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RBG-47432

February 10, 2014

U. S. Nuclear Regulatory Commission
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SUBJECT: License Amendment Request 2013-18
Revision of Ultimate Heat Sink Design Capacity
River Bend Station – Unit 1
Docket No. 50-458
License No. NPF-47

REFERENCE: 1. River Bend Station – NRC Component Design Bases Inspection Report 05000458 / 2011008, 12/6/2011 (ML113400127)

RBF1-14-0006

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Operations Inc. (EOI) hereby requests approval of a revision to the River Bend Station – Unit 1 Operating License. The change revised the River Bend Station Updated Final Safety Analysis Report to credit makeup to the ultimate heat sink in less than 30 days to account for system leakage and for operation with more than one division of standby service water in operation.

In accordance with the requirement of 10 CFR 50.91, a copy of this letter and all applicable attachments will be sent to the designated official of the Louisiana Department of Environmental Quality.

While this amendment request is neither emergency nor exigent, Entergy requests approval by February 10, 2015. The amendment will be implemented within 60 days of approval. If you have any questions regarding the information in this submittal, please contact Joseph A. Clark at 225-381-4177. This document contains no commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 10, 2014.

Eric W. Olson

EWO/dhw

IE01
NRR

Attachment 1: Description of Proposed Change
Attachment 2: Description of Prior Licensing Basis Changes
Attachment 3: Previously-changed Licensing Basis Pages
Attachment 4: Description of Prior Analytical Deficiencies
Attachment 5: Pending Design Basis Changes

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Attachment 1

Description of Proposed Change

1.0 Description

This LAR is requesting NRC approval for changes made to the River Bend Station (RBS) Updated Final Safety Analysis Report (UFSAR) in 2002 to credit makeup to the ultimate heat sink (UHS) in less than 30 days to account for system leakage and for operation with more than one division of standby service water (SSW) in operation (i.e., no emergency diesel generators (EDG) are assumed to fail). Approval for this change is requested to address a violation where the NRC determined that the change made by the site under 10CFR50.59 resulted in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the UFSAR. Attachment 2 describes the prior changes that are the subject of the violation.

The inventory losses in the UHS basin following a design-basis loss of offsite power / loss of coolant accident (LOP/LOCA) were re-calculated in response to a second violation in which NRC identified non-conservative assumptions regarding pump heat. The losses are slightly increased as a result of revision of the associated design calculation where the design safety margin after 30 days is reduced from 73,387 gallons to 49,000 gallons. In addition, the same re-analysis resulted in minor changes in the maximum service water supply temperature, maximum heat rejection to the UHS, and time of maximum heat rejection to the UHS. Attachment 3 identifies those changes associated with the pump heat re-analysis.

2.0 Background

Following the 2011 Component Design Basis Inspection (Reference 1), NRC issued RBS a non-cited violation of 10CFR50.59 for changing the UHS inventory license basis requirements to credit makeup in less than 30 days. Specifically, in 2002, RBS revised the UFSAR and design calculations to credit makeup in less than 30 days to account for system leakage and for operation with more than one division of SSW in operation (i.e., maximum safeguards conditions) where a failure of the worst case emergency diesel generator (EDG) is not assumed. This change was made under 10CFR50.59 under the premise that the design basis for 30 days inventory with no makeup did not include leakage or operation SSW with no failures of the EDGs.

Also, following the same inspection, NRC issued a second non-cited violation for utilizing a less conservative assumption (i.e., frictionless form of the conservation of energy equation) in the 30-day inventory analysis of the UHS regarding pump heat. In response to this violation, RBS has revised the affected design calculation demonstrating that the UHS contains 30 days of inventory without makeup for the design basis condition in which the most conservative failure of an EDG is assumed and not accounting for system leakage. This same methodology was also utilized in re-analyzing the maximum safeguards scenarios discussed above.

The standby cooling tower (SCT) and water storage basin form a part of the SSW system which functions as the UHS. The SSW system operates under emergency conditions, in conjunction with the UHS, to remove heat from those plant components required for safe shutdown and cool-down of the unit. The safety-related SCT is designed to function as the ultimate heat sink for the station in those situations where the normal cooling towers are unavailable. The SCT is designed to provide cooling water at less than 95°F to permit safe shutdown and cooldown of the unit, and to maintain it in a cold shutdown condition for up to 30 days with no need for replenishment. The SCT is a mechanical draft counter flow cooling tower with four 50 percent capacity cooling cells. Each redundant SSW loop is connected to two 50 percent tower cells.

The System Design Criteria for SSW states:

> The UHS shall be designed to provide sufficient cooling water for a period of 30 days to permit a safe shutdown condition, i.e., reactor temperature below 105°F, when normal cooling towers are unavailable. Certain operational practices (Maximum Safeguard Load scenarios), which involve using more than the minimum complement of equipment necessary for achieving and maintaining safe shutdown, will require monitoring of the SCT level and possible operator actions to maintain SCT inventory for 30 days. Cooling water for normal station operation, including shutdown, shall be provided by the normal cooling towers.

The capacity of the SCT water storage basin is based on the time needed to evaluate the situation, to take corrective action to mitigate the consequences of an accident, and if required, to take any necessary measures to permit water replenishment. Additionally, alternate methods are available for ensuring the continued capability of the sink beyond 30 days. The current minimum volume required in the basin for 30 days of operation following a design-basis LOCA (assuming operation of one division of SSW) is 6,347,989 gallons. The UHS basin has a capacity of approximately 6,421,376 gallons at the minimum water level of 111'-10". This excludes approximately 69,596 gallons, which constitutes the volume from minimum pump submergence elevation of 65'-0" down to the basin floor elevation of 64'-6".

RBS Calculation PM-194, Revision 8, "Standby Cooling Tower Performance and Evaporation Losses without Drywell Unit Coolers" contained inconsistencies in the methodologies utilized for determination of pump heat added to the Standby Cooling Tower (SWP-TWR1) basin by the following pumps: Standby Service Water Pumps SWP-P2A and SWP-P2C, Residual Heat Removal Pump E12-PC001A, High Pressure Core Spray Pump E22-PC001A, and Low Pressure Core Spray Pump E21-PC001. Additionally, heat added to the standby service water due to friction from operation of the Division I Standby Service Water pumps, SWP-P2A/C and the Spent Fuel Pool Cooling Pump, SFC-P1A was not included in the calculation, which is non-conservative.

These deficiencies are documented in the station's corrective action program. PM-194 has been subsequently updated to remove inconsistencies in the methodology and non-conservatisms, as well as other calculation items non-compliant to the engineering calculation procedures.

The findings affected the existing SCT basin margin of 73,387 gallons, and the required makeup water analyzed by the maximum safeguards calculation. UFSAR Section 9.2.5 was changed in 2002 to credit makeup to the UHS to account for system leakage and operation of two divisions of standby service water (no failures of EDGs). Additionally, Technical Specification Basis 3.7.1 (Standby Service Water System and Ultimate Heat Sink) was revised to credit makeup water sources to account for system leakage and when operating with no failures of EDGs. The Bases change was made under the same 50.59 evaluation as the UFSAR change.

The UHS is capable of meeting Regulatory Guide 1.27 requirements for a 30-day inventory without makeup, considering no system leakage and the failure of one EDG. Standby service water system leakage was not considered in the original license basis for the system's ability to have a 30-day inventory. The original UFSAR indicated that the system maximum losses from the UHS consisted of natural evaporation, forced evaporation, drift, and cooling for the penetration valve leakage control system. These losses were quantified in the UFSAR to demonstrate compliance with Regulatory Guide 1.27. Neither the UFSAR nor Regulatory Guide 1.27 discussed how leakage was addressed. River Bend Station was licensed without requiring consideration for leakage. Therefore, it was concluded that system leakage was not a part of the license basis.

3.0 Technical Analysis

RBS evaluated the revision of the UHS evaporation losses and heat input for the design-basis scenario which assumes that one EDG has failed using the more conservative assumption for pump heat, where the brake horsepower energy at the pump shaft during operating conditions is assumed to be converted to heat. That analysis concluded that the UHS inventory is sufficient to support LOP/LOCA heat loads without makeup for 30 days as required by Reg. Guide 1.27. The design safety margin of 73,387 gallons of water has decreased to 49,000 gallons. This analysis is based on the original UFSAR assumption of the failure of an EDG, and does not include leakage, as was the case in the original UFSAR. Additionally, all maximum SSW temperatures are within design limits.

The scenario in which no EDG failures occur was evaluated using the same assumptions for pump heat as the design-basis scenario. This evaluation also accounted for anticipated system leakage. In that evaluation, it was determined that at approximately 22 days following the LOCA event, the basin water level would fall below the minimum level required for pump submergence.

