Nebraska Public Power District
Nebraska's Energy Leader

NLS2002090
July 3, 2002

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

Subject: Response to Request for Additional Information on License Amendment Request to Revise the Ultimate Heat Sink and Reactor Equipment Cooling Water Temperature Requirements (TAC No. MB5123)
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

References:

1. Nebraska Public Power District (NPPD) letter NLS2002008, to U.S. Nuclear Regulatory Commission dated May 20, 2002, "License Amendment Request to Revise the Ultimate Heat Sink and Reactor Equipment Cooling Water Temperature Requirements."

2. NRC letter from M. Thadani to D. L. Wilson, NPPD, dated June 27, 2002, "Cooper Nuclear Station – Request for Additional Information Related to Amendment Request to Revise the Ultimate Heat Sink and Reactor Equipment Cooling Water Temperature Limits (TAC No. MB5123)"

3. Electronic communication from NRC Project Manager dated July 1, 2002.

The purpose of this letter is for the Nebraska Public Power District (NPPD) to submit a response to a Request for Additional Information (RAI) from the U.S. Nuclear Regulatory Commission (NRC) related to the amendment request that proposed an increase in the temperature limits of the Ultimate Heat Sink and the Reactor Equipment Cooling System in the Cooper Nuclear Station (CNS) technical specifications, submitted by the Reference 1 letter. The RAI was discussed with the NRC staff in a meeting conducted on June 25, 2002, and was provided by the Reference 2 letter, and by Reference 3 electronic communication. The response to the RAI is provided in the Attachment to this letter.

A copy is being provided to the NRC Region IV office and to the CNS Resident Inspector in accordance with 10 CFR 50.4(b)(1).

If you have any questions concerning this matter, please contact Mr. Paul Fleming at (402) 825-2774.

Sincerely,

David L. Wilson
Vice President-Nuclear

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Attachment:

cc: Regional Administrator w/ attachments
USNRC - Region IV

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

Senior Resident Inspector w/ attachments
USNRC

Nebraska Health and Human Services w/ attachments
Department of Regulation and Licensure

NPG Distribution w/o attachments

Records w/ attachments

Affidavit

(STATE OF NEBRASKA)
)
NEMAHA COUNTY)

David L. Wilson, 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.

David L. Wilson

Subscribed in my presence and sworn to before me this 3 day of July, 2002.

NOTARY PUBLIC

Wilma M. Werner
General Notary
State of Nebraska
My Commission Expires Oct. 26, 2002

**Response to Request for Additional Information
Related to License Amendment Request to Increase Temperature Limits of the Ultimate Heat Sink and Reactor Equipment Cooling Water System**

**Cooper Nuclear Station
Nebraska Public Power District**

The following NRC Request numbers 1 through 3 were transmitted to Nebraska Public Power District (NPPD) by NRC letter dated June 27, 2002. NRC Request numbers 4 and 5 were transmitted to NPPD by electronic communication from the NRC Project Manager for CNS on July 1, 2002.

1. NRC Request

   Discuss the methodologies and assumptions for the Cooper Nuclear Station Updated Safety Analyses Report Chapter 14 accidents that were not previously reviewed and approved by the NRC staff.

   NPPD Response

   The Cooper Nuclear Station (CNS) Updated Safety Analysis Report (USAR) Chapter 14 defines and analyzes four design basis accidents (DBA). These are: 1) Rod drop accident, 2) Loss-of-coolant accident (LOCA), 3) Refueling accident, and 4) Steam line break accident (main steam line breaks outside of secondary containment). Of these accidents the only analysis affected by the proposed increase in Ultimate Heat Sink (UHS) and Reactor Equipment Cooling (REC) temperatures is the long-term DBA-LOCA.

   The last CNS analysis, which dealt with containment response that was reviewed by the NRC, was for Amendment 82 to the CNS operating license. This amendment allowed an increase in the Technical Specification required suppression pool temperature limit from 90° F to 95°F. The analysis submitted in support of this license amendment was General Electric Report NEDC-24360-P, "Cooper Nuclear Station Suppression Pool Temperature Response", August 1981. Although this analysis mainly dealt with and was reviewed against NUREG-0783, "Suppression Pool Temperature Limits for BWR Containments", it also provided docketed containment analysis assumptions and evaluation of the impact of pool temperature increase on design basis accidents.

   Additional long-term containment analyses that would have been reviewed and accepted by the NRC include those documented in the original Safety Analysis Report.

   The following is a list of key input assumptions used in the long-term DBA-LOCA containment analysis in support of the current license amendment request to increase the UHS temperature limit to 95°F. Key assumptions denoted by an asterisk indicate differences between methodologies and assumptions previously reviewed and approved by the NRC.

