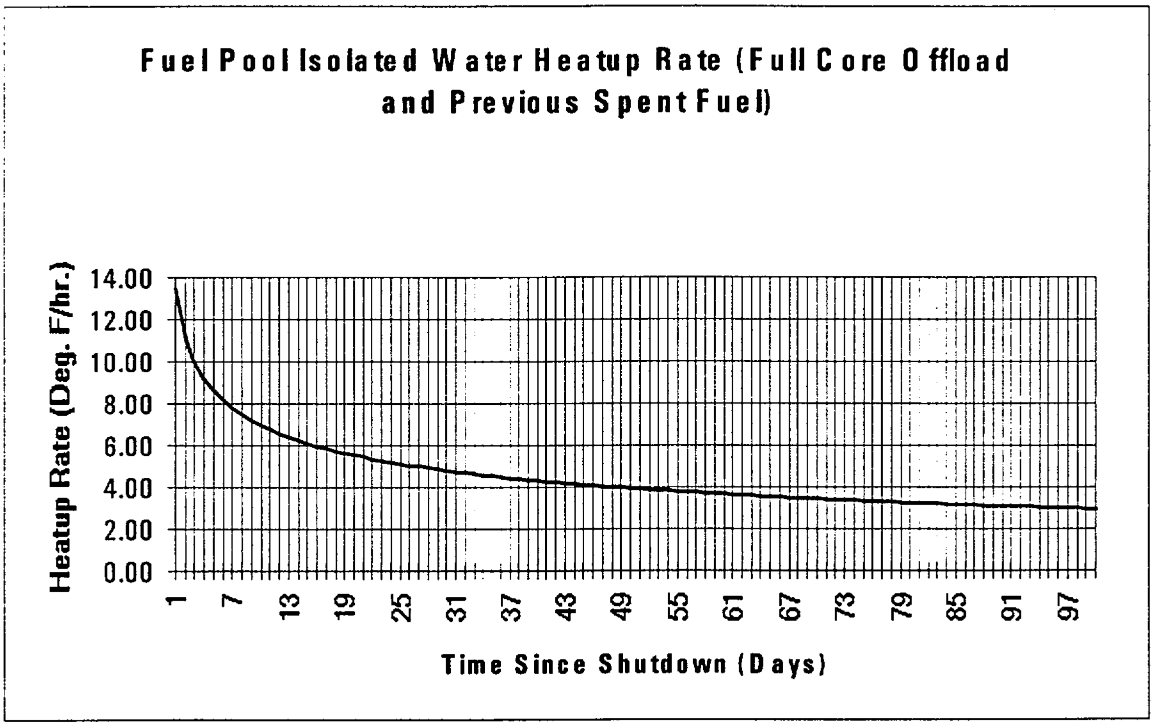
PROBABLE INDICATIONS

1C06

- Loss of RBCCW pressure
- Loss of GSW pressure

APPENDIX 3

LOSS OF FUEL POOL COOLING HEATUP RATE CURVE



CAUTION

The initial heatup rate in the spent fuel pool may be higher than the calculated value when cooling is removed from service. The calculation used to generate the heatup rate curves assumes instantaneous mixing and heat transport from the fuel area to the remainder of the system volume. In addition, the calculated heatup rates reflect bulk temperatures not local temperatures. Under natural circulation conditions and the resulting time delay in heat transport, considerable differences in temperature may exist between the fuel area and measured temperatures in fuel pool cooling heat exchanger inlets.

OPERATING INSTRUCTION

OI 149

RESIDUAL HEAT REMOVAL SYSTEM

Effective Date:

TECHNICAL REVIEW

Prepared by: ______________________ Date: __________

Validated by: ______________________ Date: __________
Operations Staff

Verified by: ______________________ Date: __________
System Engineer

Reviewed by: ______________________ Date: __________
Operations Committee

PROCEDURE APPROVAL

I am responsible for the technical content of this procedure.

