Salem Generating Station, Units 1 and 2

S-C-SF-MEE-1679, Rev. 1

SFP Cooling System Capability With Core Offload Starting 85-hours After Shutdown

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REVISION SUMMARY

Revision #	Description
0	Original Issue. Evaluates SFP cooling capabilities with an in-vessel decay time of 100 hours.
1	Revision 1 evaluates SFP cooling capabilities with an in-vessel decay time of 85 hours, and its purpose is to support Licensing Change Request LCR S06-07.

1.0 PURPOSE

This document evaluates spent fuel pool (SFP) Cooling Capabilities with 85-hours of in-vessel decay, rather than the 100-hour delay currently required by technical specifications during the period from October 15th to May 15th. As such, this evaluation is intended to provide a technical basis for a licensing change request to the USNRC to revise the technical specifications of both Salem Unit 1 and Salem Unit 2.

While this evaluation supports the licensing change request, the Salem SFP Integrated Decay Heat Management (IDHM) program (as described and detailed in USFAR Section 9.1.3.2) is relied upon to assure that adequate SFP cooling capability is available prior to off-loading fuel during a specific outage. The IDHM program assures pool temperature does not exceed 149°F with both SFP heat exchangers available or 180°F with one SFP heat exchanger available..

2.0 SCOPE

This evaluation applies to both Salem Unit 1 and Salem Unit 2, and addresses the period from October 15th through May 15th, annually, when CCW temperature is expected to be 71°F or below. During the remainder of the year (May 16th through October 14th or when CCW temperature exceeds 71°F), the current 168-hour technical specification requirement will remain intact. This evaluation deals only with decay heat resulting from the radioactive decay of fuel rods loaded into the Spent Fuel Pools. It does not address radiological dose issues associated with fuel transfer to the SFP. Radiological dose issues are addressed separately.

3.0 DISCUSSION

The Salem UFSAR, Section 9.1.3.1 makes the following statements:

"The Spent Fuel Pool Cooling System maintains pool temperature at or below 149°F, provided both SFP heat exchangers are available. If only one heat exchanger is available, pool temperature is limited to 180°F."

Later, in Section 9.1.3.2, the UFSAR states:

"In 1998, additional spent fuel pool heat removal analyses were performed. The analyses addressed potential full-core off-loads during upcoming refueling outages as well as end of plant life. These analyses concluded one pump and one heat exchanger can maintain pool temperature below 149°F under all combinations of decay time and CCW temperature except minimum decay times and very high cooling water temperatures. Under these later conditions, in vessel decay-time would be extended or parallel heat exchanger operation would be used to maintain pool temperature below 149°F."

In addition to the above, Section 9.1.3.2 describes the SFP IDHM program under which pre-outage assessments of SFP heat loads are performed prior to core offload as follows:

- Calculations to assure SFP temperature does not exceed 149°F following a full-core offload with one heat exchanger per pool.
- Calculations to assure SFP temperature does not exceed 180°F following a full-core offload with one heat exchanger for both pools.
- Validation of assumptions in the Integrated Decay Heat Management program including
    - Availability of both heat exchangers, each with an available pump and
    - Actual CCW system temperatures consistent with calculated values.

In view of the above, the questions to be resolved in this evaluation are:

1. If in-vessel decay time is reduced from 100-hours to 85-hours during the period from October 15th to May 15th, can the SFP cooling system maintain pool temperatures at or below 149°F with both heat exchangers available and below 180°F with one heat exchanger available? If so, is there a time limit on this activity based upon background heat within the Spent Fuel Pool?
2. If pool temperature is predicted to rise above 149°F, can the temperatures of both pools be maintained below 149°F by employing parallel heat exchanger operations? If so, with what frequency are the heat exchangers shifted between pools to maintain 149°F?

3.1 Background

In-vessel decay is required before moving a fresh, hot core into the SFP because of the radiation dose rates and fuel-pool cooling requirements. With regard to pool cooling, decay heat from previously irradiated fuel elements constantly decreases as the fission products and heavy elements decay. Therefore, the longer the elements are allowed to decay within the reactor vessel, the less heat duty is transferred to the SFP.

The 168-hour limit is based upon the capability of the SFP cooling system when River temperatures, and the consequent CCW temperatures, are at their highest. These analyses considered the River temperature to be at 90°F, with CCW at 99°F. This condition has never occurred at Salem, but if it did, it would occur in late July or early August, when River temperatures typically peak. The 168-hour delay imposes an unnecessary penalty on plant operators in the cooler months, when refuelings are typically scheduled. For this reason, current technical specifications permit a 100-hour delay during the period from October 15th to May 15th.

This evaluation considers SFP cooling capabilities if an 85-hour delay rather than the current 100-hour delay is imposed prior to defueling during the period between October 15th and May 15th or when CCW temperature is 71°F or below.

3.2 Assumptions/Initial Conditions

1. Both spent fuel pool cooling (SFPC) heat exchangers will be assumed to have 6% of the tubes plugged. This is a conservative assumption because the highest current tube plugging is 4% (Assumption 5.0.c, of Reference 5.1), and additional plugging is not expected with these pure water (SFP) and treated water (CCW) exchangers.
2. SFPC (one pump) flow to the heat exchanger is 2500 gpm (Reference 5.1, paragraph 6.2). When two heat exchangers are aligned to a single pool, 2 pumps will be assumed running with an average flow rate of approximately 1500 gpm per heat exchanger (Reference 5.1, paragraph 4.0.e).
3. CCW flow to the SFP heat exchanger is 3000 gpm (Assumption 5.0.a of Reference 5.1).
4. SFP heat exchanger fouling factor will be conservatively held equal to or greater than its design basis value (0.001075). The heat exchanger data sheet is shown in Reference 5.7.
5. Reactor power is conservatively assumed to be 3459 MWt [1.014 x 3411 MWt] (Reference 5.3, Input 3.19).
6. Based on current refueling programs, fuel assemblies while in the reactor vessel will be assumed to be expended in accordance with the following (Reference 5.2):
   - 76 assemblies with 17 months of effective full power operation
   - 76 assemblies with 34 months of effective full power operation
   - 41 assemblies with 51 months of effective full power operation.

7. Defueling of 193 assemblies will be assumed to require 40 hours, which is faster than all recent Salem off-load times, as shown below (References 5.4 and 5.12).

Outage	Time (hours)	Ref.	Outage	Time (hours)	Ref.
1R17	59.2	5.12	2R14	42.7	5.12
1R16	41.5	5.12	2R13	41.9	5.12
1R15	48.0	5.12	2R12	47.8	5.12
1R14	53.0	5.4	2R11	53.0	5.4
1R13	60.0	5.4	2R10	58.0	5.4

8. There are currently 1137 fuel assemblies in the Unit 1 SFP (as of 1R17 in October 2005) and 964 elements in the Unit 2 pool (as of 2R14 in April 2005). (Reference 5.12).
9. Background heat in the Unit 1 SFP was 2.31×10^6 Btu/hour prior to outage 1R13 in 1999 (Reference 5.1).
10. Background heat in the Unit 1 SFP at end of life (i.e. with a full pool) is 8.46×10^6 Btu/hr (Reference 5.5).
11. The maximum number of fuel elements that can be loaded into a Salem SFP is 1632 (Reference 5.11).
12. Background heat in the pool at any given refueling between the present and end of life (or full pool) is assumed to be a straight line between 2.31×10^6 Btu/hour (Input #9) and 8.46×10^6 Btu/hour (Input #10).
13. Net thermal capacity of SFP water at the end of life with all fuel racks filled (thereby minimizing available water volume) is 1.96×10^6 Btu/°F, as shown on page 29 of Reference 5.5. This value considers only the water volume within the SFP and does not include the fuel transfer pool.
14. The volume of the fuel transfer pool is 19,927 ft^3 (16' x 28.5' x 43.7'—Reference 5.13). Subtracting 15% for equipment, the water volume becomes 17,000 ft^3. When added to the 32,000 ft^3 of the fuel pool (Reference 5.5, page 29), the thermal capacity of the combined pools is 3.0×10^6 Btu/°F (49,000 ft^3 x 61.2 #/ft^3 x 1 Btu/# °F).
15. The surface area of the SFP is 1111.5 ft^2 (Reference 5.5, page 30). The transfer pool surface is 16' x 28.5' (Reference 5.13) or 456 ft^2. Using 75% of the transfer pool (for conservatism), the combined surface is 1453.5 ft^2, or 30% greater than the surface of the SFP alone. Hence, when considering surface evaporation, the evaporation rates of Reference 5.5 (shown in Attachment D) can be increased by a factor of 1.3 when both pools are connected. The evaporation rates, both with and without the transfer pool are listed in Attachment D.
16. SFP pump heat adds 210,000 Btu/hr to the pool (Reference 5.5, page 31). This heat is orders of magnitude below the decay heat and therefore is ignored for convenience, particularly since no credit is taken for evaporative heat (with 2 available heat exchangers) or heat lost to the concrete structure.

3.3 Basic Parameters

The basic parameters that are used throughout the remainder of this evaluation are reiterated below:

1. Refueling operations are conducted during the period from October 15 to May 15.
2. All 193 fuel assemblies are off-loaded to the Spent Fuel Pool (full core offload). This assumption bounds any partial off-loads that might be conducted.

3. In addition to the new 193 assemblies, the background heat (old assemblies) is assumed to be 8.46 x 10^6 Btu/hr, which represents a full spent fuel pool (Reference 5.5, page 50). This assumption bounds future refueling since assembly transfer to dry-cask storage would remove the oldest fuel first.
4. River temperatures are determined from 30 years of historical data.
5. Defueling begins 85 hours and completes at 125 hours after reactor shutdown.
6. All SFP heat removal is via the Spent Fuel Pool Cooling System. No credit is taken for heat transfer via evaporative cooling[1] or to the SFP (concrete) structure.

3.4 Methodology

1. Determine the decay heat rate from the off-loaded core using USNRC Branch Technical Position ASB 9-2 (Reference 5.6).
2. Determine background heat that will exist in the full spent-fuel pools.
3. Evaluate Delaware River temperatures during the period from October through May.
4. Benchmark the SFP heat exchanger design basis parameters against the Joseph Oats (Manufacturer's) data sheet, using the HTC-STX heat exchanger design computer program.
5. Using the benchmarked heat exchanger model in the HTC-STX heat exchanger computer program, determine heat duties with various SFP temperatures and CCW temperature appropriate for the time period.
6. Evaluate the ability of the SFP Cooling System to maintain pool temperature limits.

3.5 Inherent Conservatisms

This analysis considers heat removal from the Salem Spent Fuel Pools using forced cooling provided by the SFPC heat exchangers. By relying only on the SFPC heat exchangers, the analysis contains several substantial conservatisms as described below. These conservatisms could be credited in this calculation. However, at this time they will be left as providing additional temperature margins.

1 No credit is taken for evaporative cooling, i.e. pool bulk temperature cooling resulting from evaporation at the surface of the SFP, provided that both SFP heat exchangers are available[2]. Reference 5.5 indicates that evaporative cooling contributes 0.86 x 10^6 Btu/hour at 150°F and 3.87 x 10^6 Btu/hour at 180°F. Consequently, if the pool reaches 180°F, evaporative cooling amounts to about 8% of the peak heat load in the hot pool and 45% of the heat load in the non-refueling pool.

2 No credit is taken for the cooling that occurs when cold water is made-up to the pool to replace the evaporation. At 180°F, 3.87 x 10^6 Btu/hr releases 3900#/hour (3.87 x 10^6 Btu/hr/990.2 Btu/# [latent heat of vaporization for 180°F water]). When this 3900#/hr (approximately 8 gpm) is replaced with 100°F water (at 67.97 Btu/#), 311,800 Btu/hr are required to heat the 100°F water back to 180°F (147.92 Btu/#). [(147.92-67.97) Btu/# x 3900 #/hr = 311,800 Btu/hr]

3 No credit is taken for cooling through the concrete structure of the pool. Heat is conducted through the pool steel liner, concrete structure, and ultimately to the cooler environment beyond the structure. The higher the pool water temperature, the more heat transmitted through the structure.

[1] In the abnormal case where only one heat exchanger is available for both fuel pools, evaporative cooling from the pool surface will be considered in order to determine more realistic timing for the HX transfer between pools. When both SFP heat exchangers are available, no credit is taken for evaporative cooling.

[2] See Footnote #1 above.

4 RHR cooling continues to provide forced cooling to the SFP with all fuel elements removed to the SFP as long as the refueling canal remains flooded and the transfer gate is open. The cooler water in the reactor vessel and refueling canal will transfer to the SFP via natural circulation through the transfer gate. This potential cooling source is never credited in any analysis or procedure.

3.6 Evaluation

Core Decay Heat

Decay heat from the newly discharged core is determined using the USNRC Branch Technical Position ASB 9-2, Residual Decay Heat for Light-Water Reactors for Long-Term Cooling (Reference 5.6). This is a conservative computer code for calculating fuel element decay heat, and is used here without scaling factors or other adjustments.

As shown in Attachment A, pages A1 through A4, the residual heat from the 193 assembly offload to the SFP is shown to be 3.95 x 10^7 Btu/hr as summarized in the following table. The 125 hours after shutdown includes the 85-hour delay plus an additional 40 hours to offload the 193 assemblies. A 10% uncertainty factor is included per the BTP.

This is the highest heat load in the pool from the newly discharged core, and it exists only at the moment that the final assembly is moved into the pool. After that time, the heat load continuously decays to lower values. Nonetheless, this value is used throughout this evaluation as the heat in the SFP.

Table 1 – Full-Core Off-Load Decay Heat

Number of Assemblies	Reactor Power	Time to Off-Load After Shutdown	Effective Full Power Hours of Burnup	Calculated Decay Heat
76	3459 MWt	5.21 days (125 hrs.)	12,410 (17 mos.)	1.37 x 10^7 Btu/hr
76	3459 MWt	5.21 days (125 hrs.)	24,820 (34 mos.)	1.42 x 10^7 Btu/hr
41	3459 MWt	5.21 days (125 hrs.)	37,230 (51 mos.)	7.75 x 10^6 Btu/hr
Heavy Elements (all assemblies)	3459 MWt	5.21 days (125 hrs.)	Same as above	3.89 x 10^6 Btu/hr
Core Total				**3.95 x 10^7 Btu/hr**
Background Heat[3]				8.46 x 10^6 Btu/hr
Peak Pool Heat Load				**4.80 x 10^7 Btu/hr**

Background Heat

The background heat is taken from Reference 5.5 for a full spent fuel pool (8.46 x 10^6 Btu/hr—see input 3.2.10). This is a maximum value (i.e. all available fuel racks full with spent fuel) and therefore it applies to any anticipated future refueling in either Salem unit. With 1137 assemblies in the Unit 1 pool, this pool will be full in another 4 refueling outages (i.e. 1632 – 1137 – 193 = 302/76 = 3.97), with room available for one additional core. However prior to that time it is expected that the oldest fuel will be withdrawn to dry-cask storage. In any event, either before or after implementation of dry-cask storage, the maximum background heat value of Reference 5.5 will bound any potential background heat rate. Furthermore, this value is conservative since Reference 5.5 was based on a power level of 3600 MWt, which is higher than actual power levels to which the spent fuel was exposed.

[3] Derivation of background heat is discussed in the next paragraph.

The background heat value used in this evaluation (8.46 x 10^6 Btu/hr) is extremely conservative because it represents 1776 elements in the pool (the current pool is limited to 1632) with all elements exposed to 4.5 years of full power at 3600 MWt. Since the background heat in the SFP during outage 1R17 was only 3.1 x 10^6 Btu/hr, it is clear that the actual background heat in only 4 more refuelings will be well below 8.46 x 10^6 Btu/hr. Based on the above, 8.46 x 10^6 Btu/hr is appropriate for use in this design-basis evaluation, since it will bound any possible background heat scenarios. In the outage specific calculation performed in accordance with Reference 5.10, the actual background heat will be less and therefore the 85-hour decay time of this evaluation is conservative.

Delaware River/CCW Temperature

As shown in Attachment B, pages B1 through B8, the average monthly temperature in the Delaware River (measured at Reedy Island) between the months of October and May are 63°F and below. These temperatures are based upon 30 years of weekly data recorded at Reedy Island, a location just upstream of Salem and Hope Creek. These pages also show that on average, inlet temperatures at the plant run 3°F higher than Reedy Island. Even though there have been measurements of plant temperatures as much as 5°F higher (and as low as 1°F) than Reedy Island, the 3°F average is considered conservative in a condition where one of the two Salem Units is shutdown. The Salem Units account for nearly all of the output heat in the River. Hope Creek has a cooling tower, through which most waste heat is released to the environment. Therefore, with one of the two Salem Units shutdown (and only discharging waste reactor heat), historical average differentials between the plant and Reedy Island are conservative.

The differential temperature between Service Water (SW) and CCW is reduced under shutdown conditions because there is less heat load on both the CCW System and the SW System. Using both CCW heat exchangers during the few days that SFP heat loads are at their peak would lower the differential even further. However, since both CCW heat exchangers may not be available when fuel is moved, the analysis of Attachment F evaluates both one and two CCW heat exchangers. As shown in Attachment F, the CCW supply temperature is 71°F with a Service Water inlet temperature of 66°F (one CCWHX and two SFPCHXs).

Temperature	Description
63°F	Delaware River historical data
3°F	Reedy Island to plant intake
66°F	Service Water Inlet Temperature
71°F	CCW Temperature Based on 66°F SW Inlet, as shown in Attachment F[4]. [See Footnote 4 below]

Use of 71°F for this analysis is considered appropriate for two reasons:

1. This evaluation provides a technical basis for reducing the in-vessel decay time for defueling from 168-hours to 85-hours during the months from mid-October to mid-May. Before fuel is actually transferred, the Salem Integrated Decay Heat Management Program (currently based upon the Holtec CROSSTIE computer code) is implemented in accordance with Outage Risk Management procedures (Reference 5.10) for the actual conditions in existence at outage time. In the case of a particularly mild winter or particularly hot summer where River temperatures might be above pre-

[4] Attachment F is not changed from Revision 0, even though Revision 0 was based upon 4.4 x 10^7 Btu/hr while Revision 1 is based on 4.8 x 10^7 Btu/hr. This is justified because of the conservatisms in Attachment F with regard to both CCW flow rates and the calculated temperatures. Furthermore, since this evaluation concludes an 85-hour decay is justified with a CCW temperature of 71°F or below, Attachment F simply determines that these temperatures can be expected during this time period.

dicted temperatures, fuel would not be transferred until the Decay Heat Management Program indicated pool temperature limits would be achieved.[5]

2. The inherent conservatisms in this analysis (i.e. evaporative cooling, structure cooling, cold water makeup, RHR cooling) are of sufficient magnitude to account for any foreseeable changes in river temperatures or other potentially non-conservative assumptions. Hence, this calculation is considered to be sufficiently conservative.

