Nebraska Public Power District
Nebraska's Energy Leader

NLS980149
September 22, 1998

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

Subject: Response to NRC Generic Letter 97-04
Request for Additional Information
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

Reference:
1. NRC Generic Letter 97-04 dated October 7, 1997, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps"
2. Letter to G. R. Horn from NRC dated August 14, 1998, " Request for Additional Information Related to Generic Letter 97-04"
3. Letter NLS970226 to USNRC from G. R. Horn (NPPD) dated January 5, 1998, "Response to NRC Generic Letter 97-04"

On October 7, 1997, the Nuclear Regulatory Commission (NRC) issued Generic Letter 97-04 (Reference 1) regarding an issue which may have generic implications for Emergency Core Cooling System (ECCS) and containment heat removal system pumps. The Nebraska Public Power District (District) provided a response to the Generic Letter 97-04 in Reference 3 which described the methods used to determine available Net Positive Suction Head (NPSH) for the Emergency Core Cooling System (ECCS) pumps and the results of these analyses. In Reference 2 the NRC indicated that there was a concern with the District's response in that more containment overpressure is required to assure adequate NPSH than in the original analysis during plant initial licensing. The NRC indicated that this may have placed the Cooper Nuclear Station (CNS) outside of its licensing basis with respect to the issue of NPSH to the ECCS pumps.

The response to the Request for Additional Information (RAI) on this issue is detailed in the Attachment to this letter. The conclusion of this Attachment is that CNS is operating within its licensing basis related to the issue of NPSH for the ECCS pumps. In summary, this conclusion is based on the Atomic Energy Commission (AEC) Safety Evaluation Report (SER) which noted that the CNS design did not fully comply with the requirements of Safety Guide No.1 but had

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A076

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adequate margins based on a conservative containment overpressure analysis. As described in the Attachment, the AEC SER did not discuss actual values for containment overpressure credit for ECCS NPSH but only discussed available margins.

Although not directly related to the issues discussed in this response, there are other investigations presently being conducted which could potentially affect available ECCS NPSH:

1) Design basis debris loading calculations are being finalized to incorporate the guidance provided in the Safety Evaluation Report (SER) recently issued by the NRC on the Utility Resolution Guidance (URG) document developed by the Boiling Water Reactor Owners Group (BWROG) in response to the Inspection and Enforcement Bulletin (IEB) 96-03. These debris loadings will have an effect on the available NPSH for the ECCS pumps and may affect the margins discussed above.

2) Another concern which could affect the required NPSH for the ECCS pumps is the recently identified higher ECCS pump flow during the first ten minutes of the postulated accident. This potential concern has been discussed with the resident Inspectors and the NRC Project Manager. The District will inform the NRC if any of these issues involve a potential Unreviewed Safety Question (USQ).

Should you have any questions concerning this matter, please contact me.

Sincerely,

M. F. Peckham
Acting Vice President of Nuclear Energy

/dm
Attachment

cc: Regional Administrator w/enclosures
USNRC - Region IV

Senior Project Manager w/enclosures
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector w/enclosures
USNRC

NPG Distribution w/o enclosures

STATE OF NEBRASKA)
)
NEMAHA COUNTY)

M. F. Peckham, being first duly sworn, deposes and says that he is an authorized representative of the Nebraska Public Power District, a public corporation and political subdivision of the State of Nebraska; that he is duly authorized to submit this correspondence on behalf of Nebraska Public Power District; and that the statements contained herein are true to the best of his knowledge and belief.

M F Peckham

M. F. Peckham

Subscribed in my presence and sworn to before me this 22nd day of September, 1998.

GENERAL NOTARY-State of Nebraska
LUANN BRAY
My Comm. Exp. May 11, 2002

LuAnn Bray

NOTARY PUBLIC

Response to RAI Concerning
NRC Generic Letter 97-04
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

On October 7, 1997, the Nuclear Regulatory Commission (NRC) issued Generic Letter 97-04 regarding an issue which may have generic implications for Emergency Core Cooling System (ECCS) and containment heat removal system pumps. The following information is provided for Cooper Nuclear Station (CNS) in response to the Request for Additional Information on the subject of GL 97-04.

