Progress Energy

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DEC 03 2008

Serial: HNP-08-118
10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT NO. 1
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING THE LICENSE AMENDMENT REQUEST TO REVISE TECHNICAL SPECIFICATION 3.7.5a, ULTIMATE HEAT SINK MAIN RESERVOIR MINIMUM LEVEL

Ladies and Gentlemen:

On September 15, 2008, the Harris Nuclear Plant (HNP) received a request for additional information from the NRC to facilitate the review of proposed request HNP-08-049, dated April 30, 2008, for a license amendment to the Technical Specifications of the Harris Nuclear Plant. The proposed amendment would lower the minimum allowed level of the Ultimate Heat Sink Main Reservoir during Modes 1-4.

Attachment 1 provides the requested additional information.

This letter provides additional information only, and no information in the original submittal is being revised. Therefore, the no significant hazards consideration provided in HNP's April 30, 2008, letter remains valid.

This document contains no new or revised Regulatory Commitments.

Please refer any question regarding this submittal to Mr. Dave Corlett at (919) 362-3137.

I declare under penalty of perjury that the foregoing is true and correct.
(Executed on DEC 03 2008).

Sincerely,

C L Burton

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A001
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Attachment: 1. Response to the Request for Additional Information Regarding the License Amendment Request to Revise Ultimate Heat Sink Main Reservoir Minimum Level

c:

Mr. K. J. Korth, Acting NRC Sr. Resident Inspector, HNP
Ms. B. O. Hall, Section Chief N.C. DENR
Ms. M. G. Vaaler, NRC Project Manager, HNP
Mr. L. A. Reyes, NRC Regional Administrator, Region II

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Request 1: Please expand the background section discussion on page three to include the historical events (i.e., past amendments and recommendations) leading to this amendment request. Please include details on the fan coolers and the impact they have on Emergency Service Water (ESW). In addition, please discuss the historical events of the Ultimate Heat Sink (UHS) from flood to drought and any constraints with modifications.

Please expand the background section discussion on page three to include the historical events (i.e., past amendments and recommendations) leading to this amendment request.

In 1996 Harris Nuclear Plant (HNP) submitted an Amendment to Technical Specification (TS) 3/4.7.5, Ultimate Heat Sink, to reduce the maximum allowable water temperature as measured at the respective intake structures from 95°F to 94°F and to increase the minimum main reservoir level from 205.7 FT mean sea level (MSL) to 215 FT MSL. These changes were based on calculations and analyses revised or created during review of Nuclear Regulatory Commission (NRC) Generic Letter (GL) 89-13 implementation and the Self-Service Water Operational Performance Inspection (SSWOPI) conducted by Carolina Power and Light (CP&L) and outside consultants at the HNP.

During late 1994 CP&L initiated two detailed reviews of the Emergency Service Water System (ESW) at HNP. The first review focused on the status of the NRC Generic Letter 89-13 program. Concurrent with that effort, a Self-Service Water System Operational Performance Inspection (SSWOPI) was conducted. The SSWOPI followed NRC Temporary Instruction 25151118, "Service Water System Operational Performance Inspection" and NRC Inspection Procedure 40501, "Licensee Self-Assessments Related to Area-of-Emphasis Inspections." During both of these reviews, issues were raised regarding the techniques and acceptance criteria used in the ESW flow balance procedure. Accordingly, CP&L performed an in-depth review of the Technical Specification requirements for UHS level and temperature.

During this review, a calculation was performed using a hydraulic model of the ESW to determine flow rates to safety-related heat exchangers cooled by the ESW. The calculation provided the minimum test flow requirement for each heat exchanger as a function of reservoir level which would ensure adequate heat removal. Required test flow was determined for a range of reservoir levels. Under worst case conditions, at a main reservoir level of 205.7 FT MSL and a maximum inlet temperature of 95°F (the plant equipment design limit), ESW System flow would be inadequate to ensure design required heat removal by safety-related heat exchangers. At that time, it was determined that a minimum main reservoir level of 215 FT would provide adequate heat removal under worst case conditions. As a result, the minimum main reservoir limit was increased in 1996 to 215 FT MSL, first administratively and then through License Amendment 80, in order to ensure sufficient flow to various ESW heat exchangers.