Heat Exchanger Efficiency

As shown in Attachment C, pages C1 through C3, the HTC-STX heat exchanger computer code, Version 3.6, is benchmarked against the original Joseph Oats data sheet from Reference 5.7. It should be noted that the HTC-STX data sheet says that SFPC surface area is over-designed by 7.55%. This is consistent with HOLTEC International's analysis of this same heat exchanger (Reference 5.5). In Reference 5.5, HOLTEC concluded that the SFPC heat exchanger was over-designed by 7.04%. Based on their analysis, HOLTEC concluded that the design basis heat duty should have been 12.78×10^6 Btu/hour rather than the 11.94×10^6 Btu/hour of the Joseph Oats data sheet.

The same heat exchanger model that produced the benchmarked data sheet was then changed to incorporate 6% tube plugging and to revise shell-side (CCW) inlet temperature to 71°F. Using this model, heat duties were calculated for various spent fuel pool temperatures. As shown on pages C4 (for one heat exchanger) and page C5 (with two heat exchangers lined-up in parallel) heat exchanger efficiencies are determined as shown in the attached table. These efficiencies are then applied to the various conditions described below.

Table 2 – Heat Exchanger Efficiency

Page	No. HX	CCW Flow [gpm]	Tube Flow [gpm]	Shell Inlet	Tube Inlet	Plugged Tubes	Heat Duty Btu/hour	Efficiency Btu/sec °F
C4	One	3000	2500	71°F	160.9°F	6%	4.3968E7	135.8
C5	Two	3000	1500	71°F	128.4°F	6%	2.1998E7	106.5

Both SFPC Heat Exchangers

With two SFPC heat exchangers available, both Salem SFPs can be maintained below 149°F as follows:

1. With one heat exchanger aligned to each Salem SFP, the hot pool (the pool with the full-core offload) will heat toward 149°F, while the non-refueling pool will remain well below 149°F.
2. With both heat exchangers aligned in parallel to the hot pool, the hot pool will cool below 149°F, while the non-refueling pool will slowly heat toward 149°F.
3. The heat exchanger for the non-refueling pool will be swapped between the refueling pool and the non refueling pool as shown in the Table 3 below. Each succeeding cycle will be extended, since the spent fuel is constantly decaying. Assumed CCW inlet temperature is 71°F in all cases.
4. In Table 3, no credit is taken for (1) evaporative cooling from the pool surface (2) heat transfer through the pool structure (3) the volume of water contained in the fuel transfer pool or refueling cavity (which would still be attached), (4) the cool make-up water that would replace the evaporation or (5) any RHR heat exchanger.

[5] In October, River temperatures are highest on the day the fuel is offloaded and River temperatures slowly decrease thereafter. With residual heat from the fuel also decaying, SFP cooling capabilities become more conservative with each passing day. In May, however, River temperatures can be expected to slowly increase (typically 2.2°F to 2.3°F per week) after the fuel has been offloaded. This is not conservative, although the decaying residual heat would offset the temperature increases. Nonetheless, to assure that temperature increases after fuel offload do not adversely impact the results of the CROSSTIE code analysis, refueling in May (with 85-hour in-vessel decay) has been limited to May 15th. This assures that the fuel in the pool will be well decayed as River temperatures rise into the month of June.

Table 3 – Two Heat Exchanger Operation

Pool	No. HX	Average Heat Removal per HX (MBtu/hr)[6]	Heat Added (MBtu/hr)[7]	Differential (MBtu/hr)	Heatup or Cooldown Rate[8]	HX Eff. (K) (Btu/s F)	Initial Pool Temp.	Final Pool Temp.[9]	Time to Switch HX
Refuel	2	24.0	48.0	0	0	106.5	133.6°F	133.6°F	11.4 hrs.
Non-Refuel	0	0	8.46	+8.46	+4.3°F/hr	NA	100°F	149° F	11.4 hrs.
Refuel	1	34.4	46.5	+12.1	+6.2°F/hr	135.8	133.6°F	149°F	2.5 hrs.
Non-Refuel	1	31.0	8.46	-22.6	-11.5°F/hr	135.8	149°F	120°F	2.5 hrs.
Refuel	2	27.0	46.2	-7.8	-4.0°F/hr	106.5	149°F	131.2°F	6.7 hrs.
Non-Refuel	0	0	8.46	+8.46	+4.3°F/hr	NA	120°F	149°F	6.7 hrs.
Refuel	1	33.8	45.4	+11.6	+5.9°F/hr	135.8	131.2°F	149.0°F	3.0 hrs.
Non-Refuel	1	30.0	8.46	-21.4	-11.0°F/hr	135.8	149°F	116°F	3.0 hrs.
Refuel	2	26.2	45.2	-7.3	-3.7°F/hr	106.5	149°F	130.0°F	7.7 hrs.
Non-Refuel	0	0	8.46	+8.46	+4.3°F/hr	NA	116°F	149°F	7.7 hrs.

As can be seen above once the non-refueling pool reaches 149°F, the non refueling pool heat exchanger can be shifted between its own pool and the hot pool on a 2.5 hours on, 6.7 hours off basis as long as necessary to maintain both SFPs below 149°F. With each succeeding cycle, the shift times will increase slightly (3.0 hours/7.7 hours for the 2nd cycle) since the spent fuel heat load (particularly from the hot-core) is decreasing with time. This time cycle compares to 3.7 hours on, 10.8 hours off for the 100-hour decay that was evaluated in Revision 0 to this mechanical engineering evaluation. Both of these cycle times (the 85 hour and the 100 hour) are well with the capability of plant operators to achieve.

<u>One SFPC Heat Exchanger</u>

A full-core offload would not be undertaken unless both SFP heat exchangers are available. Should one heat exchanger fail or otherwise become unavailable prior to completing the offload, the offload would be suspended. Hence in the worst case scenario, one heat exchanger fails just as the full-core offload is completed and the peak heat load is in the hot-pool.

In this case, the remaining heat exchanger would be aligned to the hot-pool until the non-refueling pool (which now has no forced cooling) heats to 180°F. As shown in Table 4, this heating will take approximately 20 hours. Adding these 20 hours to the 85 hour delay and 40 hour off-load time, the non-refueling pool reaches 180°F at 145 hours after shutdown of the refuel-unit. At 145 hours, the decay heat load in the hot-pool (including the background heat) would be 4.55×10^7 Btu/hr, as shown in Table 4 Row 3. With evaporative losses from the pool surface at 2.66×10^6 Btu/hr at 170°F, the heat available to raise pool tem-

[6] Heat removal is calculated based on the heat exchanger efficiency (K value) using the average pool temperature during the specific period and an assumed 71°F CCW temperature.

[7] The heat added is determined for each cycle including the additional time since plant shutdown into the spreadsheets of Appendix A. As can be seen in this column, total heat in the refueling pool slowly decreases with time while the non-refueling pool remains constant at the maximum background heat level.

[8] Heat up or cooldown rate is calculated by dividing the differential heat rate (in Btu/hr) by the SFP heat capacity of 1.96×10^6 Btu/F (see paragraph 3.2.13).

[9] Final pool temperatures with the hot (refueling) pool in cool-down using both heat exchangers are limited by heat exchanger capacity and not by the available cool-down time. For example, in Table 3, Row 5, the 4 degree per hour cooling rate for 6.7 hours should lower pool temperature to 122.2°F (149°F – 4 x 6.7). However, at 131.2°F, the two heat exchangers (in parallel) just balance the heat input rate of 4.62×10^7 Btu/hr and therefore temperature will not decrease below 131.2°F.

perature would be 4.22 x 10^7 Btu/hr, which is well below the 4.4 x 10^7 Btu/hr that was analyzed and found to be acceptable in Revision 0 to this MEE. Hence, the evaluation of Revision 0 bounds the maximum heat load expected in this condition.

In addition to being bounded by the evaluation of Revision 0 to this MEE, Revision 0 did not credit any of the water in the refueling canal, reactor vessel or transfer pool, which would still be connected to the SFP from the refueling operations. As shown in Input 3.2.14, when the transfer pool alone is included, the heat capacity of the combined pools is 3.0 x 10^6 Btu/°F. Using this revised heat capacity, the sequence of events with one heat exchanger is shown in Table 4 below.

Table 4 – One Heat Exchanger Operation

Pool	No. HX	Average Heat Removal per HX (MBtu/hr)[10]	Heat Added (MBtu/hr)	Surface Evaporation (MBtu/hr) (Attach D)	Differential (MBtu/hr)	Heatup or Cooldown Rate[11]	Initial Pool Temp.	Final Pool Temp.	Time to Switch HX
Refuel	1	46	48.0	2.0	0	0	165°F	165°F	20 hrs.
Non-Refuel	0	0	8.46	1.56	+6.9	+2.3°F/hr	135°F	180° F	20 hrs.
Refuel	0	0	45.5	2.66	+42.8	+14.3°F/hr	165°F	180°F	1.0 hrs.
Non-Refuel	1	49.6	8.46	2.66	-43.8	-14.6°F/hr	180°F	165°F	1.0 hrs.
Refuel	1	49.1	45.3	2.66	-6.5	-2.15°F/hr	180°F	163°F	7.9 hrs.
Non-Refuel	0	0	8.46	2.66	+5.8	+1.9°F/hr	165°F	180°F	7.9 hrs.
Refuel	0	0	44.3	2.66	+41.6	+13.8°F/hr	163°F	180°F	1.2 hrs.
Non-Refuel	1	49.6	8.46	2.66	-43.8	-14.6°F/hr	180°F	162°F	1.2 hrs.
Refuel	1	48.4	44.2	2.66	-6.8	-2.3°F/hr	180°F	160°F	9 hrs.
Non-Refuel	0	0	8.46	2.66	-5.8	+1.9°F/hr	162°F	180°F	9 hrs.

As shown in Table 4, the 8-hour (hot pool)/1-hour (background pool) cycle can be continued as long as would be necessary to either restore the unavailable heat exchanger or begin transferring hot fuel back into the vessel of the refueling unit. In addition, the cooling times available prior to each heat exchanger shift are considered to be conservative and in reality, are expected to be longer. This is the case because (1) the BTP heat loads are conservative and do not consider forced outages or other lost generation time (2) the concrete structure would act to buffer the temperature changes and (3) no credit is taken for cold water make-up that replaces the evaporation. Also, when considering surface evaporation rates, the non-refueling pool may never reach 180°F, since evaporation plus heat transfer through the structure might offset the actual heat input prior to reaching 180°F. In this case, the single heat exchanger would constantly cool the hot-pool, with a maximum temperature of approximately 165°F.

Finally, a more accurate assessment of the pool heat up times will be done prior to a refueling outage, as part of the Integrated Decay Heat Management Program, so proper planning on when and if to remove a SFHX from service can be performed.

[10] Heat exchanger efficiency is 135.8 Btu/sec °F, since only one heat exchanger is available.

[11] Heat up or cooldown rate is calculated by dividing the differential heat rate (in Btu/hr) by the SFP and transfer pool heat capacity of 3.0 x 10^6 Btu/F (see paragraph 3.2.14).

4.0 CONCLUSION/RECOMMENDATION

Conclusion

This evaluation demonstrates that a fully radiated 193 element reactor core can be off-loaded to either Salem spent fuel pool with 85-hours of in-vessel decay, rather than the current 100-hours decay, provided the CCW outlet temperature is less than or equal 71°F. The evaluation also demonstrates that the required temperature (less than or equal 71°F) can be expected during the period October 15th through May 15th, annually. Therefore, the technical specifications can be written to allow an 85-hour decay either during the period from October 15th through May 15th or anytime that CCW outlet temperature is equal or below 71°F.

This conclusion is based on the capability of the SFP cooling system to (1) maintain both Salem pools below 149°F with two SFPC heat exchangers available and (2) maintain both pools below 180°F with only one heat exchanger available. This capability meets the requirements of UFSAR Chapter 9.1.3.1. A Technical Specification change will be required because the 100-hour delay is currently required by Technical Specifications during this time period.

This conclusion is justified because (1) the Salem Outage Risk Management Program[12], which includes a pre-outage assessment of the SFP heat loads and heat up rates will assure available SFPC capability prior to actually offloading fuel and (2) the inherent conservatisms in this calculation provide for additional cooling sources that are not credited herein. In order to maintain both pools below the required temperature limits, the SFPC heat exchangers may be required to operate in the crosstie mode (i.e. in parallel) for a period of time, as determined by the pre-outage assessment.

Recommendation

This evaluation justifies reduction of the Technical Specification 100-hour in-vessel decay to 85-hours during the period from October 15th to May 15th. The Technical Specification can be based upon either the time period (October 15th to May 15th) or the limiting CCW temperature (less than or equal 71°F), as Salem management may choose.

At the same time, Salem management may decide to take further steps in the future to increase SFP cooling, and thereby further reduce the decay time requirements. Such actions could include (1) installation of additional heat exchanger capability (2) connection of an RHR heat exchanger for SFP cooling in accordance with Reference 5.14 or (3) use of a fuel-shuffle that precludes a full-core off-load. Such action could be anticipated if the Technical Specifications rely on the Integrated Decay Heat Management (IDHM) program for determining the required decay time for any particular outage. Under this methodology, the Technical Specifications would state:

1. The minimum in-vessel decay time as required by radiological considerations in handling the spent fuel.
2. A requirement for the IDHM program to establish the minimum in-vessel decay time needed to assure the limits of 149°F with two available heat exchangers and 180°F with only one heat exchanger prior to the start of each specific Salem refueling outage.
3. A fuel movement limit based on the more restrictive of steps 1 or 2 above. This Technical Specification would replace both the current 100-hour and 168-hour requirements, since the time of year would not be relevant in the IDHM calculations.

[12] The Integrated Decay Heat Management Program is part of Salem Outage Risk Management.

5.0 REFERENCES

5.1 S-C-SF-MDC-1780, Revision 0, Capability of Salem Spent Fuel Pool Heat Exchangers to Maintain 149°F Pool Temperature
5.2 Phone Call with Glenn Schwartz, Salem Fuels of 5/2/02 (see Attachment E)
5.3 S-C-SF-MDC-1800, Revision 4, Decay Heat-up Rates and Curves
5.4 Phone call with Glenn Schwartz, Salem Fuels Department, on 5-3-02 (see Attachment E)
5.5 S-C-SF-MDC-1240, Revision 1, SFP Thermal-Hydraulic Calculation (HOLTEC International)
5.6 BTP ASB 9-2 Revision 2 of July 1981, USNRC Standard Review Plan 9.2.5, Ultimate Heat Sink, NUREG 0800
5.7 PSBP 301110, Westinghouse Instruction Manual, Auxiliary Heat Exchangers
5.8 Phone call with Kevin King, PSE&G Engineering, on 5/6/02 (see Attachment E)
5.9 LCR S02-03
5.10 SC.OM-AP.ZZ-0001, Revision 1, Shutdown Safety Management Program Salem Annex
5.11 T/S 5.6.3, Fuel Storage Capacity
5.12 Email T. Wathey (PSEG) to T. DelGaizo (MLEA) on 5/9/06 (Attachment E)
5.13 PSEG Drawing 204836, Revision 7—Fuel Handling System Arrangement Drawing
5.14 S-C-N230-MDC-049, Revision 0, Spent Fuel Pool Cooling Using SFP and RHR Cooling Systems
5.15 S1(2).OP-SO.SF-0002, Revision 17(16), Spent Fuel Cooling System Operation

6.0 EFFECTS ON OTHER TECHNICAL DOCUMENTS

The following procedure changes are required upon NRC approval of the LCR:

1. S1(2).OP-IO.ZZ-0007, R13(11), Cold Shutdown to Refueling; Precaution 3.6 states TS 3.9.3 is valid until the year 2010. When the LCR is approved, the 2010 expiration will be eliminated.
2. S1(2).OP-IO.ZZ-0107, R1(1), Administrative Requirements Cold Shutdown to Refueling, Precaution 3.3 states TS 3.9.3 is valid until the year 2010. When the LCR is approved, the 2010 expiration will be eliminated.
3. SC.OM-AP.ZZ-0001, Rev. 1, Shutdown Safety Management Program—Salem Annex. Paragraph 5.7.1 refers to 100-hours prior to core offload.

7.0 SIGNATURES

Preparer:	T. J. DelGaizo, Main Line Engineering	Date:	5/18/06
Peer Reviewer:	NA	Date:	NA
Verifier:	P. J. Lindsay, Main Line Engineering	Date:	5/18/06
Functional Supervisor:	PEJ 5/23/06 Alan Johnson, PSEG Nuclear LLC	Date:	5/24/06

FORM-1

CERTIFICATION FOR DESIGN VERIFICATION

Reference Number: S-C-SF-MEE-1679, Revision 1

SUMMARY STATEMENT

This revision was prepared to evaluate SFP cooling capabilities with 85 hours of in-vessel decay, rather than the 100-hour delay currently required by Technical Specifications. As such, it is intended to provide a technical basis for a licensing change request. The calculation demonstrates that a fully radiated 193 element core can be offloaded to the SFP with 85 hours of in-vessel decay and temperatures will not exceed 149°F in either pool with two SFP heat exchangers available or 180°F with one available. All changes made in Revision 1 have been checked line-by-line. The results are consistent with the previous revision of this document considering the changes made and given the design input, and methodology used conclusions reached were found to be appropriate and conservative.

The individual named below in the right column hereby certifies that the design verification for the subject document has been completed, the questions from the generic checklist have been reviewed and addressed as appropriate, and all comments have been adequately incorporated. SAP Order/Operation final confirmations are the legal equivalent of signatures.