The following response is in the same format as the original response to identify those areas where more information is required to address the NRC concern related to the NPSH design basis.

Item 1 - Specify the general methodology used to calculate the head loss associated with the ECCS suction stainers.

Response:

The response to this question is the same as the original response, shown in Attachment 2 for convenience.

Item 2 - Identify the required net positive suction head ($NPSH_r$) and the net positive suction head available ($NPSH_a$).

Response:

The response to this question is the same as the original response, shown in Attachment 2 for convenience.

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 original response to this item stated that there was no design basis NPSH provided to the NRC for which a safety evaluation was issued. Further investigation revealed that the original Atomic Energy Commission (AEC) Safety Evaluation Report (SER), issued on February 14, 1973, did discuss the issue of conformance with Safety Guide No. 1 for ECCS pump NPSH. The AEC staff identified that, although the design did not fully meet the requirements of Safety Guide

No. 1, CNS could take credit for containment overpressure due to the conservative assumptions used in the calculation of containment overpressure. Thus, the CNS design basis allows for a credit from containment overpressure to determine that there is sufficient ECCS pump NPSH in a post accident condition. The AEC staff did note that an additional margin was provided by the difference of 3 psi between the minimum containment pressure and the pressure required for minimum NPSH for the Residual Heat Removal (RHR) pumps and a similar margin of 6 psi for the Core Spray (CS) pumps. Note that the AEC SER did not discuss the actual values required from the containment overpressure to assure adequate ECCS NPSH in a post LOCA event. Although the revised ECCS NPSH analysis indicates that additional containment overpressure credit is required to assure adequate ECCS NPSH, CNS is within its licensing basis provided that the margins are maintained.

The current ECCS pump NPSH design basis calculation, discussed in the initial response under Item 3.3, does, in conformance with the CNS design basis, take credit for containment overpressure. This calculation used the same type of conservative assumptions used in the original containment overpressure analysis with some exceptions. For example, the maximum Service Water (SW) temperature used in this calculation, was the 90°F value, presently specified in the recently implemented Improved Technical Specifications (ITS) versus the 85°F value used in the original calculation. Attachment 3 shows the list of assumptions used in the original calculation (Response to FSAR Question No.6.4) and the assumptions used in the current calculation (USAR pages VI-5-16 and VII-5-17).

Due to these differences, the maximum suppression pool temperature, post accident, was 196°F versus the 192°F in the original calculation referred to in the AEC SER. This increase in suppression pool temperature increases the contribution required from containment overpressure to assure adequate ECCS pump NPSH. However, the calculated minimum containment pressure also increased, but at a slightly greater rate. Thus the net result was that, at a minimum, the margin, of 3 psi for the RHR pumps and 6 psi for the CS pumps, was maintained. This assures that the CNS design basis is maintained and the margin is not decreased so that this change was not an Unreviewed Safety Question (USQ).

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:

The response to this item is unchanged except that there was a typo in one of the tables, the correct CS pump required overpressure is shown below in bold. The results below also indicate that the 3 and 6 psi margins are maintained in the current NPSH calculation.

SUPPRESSION POOL TEMPERATURE (degrees F)	CS PUMP REQUIRED OVERPRESSURE (psi)	RHR PUMP REQUIRED OVERPRESSURE (psi)	OVERPRESSURE AVAILABLE (psi)
95	0.00	0.00	0.00
152.3	0.00	0.00	6.34
175.4	0.00	0.14	4.80
190.7	0.01	2.79	6.99
195.9	**1.11**	3.89	7.77

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:

The response to this question is the same as the original response, shown in Attachment 2 for convenience..