At the time the TS limit was officially changed to 215 FT MSL, it was recognized that future improvements to system performance would eliminate the need for such an increase. However, the change was made permanent in order to eliminate the need for future reanalysis of the ESW System to determine Operability. The level change was a conservative margin increase that, at the time, did not need to be undone.

In 2007, minimum level in the main reservoir approached 217 FT MSL. While this level was still above the TS limit of 215 FT MSL and did not immediately threaten the continued operation of the plant, it served as a warning that extended drought conditions could challenge the TS 3.7.5a main reservoir level limit. This prompted a desire to restore UHS main reservoir minimum allowed level to that approved by the NRC in the initial Safety Evaluation Report (SER) by accounting for ESW system performance improvements.

Please include details on the fan coolers and the impact they have on Emergency Service Water (ESW).

The Containment Cooling System (CCS), discussed in HNP Final Safety Analysis Report (FSAR) Section 6.2.2, maintains the containment and subcompartment atmospheres within required pressure and temperature limits during normal plant operation. This system recirculates air in the upper Containment through fan coolers which are located above the operating floor. The CCS and the containment ventilation system during normal plant operation are functionally capable of maintaining the pressure and temperature within the limits used for equipment design and assumed for Design Basis Accident (DBA) analyses. The CCS has the following functions:

1. In the event of a design basis accident containment fan coolers are designed to remove heat in the following manner:
    a. Four containment fan coolers will operate with one of the two fans in each cooler running at half speed (the other fans are idle). Heat removal capacity per containment fan cooler is stated in FSAR Table 6.2.2-1.
    b. In the case of single train failure, two containment fan coolers will operate with one of the two fans in each cooler running at half speed (the other fans are idle).
2. During normal operation, the CCS is designed to maintain the indicated containment temperature below 120°F.
3. Mixing the containment atmosphere following an accident.

The CCS consists of four safety related fan cooler units and three non-safety fan coil units. Following a DBA, only the safety related fan cooler units are required to operate. During normal power operation, safety related units operate in conjunction with the non-safety units to maintain required containment temperature. Each fan cooler is served by water from the Service Water System. Additional details are provided in HNP FSAR Table 6.2.1-6.

The safety related containment fan coolers are supplied by individual lines from the Reactor Auxiliary Building Service Water header. Each inlet line is provided with a motor-operated shutoff valve and a manual drain and vent valve. Similarly, each discharge line from the cooler is provided with a motor-operated shutoff valve. This allows each cooler to be isolated individually. The motor-operated valves on the fan cooler inlet and outlet lines are normally open and are remotely controlled from the Control Room with status indication provided at each control module.

Under accident conditions, two booster pumps (one on each of the supply lines to containment fan coolers) in conjunction with shut containment fan cooler orifice bypass valves, will maintain the service water pressure inside the coolers above the containment design pressure to prevent leaks into the Service Water System. The booster pumps are not required during normal plant operation.

The Containment Fan Coolers will attain full heat removal capability approximately 110 seconds following the LOCA coincident with loss of off-site power. The design ESW flow rate for each Containment Fan Cooler is 1300 gallons per minute (gpm). The total plant sensible heat, fission product decay heat, and heavy element decay heat rejected to the CCS System is described in more detail in HNP FSAR Section 6.2.1.3.

In addition, please discuss the historical events of the Ultimate Heat Sink (UHS) from flood to drought and any constraints with modifications.

Normal main reservoir lake level typically ranges from elevation 218 FT to 221 FT with elevation 220 FT considered normal lake level, as determined by the Main Dam spillway crest. After significant rainfall from severe storms and tropical hurricanes (Fran in 9/96 and Floyd in 9/99), main reservoir level has temporarily achieved an approximate elevation of 222 FT. In the summer of 2005 and 2007, much of the south-eastern U.S. was subject to extreme drought conditions. This resulted in significant drops in many lake levels. During 2007, minimum level in the main reservoir approached 217 FT MSL which is only 2 FT above the currently established TS limit of 215 FT MSL. Main reservoir level instruments provide for a continuous monitoring of main reservoir level and provide a low main reservoir level alarm to plant operators.

