PROCEDURE COVER SHEET

PENNSYLVANIA POWER & LIGHT CO. SUSQUEHANNA STEAM ELECTRIC STATION	
FUEL POOL DECAY HEAT REMOVAL	TP-235-011 Revision 0 Page 1 of 18

EFFECTIVE DATE: 9/25/92

PERIODIC REVIEW FREQUENCY: 2 years

PERIODIC REVIEW DUE DATE: 9/25/94

REVISED PERIODIC REVIEW DUE DATE: _____

PROCEDURE TYPE: (✓) PORC (___) NON-PORC

REVIEW TYPE: (___) Expedited Review.

(___) Alternate Review.

(✓) PORC Review.

SPECIAL TEST/EVOLUTION OR INFREQUENT COMPLEX TEST (___) YES (✓) NO

Prepared by [signature] Date 8-24-92

Reviewed by [signature] Date 9/24/92
Responsible Supervisor

Recommended [signature] Date 9/24/92
Section Head/Manager

PORC Meeting 92-134 Date 9-25-92

Approved by [signature] Date 9/25/92

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1.0 PURPOSE

To provide direction in monitoring Fuel Pool temperature with respect to Fuel Pool Cooling system decay heat removal capabilities. This information will be used to determine when a Service Water system outage can occur with reasonable assurances Fuel Pool temperatures will not exceed the ~~110°F~~ 115°F administrative limit.

2.0 DISCUSSION

The Unit 2 Fuel Pool has a normal spent fuel decay heat load due to spent fuel from previous refuelings. The BTU/Hr value is relatively constant, at 2 x 10^6 btu/hr based on past measurements and will increase gradually over time. During outages, Service Water is taken out of service. This removes Fuel Pool Heat Exchanger cooling on the outage unit. An alternate means of cooling the outage unit's Fuel Pool is required.

Plant design allows the non-outage unit's Fuel Pool Cooling system to cool both Fuel Pools by cross-tying the pools through the Cask Storage Pit. One Fuel Pool Cooling system is normally capable of cooling two pools full of normal spent fuel decay heat, however when fresh spent fuel is removed from the vessel the elevated decay heat could cause elevated Fuel Pool temperatures.

To this end, this procedure determines when, after core offload, Fuel Pool Cooling (i.e., Service Water), can be removed from service, and the outage unit's Fuel Pool can be cooled by the other unit's Fuel Pool Cooling system.

The non-outage unit's Fuel Pool Heat Exchangers are typically cleaned by PM's prior to each outage. Adequate heat exchange can be verified by the temperature monitoring method as described in EPRI Heat Exchanger Performance Monitoring Guidelines. This adequacy is demonstrated by approximately a 30°F delta T between Service Water and Fuel Pool water at full load and is derived from the original heat exchanger data sheet. Therefore if Service Water temperature is less than 85°F the heat exchangers can be expected to maintain the Fuel Pools below the 115°F administrative limit.

The Nuclear Fuels group provides a curve of decay heat for each outage of the expected Fuel Pool temperatures vs. time. This curve can be used to predict the heat loads on the Fuel Pool Cooling system on a given day.

The FSAR limit for Fuel Pool Temperature is 125 Deg. F per FSAR Section 9.1.3. This limit is based on Calculation MAI-78-74 which determined that no boiling in any fuel assembly will occur if bulk Fuel Pool Temperatures do not exceed 125 Deg. F. An administrative limit of 115 Deg. F has been chosen to provide sufficient margin between the FSAR limit in addition to providing an action level to project worst-case Fuel Pool Temperatures and to also consider providing additional/alternate means of cooling to the Fuel Pools (i.e. increasing Unit 1 Service Water Flow to the Unit 1 Fuel Pool Heat Exchangers), restoring other cooling means (i.e. Restoring RHR Shutdown Cooling, Restoring Unit 2 Service Water), or utilizing other cooling means (Utilize Unit 2 RHR in Fuel Pool Cooling Assist Mode.) Also, if this administrative limit is exceeded, HP will be notified to perform increased monitoring of Elev. 818' due to the higher Fuel Pool Temperatures.