ATTACHMENT 2
PAGE 1 of 13

Nebraska Public Power District

COOPER NUCLEAR STATION
P.O. BOX 98, BROWNVILLE, NEBRASKA 68321
TELEPHONE (402)825-3811
FAX (402)825-5211

NLS970226
January 5, 1998

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

Subject: Response to NRC Generic Letter 97-04
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

Reference:
1. NRC Generic Letter 97-04 dated October 7, 1997, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps"
2. Letter NLS970192 to USNRC from G. R. Horn (NPPD) dated November 4, 1997, "Response to NRC Generic Letter 97-04"

On October 7, 1997, the Nuclear Regulatory Commission (NRC) issued Generic Letter 97-04 (Reference 1) regarding an issue which may have generic implications for Emergency Core Cooling System (ECCS) and containment heat removal system pumps. The generic letter required, within 90 days, that licensees provide the information outlined below:

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

ATTACHMENT 2
PAGE 2 OF 13

By this letter, as committed to in Reference 2, the Nebraska Public Power District (District) is providing the required 90-day response.

Should you have any questions concerning this matter, please contact me.

Sincerely,

G. R. Horn
Senior Vice President, Energy Supply

/crm
Attachment

cc: Regional Administrator
USNRC - Region IV

Senior Project Manager
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector
USNRC

NPG Distribution

ATTACHMENT 3
PAGE 3 OF 13

STATE OF NEBRASKA)
)
NEMAHA COUNTY)

G. R. Horn, being first duly sworn, deposes and says that he is an authorized representative of the Nebraska Public Power District, a public corporation and political subdivision of the State of Nebraska; that he is duly authorized to submit this correspondence on behalf of Nebraska Public Power District; and that the statements contained herein are true to the best of his knowledge and belief.

G. R. Horn

Subscribed in my presence and sworn to before me this 5 day of January, 1998.

NOTARY PUBLIC

GENERAL NOTARY-State of Nebraska
CHERYL A. RAKES
My Comm. Exp. Nov. 18, 2000

Response to NRC Generic Letter 97-04
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

On October 7, 1997, the Nuclear Regulatory Commission (NRC) issued Generic Letter 97-04 regarding an issue which may have generic implications for Emergency Core Cooling System (ECCS) and containment heat removal system pumps. The following information is provided for Cooper Nuclear Station (CNS) in response to the generic letter.

Note that the information provided encompasses the Residual Heat Removal (RHR) and Core Spray (CS) pumps, and excludes the High Pressure Coolant Injection (HPCI) pump. While the HPCI pump can take suction from the suppression pool, the normal suction is from the Emergency Condensate Storage Tanks. In addition, during a Design Basis Accident-Loss of Coolant Accident (DBA-LOCA), the HPCI system will isolate due to low steam line pressure at less than or equal to 60 seconds into the event, which is well before the suppression pool temperatures begin to show a significant increase.

Item 1 - Specify the general methodology used to calculate the head loss associated with the ECCS suction stainers.

Response:

The head losses associated with the ECCS suction strainers are included in the cumulative head losses for the overall ECCS suction strainer/suction piping configuration. These cumulative values were developed through analysis using plant startup data collected at each ECCS pump inlet under two different test flow configurations with half of the suction strainers hooded to simulate partially blocked strainers. These flow configurations were:

- ECCS Design Flow (7700 gallons per minute (gpm) for the RHR pumps and 4720 gpm for the CS pumps).
- ECCS Recirculation Flow (2500 gpm for RHR and 1200 gpm for CS).

The relationship between the cumulative head losses and net positive suction head (NPSH) is described below.

The basic equation for calculating NPSH is:

$$NPSH = h_a - h_{vpa} + h_{st} - h_{fs}$$

Where:

h_a	=	Absolute pressure on the surface of the liquid supply level
h_{vpa}	=	Head corresponding to the vapor pressure of the liquid at the temperature being pumped
h_{st}	=	Static height that the liquid supply level is above or below the pump centerline or impeller eye
h_{fs}	=	Suction line losses including entrance losses and friction losses

Additional detail on each of the terms is provided below.

h_a = Absolute pressure on the surface of the liquid supply level

This term is based on values of suppression pool pressures and temperatures obtained from computer analyses of containment response during a DBA-LOCA event [1]. Absolute pressures are subsequently converted to head based on the following equation:

$h_a = 144 \times P_{sp} \times V_f$

Where:

144	=	Conversion factor from square inches to square feet
P_{sp}	=	Suppression pool pressure (psia)
V_f	=	Specific volume for water at the suppression pool bulk temperature (ft^3/lb)

Also see the response to Item 4 for a discussion on the crediting of containment pressure in the NPSH analysis for CNS.

h_{vpa} = Head corresponding to the vapor pressure of the liquid at the temperature being pumped

This term is obtained from the Steam Tables based on the temperature of the fluid being pumped and assumes the maximum bulk fluid temperature predicted using the DBA-LOCA containment analyses described above. Absolute pressures are converted to head in the same fashion used for h_a.