A 2002 engineering evaluation assessed the availability of alternate makeup sources. These alternate makeup sources include: (1) temporary power to the deep and shallow-well pumps, (2) using the fire protection diesel-driven pumps and system providing makeup through the existing piping, (3) makeup using circulating water flume basin using to the fire protection diesel driven pump and piping, and (4) temporary tank trucks, hoses, and makeup using temporary power to the deep well pumps and existing makeup water piping. These makeup sources are documented in off-normal operating procedures. It is concluded that adequate makeup sources are available 22 days into the postulated event to supply makeup if needed to the UHS for the case where an EDG is not assumed to fail and system leakage is accounted for.

4.0 Regulatory Analysis

Entergy has evaluated whether a significant hazards consideration is involved with the proposed amendment by focusing on three standards set forth in 10 CFR 50.92, "Issuance of Amendment," as discussed below:

The NSHC determines whether that operation of a licensed facility in accordance with a proposed amendment does not: (1) Involve a significant increase in the probability or consequences of an accident previously evaluated, or (2) Create the possibility of a new or different kind of accident from any accident previously evaluated, or (3) Involve a significant reduction in a margin of safety. The three criteria listed are separately addressed below. The changes discussed in this submittal are in accordance to the three criteria.

1. Will operation of the facility in accordance with this proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

No. The UHS does not initiate any accidents discussed in Chapter 15 of the RBS UFSAR. Moreover, the design and operability requirements remain consistent with those of the plant system currently addressed by the RBS Technical Specifications (TS) and the capacity and the characteristics of the UHS meet the RBS design criteria. The UHS remains capable of meeting the requirements of Reg. Guide 1.27 to provide sufficient inventory to support post LOCA DBA heat removal for 30 days without makeup assuming a single failure of an EDG without accounting for leakage. For the scenario where no EDG is assumed to fail and all divisions of SSW are in operation and where allowances for leakage are assumed, adequate makeup sources are available within the approximate 22 day time frame needed to maintain inventory. Therefore this proposed change does not involve an increase in the consequences of an accident previously evaluated.

2. Will operation of the facility in accordance with this proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

No. The proposed change introduces no new mode of plant operation and there is no alteration to the UHS design function or the ability of the UHS to perform its design function. Therefore, there is no possibility of a new or different kind of accident from any accident previously evaluated.

3. Will operation of the facility in accordance with this proposed change involve a significant reduction in a margin of safety?

No. During shutdown associated with a design-basis LOCA, coincident with a loss of offsite power and failure of one EDG, the UHS water basin contains sufficient capacity to provide cooling for a period of 30 days in accordance with RG 1.27. The total water loss due to leakage during a 30-day period is increased from approximately 6.35E6 gallons to 6.38E6 gallons in the system. This reduces the inventory safety margin from approximately 73,000 gallons to 49,000 gallons of water in the UHS water basin.

In addition, the maximum service water supply temperature increases from 89.97°F (1 hour post-accident) to 92.1°F (5 hours post-accident) during a design-basis accident, coincident with a LOP and a failure of the Division 2 EDG. For a maximum safeguards shutdown scenario, the maximum service water supply temperature reaches 92.36°F approximately 13 hours post-accident. For both of these cases, the maximum temperature does not exceed the design basis limit of 95°F.

These changes do not impact the design basis parameters of the UHS or compliance with RG 1.27. Moreover, the existing TS operability and surveillance requirements are not reduced by the proposed change. Therefore, the operation of the facility in accordance with this proposed change does not involve a significant reduction in a margin of safety.

5.0 Environmental Analysis

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

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Attachment 2

Description of Prior Licensing Basis Changes

In 2002, a revision to UFSAR Section 9.2.5 was evaluated in accordance with 10CFR50.59 to credit makeup to the ultimate heat sink (UHS) to account for system leakage and when operating two divisions of standby service water (SSW). Additionally, Technical Specification Bases 3.7.1 (Standby Service Water System and Ultimate Heat Sink) was revised to credit makeup water sources to account for system leakage and when operating two divisions of SSW. The UFSAR change and Bases revision were based on the same 50.59 evaluation. Those changes are indicated in Attachment 3.

The UHS is capable of meeting Regulatory Guide 1.27 requirements for a 30-day inventory without makeup, considering no system leakage. Standby service water system leakage was not considered in the original license basis for the system's ability to have a 30-day inventory. The original UFSAR indicated that the system maximum losses from the UHS consisted of natural evaporation, forced evaporation, drift, and cooling for the penetration valve leakage control system. These losses were quantified in the UFSAR to demonstrate compliance with Regulatory Guide 1.27. Neither the UFSAR nor Regulatory Guide 1.27 discuss how leakage was addressed, River Bend Station was licensed without requiring consideration for leakage. Therefore, system leakage was not a part of the license basis. A 50.59 and USAR change in 2002 clarified that makeup will be required to account for system leakage.

During the 2011 Component Design Basis Inspection, the 50.59 response that was determined to be inadequate is question 2 ("Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component important to safety previously evaluated in the UFSAR?")

NEI 96-07 (Guidelines for 10CFR50.59 Implementation) states that the term "malfunction of an SSC important to safety" refers to the failure of structures, systems and components (SSCs) to perform their intended design functions. The design function of the UHS as described in the UFSAR section 9.2.5 is as follows: "The capacity of the UHS water storage basin is designed to provide necessary cooling for the period of time (30 days) needed to evaluate the situation, to take corrective action to mitigate the consequences of an accident, and if required to take any necessary measures to permit water replenishment. In addition, procedures are available for ensuring continued capability of the sink beyond 30 days." This design function assumes failure of an EDG and does not include system leakage.

The ability to provide makeup to the UHS in less than 30 days is only credited for non-design basis scenarios and therefore does not result in a failure of the UHS basin, does not create a new leakage, does not impact the integrity of the existing piping, does not increase natural evaporation, does not increase forced evaporation, does not increase drift, and does not increase cooling requirements for supplied systems. Therefore, there is no increase to the likelihood of occurrence of a malfunction of a structure, system or component as evaluated in the UFSAR.

NEI 96-07 also states that the cause and mode of a malfunction should be considered in determining whether there is a change in the likelihood of a malfunction. The response to question 2 did not adequately address the impact to existing or new malfunctions, however; there are no new malfunctions created nor is there any impact to an existing malfunction as discussed in the above paragraph.

The NRC inspector had a specific question regarding example 4 of NEI 96-07 under question two which states that "the change involves a new or modified operator action that supports a design function credited in safety analyses provided that 1) the action is reflected in plant procedures and operator training, 2) the licensee has demonstrated that the action can be completed in time required considering the aggregate affects (workload, environmental conditions etc.), 3) the evaluation of the change considers the ability to recover from credible errors in performance of manual actions an, and 4) the evaluation considers the effect of the change on plant systems. However, the RBS position is that providing makeup for system leakage is not a design function as described in the USAR, so example 4 does not apply.

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Attachment 3

Previously-changed Licensing Basis Pages
(changes are highlighted)

B 3.7 PLANT SYSTEMS

B 3.7.1 Standby Service Water (SSW) System and Ultimate Heat Sink (UHS)

BASES

BACKGROUND

The SSW System is designed to provide cooling water for the removal of heat from unit auxiliaries, such as Residual Heat Removal (RHR) System heat exchangers, standby diesel generators (DGs), HPCS DG, and room coolers for Emergency Core Cooling System equipment required for a safe reactor shutdown following a Design Basis Accident (DBA) or transient. The SSW System also provides cooling to unit components, as required, during normal shutdown and reactor isolation modes. During a DBA, the equipment required for normal operation only is isolated from the SSW System, and cooling is directed only to safety related equipment.

The SSW System consists of two independent cooling water headers (subsystems A and B), and their associated pumps, piping, valves, and instrumentation. The two SSW pumps on each supply header are sized to provide sufficient cooling capacity to support the required safety related systems during safe shutdown of the unit following a loss of coolant accident (LOCA). Subsystems A and B service equipment in SSW Divisions 1 and 2, respectively. Additionally, the two redundant systems merge to supply the HPCS diesel generator jacket water cooler and the HPCS pump room unit cooler.

The UHS consists of one 200% cooling tower and one 100% capacity water storage basin. The basin is sized such that sufficient water inventory is available to provide heat removal capability to safely shut down the plant and to maintain it in a cold shutdown condition for a 30 day period with no external makeup water source available (Regulatory Guide 1.27, Ref. 1). This assumes the failure of Division II at the beginning of the accident. If failure does not occur, actions are required to ensure long term availability of the UHS. Makeup water sources are available when both Divisions of SSW System are operating and for post DBA system leakage (see USAR section 9.2.5 for additional details). The UHS uses five vaneaxial fans for each of four tower cells in an induced draft system arrangement. Each of the four tower cells is powered by either Standby Diesel Generator A or B (Division 1 or 2). Two operating cells are sufficient for safe shutdown. Normal makeup for the UHS basin is manually controlled and provided through the Makeup Water Treatment System by plant makeup wells.