Alan Johnson	Paul Lindsay, MLEA Inc. [signature] 5/1/06
Design Verifier Assigned By (print name of Manager/Director)*	Name of Design Verifier* / Date
Design Verifier Assigned By (print name of Manager/Director)*	Name of Design Verifier* / Date
Design Verifier Assigned By (print name of Manager/Director)*	Name of Design Verifier* / Date
Design Verifier Assigned By (print name of Manager/Director)*	Name of Design Verifier* / Date

*If the Manager/Supervisor acts as the Design Verifier, the name of the next higher level of technical management is required in the left column.

COMMENT / RESOLUTION FORM FOR DESIGN DOCUMENT

DOCUMENT NO./REV: **S-C-SF-MEE-1679, Revision 1**

COMMENTS

1) Page 2 and forward, header - change 70 hours to 85 hours.
2) 1.0 Purpose - 2[nd] sentence, add the word "to" prior to "the USNRC".
3) 1.0 - 2[nd] paragraph, see markup, abbreviate Integrated Decay Heat Management during second use. Also, see Section 3.0, 3[rd] paragraph.
4) Section 3.0, 3[rd] paragraph, add "is performed" between "SFP heat loads" and "prior to core offload".
5) Page 4, top, item 1 - change "delay" to "decay". See other markups provided.
6) 1.0 Purpose, define SFP during its first use.
7) Section 3.2.1 - is there a design reference for the less than 4% tubes plugged. The referenced calculation makes this as an assumption without a reference?
8) Section 3.2, Item 14, 19,972 should be 19,927.
9) The thermal capacities of the SFP and/or transfer pool are based on 150°F, is this conservative for 180°F?
10) Make note on Attachment D, graph is for SFP only.
11) Section 3.5, change words "only" and "exclusively" per markup since we do credit evaporation for the limiting case.
12) Section 3.5, 1[st] paragraph - delete "quantified and". Several of the following points are quantified.
13) Page 6 - combine footnotes 1 and 2 - they say the same thing.
14) Section 3.5, Item 2 - provide reference for 3400#/hour - I get 3900 using steam tables. Looks like you used total heat not heat of evaporation.
15) Page 43 of Holtec report shows that the background heat is based on operation of 3600 MWT and more racks than currently in the Salem SFP. A number as low as 8.13 Mbtu/hr could be justified versus 8.46 used. Justify.
16) Footnote 3 should be on the page before it.
17) See markups - page 8.
18) Page 7, equation requires correction 1675-1137-193 =345/76=4.5
19) Attachment 1, Page A1, remove statement "2010 total in pool."
20) Attachment F, Page 1, references the body of the calculation for total SFP heat load. Calls it 44 Mbtu/hr, but now we are at 48 Mbtu/hr. What is impact of this change?
21) Attachment F - shows with 1 CCHX and 1 SFPHX temps rise to 75°F. Any single failure which can simultaneously cause loss of both? (bus failure or EDG?)
22) Table 3 - correct 3 incorrect temperatures.
23) Minor editorial changes on page 10.
24) Table 4 - correct per markup.
25) Minor editorial changes on page 11.
26) Section 5.0 - update references.
27) Page 13 - need new dates.

RESOLUTIONS

1. Corrected. Good catch, that's a tough one.
2. Changed as suggested.
3. Changed as suggested
4. Changed as noted
5. Changed as noted
6. Done
7. The referenced calculation is all I have. However, when I asked Bob Down to update the MEE-1679 assumptions, tube plugging was not updated.
8. Corrected
9. The available SFP water volume is conservatively rounded down to 32,000 gallons from 32,990 gallons. This offsets the use of 150°F for the heat capacity (e.g., 32,990 gallons x 60.57 lbm/ft³ = 1.99 E6, therefore, the use of 1.96E6 is conservative for all SFP temperatures).
10. The note has been added to Attachment D
11. Done
12. Done
13. Footnote #2 now refers back to footnote #1.
14. This has been corrected. I had used the enthalpy of saturated steam at 180F when I should have used the latent heat of vaporization. The numbers have been revised accordingly, including the make up rate.
15. The use of the higher background heat although not present is conservative and provides margin in the evaluation.
16. I agree but Microsoft Word puts it on the next page (for whatever reason) and I don't know how to change it. The footnote is there, the reader just has to find it.
17. Corrected
18. The problem with the formula was the space available should have been 1632 not 1675 (based on input 3.2.11). This leaves the result to be about 4 more outages. Added a sentence in this paragraph about the conservatism of the 8.46E6 value (based on 3600 MWt).
19. I deleted all reference to number of elements in the pool and 2010. That was left over from the methodology of Revision 0 and doesn't apply to Revision 1.
20. See Footnote #4 on page 8. Basically, if we base the 85-hours on 71F CCW temperature, Attachment F is not critical.
21. There is no known single failure that can reduce SFP cooling to only 1 SFP and 1 CCW heat exchanger. Hence the 1-and-1 configuration is not a design basis configuration.
22. I added Footnote #7 to Table 3 to explain that the configuration with 2 HXs on the hot-pool is limited by HX capacity to remove decay heat rather than the time available for cooling (which is actually set by the heat-up of the background (non-refueling) pool.
23. Changes incorporated
24. Table 4 revised
25. Changes incorporated
26. Done
27. Done

ACCEPTANCE OF RESOLUTION

Resolutions are acceptable P.L.

P. J. Lindsay [signature] SUBMITTED BY	5/18/06 DATE	T. J. DelGaizo [signature] RESOLVED BY	5/18/06 DATE

FORM-3

GENERIC VERIFICATION CHECKLIST (SAP Standard Text Key "NR/CDV3")	REFERENCE DOCUMENT NUMBER/REVISION EG-0020, Revision 9		
	YES NO N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
1. WERE DESIGN INPUTS CORRECTLY SELECTED AND INCORPORATED INTO DESIGN?	☑ ☐ ☐	Section 3.2	N
2. ARE ASSUMPTIONS NECESSARY TO PERFORM THE DESIGN ACTIVITY ADEQUATELY DESCRIBED AND REASONABLE? WHERE NECESSARY, ARE THE ASSUMPTIONS IDENTIFIED FOR SUBSEQUENT RE-VERIFICATION WHEN THE DETAILED DESIGN ACTIVITIES ARE COMPLETED?	☑ ☐ ☐	Section 3.2	N
3. ARE THE APPROPRIATE QUALITY AND QUALITY ASSURANCE REQUIREMENTS SPECIFIED?	☐ ☐ ☑		
4. ARE THE APPLICABLE CODES, STANDARDS AND REGULATORY REQUIREMENTS INCLUDING ISSUES AND ADDENDA PROPERLY IDENTIFIED AND ARE THEIR REQUIREMENTS FOR DESIGN MET?	☐ ☐ ☑		
5. HAVE APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCE BEEN CONSIDERED?	☐ ☐ ☑		
6. HAVE THE DESIGN INTERFACE REQUIREMENTS BEEN SATISFIED?	☐ ☐ ☑		
7. WAS AN APPROPRIATE DESIGN METHOD USED?	☑ ☐ ☐	Section 3.4	N
8. IS THE OUTPUT REASONABLE COMPARED TO INPUTS?	☑ ☐ ☐	Section 3.0 and 4.0	N
9. ARE THE SPECIFIED PARTS, EQUIPMENT, AND PROCESSES SUITABLE FOR THE REQUIRED APPLICATION?	☐ ☐ ☑		
10. ARE THE SPECIFIED MATERIALS COMPATIBLE WITH EACH OTHER AND THE DESIGN ENVIRONMENTAL CONDITIONS TO WHICH THE MATERIAL WILL BE EXPOSED?	☐ ☐ ☑		
11. HAVE ADEQUATE MAINTENANCE FEATURES AND REQUIREMENTS BEEN SPECIFIED?	☐ ☐ ☑		

FORM-3

GENERIC VERIFICATION CHECKLIST	REFERENCE DOCUMENT NUMBER/REVISION EG-0020, Revision 9		
	YES NO N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
12. ARE ACCESSIBILITY AND OTHER DESIGN PROVISIONS ADEQUATE FOR PERFORMANCE OF NEEDED MAINTENANCE AND REPAIR?	☐ ☐ ☑		
13. HAS ADEQUATE ACCESSIBILITY BEEN PROVIDED TO PERFORM THE IN-SERVICE INSPECTION EXPECTED TO BE REQUIRED DURING THE PLANT LIFE?	☐ ☐ ☑		
14. HAS THE DESIGN PROPERLY CONSIDERED RADIATION EXPOSURE TO THE PUBLIC AND PLANT PERSONNEL? HAVE ALARA CONSIDERATIONS BEEN ADDRESSED?	☐ ☐ ☑ ☐ ☐ ☑		
15. ARE THE ACCEPTANCE CRITERIA INCORPORATED IN THE DESIGN DOCUMENTS SUFFICIENT TO ALLOW VERIFICATION THAT DESIGN REQUIREMENTS HAVE BEEN SATISFACTORILY ACCOMPLISHED?	☑ ☐ ☐	Section 4.0	N
16. HAS VERIFICATION OF THE ELECTRIC LOAD CONTROL PROGRAM [ND.DE-TS.ZZ-2908 (Q)] BEEN PERFORMED?	☐ ☐ ☑		
17. HAS THE EFFECT ON THE DIESEL GENERATOR LOAD SEQUENCE STUDY BEEN ANALYZED?	☐ ☐ ☑		
18. HAVE ADEQUATE PRE-OPERATIONAL AND SUBSEQUENT PERIODIC TEST REQUIREMENTS BEEN APPROPRIATELY SPECIFIED?	☐ ☐ ☑		
19. ARE ADEQUATE HANDLING, STORAGE, CLEANING AND SHIPPING REQUIREMENTS SPECIFIED?	☐ ☐ ☑		
20. ARE ADEQUATE IDENTIFICATION REQUIREMENTS SPECIFIED?	☐ ☐ ☑		
21. ARE REQUIREMENTS FOR RECORD PREPARATION REVIEW, APPROVAL, RETENTION, ETC, ADEQUATELY SPECIFIED?	☐ ☐ ☑		

COMMENT / RESOLUTION FORM FOR DESIGN DOCUMENT

DOCUMENT NO./REV: **S-C-SF-MEE-1679, Revision 1**

OWNER REVIEW COMMENTS

1) Throughout the evaluation, reference is made to "reduce from 100-hours to 85-hours during the period from October 15th to May 15th". The Recommendation section is based on an 85-hour delay for time-period or limiting CCW temperature. Consider rewording such that the 85-hours is not tied to the time-period. Such as, "reduce from current 100-hours during the period from October 15th to May 15th, to a delay of 85-hours..."
2) Page 4 Section 3.2.1 – spell out "Spent Fuel Pool Cooling (SFPC)" the first time.
3) Page 5 Section 3.2.10 – the background heat of 8.46 Mbtu/hr appears high. The background heat for unit 1 from 1R13 was 2.31 Mbtu/hr (per Assumption 3.2.9). The background heat from 1R17 was 3.047 Mbtu/hr (per S-C-SF-MDC-1810 Revision 6). Assumption 3.2.12 states that background heat in the pool at any given refueling between the present and end of life (or full pool) is assumed to be a straight line between 2.31 x 10^6 Btu/hour (Input #9) and 8.46 x 10^6 Btu/hour (Input #10).
4) Page 5 Section 3.3.3 – change "the background heat (old assemblies) are assumed" to "is assumed".
5) Page 6 Section 3.5.2 2nd sentence – change "vaporization for 180F water])." to "180°F water])."
6) Page 8 Footnote 4 last line – change "that these temperature can be" to "these temperatures can".
7) Page 9 Table 2 – modify column width for "plugged tubes", and add revision bar to right of table.
8) Page 9 Table 3 – the table is split between pages, move title and header to next page.
9) Page 9 Table 3 – change units for columns 3 and 4 to Mbtu/hr to match Table 4.
10) Page 9 Table 3 – provide reference for data in table.
11) Page 10 Table 4 – move title for Table 4 to next page.
12) Page 11 Table 4 – Table 4 does not have column for HX efficiency.
13) Page 11 Table 4 – provide reference for data in table.
14) Page 12 Reference 5.10 – change revision from "0" to "1", and verify that new revision does not impact engineering evaluation.
15) Page 13 References – add reference for S1(2).OP-SO.SF-0002 as justification for parallel HX operation.
16) Page 13 Section 6.1 – change "R13" to "Revision 13 (11)".
17) Page 13 Section 6.2 – add "Revision 1 (1)".

RESOLUTIONS
1. Revised statements in the Scope (para 2.0), Background (para 3.1) and Conclusion (para 4.0). 2. Done 3. The background heat in Reference 5.5 is very conservative. A new paragraph is added to the background heat section of paragraph 3.6 to explain the conservatisms in this number. It also discusses that this is another reason why the outage specific calculation is more appropriate. 4. Done 5. Done 6. Done 7. Done 8. Done 9. Changed columns 3, 4, and 5 from Btu/hr to MBtu/hr 10. The data in Table 3 is calculated. Footnotes are included to explain the various calculations that are not apparent. 11. Done 12. Footnote #10 added to show HX efficiency (which does not change in Table 4). I didn't include a column for HX efficiency because Table 4 already had too many columns. 13. See response to comment #10 above. 14. Changed 15. Added new Reference 5.15 16. Done 17. Done
ACCEPTANCE OF RESOLUTION Resolutions are acceptable

Bob Down SUBMITTED BY	5/22/06 DATE	T. J. DelGalzo RESOLVED BY	5/23/06 DATE

SFP Decay Heat

76 Assemblies with 24820 EFPH (34 months)

Hours after Reactor Shutdown when Refueling Begins:	85	Hours to Defuel	40
Days after Reactor Shutdown when Refueling Begins:	3.5416667	Days to Defuel	1.6666667

Infinite Core	n	An Fit Coeff.	an Fit Coeff.	S.D. (days)	ts (seconds)	P/Po Power Fr.	Po Full Power	P (Btu/hr)	No. Elem.	Bt/hr
	1	0.5980	1.772E+00	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	2	1.6500	5.774E-01	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	3	3.1000	6.743E-02	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	4	3.8700	6.214E-03	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	5	2.3300	4.739E-04	5.21	4.50E+05	2.82E-95	6.12E+07	1.73E-87		
	6	1.2900	4.810E-05	5.21	4.50E+05	2.57E-12	6.12E+07	1.57E-04		
	7	0.4620	5.344E-06	5.21	4.50E+05	2.09E-04	6.12E+07	1.28E+04		
	8	0.3280	5.716E-07	5.21	4.50E+05	1.27E-03	6.12E+07	7.76E+04		
	9	0.1700	1.036E-07	5.21	4.50E+05	8.11E-04	6.12E+07	4.96E+04		
	10	0.0865	2.959E-08	5.21	4.50E+05	4.27E-04	6.12E+07	2.61E+04		
	11	0.1140	7.585E-10	5.21	4.50E+05	5.70E-04	6.12E+07	3.49E+04		
						3.28E-03	6.12E+07	2.01E+05	76	1.53E+07

1/3Core-2Cycles	n	An Fit Coeff.	an Fit Coeff.	Op.Time (days)	to + ts (seconds	P/Po Power Fr.	Po Full Power	P (Btu/hr)		
	1	0.5980	1.772E+00	1039	8.98E+07	0.00E+00	6.12E+07	0.00E+00		
	2	1.6500	5.774E-01	1039	8.98E+07	0.00E+00	6.12E+07	0.00E+00		
	3	3.1000	6.743E-02	1039	8.98E+07	0.00E+00	6.12E+07	0.00E+00		
	4	3.8700	6.214E-03	1039	8.98E+07	0.00E+00	6.12E+07	0.00E+00		
	5	2.3300	4.739E-04	1039	8.98E+07	0.00E+00	6.12E+07	0.00E+00		
	6	1.2900	4.810E-05	1039	8.98E+07	0.00E+00	6.12E+07	0.00E+00		
	7	0.4620	5.344E-06	1039	8.98E+07	8.81E-212	6.12E+07	5.39E-204		
	8	0.3280	5.716E-07	1039	8.98E+07	8.36E-26	6.12E+07	5.11E-18		
	9	0.1700	1.036E-07	1039	8.98E+07	7.74E-08	6.12E+07	4.74E+00		
	10	0.0865	2.959E-08	1039	8.98E+07	3.03E-05	6.12E+07	1.86E+03		
	11	0.1140	7.585E-10	1039	8.98E+07	5.32E-04	6.12E+07	3.26E+04		
						5.63E-04	6.12E+07	3.44E+04	76	2.62E+06
D.H. Rate						3.05E-03	6.12E+07	1.87E+05	76	1.42E+07

	Elements In Pool	2010 total in Pool	
1/3 for 2 cycles (76 assemblies)			1.42E+07
1/3 for 3 cycles (41 assemblies)			7.75E+06
1/3 for 1 cycle (76 assemblies)			1.37E+07
Background	956	1412	8.46E+06
Heavy Elements			3.89E+06
TOTAL			4.80E+07