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1 General Electric Report GENE-637-045-1293 dated January 1994, "Containment Analyses in Support of an Increase in the RHRS Heat Exchanger Tube Plugging Margin for Cooper Nuclear Station"

h_{st} = Static height that the liquid supply level is above or below the pump centerline or impeller eye

This term is simply the minimum static height of fluid above the pump reference point (typically pump centerline or impeller eye). This is based upon the minimum suppression pool water volume allowed by Technical Specifications 3.7.A.1.a.

h_{fs} = Suction line losses including entrance losses and friction losses

For CNS, this term has been determined analytically using plant startup data taken at each ECCS pump inlet.

Item 2 - Identify the required net positive suction head ($NPSH_r$) and the net positive suction head available ($NPSH_a$).

Response:

The available NPSH is dependent on the wetwell pressure, the number of pumps operating, the piping configuration, and the suppression pool bulk fluid temperature at the most limiting condition. Pressures above atmospheric are credited. The required NPSH is based on criteria specified by the pump manufacturer. In general, values for required Containment Pressure (P_r) and $NPSH_a$ are calculated using the following equations:

$$NPSH_r = 144 \times (P_r - P_v) \times V_f + h_{st} - h_{fs}$$

Note: As used in GENE-637-045-1293, $NPSH_r$ was read from pump curves and this equation was solved for P_r.

And

$$NPSH_a = 144 \times (P_a - P_v) \times V_f + h_{st} - h_{fs}$$

Where:

144	=	Conversion factor from square inches to square feet
P_r	=	Containment pressure required for the applicable ECCS pump $NPSH_r$ as specified by the manufacturer (psia)
P_v	=	Vapor pressure based on the maximum bulk fluid temperature predicted (psia)
P_a	=	Available wetwell pressure (psia)

V_f = Specific volume of the water based on the maximum bulk fluid temperature predicted (ft^3/lb)
h_{st} = Static height that the liquid supply level is above or below the pump centerline or impeller eye (feet)
h_{fs} = Suction line losses including entrance losses and friction losses (feet)

Based on data and analysis documented in GENE-637-045-1293, the following values are provided:

- The pressure required, P_r, is 18.59 psia and 15.81 psia for the RHR and CS pumps, respectively.

- The maximum bulk fluid temperature predicted is 195.9 degrees Fahrenheit. Accordingly, P_v equals 10.5 psia and V_f equals 0.016608 ft^3/lb.

- The available wetwell pressure, P_a, is 22.46 psia.

- The static height, h_{st}, is 12.96 feet for both the RHR and the CS pumps.

- The suction line losses, h_{fs}, are 4.63 and 8.55 feet of water for the RHR and CS pumps, respectively (at flows of 7700 and 4720 gpm, respectively).

Accordingly, the values for $NPSH_r$ and $NPSH_a$ are tabulated as follows:

PUMPS	$NPSH_r$	$NPSH_a$
CS; A or B Pump	17.05 ft.	32.98 ft.
RHR; A, B, C, or D Pump	27.62 ft.	36.90 ft.

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:

While information has been provided on NPSH, no design-basis NPSH analysis has been provided to the NRC for which a safety evaluation was issued. However, an overview of the current design-basis and the various licensing submittals detailing NPSH considerations is as follows:

1. Amendment 11 to the Final Safety Analysis Report (FSAR), Question 6.4

   The first NPPD response to discussions about ECCS NPSH containment back pressure requirements is found in the submittal of Amendment 11 to the Final Safety Analysis Report (FSAR) [2]. The response to Question 6.4 states that there are times that the containment pressure must be above atmospheric in order to maintain the NPSH requirements for the core standby cooling system pumps under the long-term usage design basis analysis conditions. A plot of minimum containment pressure and pressures for ECCS Pump NPSH requirements versus time after the DBA-LOCA was provided as FSAR Figure 6.4-1.