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Service Water temperature is a function of weather and reactor power. It's value changes daily and can only be trended against past values. Past values can be found in Process Computer points AWT01.

3.0 REFERENCES

3.1 Safety Evaluation NL-88-006 (3/17/88), Operation With the Shipping Cask Storage Pit Gates Removed

3.2 Safety Evaluation NL-88-009 (3/23/88), Fuel Pool Cooling Heat Removal Capacities

3.3 Safety Evaluation NL-89-026 (4/18/89), Fuel Pool Cooling as Primary Heat Removal

3.4 M-153 Sh. 1&2, Unit 1 Fuel Pool Cooling and Cleanup

3.5 M-2153 Sh. 1&2, Unit 2 Fuel Pool Cooling and Cleanup

3.6 J-453 Sh. 3, Loop Diagram, Fuel Pool Temperature

3.7 J-2453 Sh. 3, Loop Diagram, Fuel Pool Temperature

3.8 Specification 8856-M-16, Fuel Pool Heat Exchanger Data Sheet

3.9 FSAR 9.1.3.1, Fuel Pool Cooling System

3.10 EPRI NP-7552, December 1991, Section 6, Heat Exchanger Performance Monitoring Guidelines, Temperature Monitoring Method

3.11 Calculation NAI-[illegible]-74

4.0 TEST EQUIPMENT

~~4.1 Two (2) RTD Data loggers, Telog Model 2104-1~~ NONE

5.0 NOTES & PRECAUTIONS

5.1 Attachment A has been provided to document signatures of all Test Personnel conducting steps on this test.

5.2 For test steps which cannot be completed as a result of unresolved discrepancies, the test director will identify actions taken to restore the system to a safe condition. These actions will be clearly identified and cross-referenced to the Test Control Documentation Form - Attachment B.

5.3 Sequential steps within each section of this procedure must be performed in the order specified. However, the order of procedure sections can be altered by the test director as necessary.

5.4 Attachment B, Test Control Documentation, has been provided for recording substantial test occurrences which requires Group Supervisors concurrence. Non-substantial occurrences and resolutions should also be documented on the form.

5.5 If testing reveals a system inconsistency, at the test directors discretion, troubleshooting may be performed to identify the discrepancies. Actions taken will be recorded in the Work Authorization and on the Test Control Documentation Form - Attachment B as required. Any discrepancies shall be corrected through the appropriate change mechanisms.

5.6 Maximum Service Water Temperature (°F) - the assumed maximum service water temperature on Unit 1 at the same time the Unit 2 service water outage is to begin. The temperature is obtained by review of plant computer history data of service water temperature for a period of time.

5.7 Time Since Shutdown (days) - the time from reactor shutdown (all control rods in) to the present time.

5.8 Proposed Service Water Outage Start Time Since Shutdown (days) - the scheduled time from reactor shutdown to the start of the proposed service water outage.

5.9 Decay Heat (BTU/Hr) - the heat generated by the reactor fuel and fuel by-products after the reactor is shutdown (all control rods in). For purposes of this instruction this heat is divided into two (2) parts.

5.9.1 The heat associated with fuel to be removed from the reactor vessel during refueling.

5.9.2 The heat associated with fuel already located in the fuel pool from previous outages.

5.10 Decay Heat from the Curve (BTU/hr) - the decay heat at a time Since Shutdown associated with fuel to be removed from the reactor vessel during refueling as determined by Nuclear Fuels group supplied curves.

5.11 Decay Heat in both Pools (BTU/hr) - the decay heat associated with fuel already in both unit's Duel pools prior to removing any fuel from the reactor vessel during refueling.

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5.12 Total Heat to be Removed (BTU/hr) - the sum of the Decay Heat from the Curve and the Decay Heat in both Pools.