Approved by Procedure Owner: ______________________ Date: __________
Operations

Approved by: ______________________ Date: __________
Plant Manager, Nuclear

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1.0 PURPOSE

To provide detailed instructions to the plant operating personnel for proper operation of the Residual Heat Removal System.

2.0 PRECAUTIONS AND LIMITATIONS

(1) Following maintenance of RHR System components, the pumps and piping shall be vented and filled per Section 10, Fill and Vent of the RHR System, prior to placing the system in Standby/Readiness Condition to avoid hydraulic hammer.

(2) If the pump discharge piping depressurizes below the alarm setpoint for greater than 10 seconds while required to be operable, comply with the requirements of Tech. Specs. for ECCS-Operating and ECCS-Shutdown.

(3) Once LPCI initiates do not divert LPCI flow unless adequate core cooling is assured or unless directed by EOPs.

(4) Drywell or Torus Spray should only be performed as directed by EOPs or SAGs.

(5) The Torus water volume and temperature shall be maintained per the requirements of Tech. Specs. for Suppression Pool Average Temperature. Maintain Torus water temperature above 55°F during normal operation.

(6) Prior to initiating Shutdown Cooling mode, backflush the RHR System to Radwaste (RW).

(7) Emergency flooding of the RPV or Primary Containment shall be performed only as directed by EOPs or SAGs.

(8) RHR PUMP 1P-229A or C [B or D] 186M L.O. RELAY shall be reset at Essential Switchgear 1A3[1A4] following a pump trip on overcurrent or ground fault. Prior to resetting any lockout relay, OSS permission shall be obtained.

(9) RHR PUMPS 1P-229A and C[B and D] are interlocked to prevent operation if no suction path is available.

(10) The following RHR Loop B components are controlled from remote Shutdown Panel 1C388, with Control Room controls disabled, when the associated transfer switches are in the EMER position at Panel 1C388A:

Component	Description
1P-229B and D	RHR Pumps B and D
MO-1908 (controlled from 1C390)	Shutdown Cooling Suction Valve
MO-1909, MO-1912, MO-1920	Shutdown Cooling Suction Valve
MO-1989, MO-1913, MO-1921	Torus Suction Valve
MO-1941	Heat Exchanger 1E-201B Outlet
MO-1939	Heat Exchanger 1E-201B Inlet
MO-1940	Heat Exchanger 1E-201B Bypass
MO-1935	Minimum Flow Valve
MO-1934	Full Flow Test Throttle Valve
MO-1932	Torus Spray Isolation
MO-1904	Outboard Injection Throttle Valve
MO-1905	Inboard Injection Isolation

(11) Each RHR MIN FLOW VALVE MO-2009 and MO-1935 has time delay relays installed to prevent the valve from automatically opening/closing until the valve has been CLOSED/OPEN for a nominal 2 seconds.

(12) Prolonged operation (over one hour) at minimum flow should be avoided. It may result in serious pump degradation.

(13) If Shutdown Cooling flow is lost and cannot be promptly restored, a Reactor Recirculation pump should be started to restore forced recirculation in the reactor vessel. Comply with the requirements of T.S. for RHR SDC-Hot Shutdown, RHR SDC-Cold Shutdown, RHR-High Water Level and RHR-Low Water Level.

(14) Planned outages of Shutdown Cooling during Cold Conditions or flow reduction to less than 4000 gpm with **NO** Recirc pumps running during Cold Conditions shall be approved by the Plant Manager, Nuclear or his designee.

(15) Perform a "Time-To-Boil" calculation prior to planned outages of shutdown cooling during cold shutdown conditions.

(16) If the plant is in the cold shutdown condition, with irradiated fuel in the vessel, and forced circulation is unavailable or shutdown cooling flow is less than 4000 gpm, maintain reactor water level above the minimum natural circulation level, 214 inches, as indicated on LI-4541 (WR GEMAC, FLOODUP) on 1C04, to ensure natural circulation. Comply with the requirements of T.S. for RHR SDC-Hot Shutdown, RHR SDC-Cold Shutdown, RHR-High Water Level and RHR-Low Water Level.