SFP Decay Heat

76 Assemblies with 12410 EFPH (17 months)

Days after Reactor Shutdown when Refueling Begins: 3.5416667

	n	An	an	S.D.	ts	P/Po	Po	P	No. Elem.	Bt/hr
Infinite Core		Fit Coeff.	Fit Coeff.	(days)	(seconds)	Power Fr.	Full Power	(Btu/hr)		
	1	0.5980	1.772E+00	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	2	1.6500	5.774E-01	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	3	3.1000	6.743E-02	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	4	3.8700	6.214E-03	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	5	2.3300	4.739E-04	5.21	4.50E+05	2.82E-95	6.12E+07	1.73E-87		
	6	1.2900	4.810E-05	5.21	4.50E+05	2.57E-12	6.12E+07	1.57E-04		
	7	0.4620	5.344E-06	5.21	4.50E+05	2.09E-04	6.12E+07	1.28E+04		
	8	0.3280	5.716E-07	5.21	4.50E+05	1.27E-03	6.12E+07	7.76E+04		
	9	0.1700	1.036E-07	5.21	4.50E+05	8.11E-04	6.12E+07	4.96E+04		
	10	0.0865	2.959E-08	5.21	4.50E+05	4.27E-04	6.12E+07	2.61E+04		
	11	0.1140	7.585E-10	5.21	4.50E+05	5.70E-04	6.12E+07	3.49E+04		
						3.28E-03	6.12E+07	2.01E+05	76	1.53E+07

	n	An	an	Op.Time	to + ts	P/Po	Po	P		
1/3Core-1Cycle		Fit Coeff.	Fit Coeff.	(days)	(seconds	Power Fr.	Full Power	(Btu/hr)		
	1	0.5980	1.772E+00	522	4.51E+07	0.00E+00	6.12E+07	0.00E+00		
	2	1.6500	5.774E-01	522	4.51E+07	0.00E+00	6.12E+07	0.00E+00		
	3	3.1000	6.743E-02	522	4.51E+07	0.00E+00	6.12E+07	0.00E+00		
	4	3.8700	6.214E-03	522	4.51E+07	0.00E+00	6.12E+07	0.00E+00		
	5	2.3300	4.739E-04	522	4.51E+07	0.00E+00	6.12E+07	0.00E+00		
	6	1.2900	4.810E-05	522	4.51E+07	0.00E+00	6.12E+07	0.00E+00		
	7	0.4620	5.344E-06	522	4.51E+07	4.29E-108	6.12E+07	2.62E-100		
	8	0.3280	5.716E-07	522	4.51E+07	1.03E-14	6.12E+07	6.30E-07		
	9	0.1700	1.036E-07	522	4.51E+07	7.93E-06	6.12E+07	4.85E+02		
	10	0.0865	2.959E-08	522	4.51E+07	1.14E-04	6.12E+07	6.96E+03		
	11	0.1140	7.585E-10	522	4.51E+07	5.51E-04	6.12E+07	3.37E+04		
						6.73E-04	6.12E+07	4.11E+04	76	3.13E+06
D.H. Rate						2.94E-03	6.12E+07	1.80E+05	76	1.37E+07

SFP Decay Heat

41 Assemblies with 37,230 EFPH (51 months)

Days after Reactor Shutdown when Refueling Begins: 3.54166667

	n	An	an	S.D.	ts	P/Po	Po	P	No. Elem.	Bt/hr
Infinite Core		Fit Coeff.	Fit Coeff.	(days)	(seconds)	Power Fr.	Full Power	(Btu/hr)		
	1	0.5980	1.772E+00	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	2	1.6500	5.774E-01	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	3	3.1000	6.743E-02	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	4	3.8700	6.214E-03	5.21	4.50E+05	0.00E+00	6.12E+07	0.00E+00		
	5	2.3300	4.739E-04	5.21	4.50E+05	2.82E-95	6.12E+07	1.73E-87		
	6	1.2900	4.810E-05	5.21	4.50E+05	2.57E-12	6.12E+07	1.57E-04		
	7	0.4620	5.344E-06	5.21	4.50E+05	2.09E-04	6.12E+07	1.28E+04		
	8	0.3280	5.716E-07	5.21	4.50E+05	1.27E-03	6.12E+07	7.76E+04		
	9	0.1700	1.036E-07	5.21	4.50E+05	8.11E-04	6.12E+07	4.96E+04		
	10	0.0865	2.959E-08	5.21	4.50E+05	4.27E-04	6.12E+07	2.61E+04		
	11	0.1140	7.585E-10	5.21	4.50E+05	5.70E-04	6.12E+07	3.49E+04		
						3.28E-03	6.12E+07	2.01E+05	41	8.24E+06

	n	An	an	Op.Time	to + ts	P/Po	Po	P	No. Elem.	Bt/hr
1/3Core-3 Cycles		Fit Coeff.	Fit Coeff.	(days)	(seconds	Power Fr.	Full Power	(Btu/hr)		
	1	0.5980	1.772E+00	1556	1.34E+08	0.00E+00	6.12E+07	0.00E+00		
	2	1.6500	5.774E-01	1556	1.34E+08	0.00E+00	6.12E+07	0.00E+00		
	3	3.1000	6.743E-02	1556	1.34E+08	0.00E+00	6.12E+07	0.00E+00		
	4	3.8700	6.214E-03	1556	1.34E+08	0.00E+00	6.12E+07	0.00E+00		
	5	2.3300	4.739E-04	1556	1.34E+08	0.00E+00	6.12E+07	0.00E+00		
	6	1.2900	4.810E-05	1556	1.34E+08	0.00E+00	6.12E+07	0.00E+00		
	7	0.4620	5.344E-06	1556	1.34E+08	0.00E+00	6.12E+07	0.00E+00		
	8	0.3280	5.716E-07	1556	1.34E+08	6.79E-37	6.12E+07	4.15E-29		
	9	0.1700	1.036E-07	1556	1.34E+08	7.57E-10	6.12E+07	4.63E-02		
	10	0.0865	2.959E-08	1556	1.34E+08	8.09E-06	6.12E+07	4.95E+02		
	11	0.1140	7.585E-10	1556	1.34E+08	5.15E-04	6.12E+07	3.15E+04		
						5.23E-04	6.12E+07	3.20E+04	41	1.31E+06
D.H. Rate						3.09E-03	6.12E+07	1.89E+05	41	7.75E+06

SFP Decay Heat

Contribution of Heavy Elements U-239 and Np-239

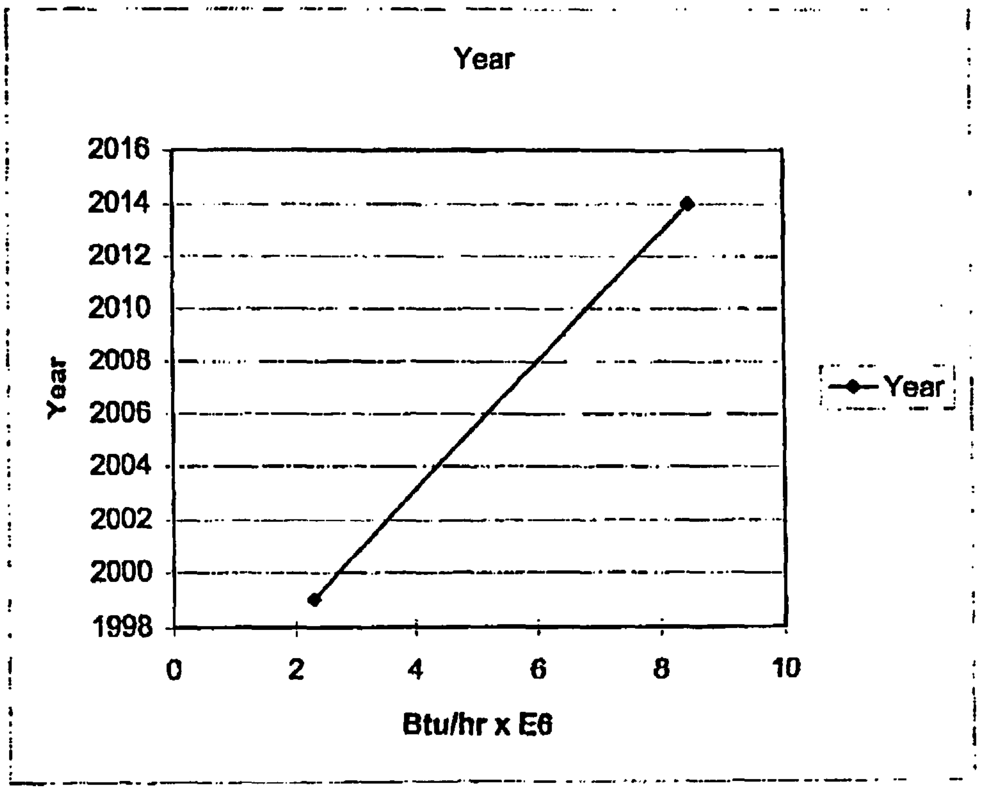
			to	ts	1-EXP	EXP	P/Po	Po	Elem	P
U-239	2.28E-03	0.7	4.47E+07	4.50E+05	1.00E+00	1.1E-96	1.76E-99	61168741	76	8.18E-90
N-239	2.17E-03	0.7	4.47E+07	4.50E+05	1.00E+00	0.215563	3.30E-04	61168741	76	1.53E+06
U-239	2.28E-03	0.7	8.94E+07	4.50E+05	1.00E+00	1.1E-96	1.76E-99	61168741	76	8.18E-90
N-239	2.17E-03	0.7	8.94E+07	4.50E+05	1.00E+00	0.215563	3.30E-04	61168741	76	1.53E+06
U-239	2.28E-03	0.7	1.34E+08	4.50E+05	1.00E+00	1.1E-96	1.76E-99	61168741	41	4.42E-90
N-239	2.17E-03	0.7	1.34E+08	4.50E+05	1.00E+00	0.215563	3.30E-04	61168741	41	8.27E+05
										3.89E+06

SFP Background Heat

Unit 1	1R13	1R14	1R15	1R16	1R17	1R18	1R19	1R20	1R21	1R22	1R23
Unit 1	Oct-99	Apr-01	Oct-02	Apr-04	Oct-05	Apr-07	Oct-08	Apr-10	Oct-11	Apr-13	Oct-14
Unit 2	2R10	2R11	2R12	2R13	2R14	2R15	2R16	2R17	2R18	2R19	2R20
Unit 2	Apr-99	Oct-00	Apr-02	Oct-03	Apr-05	Oct-06	Apr-08	Oct-10	Apr-11	Oct-12	Apr-14

Btu/hr	Year
2.31E+00	1999
8.46E+00	2014

Y	X
2010	6.819981



S-C-SF-MEE-1679 REV. 0
Attachment A
Page A5

Deleware River Temperature Data

Weekly Averages compiled into Specified Era Averages 1967 - 1997

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1967 - 1969	40.0	36.7	37.6	45.8	53.7	62.4	70.4	74.1	72.4	66.6	56.6	47.4
1970 - 1979	39.2	36.0	41.0	47.9	57.3	64.8	72.2	75.0	73.1	64.5	56.2	47.0
1980 - 1989	33.6	34.6	41.4	52.8	63.1	72.1	77.6	76.9	72.5	60.6	49.7	39.9
1990 - 1997	35.0	35.4	41.2	51.6	62.2	70.9	76.8	75.3	70.5	60.3	48.4	41.0
AVERAGE	37.0	35.7	40.3	49.5	59.1	67.5	74.2	75.3	72.1	63.0	52.7	43.8

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	42.3	39.5	39.1	44.8	49.9	58.7	68.4	72.6	70.7	65.6	56.7	47.9
	38.2	33.1	36.1	47.3	53.3	61.2	71.3	74.6	72.8	67.3	57.7	48
	37.2	35.7	35.8	46.5	55.5	64.5	72	75.1	75.2	68.6	59	49.4
	44.1	38.8	38.5	41.7	51.2	61.9	65.4	72.8	70.2	68.1	53.5	46.7
	42.7	35	36.1	43.3	55	63.1	67.8	75.3	71.9	70.3	55	45.1
	40.3	35.4	37.6	41.1	57.9	66.2	69.8	75.2	73.9	71	56.6	47.1
	43.2	40.7	37.7	43	48.6	55.1	67	72.5	71.5	66.8	59.6	49
	39.5	37.7	35.1	45.3	51.4	58.2	69.2	74.6	73.6	67.9	61.3	51.7
	38.2	36.5	35.8	44.1	53.6	62.6	70.4	74.5	76	70.1	61	51
	42.3	37.2	39.4	46.1	52.4	64.1	70.2	72.3	69	63.7	51.3	45.2
	37.7	34.7	40.3	48.8	55.9	65.5	72.9	74.7	71.8	65.9	53.2	43.1
	37.5	35.7	39.3	48.6	60.2	68	72.5	75.4	72.2	65.6	54.5	44.3
	41.9			47.5			71.6			61.9		
	37.6			49.9			73.5			63		
1967 - 1969	37			51.2			73.6			63.3		
AVERAGE	39.98	36.67	37.67	45.81	53.74	62.42	70.37	74.13	72.40	66.61	56.62	47.38

Deleware River Temperature Data

Weekly Averages compiled into Specified Era Averages 1967 - 1997

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	37.4	36	37	43.5	53.7	63.2	70.8	75.4	75.3	70.6	61.9	51.6
	40.7	35.7	39.1	44.8	51.8	61.2	70.9	74.3	75.3	69.4	59.2	49.8
	46.5	41.5	41	45	52.9	60.7	69.8	73	75.3	65.8	62.7	53.2
	42.7	40.4	43	48.4	55.5	65.7	73.8	77.4	75	69	60.3	51.9
	42.9	40.4	42.6	48.1	56.2	64.3	71.3	73.4	73.7	65.3	58.7	50.7
	44.4	40.7	41	43.5	53.8	61.9	70.6	74.5	73.4	66.5	55.9	48.1
	41.2	37.9	42.2	48.6	55.6	61.3	70.3	73.1	76.5	55.2	59	52.7
	28.2	28.6	46	56.3	62.5	65.2	76.1	77.5	74.5	54.4	57.6	49.2
	29.8	26.8	32.8	50.2	55.9	69.7	74.4	78.1	73.7	58.6	58.7	49.5
	31.4	24.7	38.8	49	64.7	70.2	76.5	73.2	73.3	67.3	56.2	48.3
	42.1	36.1	37.5	40.2	56.3	64.9	68.1	75.8	72.3	73.6	61.6	52.8
	44.4	36.5	40.1	41.3	54	63.1	68.1	74.7	71.2	72.5	59.7	50.4
	49.4	40.4	41.8	42.5	54.9	62.8	65.7	73.2	72.5	70.7	54.1	46.1
	46.6	39.3	43.5	46.1	56.4	67.1	71	76.5	72.2	72.4	52.1	44.6
	45.3	40.7	42.9	44.5	58.7	66.1	68.4	74.1	71.6	69.1	51.3	35.8
	45.2	41.1	42.1	42.4	55.1	54.8	67.8	74.6	70.2	68.9	47.9	36.8
	45.6	39.9	42.9	46.1	56.6	64.3	68.8	73.3	71.7	69.1	52.5	42.4
	37.2	30.7	46.3	60.8	67.1	58.8	73.6	74.6	70.8	64.6	50.1	39.4
	33	27.2	38.1	45.8	61.4	70.3	71.6	77.8	73.2	65.2	50.6	44.2
	35.9	23.9	42.7	48.5	65.4	71	70.2	72.6	70.3	66.3	50	39.8
	39.1	36	36.7	42	60.7	61.3	69.5	74.4	75.9	72.7	63.3	54.3
	42.5	35.8	36.1	43	49.5	58.7	69.7	73.7	74.6	70.7	65.6	53.9
	48.4	42.2	41.2	43.1	50.8	59.2	67	73.1	74.3	66.3	60.7	51.8
	43.7	42.2	40.7	46.8	54	61.7	72.6	76.8	78.2	71.4	61.4	55.1
	44.5	41.5	42.6	45.9	53.2	61.7	70.3	73	74.3	67.2	61.1	50.9
	45.9	41.9	41.2	42.1	49	60.2	69.1	74.3	73.4	67.5	63.5	55.1
	43.1	37.4	42.4	46.7	53.7	58.9	69.8	72.4	73.1	67.7	57	48
	32.9	25.4	40.6	51.6	61	65.3	75.3	77.8	75.7	60.4	56.2	41.2
	31.6	26.7	28.6	46.7	53.5	69.2	73.1	76.6	75.7	61.6	53.8	44.7
	33.5	29.6	36.2	47.3	61.8	69	71.8	79.1	75.8	60.4	52.9	46.3
	35.7	36.2	38.9	45.5	58.6	66.5	71.9	76.2	75.7	68.4	56.4	47.4
	39.2	37.9	40	46.5	55.8	66	71.9	74.3	73.5	68.2	56.6	50.7
	45.8	40.4	41.8	46.7	56.7	64	72.5	74.4	72	63.2	53.5	47.2
	42.6	39.3	44.4	50.9	58.2	68.9	74.7	77.3	73.2	67.1	56.8	47.4
	42.8	40.6	43	50	60	66.6	71.6	75	71.8	62.3	53.4	47.4
	43.4	41.8	42.6	45.6	58	66.7	72.3	74.7	70	65.7	57.4	47.5
	39.1	41.3	44.9	51.3	57.5	67.1	71.2	74	71	62.2	50.4	42.5
	26.2	36.9	46.9	60	68.2	71.1	76.1	74.9	67.7	53.3	43.8	35.6
	28.9	28.5	42	50.9	66	72.5	76.9	76.9	68.1	56.7	54.1	37.4
	32.9	30.1	46	53.4	66.4	70.5	77.2	75	66.7	57.8	51	39.5
	36			46.3			73.6			65.7		
	36.8			47.7			73			68		
	44.3			48.4			72.9			62		
	42.3			52.3			75.8			64.9		
	43.4			52.3			72.6			61.7		
	43			47			73.9			64.2		
	36.5			52			72			59.4		
	25.3			61.2			75.2			54.1		
	28.5			51.6			75.6			54.8		
1970 - 1979	33.5			56.8			79.8			54.6		
AVERAGE	39.25	36.01	40.96	47.94	57.28	64.79	72.15	75.03	73.06	64.49	56.23	47.03

