

November 3, 2003

Mr. Clay C. Warren  
Chief Nuclear Officer  
Nebraska Public Power District  
P. O. Box 98  
Brownville, NE 68321

SUBJECT: COOPER NUCLEAR STATION (CNS) - FINAL CLOSEOUT OF RESPONSES  
TO GENERIC LETTER 96-06 (TAC NO. M96799)

Dear Mr. Warren:

On September 30, 1996, the U.S. Nuclear Regulatory Commission (NRC) staff issued Generic Letter (GL) 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions." In GL 96-06, the NRC staff requested licensees to determine for postulated accident conditions, if (1) containment air cooler cooling water systems are susceptible to either water hammer or two-phase flow conditions, and (2) piping systems that penetrate containment are susceptible to thermal expansion of fluid so that over-pressurization of piping could occur.

The Nebraska Public Power District provided its assessment for the CNS, in letters dated October 28, 1996, January 28, March 27, and May 13, 1997, February 27, and June 30, 1998, and June 9, 2003. The NRC staff has completed its review of your submittals, and finds that your evaluations and corrective actions are acceptable for responding to GL 96-06. The NRC staff's safety evaluation is enclosed.

This completes the NRC staff's efforts regarding GL 96-06 for CNS TAC No. M96799. If you have any questions regarding this matter, please contact me at (301) 415-1774.

Sincerely,

*/RA/*

Michelle C. Honcharik, Project Manager, Section 1  
Project Directorate IV  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosure: Safety Evaluation

cc w/encl: See next page

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\*No substantive changes

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
OF THE RESPONSE TO GENERIC LETTER 96-06  
FACILITY OPERATING LICENSE NO. DPR-46  
NEBRASKA PUBLIC POWER DISTRICT  
COOPER NUCLEAR STATION  
DOCKET NO. 50-298

1.0 INTRODUCTION

By letters dated October 28, 1996, January 28, March 27, and May 13, 1997, February 27, and June 30, 1998, and June 9, 2003, the Nebraska Public Power District (licensee), provided its response to Generic Letter (GL) 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," for Cooper Nuclear Station (CNS). The submittals address the issues of water hammer, two-phase flow, and thermally-induced pressurization of piping runs penetrating the containment during postulated design-basis accidents for CNS.

Water hammer occurrence has been postulated to occur within containment cooling systems following a loss of offsite power (LOOP). Water hammer could occur either as part of the draining process within cooling systems following the LOOP or as a result of the convergence of water slugs following the return of electric power and restart of the pumps supplying water to the containment coolers. A main steam line break (MSLB) or loss of coolant accident (LOCA) could increase the possibility of steam formation and hence water hammer occurrence by causing boiling to occur within the containment cooler units or connecting piping. An additional concern is that excessive steam formation within the systems supplying water to the containment cooling units while the units are operating to mitigate accidents could lead to two phase flow. This could lead to unbalanced flow conditions and cause the cooling units to remove less than their design-basis heat load.

2.0 REGULATORY EVALUATION

GL 96-06 requires among other considerations that licensees provide evaluations of containment air cooling water systems to determine susceptibility to water hammer and two-phase flow during a LOCA or MSLB concurrent with a LOOP. Licensees were requested to assess the operability of affected systems and to take corrective action as appropriate. The licensee provided the required evaluations for CNS as described in the following discussions.

### 3.0 TECHNICAL EVALUATION

#### 3.1 Water Hammer and Two-Phase Flow

The containment structure at CNS is of the General Electric Mark I design. The design includes a drywell containing the reactor vessel and recirculation loops and a suppression pool. Drywell cooling is provided by four fan-coil air cooling units (FCUs). The drywell FCUs are nonsafety related and are therefore not relied upon to mitigate any design-basis transient or accident at the CNS. Cooling water is provided to the drywell FCUs by the Reactor Equipment Cooling (REC) system. The design of the drywell FCUs and the REC system limits the possibility of steam formation within the REC system following a LOCA or MSLB. The drywell FCUs automatically shut off on either high drywell pressure or low reactor water level which would occur following a LOCA or MSLB. This limits the amount of heat that is transferred from the drywell atmosphere to the REC system via the drywell FCUs. The REC system is equipped with a surge tank which has a minimum water level that is at least 74.4 feet above the drywell FCUs. The surge tank will provide an overpressure of at least 32 psig on the water in the drywell FCUs which will keep the FCUs from draining following a LOOP and minimize steam formation during a LOCA or MSLB. The REC pumps will continue to operate during a LOCA or MSLB (without a concurrent LOOP) so that cooling water flow through the idle FCUs will prevent pockets of steam from forming within the system which could lead to a water hammer.