(17) If forced circulation is unavailable, periodic monitoring of vessel metal temperatures and coolant shall be initiated per STP 3.4.9-01.

(18) The cables associated with valves MO-2003, MO-2004, MO-2005, and MO-2007 are not fire protected and the valves may require manual operator action if a fire occurs in the Torus 716' north and west areas, the north CRD module area, or the RHR valve room. Refer to AOP-913, FIRE, Tab RB1.

MO-2003 (RHR Loop A Inboard Injection)
MO-2004 (RHR Loop A Outboard Injection)
MO-2005 (RHR Loop A Torus Spray and Cooling Supply Header Isolation)
MO-2007 (RHR Loop Torus Cooling and TEST Return Header Isolation)

(19) Shutdown Cooling flow with **NO** recirc pumps running shall be greater than 4000 gpm to provide proper mixing of reactor vessel water. Shutdown Cooling flow with **NO** recirc pumps running may be reduced to 2000 gpm for circumstances which require less flow with Reactor water level above the minimum natural circulation level (214 inches as indicated on LI-4541, WR GEMAC Floodup). When operating RHR Shutdown Cooling and recirc in **PARALLEL** the Shutdown Cooling flow is required to be > 2000 gpm and < 4800 gpm, this insures adequate RHR pump minimum flow protection and that the RECIRC pump is not dead headed against the RHR SDC flow.

(20) RHR Pump starts should be limited to two starts per hour when the pump **has not** been running within the previous hour. (i.e.: two starts cold) This **does not** apply under emergency conditions.

(21) RHR Pump starts should be limited to one start per hour when the pump **has** been running within the previous hour. (i.e.: one start hot) This **does not** apply under emergency conditions.

(22) If the interlocks between the RHR pump Torus suction valves and Shutdown Cooling valves or the interlock between the pump Shutdown Cooling valves and the Torus cooling/spray valves are inoperable, operation of RHR in Shutdown Cooling constitutes an OPDRV.

(23) Closing V-19-48 or MO-2010 in Mode 3 renders the LPCI mode of RHR inoperable. Comply with Technical Specifications 3.5.1.

3.0 PLACING THE RHR SYSTEM IN STANDBY/READINESS CONDITION

(1) Verify the following systems are operational or able to support operation of the RHR System:

RHR Service Water System, OI 416 ____________
ESW System, OI 454 ____________
Instrument and Service Air System, OI 518.1 ____________
Condensate/Demin. Service Water System, OI 537 ____________
RB HVAC System, OI 734 ____________
Steam Leak Detection System, OI 858 ____________

(2) Verify 1V-AC-11 and 1V-AC-12 RHR and Core Spray Pump Room Cooling Units are operational. ____________

(3) Complete the RHR System Electrical Lineup per OI 149A1 (Attachment 1). ____________

(4) Complete the "A" RHR System Valve Lineup and Checklist per OI 149A2 (Attachment 2 and 3). ____________

(5) Complete the "B" RHR System Valve Lineup and Checklist per OI 149A4 (Attachment 4 and 5). ____________

(6) Complete the RHR System Control Panel Lineup per OI 149A6 (Attachment 6). ____________

(7) Following maintenance of RHR System components, the pumps and piping shall be vented and filled per Section 14, Fill and Vent of the RHR System, prior to placing the system in Standby/Readiness Condition to avoid hydraulic hammer. ____________

9.2.2 ENABLING DIVISION 2 SDC GROUP 4 ISOLATION (RPS BUS B)

(a) At panel 1C03, close MO-1908 and MO-1909 by momentarily placing handswitch HS-1908 and HS-1909 to the CLOSE position. ____________

(b) At panel 1C32[1C-33], remove relay block from E11-K63A[B] contacts 5 to 6 to enable MO-2003[MO-1905] isolation. ____________

(2) At panel 1C32, place keylock handswitch HS-1937B to the NORMAL position to enable MO-1937 isolation. ____________