Deleware River Temperature Data

Weekly Averages compiled into Specified Era Averages 1967 - 1997

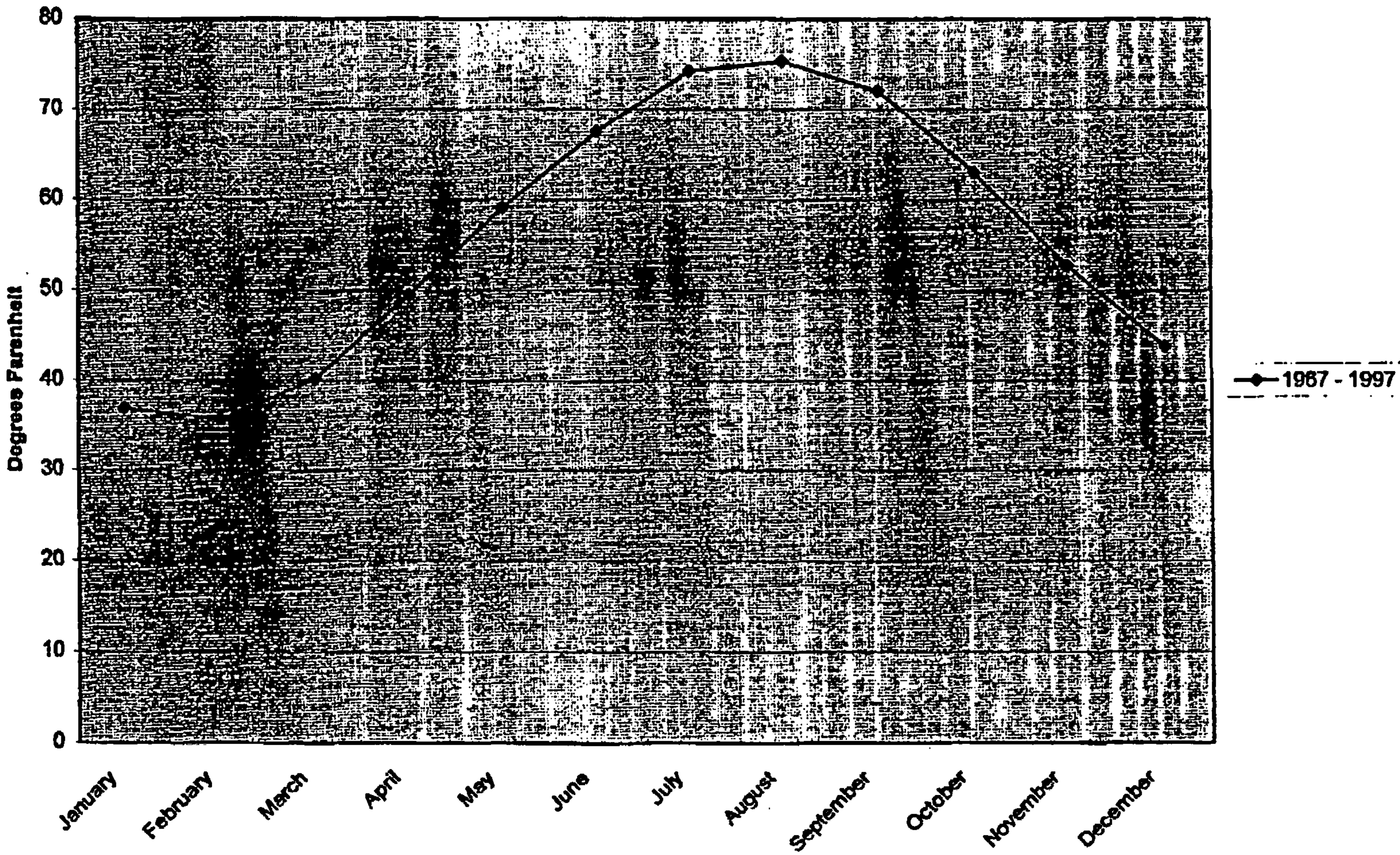
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	37.1	30.3	36.5	52.3	62.3	67.7	77	76.3	74.9	60.3	46.6	40.4
	25.6	32.4	40.6	54.7	64.5	68.3	77.9	75	72.9	55.6	43.2	37
	26.7	33.5	41	50.6	61.2	71.7	80.7	76.7	71.5	60.5	48.6	37.3
	33.3	39.9	39.7	49.8	62.8	74.1	77.8	76.8	69.2	60.2	46.3	34.8
	36	31.8	40.6	56.3	63.8	68.4	78.1	78.8	72.5	63.5	51.1	44.8
	32.4	34.6	43.1	52.3	65.4	71	77.1	76.3	70.9	60.7	49.4	41.6
	37.7	35.9	36	54.2	58.3	74.2	79	76.7	72.4	59.8	52.6	41.5
	30.7	40.5	39.1	51.1	51.8	74.5	79.5	78.7	70.2	59	46.5	42.7
	36	32.2	46.3	53.4	66.7	70.8	77.6	83.9	73.8	61.9	54.4	42.3
	37.7	36	45.3	46	67.4	71.6	73.8	76.7	70.3	67.2	53	37.7
	30.3	31.4	40.8	51.8	63.2	74	74.3	72.7	69.4	61.6	56.6	42.4
	36.3	33.3	44.9	45.8	67.5	73.7	74.7	74.9	66.9	66.5	47.1	40.5
	42.4	32.5	39	43.4	62.6	72.9	76	77	73.5	62.1	49.5	43.2
	43.5	32.5	41.6	50.5	64	75.8	73.1	75.9	72.8	67.2	47.1	41.4
	33.9	33.9	42.9	52.7	60.9	87.8	73.7	74.5	73.1	70	50.6	41
	38.2	35.1	41.8	49.1	63.9	73.3	76.6	77.7	70.9	66.3	49.4	37.3
	36.9	37	37.9	51.2	58.5	73.1	73	80.2	76	67.5	54.7	35.8
	36.7	37.3	42.4	50.9	64.5	74.9	78	76.4	73.9	66.1	49.5	31
	35.3	29.6	33	50.6	60	68.8	74.7	80.1	77.6	63.5	50.2	40.5
	26.7	30.5	41.2	54.6	58.8	69.8	77.7	76.6	71.8	57.7	52.3	41.5
	32.6	30.5	36.2	43.9	60.5	68.8	77.5	79	71.9	65.8	53.7	49.3
	38.1	31.5	37.7	46.7	57.3	67.3	75.9	78.5	74.6	60.2	56.3	43.8
	38.6	29.8	43.9	51.4	63.9	70.6	75.7	77.4	76.1	64.3	54.3	44.1
	32.7	33	34.6	51.7	60.6	72.3	75.9	78.7	69.8	65.1	54.3	44.1
	37.4	33.2	36.7	51.6	59	71.8	78.9	79.3	72.4	62	53.3	43.5
	32.1	34.2	40	51.9	56.5	67.1	76.3	83	76.3	62.7	51.4	45
	35.3	38	36	51	57.6	72.8	79.1	78.5	74.9	61.9	56.2	39.5
	35.8	32.5	43	55.3	66.1	71	78.5	76.4	71.1	57.7	42.2	32.4
	28.5	42.6	44	54.9	67.4	74.3	76.9	72.5	64.7	54.6	42.9	34.9
	24.9	35	44.4	54.4	67.9	73.8	80.8	72.5	97.3	64.9	47.1	43.4
	30.4	40.1	41	51	65.7	74.6	77.3	76.1	68.9	62.4	45	42.7
	28.9	41.8	47.4	61.3	69.3	71.9	78	74.9	69.3	60.9	49.2	34.2
	34.9	33.4	48.7	53.5	70.2	73.4	78.6	71	68.4	58.7	46	39.9
	34.2	35.1	47.4	56.4	68.5	75.8	81.6	74.3	70.1	57.5	45.5	41.2
	32.1	37.1	47.1	51.7	66.9	74.6	79.8	76.5	69.5	56.5	47.9	38.1
	36.4	36.3	47.1	55	66.5	77.4	79.9	77	69.9	58.3	44.3	26.8
	32			56.4			78.7			52.2		
	30.7			57.5			76.1			54.2		
	27.1			57.6			80.1			54.5		
	31.1			54.9			76.4			63.2		
	29.6			62			77.7			56.6		
	32.3			57.4			79.2			57.2		
	31.6			56			80.3			55.1		
	33.5			53.2			81.7			52.7		
1980 - 1989	36.9			57.4			78.9			58.5		
AVERAGE	33.58	34.56	41.36	52.79	63.14	72.05	77.56	76.88	72.49	60.55	49.68	39.93

Deleware River Temperature Data

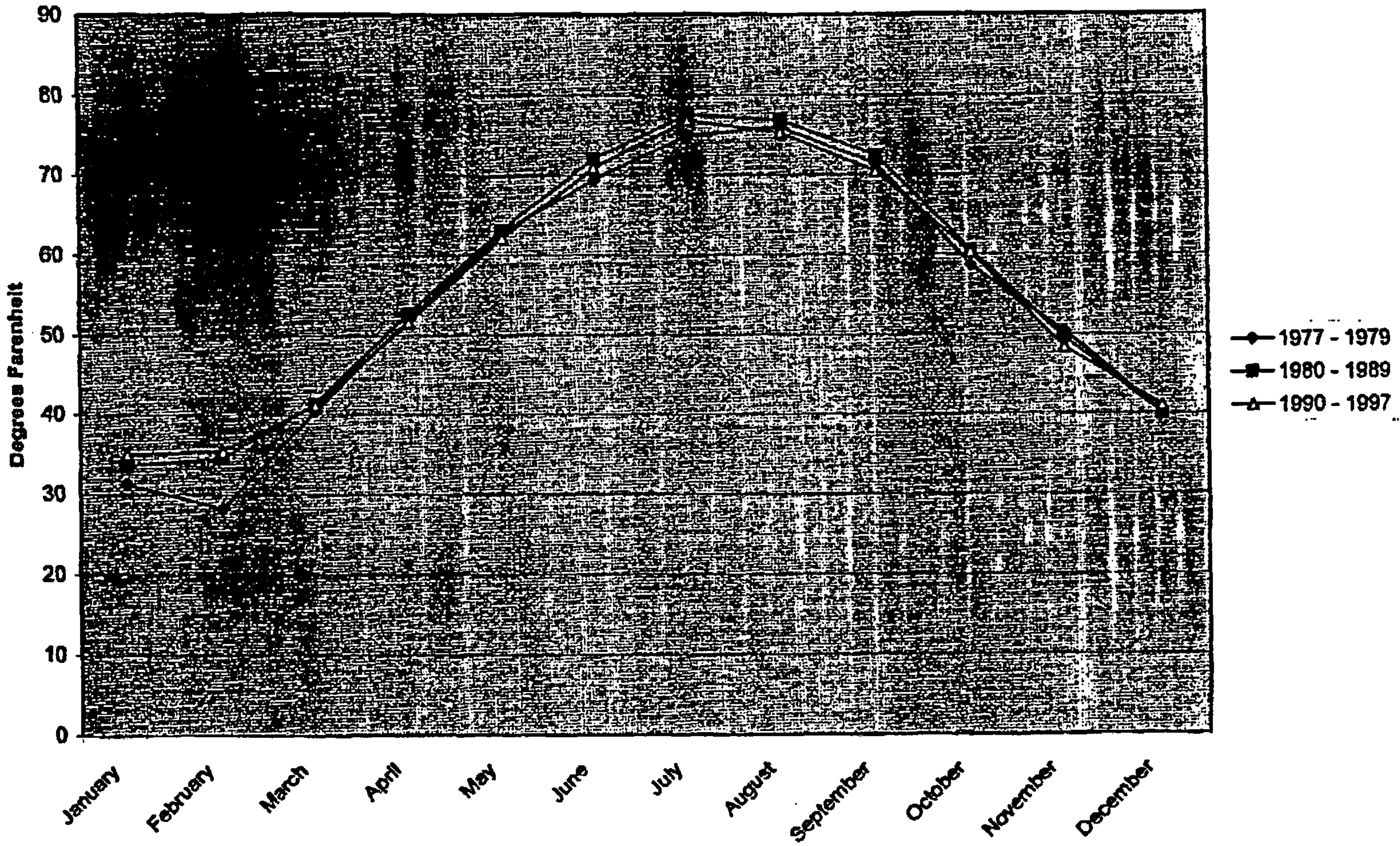
Weekly Averages compiled into Specified Era Averages 1967 - 1997

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	34.3	43.8	47.3	52	63.4	68.8	76.1	78.6	74.6	67.5	49.8	44
	39	44.8	51	54.5	63.1	71.7	79.1	75.1	70.3	60.1	47.4	44.3
	38.1	36.8	43.3	50.3	67.6	76.7	78.7	77.2	75.3	60.6	49.6	46.3
	39.3	39.9	45.2	52.3	70.9	77.4	80.3	77.4	74.1	59.8	52.2	41.6
	28.7	35.3	43.2	56.3	61.1	71.1	81.7	75.9	74	60.1	53.9	41.6
	41.8	38.7	40.9	52.4	63.9	71.5	82.2	74.9	73.1	65.1	49	41.6
	29.7	36.6	36.5	50.7	66.8	72.3	80.4	78.2	75.9	60.7	51.3	44.7
	32.9	34.8	35.9	51.1	66.9	75.6	79.7	78	71.9	62.4	48.3	42.8
	29	28.6	38.1	48.4	61.3	72.7	75.8	77.5	70.3	66.8	47	45.1
	42	32.9	40.3	50.1	63.1	77.1	77.7	76.2	70.2	67.6	49.9	42.6
	40.5	31.1	41.2	44.4	62.8	74.1	73.7	82.1	74.5	63.9	47.6	37.3
	41	33.6	45.9	44.5	67.5	75.7	78.3	79.5	71.9	64.7	51.5	34.6
	34.9	31.7	37.4	46.1	60.7	74	79.2	78.5	77.4	65.1	52.1	43.3
	39.7	33.6	40.4	48.1	66.9	77.3	77.2	79	73	68	45.7	42.4
	31.1	35.6	44.6	45.4	59.3	68.3	76.4	77.8	71.6	67	49.9	40.3
	41.3	41.3	41	50.1	61.4	67.2	77.5	76.6	76	65.5	55.9	46.9
	31.7	39.7	44.6	49.7	62.5	76.2	75.1	77.5	76.1	68.5	50.6	47.2
	39	35.1	42.7	55	58.1	67.7	77.6	77.5	74.3	64.2	51.9	45.1
1990 - 1997	41.3	36.4	36.7	48.1	63.4	68.5	75.9	77.5	80.1	62.2	52	47.9
	40.7	29.4	35.6	47.6	60.9	69.3	82.7	78.5	72.4	62	56.6	47.8
	33.1	32.5	37.5	51.7	59.6	74	81.2	82.1	76.6	62.5	54.3	42.7
	37.4	30.5	37.5	49.7	62	68.5	78.7	79.9	78.6	68.4	55.5	45.4
	28.1	35.8	45.4	46.5	57.6	63.5	79.7	76.7	72.6	62.3	52.5	42.1
	38.6	41.9	49	50.7	63.8	74.2	77.8	76	67.6	66.7	47.6	43.9
	37.3	41.3	48	57.6	76.7	78	78	78.3	69.3	63	48.7	39.5
	37.2	40.4	42.3	55.3	64.3	71.3	80.2	76.1	68.3	58.7	48.9	39.8
	35.7	33.9	40.8	55.1	68.2	76.5	78	80.1	68.9	55.8	49	39
	39.6	33.4	44.2	54.2	66.1	78	78.3	75.9	68.8	59.2	48	43.1
	26.6	35.3	47.4	58.8	70.2	75.6	81.5	77.5	68.1	59.4	43.9	31.8
	40.3	38.8	43	56.2	66.3	77.4	84	79.6	70.3	62.9	47.2	40.8
	32.3	45	47.8	58	63.3	76.5	78.5	74.4	67.9	59.6	44.4	39.3
	32.9	40.2	44.7	62.6	61.3	72.3	76.2	75.4	71.4	56.8	46.2	39.5
	39.7			60.9			77			57.4		
	37.2			59.2			78.5			56.6		
	35.4			57.7			77.5			53.6		
	38			58.1			78.5			55.3		
	26.5			61.2			81			57.7		
	37.8			57.9			84.6			60.1		
	33.3			61.3			78.3			58.6		
1990 - 1997	34.1			56.6			76.7			54.4		
AVERAGE	35.05	35.45	41.20	51.62	62.15	70.88	76.82	75.32	70.47	60.26	48.44	41.01

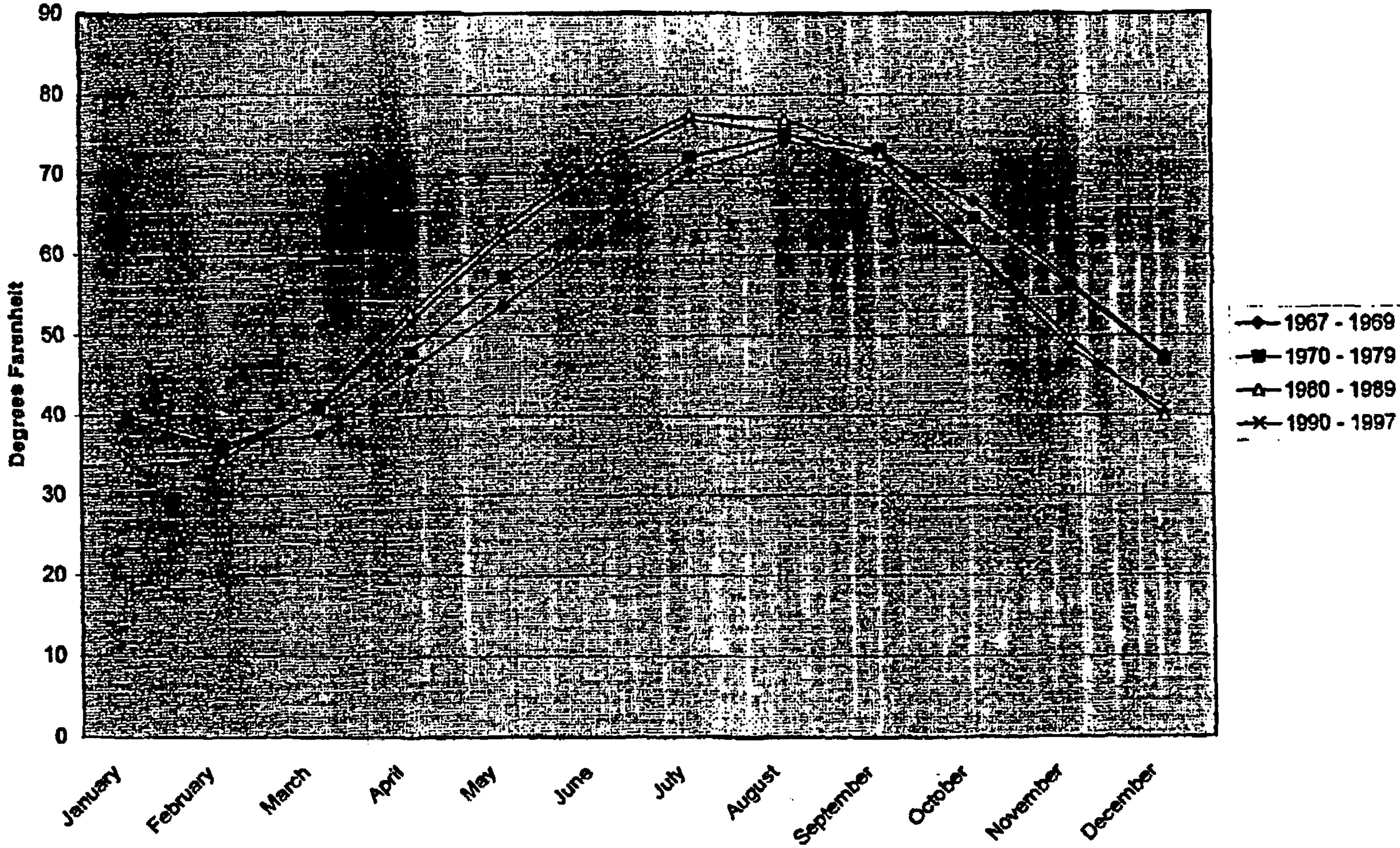
Delaware River Temperature Average 1967 to 1997



