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SUBJECT: Forwards listed info in response to GL 97-04, "Assurance of Sufficient NPSH for ECC & Containment Heat Removal Pumps."

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CP&L

Carolina Power & Light Company
PO Box 165
New Hill NC 27562

William R. Robinson
Vice President
Harris Nuclear Plant

FEB -2 1998

SERIAL: HNP-98-007
10 CFR 50.54(f)

United States Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
90-DAY RESPONSE TO NRC GENERIC LETTER 97-04, "ASSURANCE OF SUFFICIENT NET POSITIVE SUCTION HEAD FOR EMERGENCY CORE COOLING AND CONTAINMENT HEAT REMOVAL PUMPS"

Dear Sir or Madam:

Carolina Power & Light Company (CP&L) hereby responds to NRC Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps," for the Harris Nuclear Plant (HNP).

Generic Letter 97-04, dated October 7, 1997, requested each licensee to provide a written report within 90 days of the date of the Generic Letter that includes the following information for its facility:

1. Specify the general methodology used to calculate the head loss associated with the Emergency Core Cooling System (ECCS) suction strainers.
2. Identify the required Net Positive Suction Head (NPSH) and the available NPSH.
3. Specify whether the current design-basis NPSH analysis differs from the most recent analysis reviewed and approved by the NRC for which a safety evaluation was issued.
4. Specify whether containment overpressure (i.e., containment pressure above the vapor pressure of the sump or suppression pool fluid) was credited in the calculation of available NPSH. Specify the amount of overpressure needed and the minimum overpressure available.
5. When containment overpressure is credited in the calculation of available NPSH, confirm that an appropriate containment pressure analysis was done to establish the minimum containment pressure.

By letter dated November 5, 1997 (SERIAL: HNP-97-199), CP&L committed to providing the requested information on or before February 4, 1998. A written report providing the requested information for HNP is provided in the attachment to this letter.

Please refer any questions regarding this submittal to Mr. J. H. Eads at (919) 362-2646.

Sincerely,

W R Robinson

AEC/aec

Attachment

W. R. Robinson, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge and belief; and the sources of his information are employees, contractors, and agents of Carolina Power & Light Company.

Darlene S. Yarborough
Notary (Seal)

My commission expires: 2-6-2000

DARLENE S. YARBOROUGH NOTARY *** PUBLIC HARNETT COUNTY, NC

c: Mr. J. B. Brady (NRC Senior Resident Inspector)
Mr. L. A. Reyes (NRC Regional Administrator, Region II)
Mr. S. C. Flanders (NRR Project Manager, HNP)

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DOCKET NO. 50-400/LICENSE NO. NPF-63
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4. Specify whether containment overpressure (i.e., containment pressure above the vapor pressure of the sump or suppression pool fluid) was credited in the calculation of available NPSH. Specify the amount of overpressure needed and the minimum overpressure available.
5. When containment overpressure is credited in the calculation of available NPSH, confirm that an appropriate containment pressure analysis was done to establish the minimum containment pressure.

For the Harris Nuclear Plant (HNP), Carolina Power & Light Company (CP&L) provides the requested information as follows:

Requested Information Item 1:

Specify the general methodology used to calculate the head loss associated with the ECCS suction strainers.

Response:

The containment sumps are the suction sources during the recirculation phase for the Residual Heat Removal (RHR) and Containment Spray (CT) pumps. With suction from the containment sumps, the NPSH calculations for CT and RHR pumps are comprised of the static head of the fluid minus the line losses. The line losses are calculated using the loss coefficients for the suction piping. Containment overpressure is not credited in these calculations; however, credit is taken for the pressure necessary to maintain the fluid in its liquid phase (i.e., liquid vapor pressure).

The NPSH calculation for the High Head Safety Injection (SI) pumps is based on suction from the Refueling Water Storage Tank (RWST). The NPSH is more limiting for suction from the RWST than for suction from the RHR pump with the containment sump as its suction source. The RHR discharge pressure/head provides higher suction head to the SI pumps than the RWST, thereby increasing NPSH available to the SI pumps.