(3) At Panel 1C14, verify annunciator Group 2 MO-1936 or MO-1937 OVERRIDE (1C14A, C-5) reset. ____________

(4) At panel 1C42, remove the following jumpers and lifted leads:

(a) Remove jumper from terminal BB-41 to BB-42. ____________

(b) Remove jumper from terminal BB-40 to CC-35. ____________

(c) Land wire 12R from terminal BB-44 (cable 2D4206C). ____________

(5) Position MO-1908 and MO-1909 as directed by the OSS. ____________

10.0 SUPPLEMENTAL FUEL POOL COOLING

CAUTION

The RHR System can ONLY be used for Fuel Pool Cooling mode with Shutdown Cooling in service when:

The LPCI mode of RHR is not required to be operable, (Refer to Tech. Specs. and Bases for ECCS-Shutdown)

The reactor vessel head is removed,

The reactor vessel cavity and fuel pool are flooded,

The fuel pool gates are removed to prevent overfilling or draining of the fuel pool.

10.1 SUPPLEMENTAL FUEL POOL COOLING STARTUP

> **NOTE**
>
> The cooling capability of the RHR and Fuel Pool Cooling Systems may be required to maintain fuel storage pool temperatures less than 150°F after a full core off-load of fuel (NORMAL HEAT LOAD) from the reactor.
>
> Notify Access Control H.P. Technicians that supplemental fuel pool cooling is about to be started. Rad levels in plant areas may change.

10.1.1 SYSTEM STARTUP

(1) Verify Fuel Pool gates removed. ____________

(2) Verify Fuel Pool Cooling system is in operation per OI-435. ____________

(3) Transfer Fuel Pool Cooling System return from fuel pool to reactor well as follows: ____________

 (a) Verify OPEN V-34-14, Reactor Well FPC Recirc. Line Isolation. ____________

 (b) CLOSE V-34-13, Fuel Storage Pool FPC Recirc. Line Isolation. ____________

(4) Verify the RHR and Fuel Pool Cooling blank flanges are removed, and the removable spool piece (elevation 812' in cage area) is installed. ____________

(5) Verify RHR System is operating in Shutdown Cooling mode per Section 5.4. ____________

(6) Initiate Supplemental Fuel Pool Cooling as follows:

 (a) Confirm RHR loop flow indication on FI-1971A[B] A[B] RHR LOOP FLOW, on Panel 1C03. ____________

 (b) Unlock and OPEN V-19-144, RHR RETURN CROSSTIE TO FUEL POOL COOLING ISOLATION. ____________

(7) Vent RHR to FPC Crosstie Header by performing the following:

 (a) Open V-34-92 RHR CROSS-CONNECT LINE VENT.

(b) Slowly open V-34-93 RHR CROSS-CONNECT LINE VENT until a solid stream of water is observed, then close V-34-93. ____________

(c) Close V-34-92 RHR CROSS-CONNECT LINE VENT. ____________

(d) Unlock and slowly OPEN V-34-48 CROSS-CONNECT FROM RHR. ____________

(8) Adjust RHR flow to fuel storage pool by throttling MO-1904[2004] as required to direct more flow to the Fuel Pool. ____________

NOTE

Verify Fuel Pool Cooling flow is maintained at 450 gpm per pump after adjusting RHR System flow.

(9) Operate the RHR System per Section 5.4 as necessary to maintain the desired temperature of the following components as indicated on the associated multi-point recorder: ____________

Component	Recorder	Panel
REACTOR VESSEL TEMPERATURES	TR-4569	1C04
FUEL POOL (1E-211A and B HX OUTLET)	TRS-1945	1C21

10.1.2 SYSTEM SHUTDOWN

(1) Fully reopen MO-1904 [2004] and operate the RHR System per Section 5.4 as necessary. ____________

(2) Shut down the Supplemental Fuel Pool Cooling by closing and locking the following valves: ____________

Valve	Description	Position
V-19-144	RHR RETURN CROSSTIE TO FUEL POOL COOLING ISOLATION	CLOSED
V-34-48	FUEL POOL COOLING SYSTEM RHR RETURN LINE ISOLATION	CLOSED

(3) Operate the Fuel Pool Cooling System per OI 435 as necessary. ____________

(4) Remove the removable spool piece and reinstall the blank flanges, if desired.