5.13 Heat Exchanger Delta Temperature (°F) - the predicted delta temperature between the fuel pool cooling heat exchanger outlet and inlet on the fuel pool water side at a given Total heat to be Removed. A fuel pool cooling system consists of three (3) heat exchangers each with the same inlet temperature but possibly different outlet temperatures depending of service water flow to and performance of that exchanger. This arrangement is simplified by assuming the heat exchangers have the same heat exchanger delta Temperature for calculation purposes.

5.14 Minimum Fuel Pool Temperature (°F) - for a Unit 2 service water outage, the lowest fuel pool temperature that could be obtained by the Unit 1 fuel pool cooling system at a given heat load at the Maximum Service Water Temperature.

5.15 Maximum Fuel Pool Temperature (°F) - the absolute maximum FSAR limit is 125°F. The guideline temperature, based on sound engineering judgement, is ~~120°F~~ 115°F. This value is chosen to provide an adequate margin of safety.

PCAF

5.16 Expected Fuel Pool Temperature Range (°F) - for a Unit 2 service water outage, the predicted range of fuel pool temperatures at a given heat load assuming the Unit 1 fuel pool cooling system was using approximately the Maximum Service Water Temperature.

5.17 Actual Peak Service Water Temperature (°F) - for a Unit 2 service water outage, the maximum recorded Unit 1 service water temperature after removal of the Unit 2 fuel pool cooling system as a heat sink.

5.18 Actual Peak Fuel Pool Temperature (°F) - for a Unit 2 service water outage, the maximum recorded fuel pool temperature on either unit after removal of the Unit 2 fuel pool cooling system as a heat sink.

6.0 PREREQUISITES

6.1 Nuclear Fuels Engineering has provided Unit 2 End Of Cycle Decay Heat Calculation for use in determining when the newly offloaded fuel's decay heat is within the capabilities of one Fuel Pool Cooling system. Attach the calculation to Attachment C.

Confirmed By / Date

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6.1.1 CONFIRM Unit 1 Fuel Pool Heat Exchangers 1E202A,B&C are in service.

Confirmed By / Date

6.1.2 CONFIRM Unit 2 Fuel Pool Heat Exchangers 2E202A,B&C are in service.

Confirmed By / Date

~~6.2 I&C is available to support this test; WA #~~

~~Confirmed By / Date~~

6.3 Shift Supervision has given permission to begin this test.

Confirmed By / Date

PCAF

7.0 PROCEDURE

7.1 Determination of Maximum Fuel Pool Temperatures.

7.1.1 ~~SETUP two (2) RTD Dataloggers to record maximum RTD values every 30 minutes.~~

ENSURE Fuel Pool Level/Temperature recorders LR/TR-15347 and LR/TR-25347 are operational.

Confirmed By / Date

PCAF

~~7.1.2 CONNECT a RTD Datalogger to Fuel Pool Temperature probe, TE-15313 spare RTD and log temperatures. Use OCEII TD-3-5,6,87.~~

~~Confirmed By / Date~~

~~7.1.3 CONNECT a RTD Datalogger to Fuel Pool Temperature probe, TE-25313 spare RTD and log temperatures. Use OCEII TD-2-5,6,87.~~

~~Confirmed By / Date~~

7.2 Determining Pre-Outage Fuel Pool Heat Exchanger capabilities.

7.2.1 RECORD and calculate the Unit 2 Fuel Pool Cooling Water Flow and Heat Exchanger values as shown on Attachment D as required.

_____/_____
Confirmed By Date

7.2.2 RECORD and calculate the Unit 1 Fuel Pool Cooling Water Flow and Heat Exchanger values as shown on Attachment D as required.

_____/_____
Confirmed By Date

NOTE: These calculated values should be approximately 2 x 10^6 BTU/Hour. This value is based on previous decay heat data.

7.2.3 REPEAT this section by recording Unit 1 and Unit 2 data at an interval determined by the test director.

7.3 Determining Defueled Unit 2 Fuel Pool Heat Loads

7.3.1 CONFIRM that the Unit 2 Reactor Core is unloaded into the Unit 2 Fuel Pool.

_____/_____
Confirmed By Date

7.3.2 CONFIRM Cask Storage Pit Gates removed from both units connecting both Fuel Pools together.

_____/_____
Confirmed By Date

7.3.3 On the NFE supplied Decay Heat Curve, (Attachment C), locate the day of the scheduled Unit 2 Service Water outage. Record the approximate BTU value and the scheduled outage day below.