2. Technical Specification Amendment No. 82

   The most recent information presented to the NRC for review was submitted as a part of the technical basis for a change to Technical Specification 3.7.A.1.c [3]. This amendment allowed an increase in the maximum suppression pool temperature during normal operation from 90 to 95 degrees Fahrenheit.

   The basis for the temperature increase was provided by General Electric Report NEDC-24360-P [4], which was included as part of the aforementioned amendment request. Section 6.2 therein addressed the effect of the temperature increase on the ECCS Pump NPSH requirements. This report showed a long-term maximum bulk temperature of 184 degrees Fahrenheit, and calculated the $NPSH_a$ to be 47.3 and 46.6 feet of water for the RHR and CS pumps, respectively.

3. Current Design Basis

   The ECCS NPSH containment back pressure requirements currently described in the Updated Safety Analysis Report (USAR) are based on calculation GENE-637-045-1293 [5] performed in support of Design Change 91-144, "RHR Heat Exchanger Tube Plugging Margin."

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2 Letter to L. M. Muntzing (USAEC) from R. E. Reder (NPPD) dated May 30, 1972, "Amendment No. 11 to License Application, Filed on July 27, 1967, For Cooper Nuclear Station, Filed Under AEC Docket No. 50-298"

3 Letter to USNRC from J. M. Pilant (NPPD) dated June 10, 1982, "Proposed Change to Technical Specifications, Suppression Pool Temperature, Cooper Nuclear Station, NRC Docket No. 50-298, DPR-46"

4 General Electric Report NEDC-24360-P dated August 1981, "Cooper Nuclear Station Suppression Pool Temperature Response"

5 General Electric Report GENE-637-045-1293 dated January 1994, "Containment Analyses in Support of an Increase in the RHRS Heat Exchanger Tube Plugging Margin for Cooper Nuclear Station"

GENE-637-045-1293 concludes that adequate NPSH margins are maintained for both RHR and CS pumps throughout the DBA-LOCA. Tabulated results from the analysis indicated a long term maximum bulk fluid temperature of 195.9 degrees Fahrenheit, coinciding with a wetwell pressure of 22.46 psia, and pressures of 15.81 psia and 18.59 psia required for CS and RHR pump NPSH requirements, respectively.

4. ECCS Suction Strainer Replacement

The most recent assessment of ECCS NPSH was performed in support of Modification Package 96-132, "ECCS Strainer Replacement," which installed modified ECCS suction strainers in response to NRC Bulletin 96-03 [6]. Calculations supporting the current design basis (i.e., GENE-637-045-1293) were not revised as a result of this modification since the new suction stainers were shown to have head losses less than or equal to the suction strainers previously installed.

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:

CNS does credit containment overpressure in the calculation of $NPSH_a$ for use with the RHR and CS pumps. The term h_a in the $NPSH_a$ calculation represents pressure values at various suppression pool temperatures during accident conditions. Analysis for long term DBA-LOCA conditions indicate that there are times that the containment pressure must be above atmospheric in order to maintain the NPSH requirements for the core standby cooling system pumps. The analysis currently in the USAR is based on calculation GENE-637-045-1293.

The relationship between pressures required for ECCS pump NPSH and minimum containment pressure is shown on USAR Figure VI-5-15 and is based on data contained in Table C-1 of calculation GENE-637-045-1293. The amount of pressure needed varies with the temperature of the suppression pool. Five data points are listed in the table below and are used to demonstrate the relationship between pressures required and pressure available.

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[6] NRC Bulletin 96-03 dated May 6, 1996, "Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling-Water Reactors"

SUPPRESSION POOL TEMPERATURE (degrees F)	CS PUMP REQUIRED PRESSURE (psia)	RHR PUMP REQUIRED PRESSURE (psia)	WETWELL PRESSURE (psia)
95	6.20	9.06	14.70
152.3	9.24	12.06	21.04
175.4	12.05	14.84	19.50
190.7	14.71	17.49	21.69
195.9	15.81	18.59	22.47

As overpressure is considered to be the containment pressure above atmospheric (and not the pressure above the vapor pressure) [7], the previous table can be reformatted as follows to show the overpressure needed and the overpressure available.