10.2 SUPPLEMENTAL FUEL POOL COOLING WITHOUT SHUTDOWN COOLING IN SERVICE

CAUTION

The RHR System can only be used in the Fuel Pool Cooling Mode when the LPCI Mode of RHR is not required to be operable per Technical Specs. Refer to Tech. Specs. and Bases for ECCS-Shutdown.

10.2.1 SYSTEM STARTUP

NOTE

For planned terminations of Fuel Pool cooling flow, the temporary temperature monitor shall be in place prior to terminating flow. While temporary temperature monitoring is in place, Fuel Pool temperature shall be logged in the Second Assistant's Logs once per shift.

(1) Verify the Fuel Pool Cooling System is shutdown per OI 435. __________

(2) Tag closed V-34-13 (Fuel Pool Storage FPC Recirc Line Isolation) and V-34-02 (Skimmer Surge Tank 1T-61 A/B Drain Line Isol.) __________

(3) Verify closed V-34-48 (Fuel Pool Cooling System RHR Return Line Isolation) and V-34-01 (Fuel Pool Cooling System RHR Supply Line Isol.) __________

NOTE

Using 'B' RHR Loop for Supplemental Fuel Pool Cooling makes all other 'B' side RHR functions inop. Using 'A' RHR Loop for Supplemental Fuel Pool Cooling makes all 'A' and 'B' RHR functions inop. Therefore, the 'B' RHR Loop is the preferred Loop for Fuel Pool Cooling.

(4) Defeat RHR Pump 1P-229A or C [B or D] No-Suction-Path trip for the pump to be started by lifting the following leads: __________

Pump	Description
1P-229A	EE-16, 1C32
1P-229B	EE-16, 1C33
1P-229C	EE-3, 1C32
1P-229D	EE-3, 1C33

(5) Position as indicated and place tags on the following equipment in order to prevent inadvertent draining of the reactor vessel and the fuel pool: ____________

(a) For placing RHR Loop A in Fuel Pool Cooling: ____________

Valve	Description	Position
MO-1920	D PUMP SHUTDOWN CLG SUCTION	CLOSE
MO-1912	B PUMP SHUTDOWN CLG SUCTION	CLOSE
V-19-48	RHR LOOP CROSSTIE	OPEN
MO-1937	INBD RHR DRAIN TO RW ISOL	CLOSE
MO-1936	OUTBD RHR DRAIN TO RW THROTTLE ISOL	CLOSE
MO-2012	A PUMP TORUS SUCTION	CLOSE
MO-2015	C PUMP TORUS SUCTION	CLOSE
MO-2005	OUTBD TORUS CLG/SPRAY	CLOSE
MO-2007	TORUS COOLING/TEST	CLOSE
MO-2009	MIN FLOW BYPASS	CLOSE
MO-2000	INBD DRYWELL SPRAY	CLOSE
MO-2001	OUTBOARD DRYWELL SPRAY	CLOSE
MO-2044A	A RHR HX SHELL OUTBD VENT	CLOSE
1B3426	POWER SUPPLY FOR MO-2009	OPEN
V-19-124	"A" RHR LOOP KEEP FILL SUPPLY LINE STOP CHECK	CLOSE
MO-2010	RHR CROSSTIE	OPEN
MO-1904	OUTBD LPCI INJECT	CLOSE
MO-1905	INBD LPCI INJECT	CLOSE
V-19-144	RHR RETURN CROSSTIE TO FUEL POOL COOLING ISOLATION	OPEN
MO-1908	INBD SDC SUCTION	CLOSE
MO-1909	OUTBD SDC SUCTION	CLOSE
MO-1903	OUTBD DRYWELL SPRAY	CLOSE
MO-1902	INBD DRYWELL SPRAY	CLOSE
MO-1932	OUTBD TORUS COOLING/SPRAY	CLOSE
MO-1934	TORUS COOLING TEST	CLOSE
MO-1940	B HEAT EXCH BYPASS	CLOSE
MO-1941	B HEAT EXCH DISCHARGE	CLOSE
Valve	Description	Position
MO-2003	INBD LPCI INJECT	CLOSE
MO-2004	OUTBD LPCI INJECT	CLOSE
V-34-25	REACTOR WELL DRAIN LINE ISOLATION	CLOSE