Cooling water is pumped from the cooling tower basin by the four SSW pumps to the essential components through the two main supply headers (subsystems A and B). After removing

(continued)

BASES

BACKGROUND (continued)

heat from the components, the water is discharged to the cooling tower where the heat is rejected through direct contact with ambient air.

Subsystems A and B supply cooling water to equipment required for a safe reactor shutdown. Additional information on the design and operation of the SSW System and UHS along with the specific equipment for which the SSW System supplies cooling water is provided in the USAR, Section 9.2 and the USAR, Table 9.2-15 (Refs. 2 and 3, respectively). The SSW System is designed to withstand a single active or passive failure, coincident with a loss of offsite power, without losing the capability to supply adequate cooling water to equipment required for safe reactor shutdown.

Following a DBA or transient, the SSW System will operate automatically without operator action. Manual initiation of supported systems (e.g., suppression pool cooling) is, however, performed for long term cooling operations.

APPLICABLE SAFETY ANALYSES

The UHS consists of one 200% cooling tower and one 100% capacity water storage basin. The basin is sized such that sufficient water inventory is available to provide heat removal capability to safely shut down the plant and to maintain it in a cold shutdown condition for a 30 day period with no additional makeup water source available (Ref. 1) (see USAR section 9.2.5 for additional information concerning inventory requirement). The ability of the SSW System to support long term cooling of the reactor or containment is assumed in evaluations of the equipment required for safe reactor shutdown presented in the USAR, Sections 9.2, 6.2.1, and Chapter 15, (Refs. 2, 4, and 5, respectively). These analyses include the evaluation of the long term primary containment response after a design basis LOCA. The SSW System provides cooling water for the RHR suppression pool cooling mode to limit suppression pool temperature and primary containment pressure following a LOCA. This ensures that the primary containment can perform its intended function of limiting the release of radioactive materials to the environment following a LOCA. The SSW System also provides cooling to other components assumed to function during a LOCA. Also, the ability to provide onsite emergency AC power is dependent on the ability of the SSW System to cool the DGs.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)	The safety analyses for long term containment cooling were performed, as discussed in the USAR, Sections 6.2.1 and 6.2.2 (Refs. 4 and 6, respectively), for a LOCA, concurrent with a loss of offsite power, and minimum available DG power. The worst case single failure affecting the performance of the SSW System is the failure of one of the two standby DGs, which would in turn affect one SSW subsystem. If failure does not occur, actions are required to ensure long term availability of the UHS (see USAR section 9.2.5 for additional details). The SSW flow assumed in the analyses is 5800 gpm per pump to the RHR heat exchanger (USAR, Table 6.2-2, Ref. 7). Reference 2 discusses SSW System performance during these conditions. The SSW System, together with the UHS, satisfy Criterion 3 of the NRC Policy Statement.
LCO	The OPERABILITY of subsystem A (Division 1) and subsystem B (Division 2) of the SSW System is required to ensure the effective operation of the RHR System in removing heat from the reactor, and the effective operation of other safety related equipment during a DBA or transient. Requiring both subsystems to be OPERABLE ensures that either subsystem A or B will be available to provide adequate capability to meet cooling requirements of the equipment required for safe shutdown in the event of a single failure. A subsystem is considered OPERABLE when: a. The associated pumps are OPERABLE; and b. The associated piping, valves, instrumentation, and controls required to perform the safety related function are OPERABLE. OPERABILITY of the UHS is based on a maximum water temperature of 88°F with a minimum basin water level at or above elevation 111 ft 10 inches mean sea level (equivalent to an indicated level of ≥ 78%) and four OPERABLE cooling tower fan cells. The isolation of the SSW System to components or systems may render those components or systems inoperable, but may not affect the OPERABILITY of the SSW System.

(continued)

• →8

The increase in water chemistry concentration due to the absence of blowdown from the system has no effect on the operation of the UHS or the standby service water system during 30 days of operation. However, the system is operated with a controlled makeup if the normal plant makeup wells are operable following an accident.

8←•

The makeup water required after 30 days of operation is a maximum of approximately 164,000 gal/day. Additional make up is required for system leakage under licensing basis condition and when operating two divisions with system leakage. Primary makeup water is provided by the normal plant makeup wells which are described in Section 9.2.3. Makeup to the basin is manually controlled to maintain the water level above el 111 ft 10 in which is the minimum basin operating level. Should the primary makeup water source become unavailable, this makeup can be supplied by any of the following alternate methods:

1. Use temporary power to power the plant deep/shallow well pumps and provide makeup through the existing 4”-diameter pipeline into the SCT basin. Also, Fire Protection System can be used to provide make-up water into the SCT basin.
2. Temporary diesel driven pump, hoses, and valves can be used to pump CWS flume basin water into the SCT basin.
3. Temporary tank trucks, hoses and diesel driven pumps to transfer Mississippi River water into the SCT basin.

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A hypochlorite feed system is provided to inhibit biological growth in the UHS water storage basin. This system consists of a 1,000-gal. feed tank, a metering pump, a recirculation pump, and a network of distribution piping to allow treatment of separate compartments within the basin from the surface to the bottom elevation. A programmable controller sequences the opening and closing of solenoid valves on each branch of the piping network for a set amount of time to allow an adequate chemical dosage in each zone. The recirculation pump is a self-priming type which draws from the basin water surface and provides a medium for injection of the chemical and adequate dispersion through the diffuser pipes. An alternate means of adding chemicals can be achieved by using the systems tank drain valve, direct addition to the basin will allow for dispersion of the chemical through out the basin.

1←• • →11 11←•

Sodium hypochlorite or alternative biocides or corrosion inhibitors may periodically be added to the UHS basin as needed, based on sampling and analysis performed by the chemistry department.

8←•

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Attachment 4

Description of Prior Analytical Deficiencies

During the 2011 Component Design Basis Inspection at RBS, calculation PM-194 Rev. 8, “Standby Cooling Tower Performance and Evaporation Losses without Drywell Unit Coolers”, (dated 7/21/2009) was reviewed. The calculation contains methodology for determination of pump heat added to the UHS basin by the following pumps: Standby Service Water Pumps “A” and “C,” Residual Heat Removal Pump “A,” High Pressure Core Spray Pump, and Low Pressure Core Spray Pump. An assumption in the calculation states that, “All horsepower input to the various pump motors is assumed to be converted into heat and transferred to Standby Service Water”. This assumption is inconsistent with the actual methodology for determining SSW pump heat addition which is based upon heat added due to pump inefficiency. The assumption is also inconsistent with the methodology for determining emergency core cooling (ECCS) pump heat addition based upon the energy equation. In addition, an assumption with respect to the negligible contribution of kinetic energy in turbulent flow (i.e. heat generated due to friction in the flowing fluid) was not documented in the calculation. These inconsistencies are not in compliance with the requirements of Entergy procedures governing engineering calculations”.

The calculation deficiencies have no adverse impact on the operation of the standby service water pumps, ECCS pumps, or the Standby Cooling Tower. The pump heat is utilized in the calculation to quantify the evaporation losses to demonstrate that design and license requirements regarding UHS inventory for 30 days can be met. Subsequent correction of the deficiencies demonstrates that the calculation conclusions are not affected. The pending changes are indicated in Attachment 5.

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Attachment 5

Pending Design Basis Changes
(16 pages)

9.2.5.2 System Description

•→12 •→6

The UHS at River Bend Station consists of one 200 percent Seismic Category I cooling tower and one 100 percent capacity water storage basin. The basin holds approximately 6,625,314 gal of usable water at the normal water level of 113 ft 4 in to the minimum pump submergence level of 65 ft 0 in, which is available to make up for drift and evaporative losses over 30 days of operation. Major component design data are given in Table 9.2.15.

6←• 12←•

The cooling tower is designed to nominally remove 379.5 x 10^6 Btu/hr at a maximum service water flow of 33,000 gpm. Design temperature for cold water leaving the tower is 93°F, corresponding to a design tower inlet water temperature of 116°F.

The design ambient wet-bulb temperature of 81°F was based upon the maximum mean 1-day wet bulb temperature of 80.3°F recorded on July 27, 1969.

The maximum allowable cold water temperature is nominally 95°F, corresponding to the value assumed for evaluation of the containment heat removal systems (Section 6.2.2).