1. * The reactor is operating at 102 % thermal rated power (2429 MWt) with an initial reactor pressure of 1060 psia.

2. * The reactor core power includes fission energy, fuel relaxation energy, metal-water reaction energy and ANS 5.1 + 2 sigma decay heat for fuel applicable up to GE14 with Custom G-factor.

3. * Reactor blowdown flow rates are based on Moody's Homogeneous Equilibrium critical flow model. A discussion of how the SHEX computer code uses break flow is presented in section 2.1.1 of General Electric Report GE-NE-T23-00786-00-01-R2 (GE Proprietary Information), provided as Enclosure 3 of NPPD letter NLS2001064 to the NRC dated July 30, 2001, "Proposed License Amendment Related to Emergency Core Cooling System Pump Net Positive Suction Head Requirements."

4. The reactor vessel control volume includes the fluid and structural masses and energy of the primary system components including reactor vessel, recirculation loops, main steam lines to the outboard isolation valve, RCIC steam line, RHR shutdown line, LPCI line, core spray line, HPCI steam line and RWCU line.

5. A loss of offsite power occurs concurrent with the postulated LOCA. Only one diesel generator is available. This results in only one RHR pump and one RHR Service Water pump available for containment cooling after 10 minutes. The RHR pump and RHR Service Water pump are aligned to the RHR heat exchanger at 10 minutes to initiate containment cooling. Containment cooling in containment spray mode is used for Case E and containment cooling in suppression pool cooling mode is used for Case F.

6. * The portion of the feedwater inventory at a temperature higher than 212°F, after absorbing additional energy from the feedwater piping as it flows toward the vessel, is injected into the vessel. This assumption is based on the premise that all feedwater in the feedwater system, with a temperature higher than the saturation temperature of water at 14.7 psia (212°F), will flash and return to the vessel. This assumption is used to maximize the suppression pool temperature. This hot portion of the feedwater inventory is transferred to the vessel regardless of the availability considerations of feedwater and condensate pumps.

7. For the DBA-LOCA with containment sprays modeled, heat and mass transfer from the suppression pool to the suppression chamber is determined mechanistically. For the suppression pool cooling case thermal equilibrium between the suppression pool and wetwell airspace is modeled. This is a standard assumption for analyses with pool cooling modeled.

8. The DBA-LOCA is the instantaneous double-ended guillotine break of the recirculation suction line at the reactor vessel nozzle safe-end to pipe weld. The effective break area is 4.17 square feet.

9. The initial suppression pool water volume corresponds to the Technical Specification Low Water Level to maximize the suppression pool temperature response.

10. * The suppression pool temperature is initially at 100 °F.

11. * The RHR service water temperature is at the maximum value of 95 °F to maximize the suppression pool temperature.

12. Passive heat sinks in the drywell, suppression chamber airspace and suppression pool are conservatively neglected to maximize the suppression pool temperature. Heat transfer from the primary containment to the reactor building is also conservatively neglected.

13. Drywell fan coolers are inactive.

14. Control rod drive (CRD) flow is zero.

15. * All core spray and LPCI/RHR pumps have 100 % of their motor horsepower rating converted to pump heat which is added either to the RPV liquid or suppression pool water. This assumption is used to maximize the suppression pool temperature response.

16. MSIV closure starts at 0.5 seconds after the initiation of the event and full closure is achieved at 3.0 seconds after closure is initiated.

17. CST water inventory is not available for vessel makeup.

The General Electric SHEX computer program was utilized for the long-term DBA-LOCA analysis. A benchmark analysis of this computer code was submitted to the NRC as part of NLS2001064, "Proposed License Amendment Related to Emergency Core Cooling System Pump Net Positive Suction Head Requirements Cooper Nuclear Station, NRC Docket 50-298, DPR-46", July 30, 2001. This benchmark analysis demonstrated the acceptability of utilizing the SHEX computer program for long-term containment analyses at Cooper Nuclear Station. Additionally, the DBA-LOCA long-term containment response was analyzed for a time period of 180 days for EQ considerations. For times after 100,000 seconds the General Electric HXSIZ computer code was utilized.

2. NRC Request
Identify any equipment/components where the environmental qualification (EQ) temperatures were exceeded by the revised EQ temperature profile resulting from 95°F service water. Discuss how the temperature increase status of EQ was dispositioned.

NPPD Response
The containment analyses performed for USAR Case E, the long-term containment response using containment spray, and Case F, the long-term containment response using suppression pool cooling, assumed service water at 95°F as discussed in the May 20, 2002, license amendment request. The containment temperature profile for each case was run for 180 days to match the maximum post-accident operating time for environmental qualification (EQ). This analysis conservatively assumes a 95°F service water temperature for the entire 180 days post-accident.