Delaware River Average Temperatures for Past 20 years (1977 - 1997)



Delaware Water Temps by Decade 1967 - 1997



Comparison of Reedy Island and PSEG Maximum Annual Temperatures

Year	Maximum Annual Temperature at Reedy Island (°F)	Actual Maximum Annual Temperature from HC.A2438	Temperature Difference Between HC.A2438 and Reedy Island
1992	78.7	81.8	3.1
1993	82.7	85.5	2.8
1994	81.7	86.4	4.7
1995	84.6	85.4	0.8
1996	80.4	82.0	1.6
1997	79.7	84.6	4.9
Average	81.3	84.3	3

HTC-STX Version 3.6 Time: 9:01:16 AM Date: 4/30/02 File: Spfchx

*** Main *** English units

1	Job No		Item No.		EVALUATION Case		
2	Case Desciption	SFPHX					
3	TEMA Type	BEU - HORZ	Shell/Unit	1	Conn In	1 Series	1 Parallel
4	Size:	33.500 in Dia	146.3 in	Tube Length		in	Kettle Dia
5	Surface/Shell ft²	2,353.2	Gross		2,319.3 Eff 151		U-Bend Area
6	Surface/Unit ft²	2,353.2	Gross		2,319.3 Eff 151		U-Bend Area

	Performance of One Unit		SHELLSIDE	TUBESIDE
7	Fluid Circulated			SFPHX
8	Total Fluid In	lb/hr	1,490,000.0	1,140,000.0
9	Vapor	lb/hr	0.0	0.0
10	Liquid	lb/hr	1,490,000.0	1,140,000.0
11	Fluid Vap'z/Cond	lb/hr	0.0	0.0
12	Density In/Out	lb/ft³	62.050 / 61.946	61.729 / 61.841
13	Spec. Heat Vap/Liq	Btu/lb-F	0.000 / 0.997	0.000 / 0.997
14	Viscosity Vap/Liq	cP	0.000 / 0.692	0.000 / 0.588
15	Therm Cond Vap/Liq	Btu/hr-ft-F	0.000 / 0.364	0.000 / 0.370
16	Temperature In/Out	°F	95.0 / 103.0	120.0 / 109.54
17	Operating Pressure (Abs)	psi	75.000	50.000
18	Press. Drop Allow/Calc	psi	9.000 / 10.981	15.000 / 16.933
19	Number of Passes/Shell		1	4
20	Velocity, Average	ft/sec	4.07	9.61
21	Film Coef.	Btu/hr-ft²-F	1912.81	2256.37
22	Fouling Resist.	hr-ft²-F/Btu	0.000500	0.000575

23	Heat Duty	11,883,525	Btu/hr	MTD/Wtd/Corr		14.81 °F	F-CORR	0.941	
24	Transfer Rate	345.99	Serv	372.11	Calc	655.32	Clean	0.00136	Foul

	Construction of One Shell						
25	TEMA Shell Type			E	Rear End Type		U.T.
26	Tube Type			PLAIN	Bundle Dia	in	32.50
27	Tube O.D	in		0.750	No. Holes/TubeSheet		920
28	Tube I.D	in		0.652	No. Holes Counted		
29	Area Ratio			1.150	Tube Pitch	in	0.9375
30	Tube Length Total	ft		12.19	Tube Layout Angle		30
31	Tube Length Effective	ft		12.00	Impingement Plate		NO
32	Baffle Type			VERT-DBL-SEG	Crosspasses/Shell		9
33	Baffle Cut, Frac Dia/NFA			0.160/0.200	Central Spacing	in	16.558
34	Window Area	in²		94.9941	In/Out Spacing	in	23.9/4.2
35	Seal Strips			YES	Drop Under Noz In/Out	in	1.7/1.7

	Shell Nozzles		Inlet	Outlet	Tube Nozzles		Inlet	Outlet
36	Inside Dia,	in	10.00	10.00	Inside Dia,	in	10.00	10.00
37	Velocity	ft/sec	12.23	12.25	Velocity	ft/sec	9.41	9.39
38	Rho-V-Sqr	lb/ft-sec²	9280	9296	Rho-V-Sqr	lb/ft-sec²	5461	5451
39	Nozzles/Shell	(OPP. SIDE)	1	1				

	Shellside Performance		**Pressure Drop**	
40	Bundle Flow Fraction	0.761	Shell Cross/Wind	4.378/4.408
41	Mass Vel Cross/Wind	252.1/627.4	Tubes	17.750
42	Mass Vel Long/Mean	125.5/397.7	Nozzles Shell/Tube	2.195/1.183

	Bundle Diameter Clearances			**Tube Metal Temperatures**		
43	Bundle-Shell	in	1.00000	Avg. Tube Metal Temp.	°F	106.8
44	Baffle-Shell	in	0.18750	Shellside Avg Surf. Temp	°F	102.0
45	Tube-Baffle	in	0.03625	Tubeside Avg. Surf Temp	°F	111.6
46	Baffle Thk.	in	0.313			

HTC-STX	Version 3.6		Time: 9:01:16 AM		Date: 4/30/02		File: Spfchx
*** Summary ***							English units

Item No							
Service	SFPHX						
Calculation Mode	Evaluation Case						
Size	34 x 146	Type	BEU - HORZ	Connections	1 Series		1 Parallel
Surface/Unit	2,319		Shells/unit	1		Surf/Shell	2,319.35
Cost/Unit	42,668		Cost/Surf	18.4		Weight/Shell	9,531
Heat Duty	11,883,525		MTD	14.81		F-corr	0.9409
Rate-Service	345.99		Calculated	372.11		Calc Fouling	0.00136

	Shell	Tubes		
	Shell	Tubes	Tubes	0.750 x 0.049 on 0.9375 30 deg
Flow Rate	1490000	1140000	Tube No	920 Type: PLAIN
Temperature In	95.0	120.0	Baffles:	VERT DBL-SEG 16.6 space 20.0 cut
Temperature Out	103.0	109.5		
Pressure Drop	10.981	18.933	Surface Area	OK. Over design by 7.55%
Velocity	4.066	9.611	Shell pressure Drop	** Allowable exceeded.
Passes	1	4	Tube Pressure Drop	** Allowable exceeded.
Film Coef.	1912.8	2256.4	Vibration	** Tube vibration likely.
Nozzle In	1 x 10.0	10.0	Shell Nozzles	** Rho-V-Sqr exceeds 4000
Nozzle Out	1 x 10.0	10.0	Chan Nozzles	OK. Rho-V-Sqr within 8000

SERVICE SPENT FUEL PIT HX		ITEM NO. AH-SF-537	
MFR. JOS. OAT & SONS	TYPE BEU	SIZE 33.5 x 142	
NO. UNITS	CONN. SHELL (SER) (PARA)	TRANSF. AREA PER SHELL 2320 SQ.FT.	
TOTAL NO. SHELLS 1	CONN. TUBES (SER) (PARA)	PER UNIT 2320 SQ.FT.	

PERFORMANCE (PER UNIT)

		SHELL SIDE	TUBE SIDE
FLUID		WATER	WATER
TOTAL FLUID ENTERING	LB/HR		
LIQUID	LB/HR	1.49 x 10⁶	1.14 x 10⁶
VAPOR	LB/HR		
NON-CONDENSIBLES	LB/HR		
STEAM	LB/HR		
FLUID VAPORIZED OR CONDENSED			
GRAVITY - LIQUID		@ °F.	@ °F.
VISCOSITY - LIQUID CENTIPOISES		@ °F.	@ °F.
MOLECULAR WEIGHT - VAPORS			
TEMPERATURE IN.	°F.	95.0	120.0
TEMPERATURE OUT.	°F.	103.0	109.5
PRESSURE @ INLET. PSIG.			
NUMBER OF PASSES		1	4
VELOCITY. FT/SEC.		4.1	9.4
PRESSURE DROP. CLEAN PSI.		9	15
FOULING FACTOR - REQ.		.0005	1.15 x .0005 = .000575

HEAT EXCHANGED - BTU/HR. 11.94 x 10⁶ LOG MTD. °F. 15.7 CORRECTED MTD. °F 14.96

TRANSFER RATE - SERVICE 340 CLEAN 558 FOULING FACTOR .001075

CONSTRUCTION

	SHELL SIDE	TUBE SIDE
DESIGN PRESSURE - PSIG.	150	150
TEST PRESSURE - PSIG.		
DESIGN TEMPERATURE - °F.	200	200

TUBES - NO. 460 O.D. 3/4 BWG 18 LENGTH 26'-0" AV. L. PITCH 15/16 □ △ ◇

SHELL 33 1/2 I.D.

CONNECTIONS - SHELL | IN - 10 IN. 6.W. FACING | OUT - 10 IN. W.N. FACING

CHANNEL | IN - 10 IN. 150 LB. RF FACING | OUT - 10 IN. 150 LB. RF FACING

BAFFLES | CROSS DBL - SEG. SPACING 12" IN. | LONG. (PERM.)(REMOV.)(PACKED) | IMPINGE. (YES)(NO) IN. THK.

CODE REQUIREMENTS - ASME TUBES III-C/SHELL VIII TEMA CLASS R CUST. SPEC.

WT - LBS - EA. SHELL & BUNDLE 11120 LBS. FULL OF WATER 19100 LBS BUNDLE 7130 LBS

STRESS - RELIEVED PARTS MARKED SR RADIOGRAPHED MARKED XR

PART	MATERIAL	THKN.	CORR. ALL.	PART	MATERIAL	THKN.	CORR. ALL.
TUBES (AV. WALL)	SA 213 TP 304	.049		FLOAT. T.S.			
SHELL	SA 285C	.438	.125	FIXED T.S.	SA 240 TP 304	2.25	0
SHELL COVER	SA 285C	.438	.125	TUBE SUPPORTS			
CHANNEL	SA 240 TP 304	.250	0	CROSS BAFFLE	C. STL.	.625	
CHAN. COVER	SA 240 TP 304	.250	0	LONG BAFFLE			
ADD. NO. COVERS				GASKETS	SPIRAL WOUND		

REMARKS -

BA-19 3/61

1		BID	JOB NO. / DRWG. NO.
NO.	DATE	REVISIONS	SHEET 1 OF 1

GREEN BAY & GEBS, INCORPORATED ... PA.

9-C-SF-MEE-1679 REV. 0

[redacted]

Attachment C
Page C3

HTC-STX *** Summary ***	Version 3.6	Time: 2:12:11 PM	Date: 6/12/2002	File: sfphx-71ccw6%-158 English units

Item No					
Service	SFPHX-71CCinlet				
Calculation Mode	Rating Case				
Size	34 x 146	Type	BEU - HORZ Connections 1 Series		1 Parallel
Surface/Unit	2,179	Shells/unit	1	Surf/Shell	2,179.24
Cost/Unit	41,206	Cost/Surf	18.91	Weight/Shell	8,236
Heat Duty	43,968,300	MTD	64.41	F-corr	0.9486
Rate-Service	370.84	Calculated	356.37	Calc Fouling	0.00105

	Shell	Tubes		
	Shell	Tubes	Tubes	0.750 x 0.049 on 0.9375 30 deg
Flow Rate	1501800	1222716	Tube No	866 Type: PLAIN
Temperature In	71.0	160.9	Baffles:	VERT DBL-SEG 16.5 space 22.0 cut
Temperature Out	100.1	125.4		
Pressure Drop	10.413	4.458	Surface Area	** Under design by -3.91%
Velocity	4.215	5.642	Shell pressure Drop	** Allowable exceeded.
Passes	1	2	Tube Pressure Drop	OK. Within allowable.
Film Coef.	2047.0	1730.5	Vibration	** Tube vibration likely.
Nozzle In	1 x 10.0	10.0	Shell Nozzles	** Rho-V-Sqr exceeds 4000
Nozzle Out	1 x 10.0	10.0	Chan Nozzles	** Rho-V-Sqr exceeds 6000

HTC-STX	Version 3.6		Time: 2:44:21 PM		Date: 6/12/2002		File:	
*** Summary ***								English units
Item No								
Service	SFPHX-71CCinlet							
Calculation Mode	Rating Case							
Size	34 x 146	Type	BEU - HORZ	Connections	1 Series			1 Parallel
Surface/Unit	2,179		Shells/unit	1			Surf/Shell	2,179.24
Cost/Unit	41,206		Cost/Surf	18.91			Weight/Shell	9,236
Heat Duty	21,897,584		MTD	32.63			F-corr	0.9371
Rate-Service	308.38		Calculated	297.09			Calc Fouling	0.00103

	Shell	Tubes		
	Shell	Tubes	Tubes	0.750 x 0.049 on 0.9375 30 deg
Flow Rate	1501800	742640	Tube No	886 Type: PLAIN
Temperature In	71.0	126.4	Baffles:	VERT DBL-SEG 16.5 space 22.0 cut
Temperature Out	85.6	96.9		
Pressure Drop	10.441	1.783	Surface Area	** Under design by -3.97%
Velocity	4.185	3.349	Shell pressure Drop	** Allowable exceeded.
Passes	1	2	Tube Pressure Drop	OK. Within allowable.
Film Coef.	1944.2	963.4	Vibration	** Tube vibration likely
Nozzle In	1 x 10.0	10.0	Shell Nozzles	** Rho-V-Sqr exceeds 4000
Nozzle Out	1 x 10.0	10.0	Chan Nozzles	OK. Rho-V-Sqr within 6000

HTC-STX	Version 3.6	Time: 1:55:50 PM		Date: 6/12/2002		File:	
*** Summary ***							English units
Item No							
Service	SFPHX-71CCinlet						
Calculation Mode	Rating Case						
Size	34 x 146	Type	BEU - HORZ	Connections	1 Series		1 Parallel
Surface/Unit	2,179		Shells/unit	1		Surf/Shell	2,179.24
Cost/Unit	41,208		Cost/Surf	18.91		Weight/Shell	9,236
Heat Duty	42,971,104		MTD	54.37		F-corr	0.9478
Rate-Service	362.65		Calculated	358.01		Calc Fouling	0.00111

	Shell	Tubes		
Flow Rate	1501800	1222716	Tubes	0.750 x 0.049 on 0.9375 30 deg
Temperature In	71.0	160.0	Tube No	866 Type: PLAIN
Temperature Out	99.5	125.3	Baffles:	VERT DBL-SEG 16.5 space 22.0 cut
Pressure Drop	10.412	4.459	Surface Area	OK, Over design by -1.84%
Velocity	4.214	5.640	Shell pressure Drop	** Allowable exceeded.
Passes	1	2	Tube Pressure Drop	OK. Within allowable.
Film Coef.	2043.5	1725.7	Vibration	** Tube vibration likely.
Nozzle In	1 x 10.0	10.0	Shell Nozzles	** Rho-V-Sqr exceeds 4000
Nozzle Out	1 x 10.0	10.0	Chan Nozzles	** Rho-V-Sqr exceeds 6000

5-C-SF-MEE-1679 REV.0

HTC-STX	Version 3.6		Time: 1:49:54 PM		Date: 6/12/2002		File: sfphx-71ccw6%-170
*** Summary ***							English units
Item No							
Service	SFPHX-71CCinlet						
Calculation Mode	Rating Case						
Size	34 x 146	Type	BEU - HORZ	Connections	1 Series		1 Parallel
Surface/Unit	2,179		Shells/unit	1		Surf/Shell	2,179.24
Cost/Unit	41,206		Cost/Surf	18.91		Weight/Shell	9,238
Heat Duty	47,964,380		MTD	60.30		F-corr	0.9471
Rate-Service	365.01		Calculated	360.3		Calc Fouling	0.00113

	Shell	Tubes		
Flow Rate	1501800	1217710	Tubes	0.750 x 0.049 on 0.9375 30 deg
			Tube No	866 Type: PLAIN
Temperature In	71.0	170.0	Baffles:	VERT DBL-SEG 16.5 space 22.0 cut
Temperature Out	102.7	131.2		
Pressure Drop	10.407	4.410	Surface Area	OK. Over design by -1.3%
Velocity	4.221	5.652	Shell pressure Drop	** Allowable exceeded.
Passes	1	2	Tube Pressure Drop	OK, Within allowable.
Film Coef.	2065.9	1798.3	Vibration	** Tube vibration likely.
Nozzle In	1 x 10.0	10.0	Shell Nozzles	** Rho-V-Sqr exceeds 4000
Nozzle Out	1 x 10.0	10.0	Chan Nozzles	** Rho-V-Sqr exceeds 6000

HTC-STX	Version 3.6	Time: 1:43:40 PM		Date: 6/12/2002	File: sfphx-71ccw6%	
*** Summary ***					English units	
Item No						
Service	SFPHX-71CCinlet					
Calculation Mode	Rating Case					
Size	34 x 148	Type	BEU - HORZ	Connections 1 Series		1 Parallel
Surface/Unit	2,179		Shells/unit	1	Surf/Shell	2,179.24
Cost/Unit	41,206		Cost/Surf	18.91	Weight/Shell	9,236
Heat Duty	53,116,175		MTD	65.10	F-corr	0.9461
Rate-Service	368.76		Calculated	364.51	Calc Fouling	0.00113

	Shell	Tubes		
			Tubes	0.750 x 0.049 on 0.9375 30 deg
Flow Rate	1501600	1213955	Tube No	866 Type: PLAIN
Temperature In	71.0	160.0	Baffles:	VERT DBL-SEG 16.5 space 22.0 cut
Temperature Out	106.1	137.0		
Pressure Drop	10.402	4.372	Surface Area	OK. Over design by -1.16%
Velocity	4.228	5.671	Shell pressure Drop	** Allowable exceeded.
Passes	1	2	Tube Pressure Drop	OK. Within allowable.
Film Coef.	2088.7	1873.2	Vibration	** Tube vibration likely.
Nozzle In	1 x 10.0	10.0	Shell Nozzles	** Rho-V-Sqr exceeds 4000
Nozzle Out	1 x 10.0	10.0	Chan Nozzles	** Rho-V-Sqr exceeds 5000