•→14

Heat transfer to standby service water is seen to occur immediately after a DBA, postulated as a large break of a main steam line (DBA-MSL) coincident with a complete loss of offsite power. The loss of offsite power is assumed to last for the full 30 day post shutdown period. The single failure of the Division II diesel generator is postulated to occur immediately after trip.

The maximum heat transfer rate to standby service water is calculated to occur 4 to 5 ~~2 to 3~~ hr after station trip when heat rejection to standby service water occurs as follows in the unit.

14←•

Heat rejection to the standby service water system by the RHR heat exchanger and containment unit cooler is postulated to begin 0.5 hr after the DBA. Calculation of heat rejection rates for the period 0.5 hr through 3 days from the RHR heat exchanger and containment unit cooler is described in Section 6.2.1 and shown graphically on Fig. 6.2-19 and 6.2-21.

Heat rejection rates for the period 4 days to 30 days were determined as follows. The RHR heat exchangers are postulated to remove the total quantity of core decay heat produced during that interval. Containment unit cooler heat rejection rates during this interval are approximated by a straight line continuation of Fig. 6.2-21.

•→14
The analysis for the decay heat input from the reactor core to the UHS is based upon Branch Technical Position ASB 9.2. A 10 percent margin is added to the fission product heat rate to cover the uncertainty in nuclear properties for the time interval 10^1 to 10^7 sec. Decay heat rates due to fission products and heavy elements, as well as combined decay heat rates, are tabulated in Table 9.2-4.

Total integrated decay heat input to standby service water from core decay heat due to fission products and heavy elements is given in Table 9.2-5 ~~and shown on Fig. 9.2-16~~.

The integrated heat rejection from the plant auxiliaries is given in Table 9.2-6. The plant auxiliaries heat input to the standby service water system is presented in Table 9.2-7 ~~and shown on Fig. 9.2-17~~.

Heat rejection due to pump heat is given in Table 9.2-9.

The total integrated decay heat input to the standby service water from reactor core decay heat, sensible heat, pump heat, and plant auxiliaries heat is tabulated in Table 9.2-10. The operating status for safeguard equipment operating during the 30-day period is listed in Table 9.2-13.

•→12 •→6
The maximum rate of heat rejection to standby service water from all sources as shown in Table 9.2-11 is ~~1.472~~ 1.538 x 10^8 Btu/hr and occurs 5 ~~6.0~~ hrs after shutdown. This corresponds to a maximum service water supply temperature of ~~89.16~~ 92.1°F at ~~11,800~~ 15,363 gpm flow. ~~The maximum temperature of 89.97°F occurs at 1 hour.~~ |
12←• 14←•
Cold and hot water temperatures are listed in Table 9.2-11.
6←•
Cold water temperatures exiting the UHS cooling tower were calculated using the following methods.

Cold water temperatures were determined using vendor-supplied tower performance curves which relate cold water temperature and ambient wet bulb temperature for varying values of cooling tower range and constant tower water flows. The vendor has supplied curves for 50 percent through 110 percent at 10 percent intervals of the design tower flow of 33,000 gpm. The vendor curves are provided as Figures 9.2-19a through 9.2-19g. These curves are based on both the Cooling Tower Institute Test Code ATC-105, "Acceptance Test Code for Water Cooling Towers"(3), and vendor's proprietary data for the ceramic tile fill material.

Heat rejection rates and service water flow rates were determined at specific periods of time following shutdown. Tower cooling ranges were calculated using the relationship:

$$\Delta T = \frac{(HR)}{Q\ C_p}$$

where:

ΔT = Cooling range (°F)

HR = Heat rejection rate (Btu/hr)

Q = Service water flow (lbm/hr)

C_p = Specific heat of water (Btu/lbm °F)

Cold water temperatures were then interpolated from the performance curves. Hot water temperatures were found from the following relationship:

Hot Water Temp = Cooling Range + Cold Water Temp

•→6

Values of hot water temperature calculated using the above methods are conservative, yielding results higher than expected actual temperatures. A cooling tower operating in a closed loop dissipates all the heat rejected to it by allowing hot water temperatures to rise or fall to an equilibrium point defined by the amount of heat the ambient air is capable of picking up. For conservatism, the analysis of cooling tower operation disregards the dampening effect the large volume of water stored in the basin has upon the system operating temperatures.

During operation, some portion of increasing or decreasing plant heat loads goes toward raising the basin water's sensible heat, while the remainder is discharged by the tower through forced evaporation. As a result, cold water temperatures tend to follow the changes in heat rejection rates, but reach the calculated values only in the long term. The calculated values of cold water temperatures, therefore, should be considered as conservative upper boundaries instead of actual temperatures.

•→16 •→14 •→12

During the first 1 hr after shutdown, all of the heat rejected from the station is assumed to go directly toward increasing the temperature of the water stored in the SCT basin. During this time, no credit is taken for heat removal by natural evaporation from either the pool surface or in the tower fill. At shutdown there is a total of 6,431,346 ~~6,421,376~~ gal of water in the basin corresponding to a water level of 111 ft 10 in (this includes water to an elevation of 65 ft 0 in, which is the minimum pump submergence level). From Table 9.2-10, ~~1.047×10^8~~ 8.241 x 10^7 Btus are rejected to service water during the first 1 hr. This will raise the average temperature of the basin water by 1.55 ~~1.97~~°F.

6←• 12←• 14←• 16←•

•→16 •→14 •→12
The anticipated maximum SCT basin temperature prior to shutdown is 88°F. At 1 hr after shutdown, the average basin water temperature would be 88°F + 1.55° or 89.55°F. ~~1.97° or 89.97°F.~~ The first 1 hr represents all of the heat rejected to standby service water, which raises the sensible heat of the basin. The cooling tower fans may be started at 1 hr after shutdown without affecting the ability of the ultimate heat sink to remove plant heat.
6←•

The following estimated maximum losses occur for the UHS:

	Loss up to 24 hr (gal)	Total Loss for 30 days (gal)
→6 Natural Evaporation	7.86 x 10^{2}	2.359 x 10^{4}
Forced Evaporation and Drift ~~Forced Evaporation~~	3.82 ~~3.66044~~ x 10^{5}	6.27 ~~6.238~~ x 10^{6}
~~Drift~~	~~1.630 x 10^{3}~~	~~4.2841 x 10^{4}~~
PVLCS Air Compressor (cooling water not recovered)	2.88 ~~1.44~~ x 10^{3}	8.64 ~~4.32~~ x 10^{4}
Total	3.86 ~~3.70670~~ x 10^{5}	6.38 ~~6.347989~~ x 10^{6}

which is 6.38 ~~6.347989~~ x 10^{6} gal of water lost.
6←• 12←• 14←• 16←•

Forced evaporation was calculated by the following relationship:

$$E = \frac{(TH)\ C}{(LH)\ \rho}$$

where:

E = Evaporation (gal)

TH = Total integrated heat (Btu)

LH = Latent heat of incoming water (Btu/lbm)

ρ = Density of incoming water (lbm/ft^{3})

C = Conversion factor of 7.481 gal/ft^{3}

Evaporation calculated by this equation is also conservative. As stated previously, ~~approximately 20 to 30 percent~~ a fraction of the heat load goes to raising the sensible heat of the ~~water~~ air. Actual forced evaporation is expected to ~~range between 70 and 80 percent of~~ be less than the calculated value.

The quantity of water naturally evaporated from the surface of the UHS storage basin is minimal for a semi-enclosed basin such as this. For natural evaporation to occur, the vapor pressure of the ambient air must be lower than the vapor pressure of the water. During UHS operation, the air near the surface of the water is saturated at the temperature of the cold water leaving the fill material. Correspondingly, the water surface temperature is at or below this temperature, thus inhibiting natural evaporation.

•→12 •→6

A net solar and atmospheric heat load of 6.819×10^6 Btu/day was assumed to be impressed upon the water surface through the 54 ft x 54 ft center plenum and a corresponding evaporation rate to dissipate this heat added into the total integrated evaporation and drift values shown in Table 9.2-12. Sun heat load is based conservatively on solar radiation incident to a horizontal surface at 30°-45' north latitude and assuming no cloud cover.

6←•

Maximum cooling tower drift loss is assumed to be 0.01 percent of the standby service water flow rate, based upon data furnished by the UHS supplier. Drift loss is a function of the internal tower design and is independent of ambient conditions (e.g., wind speed, temperature, humidity). Cooling towers of similar design were tested at Oak Ridge National Laboratory by the Environmental Systems Company for the EPA. In their report Development and Demonstration of Low-Level Drift Instrumentation, October 1971, average drift losses of 0.005 percent were found. The towers tested at Oak Ridge National Laboratory had two-pass wood slat drift eliminators. The towers described herein utilize three-pass, close space polyvinyl chloride drift eliminators with lower air velocities which should be more efficient. Thus, basin capacity calculations, based upon 0.01 percent drift loss, conservatively predict tower drift loss.