The EQ temperature profile resulting from the Case E analysis was bounded by the existing EQ temperature profile. However, the temperature profile for Case F exceeded the existing temperature profile for some of the long-term containment cool down portion of the profile. This affected the following equipment/components located in primary containment:

Raychem Flamtrol Cable
Kerite HTK/FR 1000V Cable
BIW Bostrad 7E Cable
BIW Bostrad 7 Cable
Cerro/Rockbestos Firewall SR Cable
Cerro/Rockbestos Firewall III Cable
Cerro/Rockbestos Pyrotrol III Cable
GE Electrical Penetrations
Buchanan Terminal Blocks
Marathon Terminal Blocks
Limitorque Motorized Valve Actuators
PCI Pressure Switches
Raychem Splices
Conax Temperature Elements
Conax ECSA
Brand Rex Cable
Victoreen High Range Radiation Monitor
Conax Electrical Penetration
Hiller MSIV Solenoids
Namco EA180 Limit Switches
EGS/Patel Electrical Connectors (QDC)
IST Electrical Penetration
EGS Splice Connectors (Grayboot)
Target Rock SRV Solenoid Valves

A new CNS specific bounding EQ profile was defined which bounds the Case F containment accident profile. The EQ equipment in primary containment was evaluated to determine whether it was qualified to the new drywell temperature conditions. This evaluation was based on the new profile, for both peak temperature and post-accident operating time, since these parameters are potentially impacted by changes in the containment temperature profile. The new profile was then compared against the qualification documentation to demonstrate that the EQ equipment is qualified to the new service conditions for the required post-accident operating time. The peak accident temperature of 340°F used in the analysis bounds the peak conditions for the events. Post accident equivalency calculations, using the Arrhenius methodology, were developed to compare the Case F cool down portion of the temperature profile with the test profiles used to establish qualification of the EQ equipment in primary containment. This methodology is consistent with the CNS licensing basis, discussed in Enclosure I, section 6.C, of NPPD letter NLS8400127 to the NRC dated April 24, 1984. The NRC documented closure of this issue by their safety evaluation, "Environmental Qualification of Electric Equipment Important to Safety", dated January 30, 1985, provided to NPPD by NRC letter dated January 30, 1985. The results of the comparison for each affected component confirmed the adequacy of the test profile used to establish environmental qualification to the new EQ temperature profile for primary containment.

3. NRC Request
Explain how heat exchanger performance data obtained from the Generic Letter 89-13 program was utilized in heat transfer calculations supporting the amendment request.

NPPD Response
The heat exchangers included in the GL 89-13 program include the REC, RHR, and DG heat exchangers. Regular performance testing is performed on the REC and RHR heat exchangers. Periodic inspection and cleaning is performed on the DG heat exchangers. Design calculations have been performed for each of these heat exchangers to demonstrate their heat removal capability under design basis accident conditions. These calculations use conservative assumptions for the cooling water temperatures, cooling water flow rates, and accident heat loads. Each of these calculations has been revised to determine the effect of the increased UHS (SW) temperature.

The heat exchanger performance data obtained from the GL 89-13 program was not used as inputs in the design calculations supporting the amendment request. Rather, the assumptions used in the design calculations and results of the design calculations are used as acceptance criteria in the performance testing of the REC and RHR heat exchangers to ensure that the actual heat exchanger performance meets or exceeds that assumed in the design calculations. The performance test procedures use commercial heat exchanger performance evaluation software to perform heat transfer calculations to evaluate the test data and ensure that the actual heat exchanger performance meets the minimum criteria established by the design calculations. Each of the design calculations have been revised to determine the effect of the increased UHS (SW) temperature on the acceptance criteria and these acceptance criteria will be incorporated into the performance testing procedures as part of implementation of the amendment after issuance.

The following is a discussion of the design calculations and performance testing for the heat exchangers in the three systems.

Reactor Equipment Cooling (REC)
The worst-case heat loads to the REC system were tabulated for both a design basis LOCA with a Loss-of-offsite-power (LOOP) and for a LOCA without a LOOP. These two scenarios were chosen as being the most limiting since the first results in the lowest possible service water flow to the heat exchanger, whereas, the latter results in the greatest heat load. Analyses are performed for each of these scenarios to determine the maximum allowable fouling which would remove the post accident heat loads while providing adequate cooling to the essential REC loads. The results of these design calculations are used as acceptance criteria in the REC heat exchanger performance testing to ensure that the heat exchanger performance meets or exceeds that assumed in the design calculations.