Special Inspections of the UHS (main and auxiliary reservoirs) are provided for in Section 7.5 of EPT-811, "HNP Dam, Dike, Retaining Wall Monitoring Procedure", with the following statement: "Special inspections should be performed immediately after the dam has passed unusually large floods and after the occurrence of significant earthquakes, hurricanes, tornadoes, intense local rainfalls, or other unusual events."

In addition to visual inspection of main and auxiliary reservoir structures, embankments and spillways, existing concrete bench markers, seepage monitors, and piezometers are used to monitor the dam's stability and integrity. A Water Control Structures inspection required by NRC Regulatory Guide 1.127 is conducted and documented every 5 years by an independent consultant. Recommendations and improvements that result from these required inspections are addressed and resolved by the site.

No significant modifications have been made to the HNP UHS structures and components. Periodic visual inspections and routine maintenance activities are conducted at these UHS structures within the bounds of the site preventative maintenance programs.

Request 2: Please expand the discussion of modifications and improvements (single versus two stage pumps) on page 5, paragraph 3. Provide a discussion of the uncertainty in the calculations that support the flow balance and available margin to operate at the original UHS level. In addition, please discuss the impacts on pump submergence, vortex, and cavitations at the lower UHS water level.

Please expand the discussion of modifications and improvements (single versus two stage pumps) on page 5, paragraph 3.

<u>ESW Pumps</u>

Prior to 1996, several operability evaluations were performed to prove operability of safety related heat exchangers with reduced emergency service water (ESW) flow. In order to increase ESW system flow margin, the original Hayward-Tyler ESW pump impellers and diffusers were replaced with a new design and with new stainless steel material (versus the original carbon steel). Each original Hayward-Tyler pump impeller and diffuser was replaced with an Ingersoll-Dresser (IDP) Model 35LKX-2 pump. This is a vertical turbine, mixed-flow pump with a closed impeller arrangement involving two stages with a single suction. The lower shaft, column, and enclosing tube were also modified by IDP to transition between the remaining Hayward-Tyler assembly and the new IDP pump.

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Each of the new IDP pumps is designed to deliver a nominal 20,000 gpm at 225 FT Total Developed Head (TDH). The original Hayward-Tyler pumps were designed to deliver a nominal 21,500 gpm at 190 FT TDH.

ESW Booster Pumps

The carbon steel casings of the ESW Booster Pumps are subject to a build-up of hard sediment and corrosion that can result in poor pump performance. To mitigate this problem, the pump casings have been internally coated with Service Level III, safety-related coatings to protect from further erosion and corrosion. Two Belzona products have been evaluated as acceptable and can be utilized for repairing and coating the ESW Booster Pumps. Belzona Ceramic R-Metal (1311), which is specifically designed for rebuilding metallic surfaces damaged by erosion/corrosion, or Belzona Supermetalglide (1341), which is designed to prevent erosion/corrosion by maintaining system fluid flow, may be applied as required to the interior surfaces of the ESW Booster Pumps. Both of these products have been utilized successfully at HNP in ESW component applications and have been found to remain tightly adhered to the applied substrate.

Surveillance test results indicate an approximate 10 to 20 percent increase in pump TDH as a result of the coatings applied in RFO-12 and RFO-13.

Increase in Bore Size for Containment Fan Cooler Orifices

During the early 1990's, ESW flow margin to the containment fan coolers was very small. With the establishment of an administrative limit of 215 FT on main reservoir Level, and prior to ESW Pump replacement, there was less than one percent margin between available flow and existing limits. In order to increase margin, the bore in the orifice plates located downstream of the containment fan coolers was increased in size from 4.680" to 5.000" in order to increase fan cooler flow by roughly ten percent. The orifice plates provide increased resistance during ESW Booster Pump operation which maintains ESW pressures inside containment higher than containment pressure during a loss-of-coolant accident (LOCA).