HTC-STX *** Summary ***	Version 3.6		Time: 4:01:40 PM		Date: 6/12/2002		File: sfphx-71ccw6%-135 English units
Item No							
Service	SFPHX-71CCInlet						
Calculation Mode	Rating Case						
Size	34 x 146	Type	BEU - HORZ	Connections	1 Series		1 Parallel
Surface/Unit	2,179		Shells/unit	1		Surf/Shell	2,179.24
Cost/Unit	41,206		Cost/Surf	18.91		Weight/Shell	9,236
Heat Duty	30,407,980		MTD	39.57		F-corr	0.9505
Rate-Service	352.63		Calculated	344.49		Calc Fouling	0.00109

	Shell	Tubes		
	Shell	Tubes	Tubes	0.750 x 0.049 on 0.9375 30 deg
Flow Rate	1501600	1232728	Tube No	566 Type: PLAIN
Temperature In	71.0	135.0	Baffles:	VERT DBL-SEG 16.5 space 22.0 cut
Temperature Out	91.2	110.6		
Pressure Drop	10.428	4.576	Surface Area	** Under design by -2.31%
Velocity	4.197	5.598	Shell pressure Drop	** Allowable exceeded.
Passes	1	2	Tube Pressure Drop	OK. Within allowable.
Film Coef.	1986.9	1547.3	Vibration	** Tube vibration likely.
Nozzle In	1 x 10.0	10.0	Shell Nozzles	** Rho-V-Sqr exceeds 4000
Nozzle Out	1 x 10.0	10.0	Chan Nozzles	** Rho-V-Sqr exceeds 6000

HTC-STX	Version 3.6	Time: 2:19:55 PM	Date: 6/12/2002	File: sfphx-71ccw6%-149
*** Summary ***				English units

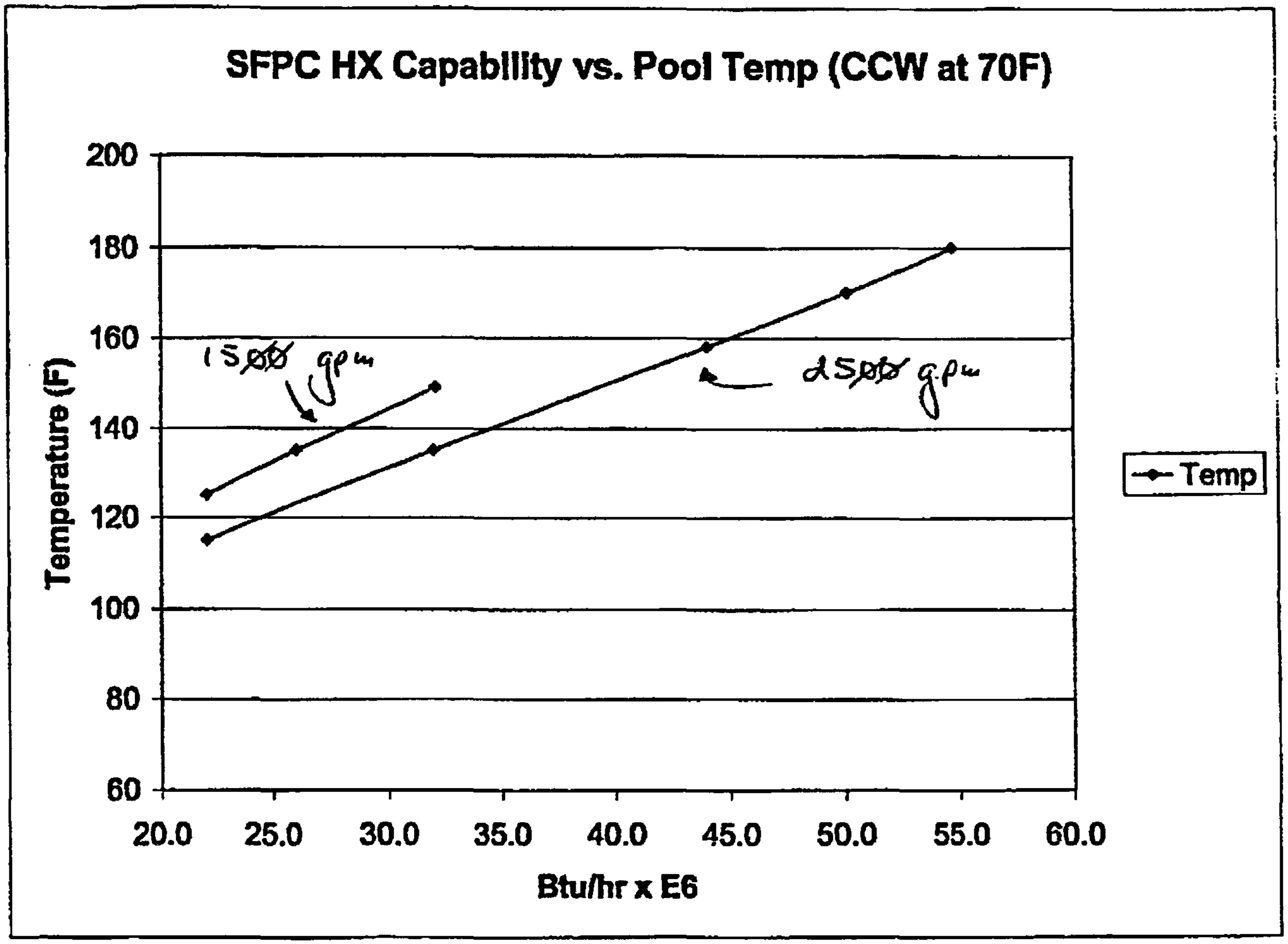
Item No						
Service	SFPHX-71CCInlet					
Calculation Mode	Rating Case					
Size	34 x 148	Type	BEU - HORZ	Connections 1 Series		1 Parallel
Surface/Unit	2,179		Shells/unit	1	Surf/Shell	2,179.24
Cost/Unit	41,206		Cost/Surf	18.91	Weight/Shell	9,236
Heat Duty	29,943,250		MTD	44.18	F-corr	0.9363
Rate-Service	311.02		Calculated	306.52	Calc Fouling	0.00111

	Shell	Tubes		
			Tubes	0.750 x 0.049 on 0.9375 30 deg
Flow Rate	1501800	736633	Tube No	666 Type: PLAIN
Temperature In	71.0	149.0	Baffles:	VERT DBL-SEG 16.5 space 22.0 cut
Temperature Out	90.9	108.7		
Pressure Drop	10.427	1.738	Surface Area	OK. Over design by -1.45%
Velocity	4.196	3.382	Shell pressure Drop	** Allowable exceeded.
Passes	1	2	Tube Pressure Drop	OK. Within allowable.
Film Coef.	1979.6	1043.9	Vibration	** Tube vibration likely.
Nozzle In	1 x 10.0	10.0	Shell Nozzles	** Rho-V-Sqr exceeds 4000
Nozzle Out	1 x 10.0	10.0	Chan Nozzles	OK. Rho-V-Sqr within 6000

9-C-SF-MEC-1079 REV.0

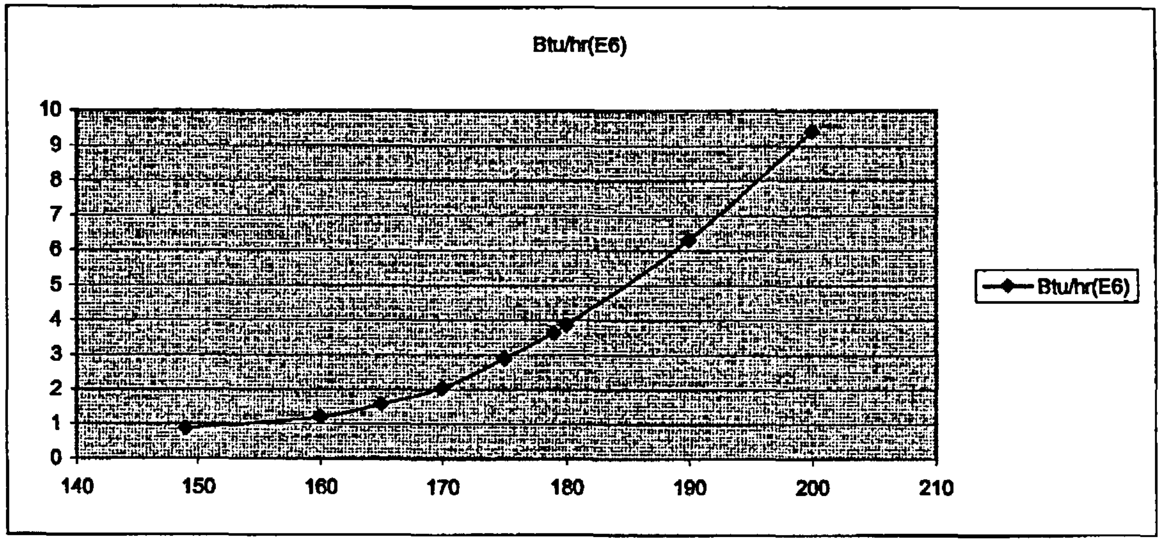
Attachment C
Page C10

Btu/hr E6	Temp
22.0	125
26.1	135
32.1	149
22.0	115
32.0	135
44.0	158
50.1	170
54.7	180



SFP Evaporation Losses

Temp	SFP Only Btu/hr(E6)	w/TRF Pool Btu/hr (E6)
149	0.86	1.118
160	1.2	1.56
165	1.579	2.0527
170	2.05	2.665
175	2.9	3.77
179	3.64	4.732
180	3.87	5.031
190	6.3	8.19
200	9.41	12.233



DOCUMENTED TELEPHONE CONVERSATION

Reference 5.2

Date: 5/2/02

From: Glen Schwartz, PSEG Fuels

To: Ted DelGaizo, MLEA Inc.

Subject: Future Refueling Plans

1. Based on current projections, Salem Station will replace 76 spent fuel assemblies during upcoming refueling outages. Consequently, at the end of each cycle, the core would contain the following types of assemblies:

   76 assemblies with 1 operating cycle
   76 assemblies with 2 operating cycles
   41 assemblies with 3 operating cycles

   193 total assemblies

DOCUMENTED TELEPHONE CONVERSATION

Reference 5.4

Date: 5/3/02

From: Glenn Schwartz, PSEG Fuels

To: Ted DelGaizo, MLEA Inc.

Subject: Spent Fuel Pool Information

1. There are currently 920 fuel assemblies in the Unit 1 pool as of 1R14 (April 2001) and 812 elements in the Unit 2 pool as of 2R12 (April 2002).

2. Refueling was performed during the recent past Salem outages as shown below:

	Off-Load Started	Off-Load Complete	Re-Load Started
1R13	9/28/99 at 1855	10/1/99 at 0607	10/8/99 at 0411
1R14	4/14/01 at 1508	4/16/01 at 2044	4/26/01 at 1811
2R10	4/14/99 at 0527	4/16/99 at 1549	4/28/99 at 1930
2R11	10/16/00 at 0104	10/18/00 at 0616	10/24/00 at 0807

DOCUMENTED TELEPHONE CONVERSATION

Reference 5.8

Date: 5/6/02

From: Kevin King, PSEG Engineering

To: Ted DelGaizo, MLEA Inc.

Subject: CCW Temperatures with Shutdown Conditions

Question: Based upon shutdown conditions with Service Water inlet temperature at 66°F and approximately 4×10^7 Btu/hr of heat duty, what is the CCW outlet temperature according to the ProtoFlo model of the CCW system.

Answer: With on SW/CCW heat exchanger in operation, the CCW outlet temperature is approximately 7°F higher than the inlet SW temperature. If both CCW heat exchangers are operating and sharing the heat duty, the CCW temperature is approximately 3°F higher than SW temperature.

Ted DelGaizo

From: King, Kevin C. [Kevin.King@pseg.com]
Sent: Wednesday, May 15, 2002 5:32 PM
To: Ted DelGaizo (E-mail)
Subject: CC temperature confirmation

Ted

I ran my P-Flo model, and got the following results with 1 and 2 SFHXs. For both cases, SW temp = 66°F, SW flow = 10000 gpm, CC flow to SFHX = 3000 gpm.

1 SFHX (Q = 44 MBtu/hr):
SFP flow = 2500 gpm
SFP temp = 161.8°F
CC temp = 69.3°F

2 SFHXs (Q = 22 MBtu/hr per hx):
SFP flow = 1740 gpm
SFP temp = 121.0°F
CC temp = 67.7°F

Thus your assumption for 70°F CC temp is valid (and slightly conservative).

Kevin

S-C-SF-MEE-1679 REV. 0
Attachment E
Page E4 of 5

Ted DelGaizo

From: Wathey, Thomas R. [Thomas.Wathey@pseg.com]
Sent: Tuesday, May 09, 2006 12:58 PM
To: Ted DelGaizo; Schwartz, Glenn S.
Subject: RE: Assumptions for S-C-SF-MEE-1679

Here is the information for #7:

1R17 - 59h 10m

2R14 - 42h 39m

1R16 - 41h 32m

2R13 - 41h 51m

1R15 - 48h

2R12 - 47h 45m

Note that with anticipated changes over the next couple of years to both the Tech Spec (100 hours to move fuel after shutdown) and equipment upgrades, the total time from shutdown to fully offloaded could be in the 120 hr timeframe versus 142 hr currently.

The following is for #8:

There are currently 1137 fuel assemblies in the Unit 1 SFP (as of 1R17 in October 2005) and 964 fuel assemblies in the Unit 2 pool (as of 2R14 in April 2005).

CC Temperature Assumption Validation

Preparer:	Kevin King	Date:	5/16/02
Reviewer:	Ted Delgaizo	Date:	5/16/02

1.0 PURPOSE:

To determine the CC inlet temperature to the SFHX (CC supply temperature) based on the SFP heat load and SW temperature requirements specified in Section 2.

2.0 INPUTS/ASSUMPTIONS:

2.1 SW temperature = 66°F [= 63° (Reedy Island historical data) + 3° (Reedy Island to plant intake) – Calc, Section 3.6]

2.2 SW flow to CCHXs = 10000 gpm (max allowable flow). For the plate CCHX (#12), this is 5000 gpm per each half.

2.3 CC flow to SFHX = 3000 gpm (Calc, Section 3.2.3)

2.4 The tube and shell CCHX (#11) is assumed to be 2% plugged (Reference 3.2, Section 3.3.6). No. tubes = 3400*0.98 = 3332; Surface area = 16954 * 0.98 = 16615 ft^2.

2.5 The SFHX is modeled as a fixed heat load. The required SFHX heat load from Calculation Section 3.6 is 44 MBtu/hr (1 SFHX aligned) and 22 MBtu/hr (2 SFHXs aligned). For the two SFHX condition, it is assumed that the total SFP heat load is split equally between the two SFHXs.

3.0 REFERENCES:

3.1 S-1-CC-MDC-1788, Rev. 0, Component Cooling System Thermal-Hydraulic Model (Unit 1)

3.2 S-1-CC-MDC-1817, Rev. 2, Component Cooling System Thermal-Hydraulic Analysis – Unit 1

3.3 S-C-CC-MDC-1798, Rev. 2, Component Cooling System Heat Exchangers

3.4 Procedure S1.OP-SO.RHR-0001, Rev. 14, Initiating RHR

Preparer:	Kevin King	Date:	5/16/02
Reviewer:	Ted Delgaizo	Date:	5/16/02

4.0 METHODOLOGY:

The Unit 1 CC Thermal-Hydraulic Model developed per Reference 3.1 will be used for this analysis. The default model database "S1CCR0.dbd" from Reference 3.1 will be the baseline database. A new working database "S1CCR0 - Refueling.pdb" will be created for this analysis, and will be saved as default database "S1CCR0 - Refueling.dbd".

Approach:

1. Set the CC model alignment to match actual field conditions.
2. Input the known parameters from Section 2.0 into the model.
3. Run model, and determine the CC System supply temperature (SFHX inlet)*.

***12 CCHX modeling:**

The 12 CCHX is a plate type heat exchanger. It is modeled in Proto-Flo as a UA-counter flow type heat exchanger since the current version of Proto-Flo cannot plate type heat exchangers. That is, a fixed U value is inputted into the model. This requires a trial and error solution within Step 3 above to determine U, using the plate CCHX model developed per Reference 3.3, as follows:

1. Perform an initial run of the system model to determine the CC flows to each half of the plate CCHX.
2. Input the CC flows determined from above, SW flow (5000 gpm per half), SW inlet temperature (66°F) and an initial estimate of the CC inlet temperature into the plate CCHX model.
3. Run the plate CCHX model to determine the U values.
4. Input the U values into the system model.
5. Run system model.
6. Repeat until U values and CC inlet temperatures agree.

CC Temperature Assumption Validation

Preparer:	Kevin King	Date:	5/16/02
Reviewer:	Ted Delgaizo	Date:	5/16/02

5.0 ANALYSIS:

Discussion

This analysis will use the CC System Thermal-Hydraulic Model, which will perform a thermal balance between the CCHXs and the SFHX. The CC system temperatures are determined by Proto-Flo as a result of this thermal balancing. By setting the SW flow to the CCHXs to the maximum value of 10000 gpm, the resultant CC supply temperature (CCHX CC outlet temperature) represents the minimum temperature for a given heat load and SW temperature. Thus if the CC supply temperature is set in the field at a value less than this, the setpoint value could not be maintained as the flow controls would limit SW flow to 10000 gpm.

System Alignment

The Normal Operations alignment from the default model database "S1ccr0.dbd", which has two pumps aligned to the entire system, except the RHRHXs, is modified as follows:

1. The BAE Package is isolated by closing valve 1CC48. This is in accordance with Reference 3.4, which isolates the BAE Package prior to initiating RHR.
2. Letdown HX (LDHX) temperature control valve 1CC71 is closed, as letdown is isolated during shutdown modes.
3. The containment isolation valves are closed, as the containment loads are isolated during shutdown modes. This includes: 1CC113 & 1CC215 (Excess LDHX); 1CC117, 1CC118, 1CC131, 1CC136, 1CC187 & 1CC190 (RCPs)
4. The RHRHX isolation valves (11&12 CC16) remain closed as RHR is not required after a full core offload.
5. Flow to the SFHX is set to 3000 gpm by establishing throttle valve 1CC37 as the flow balancing parameter.
6. With the above valve alignments, only one CC pump is required – 13 CC Pump is selected. Since flow to the SFHX is being set to a specific value, the pump curve to be used is not critical – the "benchmark" curve is selected.
7. All heat exchanger heat loads are set to 0, except the CCHXs and SFHX. The parameters for these HXs (flows, temperatures, 12 CCHX Us) are inputted.