BTU/Hour _____, Service Water Outage Day _____

_____/_____
Confirmed By Date

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7.3.4 Approximately three (3) days before the above day, PERFORM the following:

a. If Fuel Pool Gates removed, REQUEST OPERATIONS remove RHR Service Water Cooling from the Unit 2 vessel.

_____ / _____
Confirmed By Date

b. CLOSE Fuel Pool Hx A Service Wtr Inlet Vlv 210090.

_____ / _____
Confirmed By Date

c. CLOSE Fuel Pool HX B Service Wtr Inlet Vlv 210092.

_____ / _____
Confirmed By Date

d. CLOSE Fuel Pool Hx C Service Wtr Inlet Vlv 210094.

_____ / _____
Confirmed By Date

NOTE: During this section Fuel Pool Temperatures may peak above the ~~160F~~ 115°F administrative limit. This situation is acceptable because the Service Water system is still available; and can be returned to service by performing the restoration section of this procedure.

PCAF

e. Continue to MONITOR Unit 1 Fuel Pool Temperature using ~~the datalogger installed~~ in section 7.1.
LR/TR-15347 referenced

_____ / _____
Confirmed By Date

f. Continue to MONITOR Unit 2 Fuel Pool Temperature using ~~the datalogger installed~~ in section 7.1.
LR/TR-25347 referenced

_____ / _____
Confirmed By Date

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g. PLOT the Unit 1 Fuel Pool Temperature, at the discretion of the Test Director, noting any cycling. Attach the plots to Attachment E.

_____/_____
Confirmed By Date

h. PLOT the Unit 2 Fuel Pool Temperature, at the discretion of the Test Director, noting any cycling. Attach the Plots to Attachment E.

_____/_____
Confirmed By Date

i. RECORD and calculate the Unit 1 Fuel Pool Cooling Water Flow and Heat Exchanger values as shown on Attachment D as required.

_____/_____
Confirmed By Date

j. CONFIRM data on Attachment D shows approximately 30°F delta T between Service Water Inlet and Fuel Pool Inlet, and the heat removed approximates the values given on the Decay Heat curve (Attachment C).

_____/_____
Confirmed By Date

7.3.5 CONFIRM the Unit 1 Fuel Pool temperature cycles throughout the day and does not exceed 115°F. Note maximum temperature in Attachment F.

_____/_____
Confirmed By Date

7.3.6 CONFIRM the Unit 2 Fuel Pool temperature cycles throughout the day and does not exceed 115°F. Note maximum temperature in Attachment F.

_____/_____
Confirmed By Date

PCAF

7.3.7 REVIEW the current Unit 1 and Unit Fuel Pool data with, but not limited to, the following considerations. Note findings in Attachment F.

a. The outdoor weather is not abnormally cool.

b. The other Unit is not in a forced outage or at a reduced power level giving low Service Water temperatures.

c. Review past Unit 1 & 2 Service Water Pump Discharge Temperature Computer points AWT01 to compare with current data.

d. The other Unit is not operating with reduced Circ. Water flow.

e. Any other condition that could be construed as being responsible for abnormal Service water cooling.

7.4 RECOMMEND to OPS to remove the Unit 2 Service Water system from service based on confirmation of Unit 1 Fuel Pool Cooling capacity and pool temperatures not exceeding 115°F.

OR

7.5 RECOMMEND to OPS to return the Unit 2 Fuel Pool Clg Hx to service when the Fuel Pool temperatures exceed 115°F or other items noted in step 7.3.6 are not indicative of adequate heat removal.

NOTE: The 115°F administrative limit can only be increased up to the 125°F FSAR limit with the appropriate PORC approvals.