•→14 •→6

The cooling tower storage facility has a capacity of approximately ~~6,421,376~~ 6,431,346 gal at the minimum basin water level of 111 ft 10 in (as mentioned earlier). This excludes the approximate 70,000 gallons, which represents the water from the minimum pump submergence el. of 65 ft 0 in to the basin floor elevation of 64 ft 6 in. During the first 30 days of operation following a DBA, ~~6.347989~~ 6.38 x 10^6 gal of water are lost due to non-non-returned cooling water supply to PVLCS, evaporation and drift. The remaining ~~73,387~~ 49,000 gal of water are used as a design safety margin.

6←• 12←• 14←•

The licensing basis capacity determination, inventory losses and design safety margin described previously assumes that the Division 2 diesel generator failed at the beginning of the event. If division 2 does not fail as assumed, additional heat load would be placed on the UHS due to the second division operating. In this case, the inventory of the UHS would be less than 30-days. (Note that 30-days UHS inventory is available to meet RG 1.27 requirements based on the licensing basis capacity determination.) In addition, the licensing basis capacity determination does not assume any UHS or Standby Service Water System leakage. The UHS design margin (~~73,387~~ gallons) and makeup sources are available to address the additional heat load from Division 2 and post event system leakage. Makeup quantities and sources to the UHS are discussed below. Operator actions would be required for this event to ensure adequate long term UHS inventory.

49,000

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TABLE 9.2-5

●→14

DECAY HEAT REJECTION* AND CONTAINMENT UNIT COOLER HEAT LOAD
TO STANDBY SERVICE WATER FOLLOWING A **LARGE BREAK OF A MAIN STEAM LINE DBA-MSL**

●→12 12←●

(HEAT Removal Rates: Btu/Hr)

Time After Shutdown		Time (sec)	RHR	EVR	Total	Pump Adjustment	Adjusted Total	Integral Heat Load (BTU)
0.00	hr	0.00E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10.00	min	6.00E+02	0.000E+00	0.000E+00	0.000E+00	1.071E+07	-1.071E+07	1.79 ~~8.925E+06~~ 6
0.50	hr	1.80E+03	7.960E+07	-7.809E+04	7.952E+07	1.132E+07	6.819 ~~6.820E+07~~	5.56 ~~9.584E+06~~
1	hr	3.60E+03	9.114E+07	-1.996E+04	9.112E+07	8.142E+06	8.297E+07	9.63 ~~3.779E+07~~ 6
1.5	hr	5.40E+03	9.460E+07	-1.076E+04	9.459E+07	8.142E+06	8.645E+07	1.37 ~~4.296E+07~~
2	hr	7.20E+03	9.799E+07	6.315E+03	9.799E+07	8.142E+06	8.985E+07	1.78 ~~4.408E+07~~
2.5	hr	9.00E+03	1.011E+08	1.150E+04	1.011E+08	8.142E+06	9.294E+07	2.18 ~~4.670E+07~~
3	hr	1.08E+04	1.033E+08	2.653E+04	1.034E+08	8.142E+06	9.522E+07	2.59 ~~4.704E+07~~
4	hr	1.44E+04	1.061E+08	4.983E+04	1.061E+08	8.142E+06	9.799E+07	3.41 ~~9.660E+07~~
5	hr	1.80E+04	1.070E+08	6.911E+04	1.071E+08	8.142E+06	9.895E+07	4.22 ~~9.847E+07~~
6	hr	2.16E+04	1.070E+08	8.672E+04	1.071E+08	8.142E+06	9.892E+07	5.03 ~~9.894E+07~~
8	hr	2.88E+04	1.054E+08	1.045E+05	1.055E+08	8.142E+06	9.732E+07	6.66 ~~1.062E+08~~ 7
10	hr	3.60E+04	1.019E+08	1.000E+05	1.020E+08	8.142E+06	9.383E+07	8.29 ~~1.911E+08~~ 7
12	hr	4.32E+04	9.774E+07	1.329E+05	9.787E+07	8.142E+06	8.973E+07	9.92 ~~1.836E+08~~ 7
16	hr	5.76E+04	9.116E+07	1.310E+05	9.129E+07	8.142E+06	8.315E+07	1.32 ~~3.458E+08~~
20	hr	7.20E+04	8.572E+07	1.564E+05	8.587E+07	8.142E+06	7.773E+07	1.64 ~~3.218E+08~~
24	hr	8.64E+04	8.088E+07	1.353E+05	8.102E+07	8.142E+06	7.288E+07	1.97 ~~3.012E+08~~
2	d	1.73E+05	6.581E+07	1.055E+05	6.592E+07	8.142E+06	5.777E+07	3.92 ~~4.668E+09~~ 8
3	d	2.59E+05	5.749E+07	9.215E+04	5.759E+07	8.142E+06	4.944E+07	5.88 ~~4.287E+09~~ 8
4	d	3.46E+05	5.195E+07	8.327E+04	5.204E+07	8.142E+06	4.389E+07	7.83 ~~4.420E+09~~ 8
5	d	4.32E+05	4.780E+07	7.662E+04	4.788E+07	8.142E+06	3.974E+07	9.79 ~~4.004E+09~~ 8
6	d	5.18E+05	4.480E+07	7.181E+04	4.487E+07	8.142E+06	3.673E+07	1.17 ~~9.176E+08~~ 9
7	d	6.05E+05	4.187E+07	6.711E+04	4.194E+07	8.142E+06	3.379E+07	1.37 ~~8.462E+08~~ 9
8	d	6.91E+05	3.984E+07	6.385E+04	3.990E+07	8.142E+06	3.176E+07	1.56 ~~7.866E+08~~ 9
9	d	7.78E+05	3.780E+07	6.059E+04	3.787E+07	8.142E+06	2.972E+07	1.76 ~~7.370E+08~~ 9
10	d	8.64E+05	3.617E+07	5.798E+04	3.623E+07	8.142E+06	2.809E+07	1.96 ~~6.938E+08~~ 9
15	d	1.30E+06	3.091E+07	4.954E+04	3.096E+07	8.142E+06	2.282E+07	2.93 ~~3.064E+09~~
20	d	1.73E+06	2.709E+07	4.342E+04	2.714E+07	8.142E+06	1.899E+07	3.91 ~~2.609E+09~~
25	d	2.16E+06	2.474E+07	3.966E+04	2.478E+07	8.142E+06	1.664E+07	4.89 ~~2.438E+09~~
30	d	2.59E+06	2.268E+07	3.636E+04	2.272E+07	8.142E+06	1.458E+07	5.86 ~~4.873E+09~~

14←●

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TABLE 9.2-6

•→14

PLANT AUXILIARIES HEAT LOAD (BTU/hr)
INPUT TO STANDBY SERVICE WATER FOLLOWING A DBA

•>12 12<•

Component	0 - 30 min	30 min - 1 hr	1 hr - 2 hr	2 hr - Day 1	Day 1- Day 10	Day 10 - Day 30	
SDG Jacket Wtr Cooler 'A'	1.203E+07	1.203E+07	1.203E+07	1.203E+07	1.203E+07	1.203E+07	
HPCS DG Jacket Cooler	8.580E+06	8.580E+06	8.580E+06	8.580E+06	8.580E+06	8.580E+06	
Control Room Chillers	2.803E+06	2.803E+06	2.803E+06	2.803E+06	2.803E+06	2.803E+06	
Fuel Pool Coolers	0.000E+00	0 ~~1.385E+07~~	0 ~~1.385E+07~~	2.1479E+07* ~~1.385E+07~~	1.3010E+07* ~~1.144E+07~~	1.1399E+07* ~~1.144E+07~~	
•→16							
Aux Building Unit Coolers						Values typical across all times.	
HVR-UC2	~~1.875E+05~~	~~1.875E+05~~	~~1.875E+05~~	~~1.875E+05~~	~~1.875E+05~~	~~1.875E+05~~	8.789E+04
HVR-UC3	~~3.182E+05~~	~~3.182E+05~~	~~3.182E+05~~	~~3.182E+05~~	~~3.182E+05~~	~~3.182E+05~~	1.708E+05
HVR-UC5	~~7.219E+05~~	~~7.219E+05~~	~~7.219E+05~~	~~7.219E+05~~	~~7.219E+05~~	~~7.219E+05~~	5.396E+05
HVR-UC6	6.108E+05	4.073E+05	4.073E+05	4.073E+05	4.073E+05	4.073E+05	
HVR-UC7	~~4.861E+05~~	~~4.861E+05~~	~~4.861E+05~~	~~4.861E+05~~	~~4.861E+05~~	~~4.861E+05~~	2.948E+05
HVR-UC8	~~4.054E+05~~	~~4.054E+05~~	~~4.054E+05~~	~~4.054E+05~~	~~4.054E+05~~	~~4.054E+05~~	2.424E+05
HVR-UC11A 16←•	~~1.012E+06~~	~~1.012E+06~~	~~1.012E+06~~	~~1.012E+06~~	~~1.012E+06~~	~~1.012E+06~~	5.576E+05
RHR Pump Cooler 'A'	0.000E+00	0.000E+00 ~~5.360E+04~~	0.000E+00 ~~5.360E+04~~	5.360E+04	5.360E+04	5.360E+04	
PVLCS Air Compressor	1.200 ~~1.201~~E+05	1.200 ~~1.201~~E+05	1.200 ~~1.201~~E+05	1.200 ~~1.201~~E+05	1.200 ~~1.201~~E+05	1.200 ~~1.201~~E+05	
add: 14←•RMS-RE15A	1.118E+05						1.118E+05
RMS-RE11A	2.000E+02						2.000E+02