(b) For placing RHR Loop B in Fuel Pool Cooling: ____________

Valve	Description	Position
MO-2011	A PUMP SHUTDOWN CLG SUCTION	CLOSE
MO-2016	C PUMP SHUTDOWN CLG SUCTION	CLOSE
MO-2010	RHR CROSSTIE	CLOSE
MO-1937	INBD RHR DRAIN TO RW ISOL	CLOSE
MO-1936	OUTBD RHR DRAIN TO RW THROTTLE ISOL	CLOSE
MO-1921	D PUMP TORUS SUCTION	CLOSE
MO-1913	B PUMP TORUS SUCTION	CLOSE
MO-1932	OUTBD TORUS CLG/SPRAY	CLOSE
MO-1935	MIN FLOW BYPASS	CLOSE
MO-1902	INBD DRYWELL SPRAY	CLOSE
M0-1903	OUTBOARD DRYWELL SPRAY	CLOSE
MO-1949A	B RHR HX SHELL OUTBD VENT	CLOSE
MO-1934	TORUS COOLING/TEST	CLOSE
1B4430	POWER SUPPLY FOR MO-1935	OPEN
V-19-20	"B" RHR LOOP KEEP FILL SUPPLY LINE STOP CHECK	CLOSE
MO-1904	OUTBD LPCI INJECT	CLOSE
MO-1905	INBD LPCI INJECT	CLOSE
V-19-144	RHR RETURN CROSSTIE TO FUEL POOL COOLING ISOLATION	OPEN
MO-1908	INBD SDC SUCTION	CLOSE
MO-1909	OUTBD SDC SUCTION	CLOSE
V-34-25	REACTOR WELL DRAIN LINE ISOLATION	CLOSE

(6) OPEN RHR pump Shutdown Cooling suction valves on Panel 1C03 , as follows:

(a) For placing RHR Loop A in service ____________

Valve	Description	Position
MO-2011	A PUMP SHUTDOWN CLG SUCTION	OPEN
MO-2016	C PUMP SHUTDOWN CLG SUCTION	OPEN

(b) For placing RHR Loop B in service ____________

Valve	Description	Position
MO-1912	B PUMP SHUTDOWN CLG SUCTION	OPEN
MO-1920	D PUMP SHUTDOWN CLG SUCTION	OPEN

NOTE

Fuel Pool Cooling Panel 1C-65/1C-66 Trouble Alarm will come in due to skimmer surge tank high level when performing the following step.

(7) Raise Fuel Pool Skimmer Surge Tank Water Level to 135 inches per OI 435 for increased RHR Pump NPSH and to allow for skimmer surge level drop when starting RHR Pump. ____________

(8) Vent/fill system as follows:

(a) In the RHR Valve Room, Open V-19-46, "B" RHR LPCI Header Condensate Service Water Inboard Isolation. ____________

(b) Slowly open V-19-45, "B" RHR LPCI Header Condensate Service Water Outboard Isolation. ____________

(c) In RB 3rd floor cage, Open V-34-92, Fuel Storage Pool RHR Return Line Inboard Vent. ____________

(d) Slowly open V-34-93, Fuel Storage Pool RHR Return Line Outboard Vent, until a solid stream of water is observed, then close V-34-93. ____________

(e) Close V-34-92, Fuel Storage Pool RHR Return Line Inboard Vent. ____________

(f) Close V-19-45, "B" RHR LPCI Header Condensate Service Water Outboard Isolation. ____________