7.6 If recommendation made to OPS to remove Unit 2 Service Water from service (Step 7.4), PERFORM the following:

7.6.1 CONTINUE to monitor Fuel Pool Temperatures/heat Exchanger Capacities/Service Water Temperatures in accordance with Steps 7.3.4.e through 7.3.6

Confirmed By

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NOTE: IF UNIT 1 SERVICE WATER TEMPERATURE EXCEEDS 85 DEG F, UNIT 1/UNIT 2 FUEL POOL TEMPERATURES MAY EXCEED ADMINISTRATIVE LIMIT OF 115 DEG F.

7.6.2 If Fuel Pool Temperatures exceed administrative limit of 115 Deg F, PERFORM the following:

a. NOTIFY HP to perform increased monitoring on Elev. 816' based on higher Fuel pool Temperatures.

_____
Confirmed By

b. CALCULATE worst-case Fuel Pool Temperatures based on projected weather patterns, service water temperatures, and decay heat values.

_____
Confirmed By

c. Based on 7.6.2.b above, RECOMMEND to Plant Management/operations to consider performing the following as necessary:

1. INCREASE Unit 1 Service Water Flow to Unit 1 Fuel Pool Heat Exchangers (NSE support required.)

NOTE: Unit 1 Service Water pressure must be monitored and remain approximately 10 psi above Unit 1 Fuel Pool Cooling Pressure.

AND/OR

2. RESTORE Unit 2 RHR Shutdown Cooling to the Reactor Vessel IAW OP-249-002.

AND/OR

3. RESTORE Unit 2 Service Water to the Unit 2 Fuel Pool Cooling Heat Exchangers IAW OP-235-001.

AND/OR

4. PLACE Unit 2 RHR System in Fuel Pool Cooling Assist Mode IAW OP-249-003.

AND/OR

5. PLACE Unit 1 RHR System in Fuel Pool Cooling Assist Mode IAW OP-149-003.

_____
Confirmed By

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7.7 If recommendation made to OPS to return Unit 2 Service Water to service to the Unit 2 Fuel Pool Heat Exchangers, (Step 7.5), PERFORM the following:

7.7.1 CONTINUE to monitor Unit 1/Unit 2 Fuel Pool Temperatures/heat Exchanger Capacities IAW Steps 7.2.1, 7.2.2, and 7.3.4.e through 7.3.4.h.

_____
Confirmed By

7.7.2 REVIEW data in Step 7.7.1 above, projected weather patterns and subsequent Unit 1 Service Water Temperatures.

_____
Confirmed By

7.7.3 Based on review of data in 7.7.2, RE-PERFORM Steps 7.3.4 through 7.3.7.

_____
Confirmed By

7.7.4 PERFORM Step 7.4 OR Step 7.5 of this procedure.

_____
Confirmed By

PAGE

8.0 RESTORATION

~~8.1 REMOVE the Unit 1 Fuel Pool Temperature Datalogger from OCCII-TB-3-5,6,17.~~

~~_____ / _____
Confirmed By Date~~

~~8.2 REMOVE the Unit 2 Fuel Pool Temperature Datalogger from OCCII-TB-2-5,6,17.~~

~~_____ / _____
Confirmed By Date~~

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8.1 OPEN Fuel Pool Hx A Service Wtr Inlet Vlv 210090.

_____/_____
Confirmed By Date

8.2 OPEN Fuel Pool Hx B Service Wtr Inlet Vlv 210092.

_____/_____
Confirmed By Date

8.3 OPEN Fuel Pool Hx C Service Wtr Inlet Vlv 210094.

_____/_____
Confirmed By Date

8.4 NOTIFY OPS that the Unit 2 Fuel Pool Clg Hx's are back in service.

_____/_____
Confirmed By Date

9.0 ACCEPTANCE CRITERIA

9.1 Unit 1 Fuel Pool Cooling System is capable of maintaining both Unit 1 and Unit 2 Fuel Pools below the 110°F (115°F) administrative limit.

_____/_____
Confirmed By Date

10.0 REVIEW

10.1 Confirm that the ~~Chemistry~~ N555-Vessel Systems Group Supervisor has reviewed the completed procedure and the results are acceptable.