NOTE: These heat rates assume a coincident loss of offsite power.
*Fuel Pool Loads decrease from the value shown through the remaining time period shown.

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Add this column

TABLE 9.2-7

PLANT AUXILIARIES HEAT INPUT
TO STANDBY SERVICE WATER

•→16 •→14 •→12

Time	Time (sec)	SPC Heat Rejection Rate (Btu/hr) x 10^7	Other Auxiliaries Heat (Btu/hr) x 10^7	~~Integrated~~ Heat (Btu)
0.0 hr	0.0	~~2.759~~	2.640	0.0
0.5	1.8 x 10^3	~~4.150~~	2.620	1.320 ~~1.38~~ x 10^7
1.0	3.6 x 10^3	~~4.150~~	2.620	2.630 ~~3.454~~ x 10^7
1.5	5.4 x 10^3	~~4.150~~	2.620	3.940 ~~5.529~~ x 10^7
2.0	7.2 x 10^3	2.148 ~~4.150~~	2.620	5.249 ~~7.604~~ x 10^7
2.5	9.0 x 10^3	2.122 ~~4.150~~	2.625	7.629 ~~9.679~~ x 10^7
3.0	1.08 x 10^4	2.095 ~~4.150~~		9.996 ~~1.175~~ x 10^{7}
4.0	1.44 x 10^4	2.043 ~~4.150~~		1.469 ~~1.590~~ x 10^8
5.0	1.80 x 10^4	1.990 ~~4.150~~		1.933 ~~2.005~~ x 10^8
6.0	2.16 x 10^4	1.938 ~~4.150~~		2.392 ~~2.420~~ x 10^8
8.0	2.88 x 10^4	1.832 ~~4.150~~		3.294 ~~3.350~~ x 10^8
10.0	3.60 x 10^4	1.727 ~~4.150~~		4.175 ~~4.080~~ x 10^8
12.0	4.32 x 10^4	1.622 ~~4.150~~		5.035 ~~4.910~~ x 10^8
16.0	5.76 x 10^4	1.412 ~~4.150~~		6.692 ~~6.570~~ x 10^8
20.0	7.20 x 10^4	1.305 ~~4.150~~		8.285 ~~8.230~~ x 10^8
24.0	8.64 x 10^4	1.301 ~~4.150~~		9.856 ~~9.889~~ x 10^8
2 days	1.73 x 10^5	1.286 ~~3.909~~		1.925 ~~1.927~~ x 10^9
3	2.59 x 10^5	1.265 ~~3.909~~		2.882 ~~2.865~~ x 10^9
4	3.46 x 10^5	1.245 ~~3.909~~		3.793 ~~3.803~~ x 10^9
5	4.32 x 10^5	1.226 ~~3.909~~		4.719 ~~4.741~~ x 10^9
6	5.18 x 10^5	1.207 ~~3.909~~		5.641 ~~5.679~~ x 10^9
7	6.05 x 10^5	1.189 ~~3.909~~		6.559 ~~6.617~~ x 10^9
8	6.91 x 10^5	1.172 ~~3.909~~		7.472 ~~7.555~~ x 10^9
9	7.76 x 10^5	1.156 ~~3.909~~		8.382 ~~8.493~~ x 10^9
10	8.64 x 10^5	1.140 ~~3.909~~		9.287 ~~9.431~~ x 10^9
15	1.30 x 10^6	1.069 ~~3.909~~		1.376 ~~1.412~~ x 10^{10}
20	1.73 x 10^6	1.010 ~~3.909~~		1.816 ~~1.881~~ x 10^{10}
25	2.16 x 10^6	0.960 ~~3.909~~		2.249 ~~2.350~~ x 10^{10}
30	2.59 x 10^6	0.917 ~~3.909~~		2.676 ~~2.819~~ x 10^{10}

12←• 14←• 16←•

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TABLE 9.2-9

HEAT REJECTED BY OPERATING PUMPS FOLLOWING DBA

Time	Time (sec)	Heat Rejection Rate (Btu/hr) x 10^{6}	Integrated Heat (Btu)
•→14 •→12		0.000	0.000
0.0 hr		~~6.482~~	~~1.076 x 10^{6}~~
14←•			
0.5	1.8 x 10^{3}	11.132 ~~6.805~~	5.56 ~~6.478~~ x 10^{6}
1.0	3.6 x 10^{3}	8.142 ~~6.805~~	9.63 ~~9,880~~ x 10^{6}
1.5	5.4 x 10^{3}	8.142 ~~6.805~~	1.37 ~~1.328~~ x 10^{7}
2.0	7.2 x 10^{3}	8.142 ~~6.805~~	1.78 ~~1.669~~ x 10^{7}
2.5	9.0 x 10^{3}	8.142 ~~6.805~~	2.18 ~~2.009~~ x 10^{7}
3.0	1.08 x 10^{4}	8.142 ~~6.805~~	2.59 ~~2.349~~ x 10^{7}
4.0	1.44 x 10^{4}	8.142 ~~6.805~~	3.41 ~~3.029~~ x 10^{7}
5.0	1.80 x 10^{4}	8.142 ~~6.805~~	4.22 ~~3.710~~ x 10^{7}
6.0	2.16 x 10^{4}	8.142 ~~6.805~~	5.03 ~~4.390~~ x 10^{7}
8.0	2.88 x 10^{4}	8.142 ~~6.805~~	6.66 ~~5.751~~ x 10^{7}
10.0	3.60 x 10^{4}	8.142 ~~6.805~~	8.29 ~~7.112~~ x 10^{7}
12.0	4.32 x 10^{4}	8.142 ~~6.805~~	9.92 ~~8.473~~ x 10^{7}
16.0	5.76 x 10^{4}	8.142 ~~6.805~~	1.32 ~~1.120~~ x 10^{8}
20.0	7.20 x 10^{4}	8.142 ~~6.805~~	1.64 ~~1.392~~ x 10^{8}
24.0	8.64 x 10^{4}	8.142 ~~6.805~~	1.97 ~~1.664~~ x 10^{8}
2 days	1.73 x 10^{5}	8.142 ~~6.805~~	3.92 ~~3.297~~ x 10^{8}
3	2.59 x 10^{5}	8.142 ~~6.805~~	5.88 ~~4.930~~ x 10^{8}
4	3.46 x 10^{5}	8.142 ~~6.805~~	7.83 ~~6.563~~ x 10^{8}
5	4.32 x 10^{5}	8.142 ~~6.805~~	9.79 ~~8.197~~ x 10^{8}
6	5.18 x 10^{5}	8.142 ~~6.805~~	1.17 ~~9.830~~ x $10^{\cancel{8}}$ 9
7	6.05 x 10^{5}	8.142 ~~6.805~~	1.37 ~~1.146~~ x 10^{9}
8	6.91 x 10^{5}	8.142 ~~6.805~~	1.56 ~~1.310~~ x 10^{9}
9	7.76 x 10^{5}	8.142 ~~6.805~~	1.76 ~~1.473~~ x 10^{9}
10	8.64 x 10^{5}	8.142 ~~6.805~~	1.96 ~~1.636~~ x 10^{9}
15	1.30 x 10^{6}	8.142 ~~6.875~~	2.93 ~~2.461~~ x 10^{9}
20	1.73 x 10^{6}	8.142 ~~6.875~~	3.91 ~~3.286~~ x 10^{9}
25	2.16 x 10^{6}	8.142 ~~6.875~~	4.89 ~~4.111~~ x 10^{9}
30	2.59 x 10^{6}	8.142 ~~6.875~~	5.86 ~~4.936~~ x 10^{9}
12←•			