Residual Heat Removal (RHR)
The RHR heat exchanger calculation uses assumptions that are consistent with those used in the long-term containment response calculations. This calculation determines the maximum

allowable tube plugging for the RHR heat exchanger. The results of this calculation are not directly used as acceptance criteria in the performance test of the RHR heat exchanger. The performance evaluation procedure uses commercial heat exchanger performance evaluation software to determine the actual heat exchanger fouling factor from the test results. This fouling factor is then used by the program to calculate a projected heat removal capability under accident conditions with temperatures and flows consistent with those used in the RHR heat exchanger calculation and containment response analyses. The actual heat removal capability of the RHR heat exchanger is the acceptance criteria for heat exchanger performance and must exceed the heat removal capability assumed in the accident analyses and in the RHR heat exchanger design calculation.

Emergency Diesel Generator

The design calculation for the emergency diesel generator (DG) heat exchangers determines the minimum SW flow rates which will provide adequate DG cooling at the increased SW temperature. These minimum SW flow rates are used as acceptance criteria in the SW flow surveillance. Performance tests are not performed on the DG heat exchangers. In place of performance testing, periodic cleaning and inspection of the DG lube oil and jacket water coolers is performed. Lube oil and jacket water cooler temperature measurements are trended to detect degradation. The DG intercoolers are periodically inspected and cleaned, and temperature measurements are trended to detect degradation.

4. NRC Request
Compare how long it takes to cooldown and depressurize the containment at the current vs. the proposed cooling water temperature limits.

NPPD Response
Table 1 provides a comparison of the long-term containment response for Case E at 90°F vs. the requested 95°F Ultimate Heat Sink (UHS) temperature. Case E long-term containment response is defined by the operation of one RHR cooling loop with 1 RHR pump, 1 RHR service water booster pump, 1 service water pump, and 1 RHR heat exchanger – with containment spray. The data presented in Table 1 is derived from the tabular data presented in the respective calculations.

Table 1- Comparison of Long-Term Containment Cooling (90°F vs. 95°F UHS temperature)

Time for 90°F (sec)	Time for 95°F (sec)	Drywell Pressure 90°F (psia)	Drywell Pressure 95°F (psia)	Wetwell Pressure 90°F (psia)	Wetwell Pressure 95°F (psia)	Suppression Pool Temp. 90°F (°F)	Suppression Pool Temp. 95°F (°F)
1034	990	22.7	24.1	23.2	24.5	158.0	166.2
10,145	10,371	25.1	26.8	25.5	27.3	186.3	196.3
20,043	20,098	26.2	28.5	26.7	29.0	193.4	205.3
30,387	30,516	26.6	29.1	27.1	29.6	195.4	208.4
40,022	40,320	26.6	29.0	27.0	29.5	195.0	208.5
50,317	50,117	26.2	28.6	26.7	29.0	193.3	207.0
60,578	60,488	25.9	27.9	26.2	28.4	190.9	204.7
70,956	70,800	25.5	27.5	25.7	27.9	188.2	202.7
81,477	81,673	25.0	26.7	25.4	27.1	185.4	199.8
92,158	92,417	24.6	26.1	25.0	26.5	182.6	196.9
100,000	100,000	24.4	25.7	24.7	26.0	180.6	194.9

5. NRC Request
Discuss to what extent the ratings of the emergency diesel generator is affected at the higher cooling water temperature limits [Note that the TS Surveillance typically requires the EDG to be able to operate at 110% of rated load for a specified period of time].

NPPD Response
The diesel generator(s) heat exchangers for the engine cooling water system, including the engine jacket, lube oil coolers, and intercoolers, were designed and fabricated in accordance with TEMA Standards and capable of adequately cooling the engine at 110% of rated load and any other continuous rated load point that is within the engine generator load range.

The calculations completed to evaluate the impact of increased Ultimate Heat Sink (UHS) temperature on diesel generator performance show that these heat removal capabilities will continue to be met at 95°F UHS temperature. These calculations also show that vendor recommended temperature limits will continue to be met at the increased UHS temperature. Therefore, there is no affect on the ratings of the diesel generators due to the proposed increase in UHS temperature.

Correspondence Number: NLS2002090

The following table identifies those actions committed to by Nebraska Public Power District (NPPD) in this document. Any other actions discussed in the submittal represent intended or planned actions by NPPD. They are described for information only and are not regulatory commitments. Please notify the NL&S Manager at Cooper Nuclear Station of any questions regarding this document or any associated regulatory commitments.

COMMITMENT	COMMITTED DATE OR OUTAGE
Each of the design calculations has been revised to determine the effect of the increased UHS (SW) temperature on the acceptance criteria and these acceptance criteria will be incorporated into the performance testing procedures as part of implementation of the amendment after issue.	Concurrent with amendment implementation