Each sump is configured with a coarse outer screen and a fine inner screen. No other strainers exist on the suction piping to the RHR and CT pumps. To assure acceptable sump performance, a hydraulic model (about 1:3 scale) of one of the recirculation sumps was constructed and tested. Initial tests indicated air core vortices could form. Therefore, vortex suppression devices were added to the sump design during the construction phase of the plant. The sump design with the vortex suppresser installed was found to have acceptable hydraulic performance. The measured inlet loss coefficient for the clean screen losses, vortex suppression device, an elbow downstream of the inlet, and the suction piping was 0.69 and 0.54 for the RHR and CT suction lines, respectively. Additionally, as required by Regulatory Guide 1.82, the fluid velocity at the sump screen was calculated to ensure that the fluid velocity was not greater than 0.2 ft/sec with one half of the vertical screen area assumed to be blocked. This criteria ensures potential loss of coolant accident (LOCA) debris is not transported to the sumps and onto the screens. The calculation concluded that the fluid flow velocity through the screens is 0.13 ft/sec. With this low fluid velocity, the losses through the assumed half-blocked screens are negligible. The calculation concluded that potential debris would not be transported to the sumps. Therefore, sump screen blockage is not expected.

The current design-basis NPSH calculation for the RHR pumps uses loss coefficients for the sump outlet, the elbow downstream of the inlet, and the suction piping of 0.5, 0.175, and 0.743, respectively, for a combined loss coefficient of 1.418. Based on the sump model and the fluid velocity calculation described above, the RHR NPSH calculation does not assign a loss coefficient for the screens. The combined loss coefficient in the RHR NPSH calculation (1.418) is conservative when compared to the hydraulic model loss coefficient (0.69). Similarly, the current design-basis NPSH calculation for the CT pumps uses loss coefficients of 0.5, 0.1 and 0.56, for a combined loss coefficient of 1.16. The CT NPSH calculation also does not assign a loss coefficient for the screens, based on the sump model and the fluid velocity calculation. The combined loss coefficient in the CT NPSH calculation (1.16) is conservative when compared to the hydraulic model loss coefficient (0.54).

Requested Information Item 2:

Identify the required NPSH and the available NPSH.

Response:

The required and available NPSH values are shown in Table 1. The required NPSH is based on the vendor certified pump curves. The available NPSH is based on the referenced calculations with suction from the containment sumps unless noted.

Table 1: HNP Current Design-Basis NPSH Values

HNP Current Design-Basis			
System	Required NPSH	Available NPSH	Reference Documents
Residual Heat Removal (RHR)	19' @ 4500 gpm	22.2' @ 4500 gpm	Calculation SI-0043 and ESR 95-00344
Containment Spray (CT)	12' @ 2110 gpm	27.23' @ 2110 gpm	Calculation CT-0026
High Head Safety Injection (SI)	28' @ 710 gpm	42' @ 710 gpm	Calculation SI-0049

Residual Heat Removal (RHR): The current HNP engineering analysis revised the required RHR NPSH from 18' to 19' and the available RHR NPSH from 20' to 22.2' based on the referenced design documents. As discussed in the response to requested information item 3, an FSAR change has been approved to make this change to Table 6.3.2-1 in the next FSAR Amendment (Amendment 49). An additional value of required RHR NPSH of 16' @ 3750 gpm is provided in FSAR Table 5.4.7-2.

Containment Spray (CT): No reliance is placed on containment overpressure (i.e., containment pressure above the vapor pressure of the sump fluid) for meeting the NPSH requirements. A "clarification" statement in FSAR Section 1.8, conformance to NRC Regulatory Guide 1.1, states "The temperature and pressure used for calculating NPSH for the containment spray pumps were (1) saturation temperature corresponding to the predicted containment pressure, and (2) the expected post-LOCA pressure." This "clarification" statement is potentially misleading. FSAR Section 6.2.2.3.2.1 accurately describes how the containment spray NPSH is calculated. It states, "No reliance is placed on the containment pressure for meeting the NPSH requirements for the containment spray pumps (however, credit is taken for the pressure necessary to maintain the fluid in its liquid phase, i.e., liquid vapor pressure)." A change will be made during the next routine FSAR update to revise the misleading "clarification" statement in FSAR Section 1.8.

High Head Safety Injection (SI): The available NPSH value listed in Table 1 for the SI pumps is based on suction from the Refueling Water Storage Tank (RWST). The NPSH is more limiting for suction from the RWST than for suction from the RHR pump with the containment sump as its suction source. The RHR discharge pressure/head provides higher suction head to the SI pumps than the RWST, thereby increasing NPSH available to the SI pumps.

Requested Information Item 3:

Specify whether the current design-basis NPSH analysis differs from the most recent analysis reviewed and approved by the NRC for which a safety evaluation was issued.

Response:

The current design-basis NPSH analysis for the RHR pumps differs from the most recent analysis reviewed and approved by the NRC. The current design-basis NPSH analysis for the CT pumps is the same as the analysis most recently reviewed and approved NRC. Documentation does not indicate that the NRC reviewed and approved specific NPSH values for the SI pumps. The comparison of the HNP current design-basis NPSH values to the most recent values reviewed and approved by the NRC for which a safety evaluation was issued is shown in Table 2.