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TABLE 9.2-10

TOTAL INTEGRATED HEAT INPUT TO
STANDBY SERVICE WATER FROM RHR
HEAT EXCHANGERS, CONTAINMENT UNIT COOLER,
PUMPS, AND PLANT AUXILIARIES

Total Integrated Heat (Btu)

•→16 •→14 •→12 •→6

Time	Time (sec)	RHR Heat Exchangers and Containment Unit Cooler	Pumps	Plant Auxiliaries	Total Integrated Heat
0.0	0.0	0.0	~~0.0~~	~~0.0~~	~~0.0~~
0.5 hr	1.8×10^3	~~8.689~~ 8.687 $\times 10^6$	~~6.478×10^6~~	~~2.757×10^7~~	~~4.274×10^7~~
1.0	3.6×10^3	4.648×10^7	~~9.880×10^6~~	~~4.832×10^7~~	~~1.047×10^8~~
2.0	7.2×10^3	1.329×10^8	~~1.669×10^7~~	~~8.[illegible] $\times 10^7$~~	~~2.394×10^8~~
24.0	8.64×10^4	2.059×10^9	~~1.664×10^8~~	~~1.[illegible]~~	~~3.228×10^9~~
5 days	4.32×10^5	7.037×10^9	~~8.197×10^8~~	~~4.755×10^9~~	~~1.261×10^{10}~~
10	8.64×10^5	1.102×10^{10}	~~1.636×10^9~~	~~9.445×10^9~~	~~2.210×10^{10}~~
30	2.59×10^6	2.059×10^{10}	~~4.939×10^9~~	~~2.821×10^{10}~~	~~5.374×10^{10}~~

6< • 12< • 14< • 16< •

REPLACE

0.0	0.0	0.0
5.560 x 10^6	1.320 x 10^7	2.745 x 10^7
9.630 x 10^6	2.630 x 10^7	8.241 x 10^7
1.780 x 10^7	5.249 x 10^7	2.032 x 10^8
1.970 x 10^8	9.856 x 10^8	3.242 x 10^9
9.790 x 10^8	4.719 x 10^9	1.274 x 10^10
1.960 x 10^9	9.287 x 10^9	2.227 x 10^10
5.860 x 10^9	2.676 x 10^10	5.321 x 10^10

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TABLE 9.2-11

STANDBY COOLING TOWER PERFORMANCE
FOLLOWING A LARGE BREAK OF A MAIN STEAM LINE (DBA-MSL)

•→16 •→14 •→12 •→6

Time		Time (sec)	Heat Load (Btu/hr)	Service Water Flow (gpm)	Forced Evaporation Rate (gpm)	Integrated Evaporation (gal)	Cold Water Temp. (°F)	Hot Water Temp. (°F)
0.5	hr	1.80E+03	4.557E+07	3980	0.000E+00	0	N/A	N/A
1	hr	3.60E+03	1.239E+08	11800	0.000E+00	N/A	89.97	111.06
2	hr	7.20E+03	1.347E+08	11800	263.61	15,816	88.56	111.50
3	hr	1.08E+04	1.410E+08	11800	276.24	32,391	88.76	112.77
4	hr	1.44E+04	1.449E+08	11800	284.00	49,431	89.04	113.71
5	hr	1.80E+04	1.468E+08	11800	287.78	66,697	89.16	114.15
6	hr	2.16E+04	1.472E+08	11800	288.70	84,019	89.16	114.23
8	hr	2.88E+04	1.464E+08	11800	287.01	118,461	89.06	113.99
10	hr	3.60E+04	1.439E+08	11800	281.94	152,294	88.99	113.48
12	hr	4.32E+04	1.401E+08	11800	274.53	185,238	88.71	112.56
16	hr	5.76E+04	1.347E+08	11800	263.63	248,509	88.56	111.50
20	hr	7.20E+04	1.287E+08	11800	251.64	308,903	88.39	110.31
24	hr	8.64E+04	1.236E+08	11800	241.48	366,844	88.24	109.28
2	d	1.73E+05	1.112E+08	11800	216.52	678,638	86.08	105.01
3	d	2.59E+05	9.950E+07	11800	193.28	956,966	85.38	102.32
4	d	3.46E+05	9.256E+07	11800	179.59	1,215,572	84.98	100.74
5	d	4.32E+05	8.771E+07	11800	170.04	1,468,433	84.72	99.65
6	d	5.18E+05	8.413E+07	11800	162.99	1,695,144	84.44	98.76
7	d	6.05E+05	8.115E+07	11800	157.05	1,921,299	83.40	97.22
8	d	6.91E+05	7.867E+07	11800	152.19	2,140,446	83.47	96.86
9	d	7.78E+05	7.663E+07	11800	148.22	2,353,888	83.51	96.56
10	d	8.64E+05	7.480E+07	11800	144.61	2,562,127	83.30	96.03
15	d	1.30E+06	7.141E+07	9000	138.46	3,559,042	83.80	99.74
20	d	1.73E+06	6.687E+07	9000	129.52	4,491,601	83.40	98.32
25	d	2.16E+06	6.378E+07	9000	123.47	5,380,573	83.30	97.54
30	d	2.59E+06	6.157E+07	9000	119.14	6,238,354	83.20	96.94

6←• 12←• 14←• 16←•

TO BE UPDATED

Replace with Table shown on next page.

Revision 23

1 of 1

Time	Time (sec)	Total SSW Heat Load (Btu/hr)	Service Water Flow (gpm)	Forced Evaporation Rate (gpm)	SCT Surf Evap, Drift, and Leaks (gpm)	Integrated Water Loss (gal)	Cold Water Temp (°F)	Hot Water Temp (°F)
0.5 hr	1.80E+03	1.027E+08	13210	199	3.87	3.273E+03	88.51	104.10
1 hr	3.60E+03	1.175E+08	13210	228	3.87	9.802E+03	89.55	107.40
2 hr	7.20E+03	1.463E+08	15370	285	4.08	2.414E+04	91.80	110.90
3 hr	1.08E+04	1.511E+08	15368	294	4.08	4.178E+04	92.00	111.80
4 hr	1.44E+04	1.533E+08	15365	299	4.08	5.982E+04	92.09	112.20
5 hr	1.80E+04	1.538E+08	15363	300	4.08	7.800E+04	92.10	112.20
6 hr	2.16E+04	1.532E+08	15361	298	4.08	9.620E+04	92.08	112.10
8 hr	2.88E+04	1.506E+08	15356	293	4.08	1.322E+05	92.00	111.70
10 hr	3.60E+04	1.460E+08	15352	284	4.08	1.673E+05	91.80	110.90
12 hr	4.32E+04	1.409E+08	15347	274	4.08	2.014E+05	91.60	110.00
16 hr	5.76E+04	1.322E+08	15338	257	4.08	2.660E+05	91.20	108.60
20 hr	7.20E+04	1.257E+08	15329	244	4.08	3.271E+05	91.00	107.50
24 hr	8.64E+04	1.208E+08	15319	235	4.08	3.855E+05	90.80	106.60
2 d	1.73E+05	1.056E+08	15264	204	4.07	7.073E+05	88.20	102.10
3 d	2.59E+05	9.785E+07	15209	189	4.07	9.980E+05	87.80	100.70
4 d	3.46E+05	9.189E+07	15154	178	4.06	1.268E+06	87.50	99.70
5 d	4.32E+05	8.738E+07	15098	169	4.06	1.523E+06	87.20	98.90
6 d	5.18E+05	8.405E+07	15043	162	4.05	1.767E+06	87.10	98.30
7 d	6.05E+05	8.090E+07	14988	156	4.04	2.003E+06	86.90	97.70
8 d	6.91E+05	7.861E+07	14933	152	4.04	2.230E+06	86.80	97.30
9 d	7.78E+05	7.639E+07	14878	148	4.03	2.452E+06	86.60	97.00
10 d	8.64E+05	7.456E+07	14822	144	4.03	2.667E+06	86.50	96.60
15 d	1.30E+06	6.832E+07	12061	132	3.75	3.687E+06	85.20	96.60
20 d	1.73E+06	6.385E+07	11854	123	3.73	4.633E+06	84.90	95.80
25 d	2.16E+06	6.096E+07	11658	118	3.71	5.527E+06	84.70	95.20
30 d	2.59E+06	5.844E+07	11471	113	3.69	6.382E+06	84.60	94.80