_____/_____
Group Supervisor Date

11.0 RECORDS

11.1 The original completed procedure is to be transmitted to DCC for permanent record retention under file R48-1, "Completed Technical Procedures" and cross-referenced to S235, Fuel Pool Cooling.

TEST PERSONNEL SIGNATURE SHEET

Sheet ____ of ____

NAME	SIGNATURE	INITIALS

Attachment B
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TEST CONTROL DOCUMENTATION

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Nuclear Fuels Engineering
End of Cycle Decay Heat Curve

Attach supplied curve here

Attachment D
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Unit 2 Heat Removal

FI-25323 Fuel Pool Clg Wtr on Pnl 2C206 _____GPM

TI-28724 Service Water Inlet Temp. _____°F

TRSH-25316 pen 4, Fuel Pool Hx Inlet Temp. _____°F

TRSH-25316 pen 1,2,&3 Average Fuel Pool Hx Outlet Temp. =

$$\left(\frac{\_\_ + \_\_ + \_\_}{3}\right)°F = \quad °F \text{ ave}$$

Heat removal from Unit 2 Fuel Pool Cooling System =

$$\left(\text{FT-25324gpm}\right)\left(\frac{FT^3}{7.48\ gallon}\right)\left(\frac{62.4\ lb}{FT^3}\right)\left(\frac{60\ min}{hour}\right)\left(\frac{1\ BTU}{lb\text{-}°F}\right)\left(\text{Hx Inlet Temp} - \text{Ave Hx Outlet Temp}\right)F° = \frac{BTU}{Hour}$$

$$\left(\text{FT-15324gpm}\right)\left(500.535\right)\left(\text{Hx Inlet Temp} - \text{Ave Hx Outlet Temp}\right)F° = \frac{BTU}{Hour}$$

Unit 1 Heat Removal

FI-15323 Fuel Pool Clg Wtr on Pnl 1C206 _____GPM

TI-18724 Service Water Inlet Temp. _____°F

TRSH-15316 pen 4, Fuel Pool Hx Inlet Temp. _____°F

TRSH-15316 pen 1,2,&3 Average Fuel Pool Hx Outlet Temp. =

$$\left(\frac{\_\_ + \_\_ + \_\_ \quad °F}{3}\right) = \quad °F \text{ ave}$$

Heat removal from Unit 1 Fuel Pool Cooling System =

$$\left(\text{FT-25324gpm}\right)\left(\frac{FT^3}{7.48\ gallon}\right)\left(\frac{62.4\ lb}{FT^3}\right)\left(\frac{60\ min}{hour}\right)\left(\frac{1\ BTU}{lb\text{-}°F}\right)\left(\text{Hx Inlet Temp} - \text{Ave Hx Outlet Temp}\right)F° = \frac{BTU}{Hour}$$

$$\left(\text{FT-15324gpm}\right)\left(500.535\right)\left(\text{Hx Inlet Temp} - \text{Ave Hx Outlet Temp}\right)F° = \frac{BTU}{Hour}$$

Total Heat to be removed in both pools =

$$\left(\text{Unit 1 Decay Heat}\right) + \left(\text{Unit 2 Decay Heat}\right) = \frac{BTU}{Hour}$$

Date _____/_____/_____

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Attach annotated Fuel Pool Temperature Plots here!

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Unit 2 _____ Refueling Outage Summary Sheet Date ___/___/___

Post Unit 2 Fuel Offload with Unit 2 Fuel Pool Cooling O.O.S.

Unit 1 Service Water Peak Temperature _____ °F

Unit 1 Fuel Pool Peak Temperature _____ °F

Unit 2 Fuel Pool Peak Temperature _____ °F

Special Considerations: (from step 7.3.8)

Unit 1 Fuel Pool Cooling System is removing decay heat from both the Unit 1/Unit 2 Fuel Pools and is maintaining a temperature below the ~~110°F~~ 115°F administrative limit.

_____/_____
System Engineer

_____/_____
Supervisor