Provide a discussion of the uncertainty in the calculations that support the flow balance and available margin to operate at the original UHS level.

Available margin is based on the minimum required flow for a particular reservoir level. The minimum required flows for each ESW component are determined in calculation SW-0080 for various reservoir levels. In this calculation, the design-basis ESW flow rate (the flow rate required to remove the design-basis heat load) for each component is increased by four percent to account for the stated accuracy of the base hydraulic model before adjustments for reservoir level are made.

The four percent value originates from the base ESW hydraulic model developed in calculation SW-0051. The four percent value was based on the ability to calibrate the original model to both flows and pressures and is largely a function of the quality and amount of data available when SW-0051 was created. The SW-0080 model includes the four percent uncertainty from SW-0051; however, SW-0080, which concerns only flows and not pressures, is calibrated to match the current design-basis flow rates before adjustments for reservoir level are made. Increasing SW-0080 flow rates by four percent is conservative.

The limiting flow values from SW-0080 are used as input into calculation HNP-M/MECH-1011. Calculation HNP-M/MECH-1011 determines how much degradation each ESW Pump and ESW Booster Pump can stand before an ESW component flow limit is reached. Instrument uncertainty is considered in HNP-M/MECH-1011 that is in addition to the four percent uncertainty included in SW-0080. The available margin to operate at the original UHS level is detailed in *Request 4* of this submittal.

In addition, please discuss the impacts on pump submergence, vortex, and cavitations' at the lower UHS water level.

Calculation SW-0082 states that the ESW Pumps require a minimum submergence of 6 FT above the bottom of the bell. The bottom of the bell elevation is 191.7 FT, which corresponds to a minimum submergence water level elevation of 197.7 FT. This is well below the proposed main reservoir minimum level of 206 FT. It is also below the minimum post-accident main reservoir level of 203.6 FT as calculated in SW-0085 (the maximum evaporation case). Therefore, the 206 FT limit will have no adverse impact on ESW Pump performance.

Note that, according to drawing 1364-007370, this value for minimum submergence applies to a design capacity of 20,000 gpm. This capacity exceeds the total pump flow rates recorded during typical flow balances (EPT-250 and EPT-251).

The Cooling Tower Make-Up (CTMU) Pumps are not safety-related components. However, they do draw water from the main reservoir, so their minimum required submergence is considered.

According to specification CAR-SH-M-067P, the CTMU Pumps require 8.6 FT of submergence at a runout capacity of 33,800 gpm. According to drawing 1364-044820, the minimum submergence is 109 IN (9.1 FT) at runout capacity. Per the elevations shown on drawing 1364-044820, 109 IN of submergence (the larger of the two values) is equivalent to an elevation of 200.6 FT. This is well below the proposed main reservoir minimum level of 206 FT. It is also below the minimum post-accident main reservoir level of 203.6 FT as calculated in SW-0085 (the maximum evaporation case). Therefore, the 206 FT limit will have no adverse impact on CTMU Pump performance.

Request 3: In Table EPT-250 (A) table, there is 4% margin for the ESW system reported. It is also stated that calculation SW-0800 uses a 4% margin of error. Please clarify and address the difference between the reported margin and the calculated uncertainty.

The limits shown in tables EPT-250(A) and EPT-250(B) are based on calculation SW-0080. This calculation includes a four percent margin of error in all of its limits.

The margins shown in tables EPT-250(A) and EPT-250(B) represent the difference between recorded flow rates and the SW-0080 limits.

Thus, the 4.2 percent margin shown on the EPT-250(A) table for ESCW is over and above the SW-0080 flow limit and its four percent margin of error. This is true for all of the component margins and limits shown in the EPT-250(A) and EPT-250(B) tables.

Request 4: In table EPT-250 (A) and (B), no data on CSIP C pump and gear were reported. Please provide applicable data if CSIP C is credited for flow balance and discuss its function.

Charging Safety Injection Pump (CSIP) C is the “swing” pump. It may be powered by either A or B safety bus and may be placed in service if CSIP A or B is out of service for maintenance.