(g) Close V-19-46, "B" RHR LPCI Header Condensate Service Water Inboard Isolation. ____________

(h) In the Torus area, Open V-19-27, "B" RHR Loop Flushing Water Supply Inboard Isolation. ____________

(i) Slowly open V-19-26, "B" RHR Loop Flushing Water Supply Outboard Isolation to pressurize the RHR suction piping with Condensate Service. ____________

(j) In the Skimmer Surge Tank room, Open V-19-198 RHR SDC INBOARD VENT ISOLATION. ____________

(k) Slowly open V-19-199 RHR SDC OUTBOARD VENT ISOLATION until a solid stream of water is observed, then close V-19-199. ____________

(l) Close V-19-198 RHR SDC INBOARD VENT ISOLATION. ____________

(m) Close V-19-26 and V-19-27 RHR SDC OUTBOARD and INBOARD VENT ISOLATION. ____________

NOTE

Fuel Pool Skimmer Surge Tank water level may drop when opening V-34-01. Prepare to make up water to the Skimmer Surge Tanks to maintain level.

(9) Position the following valves: ____________

Valve	Description	Position
V-34-48	FUEL POOL COOLING SYSTEM RHR RETURN LINE ISOLATION	OPEN
V-34-01	FUEL POOL COOLING SYSTEM RHR SUPPLY LINE ISOLATION	OPEN

(10) Start up RHR Service Water System per Section 4 of OI 416 and throttle flow to 1E-201A[B] HX as required at a flowrate of between 2000 gpm and 2600 gpm per running RHRSW pump. ____________

(11) Verify 1V-AC-12[11] A[B] RHR/CS RM CLG UNIT in operation on Panel 1C23. ____________

(12) Verify A[B] ESW Pump is in operation. ____________

(13) Verify CLOSED MO-2029[1939] A[B] HEAT EXCH INLET on Panel 1C03. ____________

NOTE

Fuel Pool Cooling Panel 1C-65/1C-66 Trouble Alarm will clear when skimmer surge tank level drops below high alarm point when the RHR pump is started.

CAUTION

Total Fuel Pool Cooling flow shall NOT be greater than 1300 gpm to prevent Fuel Pool Water inventory from overflowing into the FPCC weir ventilation ductwork.

The heat exchanger inlet valve should be throttled open within 10 seconds after starting an RHR pump to ensure adequate minimum flow for the pump.

(14) Start RHR Pump 1P-229A or C [B or D] by placing the associated hand switch on Panel 1C03 in the START position: __________

Switch	Description
HS-2014 [1915]	RHR PUMP 1P-229A[B]
HS-1028 [1923]	RHR PUMP 1P-229C[D]

CAUTION

RHR Pumps can operate at approximately 1200 gpm for 14 days with respect to minimum flow requirements. However, the pumps should be monitored periodically for signs of overheating.

(15) IMMEDIATELY throttle OPEN MO-2029[1939] A[B] HEAT EXCH INLET valve on Panel 1C03 until FI-1971A[B] A[B] RHR LOOP FLOW indicates 1200 gpm. __________

(16) Per OI 435, maintain Fuel Pool Skimmer Surge Tank water level high in green band for increased RHR Pump NPSH. __________

(17) Verify the following:

(a) RX WATER LEVEL indications are not increasing or decreasing. __________

(b) Verify Fuel Pool Skimmer Surge Tank Level and Fuel Pool Level indications LI-3412 and LI-3413 on 1C04 are constant.

(18) Monitor Fuel Pool Temperature via temporary monitoring.

10.2.2 SYSTEM SHUTDOWN

CAUTION

Securing the RHR Pump will cause a rise in skimmer surge tank level.

NOTE

Minimize time between lowering fuel pool skimmer surge tank level and securing RHR pump to minimize potential RHR pump cavitation.