SUPPRESSION POOL TEMPERATURE (degrees F)	CS PUMP REQUIRED OVERPRESSURE (psi)	RHR PUMP REQUIRED OVERPRESSURE (psi)	OVERPRESSURE AVAILABLE (psi)
95	0.00	0.00	0.00
152.3	0.00	0.00	6.34
175.4	0.00	0.14	4.80
190.7	0.01	2.79	6.99
195.9	0.11	3.89	7.77

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7 This clarification was provided by the NRC as described in letter to NEI Administrative Points of Contact from D. J. Modeen (NEI) dated December 5, 1997, "NEI Workshop on NRC Generic Letter 97-04, 'Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps'"

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 previously noted, calculation GENE-637-045-1293 was initiated to support Design Change 91-144 and is the basis for USAR figure VI-5-15, titled "Minimum Containment Pressure for Operation of ECCS Pumps." This calculation contains several assumed conservatisms which assure the minimum containment pressure has been established. An overview of these conservatisms is provided below:

- The reactor is initially at 102 percent of rated thermal power per Regulatory Guide 1.49. The ANS 5.1 decay heat model is used assuming an exposure of 25,700 MWD/st.

- Offsite power is assumed lost at the initiation of the accident and is not restored during the entire event.

- Only one on-site diesel generator is available during the entire event. Consequently, only one CS pump, RHR pump (Containment Cooling mode), and RHR Service Water Booster pump are assumed available. A heat transfer coefficient value of 177 Btu/(sec-degrees Fahrenheit) is used for the RHRS heat exchanger with this configuration to conservatively represent the 15 percent maximum allowable tube plugging.

- The service water temperature used for cooling remains at 90 degrees Fahrenheit throughout the transient.

- At the initiation of the accident the suppression pool has the minimum Technical Specification water volume of 87,650 cubic feet and its temperature is at the Technical Specification limit of 95 degrees Fahrenheit.

- To minimize the mass of non-condensable gases in the drywell, the bulk temperature is assumed to be 150 degrees Fahrenheit together with 100 percent humidity at the time of the accident. This assumption is conservative since a smaller condensable gas mass will result in lower containment back pressure for the NPSH evaluation.

- The initial containment pressure is 0 psig to minimize non-condensable gas mass in the containment.

- A containment gas leakage rate of approximately 5 percent per day is assumed, which corresponds to about 10 times the Technical Specification leakage limit.

- The discharge from the RHR heat exchanger always returns to the pool via the drywell and torus sprays to minimize the containment pressure by spraying cold water into the containment air space.

- Suppression pool cooling by the RHR heat exchanger is initiated at 600 seconds into the event.

- During the event the portion of feedwater in the feedwater system that is higher in temperature than the peak pool temperature is assumed to return to the reactor vessel.

- Heat loss from the torus shell surface to the reactor building air space is neglected.

- The power required to operate the CS and RHR pumps is added to the containment heat load by increasing the water temperature at the pump discharge accordingly.

Further, the Emergency Operating Procedures (EOPs) include graphs for RHR and CS NPSH limits which are based on available overpressure. Thus, the EOPs provide the necessary information to assure that NPSH requirements are maintained during accident conditions.

In summary, the overpressure requirements have been developed using conservatisms which assure the minimum containment pressure has been established, and are maintained during accident conditions through the EOPs.

ATTACHMENT 3 LIST OF NRC COMMITMENTS

Correspondence No: NLS970226

The following table identifies those actions committed to by the District in this document. Any other actions discussed in the submittal represent intended or planned actions by the District. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Licensing Manager at Cooper Nuclear Station of any questions regarding this document or any associated regulatory commitments.

COMMITMENT	COMMITTED DATE OR OUTAGE
None.	

COOPER NUCLEAR STATION

FSAR Question No. 6.4

Show the margin in required NPSH in terms of overpressure and time that will be available to the core standby cooling system pumps for various amounts of equipment assumed to be operable. Indicate conformance with AEC Safety Guide No. 1.