Following a LOOP, the REC pumps will stop and the isolation valves between the REC pumps and the drywell FCUs will close on reduced system pressure. The REC pumps can be loaded onto the emergency power buses, allowing drywell cooling to be manually restored as deemed appropriate. Based on recent evaluations in the June 9, 2003, submittal, the licensee has determined that significant voiding might occur within the FCUs following a small MSLB within containment under conditions where power to the REC pumps is temporarily lost and then restored. A small MSLB might not cause drywell spray to actuate, resulting in elevated containment temperatures and subsequent voiding in the containment FCUs. The licensee evaluated the potential water hammer that might occur using the methodology of NUREG/CR-5220 Vol. 1, "Diagnosis of Condensation-Included Waterhammer, Methods and Background," Creare Inc., October 1998, as allowed by GL 96-06. No cushioning of the colliding water columns by steam or air was assumed in the analysis and REC flow was assumed to be at the maximum steady-state value immediately upon restoration of power. The licensee determined that even under these conditions, neither the FCUs nor the associated piping would be damaged due to water hammer. In actuality, the isolation valve downstream of the REC pumps has a long opening stroke time of 32 seconds. The slow opening time would result in slower than steady-state flow to the containment coolers, which would cause any voids that might be present to condense more slowly thereby reducing the magnitude of any potential water hammer.

The licensee has implemented a procedural caution prescribing that drywell cooling not be restored under containment conditions when significant voiding might occur within the REC system. This caution will further assure REC system integrity during a LOCA or MSLB concurrent with a LOOP.

In addition to water hammer, GL 96-06 is concerned with the occurrence of two phase flow conditions within the containment FCUs that could affect REC system flow stability and heat transfer assumptions that are credited for design-basis accidents. Because the containment

FCUs at CNS are not relied upon to mitigate design-basis accidents and are designed to trip if such accidents occur, this aspect of GL 96-06 does not apply to the containment FCUs at CNS.

### 3.2 Thermally-Induced Pressurization of Piping Runs

In its submittal of January 28, 1997, the licensee identified six penetrations which are vulnerable to a water solid volume that would be subjected to an increase in pressure due to heating of trapped fluid. In this submittal, the licensee determined that all penetrations were operable based on a bounding analysis, but that additional actions would be necessary. In its submittals dated March 27, and May 13, 1997, the licensee stated that for two of the penetrations, relief valves were installed to prevent overpressurization and that for one penetration, a spectacle flange was installed and the piping was procedurally drained. In its February 27, 1998, and June 9, 2003, submittals, the licensee provided the results of evaluations performed for the other three penetrations. For one of these penetrations it was determined that the minimum temperature of the pipe and fluid is above the maximum drywell accident temperature such that overpressurization would not occur. For another penetration, it was determined that it would remain within the limits of Appendix F of Section III of the American Society of Mechanical Engineers Code. For the last penetration, the licensee will prevent overpressurization by following an operating procedure which ensures that the pipe and fluid temperature during normal operation is never below the maximum drywell accident temperature.

### 4.0 CONCLUSION

Based on the information that was provided and the considerations discussed in Section 3.1 above, the NRC staff concludes that the licensee has adequately addressed the issues raised in GL 96-06 regarding the potential for water hammer and two-phase flow, and that the integrity of the containment FCUs and the REC system will be maintained during a LOCA or MSLB with a concurrent LOOP.

Additionally, the NRC staff concludes that the licensee's evaluation and corrective actions provide an acceptable resolution for the issue of thermally-induced pressurization of piping runs penetrating the containment.

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Date: November 3, 2003

Cooper Nuclear Station

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