At the times the referenced EPT-250 and EPT-251 flow balance procedures were performed, on May 24, 2007, and October 13, 2007, CSIP C was not in service and flows to CSIP C were not recorded. A partial performance of EPT-251 was performed on August 24, 2006, in which CSIP C flows were recorded:

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EPT-250 (A)
Aux.
251.3
5/24/2007

	Recorded gpm	Limit gpm	Margin %
AH-2	1555	1446	7.5
AH-3	1670	1446	15.5
ESCW	2450	2351	4.2
CCW	11180	10373	7.8
EDG	1039	934	11.2
CSIP A Pump	19.2	15	25.9
CSIP A Gear	20.7	8	151.6
CSIP B Pump	-	-	-
CSIP B Gear	-	-	-
CSIP C Pump	-	-	-
CSIP C Gear	-	-	-
Sum	17934	16574	8.2

EPT-251 (B)
Main
217.3
10/13/2007

	Recorded gpm	Limit gpm	Margin %
AH-4	1596	1368	16.6
AH-1	1495	1368	9.3
ESCW	2488	2126	17.0
CCW	10580	9381	12.8
EDG	938	851	10.3
CSIP A Pump	-	-	-
CSIP A Gear	-	-	-
CSIP B Pump	22.06	14	59.9
CSIP B Gear	18.65	7	150.5
CSIP C Pump*	20.7	15	41.9
CSIP C Gear*	17.2	8	119.2
Sum	17138	15116	13.4

* Partial EPT-251 performed on 8/24/06.

Flows to CSIP C are similar in magnitude to CSIP A and B. The CSIPs are not limiting components in terms of ESW system degradation due to the very large flow margins available to the CSIPs.

Request 5: On page 8, paragraph 1, it is stated that throttling of the system provides extra conservatism in the calculation. Please clarify this statement and provide a discussion to support this assertion.

As pump performance degrades over time, the effects could be mitigated to some degree by rebalancing the system. That is, components with little margin could be throttled less (assuming they are throttled). Flow to low-margin components could also be increased by decreasing flow to components with more margin. This ability to redistribute flow within the system is not accounted for in the evaluation due to the difficulties in quantifying such action. Currently, flow to most ESW components (including Component Cooling Water, Essential Services Chilled Water, and the Containment Fan Coolers) is throttled to some degree as recorded in the Service Water System Valve Lineup Checklist.

Request 6: On page 8, section 4.2, paragraph 1, it is stated that the ESW system prevents unmonitored outleakage via the ESW piping at the maximum expected post-accident containment pressure. Please clarify this statement and provide a discussion to support this assertion.

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Under accident conditions two booster pumps, one on each of the supply lines to the containment fan coolers, in conjunction with containment fan cooler orifice bypass valves being shut will maintain the service water pressure inside the coolers above the containment design pressure to prevent leaks into the Service Water System. The booster pumps are not required during normal plant operation. By maintaining ESW system pressure greater than containment design pressure, no unmonitored release path or leak will exist into the ESW system from containment.

Request 7: On page 8, section 4.2, paragraph 3, it is stated that "the results also show that ESW pressure, not flow, currently defines the available ESW system margin." Please clarify and provide the results and the available margin obtained using calculation HNP-M/MECH-1011, and discuss these results in further detail.

As ESW Pump and ESW Booster Pump performance degrades over time, flows and pressures will fall. At some point, one of two things will happen first:

- Flow to a heat exchanger will reach its minimum value, or
- Minimum pressure in the containment fan cooler piping will equal the maximum post-accident containment pressure.

If a flow limit is reached first, then flow defines the available ESW system margin. If the pressure limit is reached first, then pressure defines the margin.