Response

The entire spectrum of possible operating modes of the core standby cooling network has been examined for adequacy with regard to NPSH at the various pumps. Adequate NPSH is available to the core standby cooling system pumps for all the various modes of operation.

The most limiting of all the various modes occurs during the long term transient following a design basis loss of coolant accident when one core spray and one RHR pump will be running continuously. Figure 6.4.1 is a plot of both the minimum containment pressure required in order that the core spray and RHR pumps have adequate NPSH and a plot of the minimum containment pressure that would actually occur. At all times there would be at least a 3 psi margin.

In order to demonstrate the margin inherent in Figure 6.4.1, the following is a list of the major assumptions used to calculate the suppression pool temperature and the minimum containment pressure following the design basis loss of coolant accident.

1. Offsite power is assumed lost at the time of the accident and is not restored during the period of interest. (~2 days)

2. One of the onsite diesel generators fails to start and remains out of service during the entire transient.

3. The service water temperature remains at its maximum possible value of 85° F throughout the transient. Normally service water temperature would be at least 10° F less than maximum.

4. The RHR heat exchanger has its design fouling factor.

5. Prior to the accident the maximum temperature of 150° F exists in the drywell together with 100% humidity. Normal operating conditions would be 135F/20%.

6. Minimum pre-accident containment pressure of 0 psig. Normal operating pressure could be as high as .7 psig. There are no circumstances under which a sub-atmospheric pressure could exist in the containment.

7. A containment gas leakage rate of 5% per day. This is ten times the design basis leak rate of .5% day.

8. The discharge of the RHR pump is being returned to the system via the drywell and torus sprays and the containment atmosphere is at the spray temperature; this minimizes the containment pressure.

The result of assumptions 1, 2, 3, 4, is to maximize the peak suppression pool temperature. With no offsite power and with one diesel-generator out of service the pool will be cooled by one RHR heat exchanger with one RHR and one S. W. pump. This, together with the maximum service water temperature, results in a peak pool temperature of 192°F. The suppression pool is assumed to be the only heat sink even though the metal structures within the containment are capable of storing considerable energy. No credit is taken for any heat losses from the containment other than the energy being removed by the RHR heat exchanger.

Assumptions 5, 6, 7, result in the minimum possible quantity of non-condensible gases being present in the containment during the transient; which in turn results in the minimum possible pressure. Assumption 8 gives the minimum containment gas temperature and thus also minimized the pressure.

The combination of maximum fluid temperature and minimum containment pressure calculated with the above assumptions are the most severe conditions for which adequate NPSH must be shown to exist. Figure 6.4.1 shows that adequate NPSH would indeed exist even under these very degraded circumstances.

It can be seen that there is a period during which the containment pressure must be in excess of atmospheric pressure if adequate NPSH is to be provided. The design basis for the standby core cooling systems for this unit did not include the requirement that they be functional with no containment back pressure.

These pumping systems were designed long before Safety Guide No. 1 was proposed, and due to back pressure dependence do not strictly conform with Safety Guide No. 1. However, adequate NPSH is provided for all conditions. The dependence on back pressure is justified by the conservative models used to calculate the minimum back pressure. In the incredibly remote event that all the unlikely circumstances assumed above do indeed occur simultaneously for some reason and there is a concomitant loss of back pressure, the plant operator would always have recourse to the RHR/Service Water intertie.

Attachment 3
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independent of any external signal. Thus, neither the normal nor accident environment in the containment affects the operability of the LPCI equipment for the accident. It is concluded that safety design basis 9 is satisfied.

Using the suppression pool as the source of water for the LPCI subsystem establishes a closed loop for recirculation of LPCI water escaping from the break. The LPCI and appropriate portions of the reactor recirculation loops are designed as Class I (see Appendix C) so that they meet design basis 8.

5.3 CSCS Pumps NPSH

The entire spectrum of possible operating modes of the CSCS has been examined for adequacy with regard to NPSH at the various pumps. Adequate NPSH is available to the CSCS pumps for all the various modes of operation.

The most limiting of all the various modes occurs during the long term transient following a design basis LOCA when one Core Spray and one RHR pump will be running continuously. Figure VI-5-15 is a plot of both the minimum containment pressure required for the Core Spray and RHR pumps to have adequate NPSH and a plot of the minimum containment pressure that would actually occur. At all times there would be at least a 3 psi margin.