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TABLE 9.2-12

TOTAL INTEGRATED EVAPORATION AND DRIFT FOLLOWING DBA

• >16

•→14 •→12 •→6

Time	Time (Sec)	Integrated Forced Evaporation (gal)	Integrated Drift (gal)	Integrated PVLCS Leakage (gal)	Integrated Natural Evaporation (gal)	Total Integrated Loss (gal)
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5 hours	1.8×10^3	0.0	0.0	30	16	46.0
1 hour	3.6×10^3	0.0	71	60	35	93
2 hours	7.2×10^3	15,820	142	120	65	16,073
3 hours	1.08×10^4	32,390	213	180	98	32,811
4 hours	1.44×10^4	49,430	284	240	131	50,014
5 hours	1.80×10^4	66,700	355	300	164	67,444
6 hours	2.16×10^4	84,020	426	360	197	84,930
8 hours	2.88×10^4	118,500	567	480	263	119,698
10 hours	3.60×10^4	152,300	708	600	329	153,859
12 hours	4.32×10^4	185,200	850	720	396	187,130
16 hours	5.76×10^4	248,500	1133	960	524	251.055
20 hours	7.76×10^4	308,900	1416	1200	656	312,103
24 hours	8.64×10^4	366,800	1699	1440	787	370,699
2 days	1.73×10^5	678,700	3399	2880	1572	686,419
3 days	2.59×10^5	957,000	5098	4320	2357	968,673
4 days	3.46×10^5	1,216,000	6798	5760	3144	1,231,204
5 days	4.32×10^5	1,461,000	8497	7200	3931	1,479,990
6 days	5.18×10^5	1,685,000	10196	8640	4718	1,718,628
7 days	6.05×10^5	1,921,000	11896	10080	5500	1,948,708
8 days	6.91×10^5	2,141,000	13595	11520	6286	2,171,781
9 days	7.76×10^5	2,354,000	15295	12960	7077	2,389.149
10 days	8.64×10^5	2,562,000	16994	14400	7863	2,601,313
15 days	1.30×10^6	3,559,000	23473	21600	11797	3,615,841
20 days	1.73×10^6	4,492,000	29954	28800	15701	4,566,012
25 days	2.16×10^6	5,381,000	36433	36000	19662	5,472,596
30 days	2.59×10^6	6,239,000	42912	43200	23594	6,347,989

6←• 12←• 14←• 16←•

TO BE UPDATED

Note: Information added to Table 9.2-11

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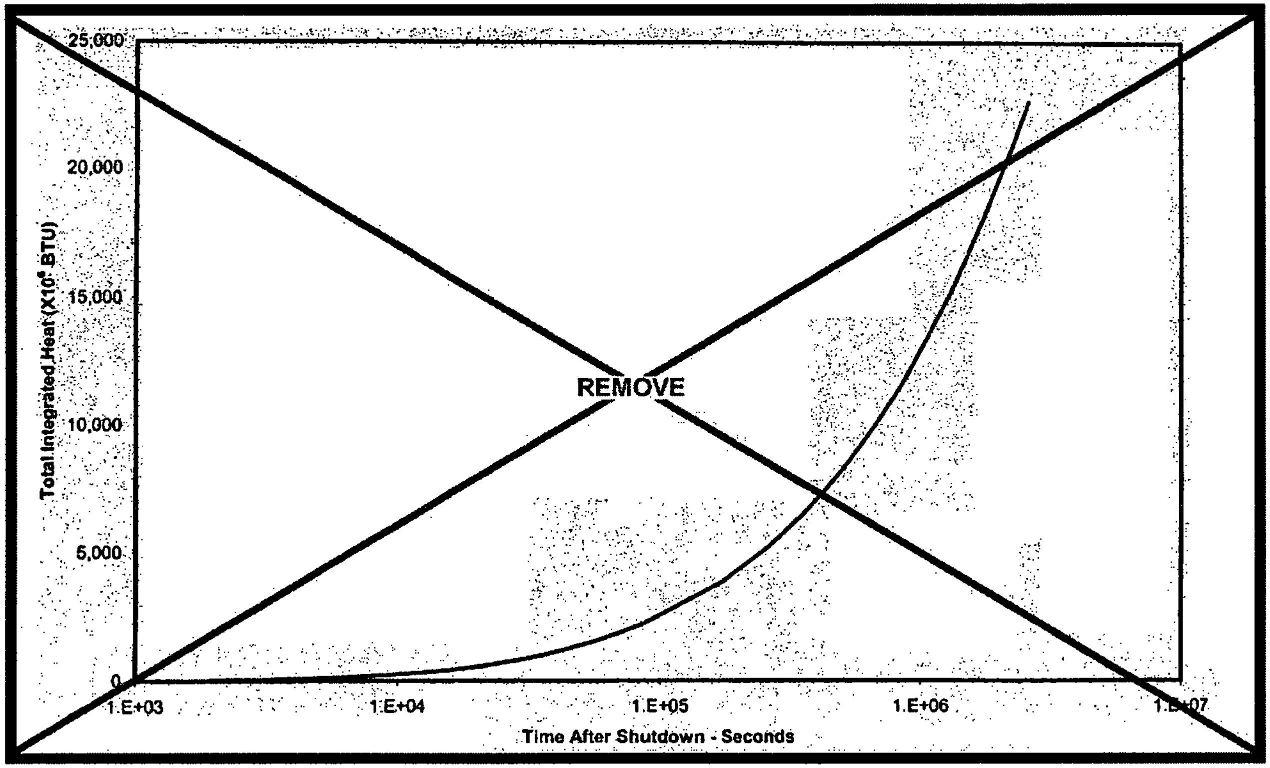

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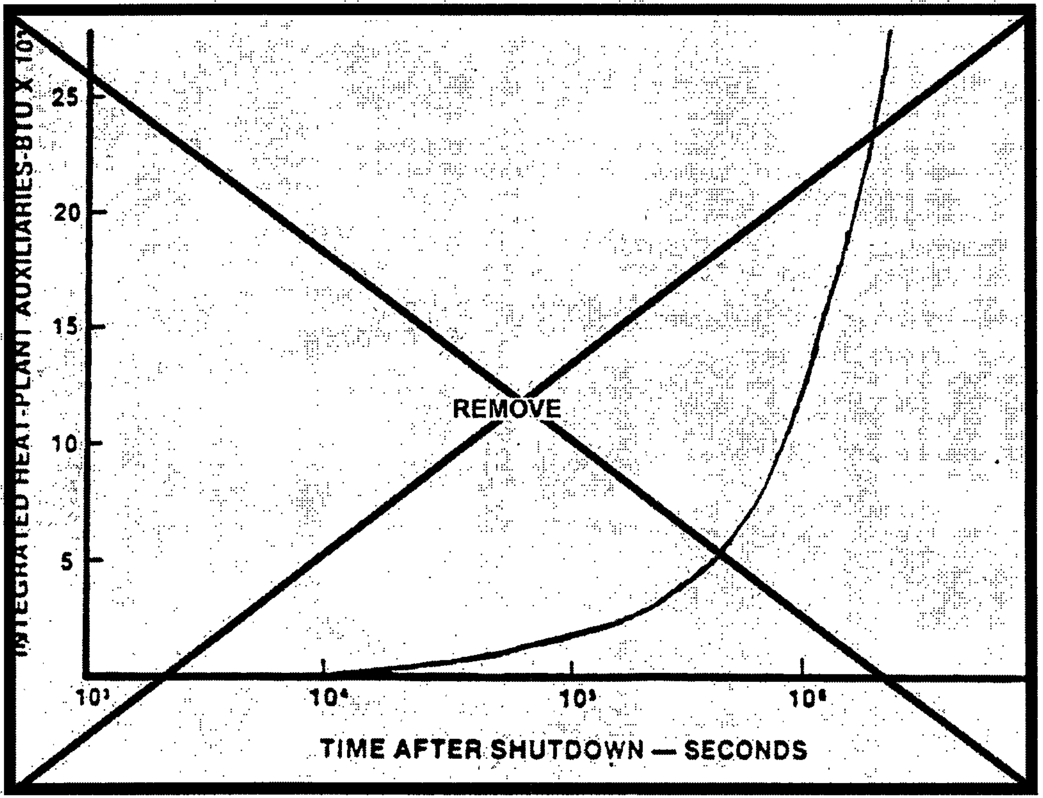
been deleted.
Refer to Table 9.2-5

Figure 9.2-16

TOTAL INTEGRATED RHR HEX
AND CONTAINMENT UNIT COOLER
HEAT INPUT TO SSW FOLLOWING LOCA

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

REVISION 14 SEPTEMBER 2001



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been deleted.
Refer to Table 9.2-7

FIGURE 9.2-17

PLANT AUXILIARIES HEAT INPUT TO
SSW FOLLOWING A LOCA

RIVER BEND STATION
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REVISION 15 MAY 2002