CC Temperature Assumption Validation

Preparer: Kevin King Date: 5/16/02

Reviewer: Ted Delgaizo Date: 5/16/02

Results

Cases were run with both one and two SFHXs and with both one and two CCHXs. Since Unit 1 has one tube and shell CCHX and one plate type CCHX, separate cases were run with each individual CCHX. A summary of the pertinent results are included below. The complete Proto-Flo reports are saved as report files, and are included on the disk included with this evaluation. The 12 CCHX spreadsheet model results are included on pages 5 and 6 of this attachment.

Case	CCHXs	# SFHXs	Q_{SFHX} (MBtu/hr)	CC supply temperature (°F)
1	11 & 12	1	44	69.3
2	11	1	44	75.0
3	12	1	44	74.5
4	11 & 12	2	22	67.7
5	11	2	22	70.7
6	12	2	22	70.6

6.0 CONCLUSION:

The minimum CC supply temperature with a SFP heat load of 44 MBtu/hr and a SW temperature of 66°F is as follows:

# CCHXs	# SFHXs	CC supply temperature (°F)
2	1	69.3
1	1	75.0
2	2	67.7
1	2	70.7

EXCEL Spreadsheet for 12 CCHX Evaluation - EOL Full Core SFP Discharge

	11 & 12 CCHXs; 1 SFHX				
	A half		B half		Total
	SW	CC	SW	CC	
Inlet temp (°F)	66.00	91.37	66.00	91.37	
Outlet temp (°F)	70.61	69.44	70.64	69.47	
Mass Flow (lb_m/hr)	2,521,178	530,990	2,521,178	535,008	
Volumetric Flow (gpm)	5000	1057	5000	1065	
Fouling (hr-ft^2-°F/Btu)	0.001000		0.001000		
Properties:					
Tavg (°F)	68.31	80.40	68.32	80.42	
Density @ Ti (lb_m/ft^3)	62.86	62.63	62.86	62.63	
Density @ Tav (lb_m/ft^3)	62.84	62.21	62.84	62.21	
Cp (Btu/lb_m-°F)	1.0008	0.9998	1.0008	0.9998	
k (Btu/hr-ft-°F)	0.3483	0.3547	0.3484	0.3547	
Dynamic visc (lb_m/ft-hr)	2.473	2.064	2.473	2.064	
Kinematic visc (ft^2/s)	1.093E-05	9.217E-06	1.093E-05	9.215E-06	
Pr	7.106	5.820	7.105	5.818	
Film Resistance:					
Velocity (ft/s)	1.631	0.345	1.631	0.347	
Re	4478	1122	4477	1131	
Nu	128.22	40.35	128.23	40.59	
h (Btu/hr-ft^2-°F)	1488.9	477.0	1489.0	479.9	
C (Btu/hr-°F)	2,523,314	530,907	2,523,320	534,924	
C_{min} (Btu/hr-°F)	530,907		534,924		
C_{max} (Btu/hr-°F)	2,523,314		2,523,320		
r (C_{min}/C_{max})	0.2104		0.2120		
R (hr-ft^2-°F/Btu)	0.0039719		0.0039594		
U (Btu/hr-ft^2-°F)	251.8		252.6		
NTU	2.2767		2.2668		
Effectiveness	0.8645		0.8631		
LMTD (°F)	9.63		9.66		
Q (MBtu/hr)	11.64		11.71		23.36

	11 & 12 CCHXs; 2 SFHXs				
	A half		B half		Total
	SW	CC	SW	CC	
Inlet temp (°F)	66.00	78.80	66.00	78.80	
Outlet temp (°F)	68.32	67.82	68.33	67.84	
Mass Flow (lb_m/hr)	2,521,178	533,600	2,521,178	537,124	
Volumetric Flow (gpm)	5000	1060	5000	1067	
Fouling (hr-ft^2-°F/Btu)	0.001000		0.001000		
Properties:					
Tavg (°F)	67.16	73.31	67.17	73.32	
Density @ Ti (lb_m/ft^3)	62.86	62.76	62.86	62.76	
Density @ Tav (lb_m/ft^3)	62.85	62.27	62.85	62.27	
Cp (Btu/lb_m-°F)	1.0006	1.0003	1.0006	1.0003	
k (Btu/hr-ft-°F)	0.3478	0.3515	0.3478	0.3515	
Dynamic visc (lb_m/ft-hr)	2.512	2.260	2.512	2.259	
Kinematic visc (ft^2/s)	1.110E-05	1.008E-05	1.110E-05	1.008E-05	
Pr	7.227	6.431	7.227	6.430	
Film Resistance:					
Velocity (ft/s)	1.631	0.346	1.631	0.348	
Re	4408	1029	4408	1036	
Nu	127.56	39.26	127.56	39.46	
h (Btu/hr-ft^2-°F)	1478.8	460.0	1478.9	462.4	
C (Btu/hr-°F)	2,522,809	533,771	2,522,812	537,296	
C_{min} (Btu/hr-°F)	533,771		537,296		
C_{max} (Btu/hr-°F)	2,522,809		2,522,812		
r (C_{min}/C_{max})	0.2116		0.2130		
R (hr-ft^2-°F/Btu)	0.0040542		0.0040430		
U (Btu/hr-ft^2-°F)	246.7		247.3		
NTU	2.2186		2.2101		
Effectiveness	0.8576		0.8564		
LMTD (°F)	4.95		4.96		
Q (MBtu/hr)	5.86		5.89		11.75

EXCEL Spreadsheet for 12 CCHX Evaluation - EOL Full Core SFP Discharge

	12 CCHX only; 1 SFHX				
	A half		B half		Total
	SW	CC	SW	CC	
Inlet temp (°F)	66.00	96.91	66.00	96.91	
Outlet temp (°F)	74.73	74.60	74.76	74.66	
Mass Flow (lb_m/hr)	2,521,178	988,110	2,521,178	994,132	
Volumetric Flow (gpm)	5000	1969	5000	1981	
Fouling (hr-ft^2-°F/Btu)	0.001000		0.001000		
Properties:					
Tavg (°F)	70.36	85.76	70.38	85.78	
Density @ Ti (lb_m/ft^3)	62.86	62.56	62.86	62.56	
Density @ Tav (lb_m/ft^3)	62.83	62.16	62.83	62.16	
Cp (Btu/lb_m-°F)	1.0012	0.9995	1.0012	0.9995	
k (Btu/hr-ft-°F)	0.3493	0.3570	0.3493	0.3570	
Dynamic visc (lb_m/ft-hr)	2.406	1.934	2.406	1.934	
Kinematic visc (ft^2/s)	1.064E-05	8.644E-06	1.064E-05	8.642E-06	
Pr	6.896	5.416	6.895	5.414	
Film Resistance:					
Velocity (ft/s)	1.631	0.642	1.631	0.646	
Re	4600	2229	4601	2244	
Nu	129.41	66.87	129.42	67.20	
h (Btu/hr-ft^2-°F)	1506.9	795.8	1507.1	799.6	
C (Btu/hr-°F)	2,524,232	987,660	2,524,239	993,678	
C_{min} (Btu/hr-°F)	987,660		993,678		
C_{max} (Btu/hr-°F)	2,524,232		2,524,239		
r (C_{min}/C_{max})	0.3913		0.3937		
R (hr-ft^2-°F/Btu)	0.0031243		0.0031181		
U (Btu/hr-ft^2-°F)	320.1		320.7		
NTU	1.5559		1.5495		
Effectiveness	0.7217		0.7200		
LMTD (°F)	14.34		14.36		
Q (MBtu/hr)	22.03		22.11		44.14

	12 CCHX only; 2 SFHXs				
	A half		B half		Total
	SW	CC	SW	CC	
Inlet temp (°F)	66.00	82.02	66.00	82.02	
Outlet temp (°F)	70.49	70.60	70.50	70.62	
Mass Flow (lb_m/hr)	2,521,178	991,204	2,521,178	997,242	
Volumetric Flow (gpm)	5000	1970	5000	1982	
Fouling (hr-ft^2-°F/Btu)	0.001000		0.001000		
Properties:					
Tavg (°F)	68.24	76.31	68.25	76.32	
Density @ Ti (lb_m/ft^3)	62.86	62.73	62.86	62.73	
Density @ Tav (lb_m/ft^3)	62.85	62.25	62.85	62.25	
Cp (Btu/lb_m-°F)	1.0008	1.0001	1.0008	1.0001	
k (Btu/hr-ft-°F)	0.3483	0.3528	0.3483	0.3529	
Dynamic visc (lb_m/ft-hr)	2.475	2.174	2.475	2.173	
Kinematic visc (ft^2/s)	1.094E-05	9.700E-06	1.094E-05	9.698E-06	
Pr	7.113	6.161	7.112	6.160	
Film Resistance:					
Velocity (ft/s)	1.631	0.643	1.631	0.647	
Re	4472	1988	4473	2000	
Nu	128.19	64.40	128.19	64.71	
h (Btu/hr-ft^2-°F)	1488.3	757.4	1488.4	761.1	
C (Btu/hr-°F)	2,523,286	991,311	2,523,290	997,348	
C_{min} (Btu/hr-°F)	991,311		997,348		
C_{max} (Btu/hr-°F)	2,523,286		2,523,290		
r (C_{min}/C_{max})	0.3929		0.3953		
R (hr-ft^2-°F/Btu)	0.0031961		0.0031898		
U (Btu/hr-ft^2-°F)	312.9		313.5		
NTU	1.5153		1.5091		
Effectiveness	0.7131		0.7114		
LMTD (°F)	7.54		7.55		
Q (MBtu/hr)	11.33		11.37		22.69

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: S-C-SF-MEE-1679 **Revision:** 1
Calculation Title: SFP Cooling Capability with Core Off-Load Starting 85-Hrs after SD

Activity Description: The activity evaluates the capability of the spent fuel pool cooling system to maintain fuel pool temperatures within UFSAR requirements (149°F with both heat exchangers and 180°F with one SFP heat exchanger) if in-vessel decay is reduced from 100-hours to 85-hours during the period October 15th to May 15th. The activity is intended to provide the basis for a licensing change request in order to change the Salem TS to require an 85-hour decay period rather than 100-hours.

Note that more than one process may apply. If unsure of any answer, contact the cognizant department for guidance.

Activities Affected	Yes	No	Action
1. Does the proposed activity involve a change to the Technical Specifications or the Operating License?	☒	☐	If Yes, contact Licensing. See NOTE in Section 4.1.1. LCR No. (later) The intention of the activity is to change the technical specifications.
2. Does the proposed activity involve a change to the Quality Assurance Plan? Example: • Changes to Chapter 17.2 of UFSAR	☐	☒	If Yes, contact Quality Assessment.
3. Does the proposed activity involve a change to the Security Plan? Examples: • Change program in NC.NA-AP.ZZ-0033(Q) • Change indoor/outdoor security lighting • Placement of component or structure (permanent or temporary) within 20 feet of perimeter fence • Obstruct field of view from any manned post • Interfere with security monitoring device capability • Change access to any protected or vital area • Modify safeguards systems or equipment	☐	☒	If Yes, contact Security Department.
4. Does the proposed activity involve a change to the Emergency Plan? Examples: • Change ODCM/accident source term • Change liquid or gaseous effluent release path • Affect radiation monitoring instrumentation or EOP/AOP setpoints used in classifying accident severity • Affect emergency response facilities or personnel, including control room • Affect communications, computers, information systems or Met tower	☐	☒	If Yes, contact Emergency Preparedness
5. Does the proposed activity involve a change to the ISI Program Plan? Example: • Affect Nuclear Class 1, 2, or 3 Piping, Vessels, or Supports (Guidance in NC.CC-AP.ZZ-0007(Q))	☐	☒	If Yes, contact Engineering Programs ISI/IST.

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: S-C-SF-MEE-1679 **Revision:** 1
Calculation Title: SFP Cooling Capability with Core Off-Load Starting 85-Hrs after SD

Activities Affected	Yes	No	Action
6. Does the proposed activity involve a change to the IST Program Plan? Example: • Affect the design or operating parameters of a Nuclear Class 1, 2, or 3 Pump or Valve (Guidance in NC.CC-AP.ZZ-0007(Q))	☐	☒	If Yes, contact Engineering Programs ISI/IST.
7. Does the proposed activity involve a change to the Fire Protection Program? Examples: • Change program in NC.DE-PS.ZZ-0001(Q) • Change combustible loading of safety related space • Change or affect fire detection system • Change or affect fire suppression system/component • Change fire doors, dampers, penetration seal or barriers • See NC.CC-AP.ZZ-0007 for details • Change or affect FFP compensatory measures	☐	☒	If Yes, contact Design Engineering.
8. Does the proposed activity involve Maintenance, which restores SSCs to their original design and configuration? Examples: • CM or PM activity • Implements an approved Design Change? • Troubleshooting (which does not require 50.59 screen per SH.MD-AP.ZZ-0002)	☐	☒	If Yes, process in accordance with NC.WM-AP.ZZ-0001(Q)
9. Is the proposed activity a temporary change (T-Mod), which ***meets all the following conditions***? • Directly supports maintenance and is NOT a compensatory measure to ensure SSC operability. • Will be in effect at power operation less than 90 days. • Plant will be restored to design configuration upon completion. • SSCs will NOT be operated in a manner that could impact the function or operability of a safety related or Important-to-Safety system.	☐	☒	If Yes, contact Engineering.

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: S-C-SF-MEE-1679 **Revision:** 1
Calculation Title: SFP Cooling Capability with Core Off-Load Starting 85-Hrs after SD

Activities Affected	Yes	No	Action
10. Does the proposed activity consist of changes to maintenance procedures, which do NOT affect SSC design, performance, operation or control? **Note:** Procedure information affecting SSC design, performance, operation or control, including Tech Spec required surveillance and inspection, ***requires 50.59 screening***. Examples include acceptance criteria for valve stroke times or other SSC function, torque values, and types of materials (e.g., gaskets, elastomers, lubricants, etc.)	☐	☒	If Yes, process in accordance with NC.NA-AP.ZZ-0001(Q)
11. Does the proposed activity involve a *minor* UFSAR change (including documents incorporated by reference)? <u>Examples</u>: • Reformatting, simplification or clarifications that do not change the meaning or substance of information • Removes obsolete or redundant information or excessive detail • Corrects inconsistencies within the UFSAR • Minor correction of drawings (such as mislabeled ID)	☐	☒	If Yes, process in accordance with NC.NA-AP.ZZ-0035(Q)
12. Does the proposed activity involve a change to an Administrative Procedure (NAP, SAP or DAP) governing the conduct of station operations? <u>Examples</u>: • Organization changes/position titles • Work control/ modification processes	☐	☒	If Yes, process in accordance with NC.NA-AP.ZZ-0001(Q) and NC.DM-AP.ZZ-0001(Q)
13. Does the proposed activity involve a change to a regulatory commitment?	☐	☒	If Yes, contact Licensing.
14. Does the activity impact other programs controlled by regulations, operating license or Tech Spec? <u>Examples</u>: • Chemical Controls Program • NJ "Right-to-know" regulations • OSHA regulations • NJPDES Permit conditions • State and/or local building, electrical, plumbing, storm water management or "other" codes and standards • 10CFR20 occupational exposure	☐	☒	If Yes, process in accordance with applicable procedures such as: NC.NA-AP.ZZ-0038(Q) NC.LR-AP.ZZ-0037(Q)

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: S-C-SF-MEE-1679 **Revision:** 1
Calculation Title: SFP Cooling Capability with Core Off-Load Starting 85-Hrs after SD

Activities Affected	Yes	No	Action
15. Does the proposed activity affect the Independent Spent Fuel Storage Installation (ISFSI) or the Dry Cask Storage System (DCSS) or their analyses? Examples: • Affect the spent fuel canisters or casks • Affect the method of lifting, rigging or transporting DCSS • Challenge Spent Fuel Pool level limits or reactivity limits • Affect fire hazard analyses for the Heavy Haul Path • Affect procedures for DCSS operation or ISFSI activities	☐	☒	If Yes, contact Licensing and initiate the 10CFR72.48 screening process per NC.NA-AS.ZZ-0041 (NAS-41).
16. Has the activity already received a 10CFR50.59 Screen or Evaluation under another process? Examples: • Calculation • Design Change Package or OWD change • Procedure for a Test or Experiment • DR/Nonconformance • Incorporation of previously approved UFSAR change	☐	☒	Take credit for 10CFR50.59 Screen or Evaluation already performed.
17. Is the proposed change a change to a Chemistry procedure as described in paragraph 4.1.7?	☐	☒	If YES, no 50.59 Screen is required

If any other program or regulation *may be* affected by the proposed activity, contact the department indicated for further review in accordance with the governing procedure. If responsible department determines their program is not affected, attach a written explanation.

If ALL of the answers on the previous pages are "No," then check A below:

A. [ ] None of the activity is controlled by any of the processes above, therefore a 10CFR50.59 review IS required. Complete a 10CFR50.59 screen.

If one or more of the answers on the previous pages are "Yes," then check either B or C below as appropriate and explain the regulatory processes which govern the change:

B. [X] All aspects of the activity are controlled by one or more of the processes above, therefore a 10CFR50.59 review IS NOT required.

C. [ ] Only part of the activity is controlled by the processes above, therefore a 10CFR50.59 review IS required. Complete a 50.59 screen.

Explanation: A 10 CFR 50.59 screen is not required. A licensing change request will be prepared in order to change the Technical Specifications.

[signature]	5/18/2006	T. J. DelGalzo, MLEA	7/16/2006
PREPARER (SIGN)	DATE	NAME (PRINT)	QUAL EXPIRES
[signature]	05/22/2006	Barry L. Barkley, MLEA	12/06/2007
REVIEWER (SIGN)	DATE	NAME (PRINT)	QUAL EXPIRES