Calculation HNP-M/MECH-1011 considers how much margin is available for ESW Pump and ESW Booster Pump performance degradation based on flow and pressure. The following summary table is taken from the calculation:

A TRAIN	Pump	Degradation	By	Basis
	A Main	18%	head	flow limits
	A Main	**11%**	**head**	**CFC press limits**
	A Booster	38%	head	flow limits
	A Booster	44%	flow	flow limits
	A Booster	15%	head	CFC press limits
	A Booster	**22%**	**flow**	**CFC press limits**
B Train	Pump	Degradation	By	Basis
	B Main	25%	head	flow limits
	B Main	**16%**	**head**	**CFC press limits**
	B Booster	40%	head	flow limits
	B Booster	54%	flow	flow limits
	B Booster	18%	head	CFC press limits
	B Booster	**33%**	**flow**	**CFC press limits**

The cases with the least amount of margin are all related to maintaining fan cooler pressure above containment pressure. Therefore, ESW pressure defines the available ESW system margin.

Note that HNP-M/MECH-1011 considers two possible means of pump degradation: Degradation by TDH (i.e., "by head") and degradation by flow. Degradation by TDH represents the effects of wear ring erosion while degradation by flow represents the effects of impeller erosion. Therefore, the percentage values shown in the table are either "by head" or "by flow", depending on the mechanism. HNP-M/MECH-1011 only considers degradation by head for the ESW Pumps. This is based on past experience with a wear ring failure in the B ESW Pump which demonstrated that this type of failure in this mixed-flow pump results in degradation by TDH.

Request 8: On page 9, paragraph 2, the application states that there is a 3 psi pressure drop from the 220 ft to the 206 ft elevation inside containment. Please expand the discussion with regard to remaining pressure specific drops and available margin.

This portion of the LAR focuses on calculation SW-0086. Calculation SW-0086 considers the ESW pressures inside containment following the single failure of either a booster pump or a containment fan cooler orifice bypass valve, or both. The minimum calculated pressure for the worst-case failure scenario based on a minimum main reservoir level of 215 FT is 17 PSIG. EOP-FRP-J.1, "Response to High Containment Pressure", will isolate the containment fan coolers if containment pressure exceeds 10 PSIG and the booster pumps are not running. Therefore, there is a 7 PSIG margin before the procedure would require revision.

In order to assess the impact of a 10 FT drop in reservoir level on SW-0086, the results of calculation HNP-M/MECH-1011 are referenced. In HNP-M/MECH-1011, it is seen that a 14 FT drop in reservoir level, by itself (i.e., all other factors unchanged), will result in no more than a 3 PSIG drop in ESW pressure at the containment fan coolers. The 14 FT drop from HNP-M/MECH-1011 bounds the proposed 10 FT decrease in Tech Spec 3.7.5.a.

Since the resultant 3 PSIG drop is less than the difference between the current SW-0086 calculated pressure (17 PSIG) and the pressure used in EOP-FRP-J.1 (10 PSIG), the procedure will remain unaffected and the calculation does not need to be revised immediately to support the license amendment. The calculation SW-0086 will still be revised at a later date per EC 69450 to document the decrease in margin.

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Request 9: On page 12, section 4.3, it is stated that the ESW supply temperature must remain below 95°F. However, in the revised technical specification 3.7.5 (b), it states that water temperature at the respective intake structure is less than 94°F. Please explain the temperature discrepancy.

This is not a discrepancy. In order for the various heat exchangers served by the ESW system to be able to remove their design-basis heat loads, ESW inlet temperature must remain at or below the maximum assumed value of 95 °F. The 94 °F limit in Technical Specification 3.7.5.b provides assurance that the main reservoir supply temperature will not rise above 95 °F immediately following an accident due to heat input from the plant and considering worst-case environmental conditions.

Calculation SW-0085 determines main and auxiliary reservoir temperatures and levels over various durations under worst-case environmental and plant heat load conditions. It includes an evaluation for an initial reservoir temperature of 94 °F. The calculation concludes that ESW supply temperature is expected to remain below 95 °F for all cases. This conclusion is based on an initial main reservoir level of 205.7 FT for all cases.

Request 10: Please discuss the impacts of a requested lower minimum UHS level available for cooling of ESW and other plant components that may be relied upon to satisfy the mitigation strategies required by Section B.5.b of Commission order EA-02-026.

This change has no impact on any B.5.b recovery strategies. The water source used for B.5.b scenarios is the auxiliary reservoir. Revising the main reservoir minimum level will have no impact on any B.5.b recovery strategy.