In order to demonstrate the margin inherent in Figure VI-5-15, the following is a list of the major assumptions used to calculate the suppression pool temperature and the minimum containment pressure following the design basis LOCA.[39]

1. The reactor is initially at 102 percent of rated thermal power per Regulatory Guide 1.49. The ANS 5.1 decay heat model is used assuming an exposure of 25,700 MWD/st (amount of energy generated per unit metric-ton fuel mass), which represents a high fuel burnup, and, therefore, a high decay power condition.

2. Offsite power is assumed lost at the initiation of the accident and is not restored during the entire event.

3. Only one onsite diesel generator is available during the entire event. Consequently, only one pump each for the Core Spray (4,720 gpm), LPCI/Containment Cooling (7,700 gpm), and RHR Service Water Booster System (4,000 gpm) is assumed to be available.

4. The power required to operate the core spray pump and LPCI/Containment Cooling pump is added to containment heat load by increasing water temperature at the pump discharge accordingly.

5. At the initiation of the accident, the suppression pool has the minimum water volume of 87,650 ft^3 and the maximum temperature of 95°F.

6. The service water temperature remains at 90°F throughout the event.

7. During the event, the portion of feedwater in the feedwater system that is higher in temperature than peak pool temperature is assumed to continue to return to the reactor vessel.

8. No heat loss from the primary containment to the reactor building airspace is assumed.

9. The minimum thermal capability specified in Table IV-8-1 is used for the RHR heat exchangers.

10. Containment cooling by the RHR heat exchanger is initiated at 600 seconds into the event.

11. The drywell bulk temperature is assumed to be 150°F together with 100 percent humidity prior to the accident. Normal operating conditions would be 135°F with 20 percent humidity.

12. The initial containment pressure is 0 psig. Normal operating pressure could be as high as 1.5 psig. There are no circumstances under which a sub-atmospheric pressure could exist in the containment.

13. A containment gas leakage rate of 5 percent per day is assumed. This is substantially higher than the allowed leakage rate of 0.635 percent per day at 58 psig (see Section V-2, "Primary Containment System").

14. The discharge from the RHR heat exchanger always returns to the suppression pool via the drywell and torus sprays to minimize the containment pressure by spraying cold water into the containment air space.

The result of assumptions 1 through 9 is to maximize the peak suppression pool temperature. With no offsite power and with one diesel-generator out of service the pool will be cooled by one RHR heat exchanger with one RHR and one SW pump. This, together with the maximum Service Water temperature, results in a peak pool temperature of 196°F. The suppression pool is assumed to be the only heat sink even though the metal structures within the containment are capable of storing considerable energy. No credit is taken for any heat losses from the containment other than the energy being removed by the RHR heat exchanger.

Assumptions 11, 12, 13, result in the minimum possible quantity of non-condensible gases being present in the containment during the transient; which in turn results in the minimum possible pressure. Assumption 14 gives the minimum containment gas temperature and thus also minimized the pressure.

The combination of maximum fluid temperature and minimum containment pressure calculated with the above assumptions are the most severe conditions for which adequate NPSH must be shown to exist. Figure VI-5-15 shows that adequate NPSH would indeed exist even under these very degraded circumstances.

It can be seen that there is a period during which the containment pressure must be in excess of atmospheric pressure if adequate NPSH is to be provided. The design basis for the CSCS for CNS did not include the requirements that they be functional with no containment back pressure.

These pumping systems were designed long before Safety Guide No. 1 was proposed, and due to back pressure dependence do not strictly conform with Safety Guide No. 1. However, adequate NPSH is provided for all conditions. The dependence on back pressure is justified by the conservative models used to calculate the minimum back pressure. In the incredibly remote event that all the unlikely circumstances assumed above do indeed occur simultaneously for some reason and there is an accompanying loss of back pressure, the plant operator would always have recourse to the RHR/Service Water intertie.

Separate analyses were performed to demonstrate that local suppression pool temperatures are maintained below 200°F to ensure stable steam condensation.[34][35][40]