(1) Per OI 435, reduce Fuel Pool Skimmer Surge Tank water level to 75 inches. ______

(2) Close MO-2030[1940] A[B] HEAT EXCH BYPASS valve and MO-2029[1939] A[B] HX INLET valve on Panel 1C03. When the valves close, immediately perform Step (3). ______

NOTE

Fuel Pool Cooling Panel 1C-65/1C-66 Trouble Alarm may come in when skimmer surge tank reaches the high level alarm point when level rises when the RHR pump is secured.

(3) Secure RHR Pump 1P-229A or C [B or D], by placing the associated hand switch on Panel 1C03 in the STOP position: ______

Switch	Description
HS-2014[1915]	RHR PUMP 1P-229A[B]
HS-2018[1923]	RHR PUMP 1P-229C[D]

(4) Close and lock the following valves: ______

Valve	Description	Position
V-19-144	RHR RETURN CROSSTIE TO FUEL POOL COOLING ISOLATION	CLOSED
V-34-1	FUEL POOL COOLING SYSTEM RHR SUPPLY LINE ISOLATION	CLOSED
V-34-48	FUEL POOL COOLING SYSTEM RHR RETURN LINE ISOLATION	CLOSED

(5) Operate the RHR System per Section 5.4 as necessary.

(6) Operate the Fuel Pool Cooling System per OI 435 as necessary.

10.3 ADDING WATER TO THE SPENT FUEL POOL VIA RHR

> **CAUTION**
>
> Performance of adding water to the spent fuel pool via RHR will make LPCI and Containment Spray Inoperable.

(1) Verify RHR System in operation with capability to inject from the Torus to the spent fuel pool. ____________

(2) Station personnel on the Refuel Floor, if accessible, to observe fuel pool level. ____________

(3) Unlock and slowly open V-19-144 RHR RETURN CROSSTIE TO FUEL POOL COOLING ISOLATION. ____________

(4) Vent the RHR to FPC Crosstie Header by performing the following:

(a) Open V-34-92 FUEL STORAGE POOL RHR RETURN LINE INBOARD VENT. ____________

(b) Slowly open V-34-93 FUEL STORAGE POOL RHR RETURN LINE OUTBRD VENT until a solid stream of water is observed, then close V-34-93. ____________

(c) Close V-34-92. ____________

> **CAUTION**
>
> Performance of the following step will cause RHR system flow to increase. Do not let the system pressure drop below the low-pressure alarm setpoint and monitor pump motor amps.

(5) In coordination with the personnel (if available) on the Refuel Floor , unlock and slowly throttle open V-34-48 (FUEL POOL COOLING SYS RHR RETURN LINE ISOL) valve as necessary. ____________

(6) Control Fuel Pool level , by throttling V-34-48 as necessary.

(7) Secure filling as follows:

(a) Close and lock V-34-48 ____________

(b) Close and lock V-19-144. ____________

11.0 RHR SYSTEM PRESSURIZING, FILLING, AND VENTING WITH THE CONDENSATE SERVICE SYSTEM

> **CAUTION**
>
> Since the Condensate Service Water System is not SAFETY-RELATED, the length of time it is aligned to the RHR System should be minimized.

(1) Pressurize the RHR System with Condensate Service Water as follows: ____________

> **NOTE**
>
> If keylock MO-2010 RHR CROSSTIE valve, and V-19-48 RHR LOOP CROSSTIE are OPEN, both RHR loops can be pressurized by opening any set of Condensate Service Water supply valves listed in Step (1)(a) or (b).

(a) Pressurize RHR Loop A by OPENING either set of valves: ____________

Valve	Description
V-20-17	"A" RHR LPCI HEADER CONDENSATE SERVICE WATER OUTBOARD ISOLATION
V-20-18	"A" RHR LPCI HEADER CONDENSATE SERVICE WATER INBOARD ISOLATION
V-20-43	CROSSTIE "A" SIDE FLUSH WATER SUPPLY ISOLATION
V-20-44	RHR CROSSTIE HEADER FLUSH WATER SUPPLY ISOLATION