Table 2: HNP Current Design-Basis NPSH Values vs. NRC Reviewed/Approved NPSH Values

	HNP Current Design-Basis		NRC Reviewed/Approved	
System	Required NPSH	Available NPSH	Required NPSH	Available NPSH
RHR	19' @ 4500 gpm	22.2' @ 4500 gpm	18' @ 4500 gpm	20' @ 4500 gpm
CT	12' @ 2110 gpm	27.23' @ 2110 gpm	12' @ 2110 gpm	27.23' @ 2110 gpm
SI	28' @ 710 gpm	42' @ 710 gpm	Not Specified	Not Specified

Residual Heat Removal (RHR): The NRC reviewed/approved values shown in Table 2 for the RHR pumps are those specified in HNP FSAR Table 6.3.2-1 from the initial FSAR up through the most recently submitted FSAR Amendment (Amendment 48). As noted in the response to requested information item 2, Amendment 49 of the FSAR revises the required RHR NPSH to 19' and the available RHR NPSH to 22.2'. These changes are not due to a change in the methodology for calculating NPSH values. Rather, an evaluation of the issues presented in Generic Letter 97-04 determined that the required NPSH value of 18' was non-conservative. The FSAR value of required NPSH is being changed to 19' based on the most conservative RHR pump curve. Until January 1997, HNP did not have a calculation for available RHR NPSH. Design-basis information indicated only in general terms that adequate NPSH margin existed. The previous FSAR value of 20' available NPSH was a conservative value used to indicate adequate NPSH margin. In response to NRC Information Notice 96-55, "Inadequate Net Positive Suction Head of Emergency Core Cooling and Containment Heat Removal Pumps Under Design Basis Accident Conditions" (dated October 22, 1996), CP&L performed a calculation, which provides the HNP current design-basis value of 22.2' available NPSH.

The NRC safety evaluation documented in NUREG-1038, Supplement 3, "Safety Evaluation Report Related to the Operation of Shearon Harris Nuclear Power Plant, Unit No. 1," dated May 1986, includes the NRC determination that the HNP NPSH margin and containment sump design are acceptable. This determination referenced CP&L letter NLS-85-384, "Containment Recirculation Sump Evaluation Report" dated October 25, 1985. In that letter, CP&L provided the required RHR NPSH as 17' @ 3891 gpm, and the available RHR NPSH as 26.16' @ 2.96' minimum containment water level above containment floor elevation 221'. The 3891 gpm flow

rate was considered to be representative of the expected RHR flow; however, the design rated flow rate for the RHR pumps is 4500 gpm. Using 4500 gpm in the NPSH analysis gives the most limiting value of NPSH margin. Therefore, 4500 gpm is used in the current design-basis NPSH analysis.

Containment Spray (CT): The NRC reviewed/approved values shown in Table 2 for the CT pumps are those specified in HNP FSAR Table 6.2.2-8 from FSAR Amendment 27 through the most recently submitted FSAR Amendment (Amendment 48). Amendment 27 of the FSAR reflected the NPSH analysis for the CT pumps provided in CP&L letter NLS-85-384, dated October 25, 1985.

High Head Safety Injection (SI): Documentation does not indicate that the NRC reviewed and approved specific values for required and available NPSH for the SI pumps. However, the NRC safety evaluation documented in NUREG-1038, dated November 1983, states that the available NPSH for the centrifugal charging pumps has been shown to provide adequate margin by calculations performed to meet the safety intent of Regulatory Guide 1.1, "Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal System Pumps." This conclusion was based on information provided in CP&L letter dated August 2, 1982, which responded to NRC Safety Review Question 440.40 by providing the general description of the analysis method and associated pump curves for the centrifugal charging pumps.

Requested Information Item 4:

Specify whether containment overpressure (i.e., containment pressure above the vapor pressure of the sump or suppression pool fluid) was credited in the calculation of available NPSH. Specify the amount of overpressure needed and the minimum overpressure available.

Response:

As noted in the response to requested information item 1, containment overpressure is not credited in the calculation of NPSH available for either the Residual Heat Removal, Containment Spray, or High Head Safety Injection pumps.

Requested Information Item 5:

When containment overpressure is credited in the calculation of available NPSH, confirm that an appropriate containment pressure analysis was done to establish the minimum containment pressure.

Response:

As noted in the response to requested information item 1, containment overpressure is not credited in the calculation of NPSH available for either the Residual Heat Removal, Containment Spray, or High Head Safety Injection pumps.