Omaha Public Power District
444 South 16th Street Mall
Omaha, Nebraska 68102-2247

October 21, 1998
LIC-98-0132

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555-0001

References:
1. Docket No. 50-285
2. NRC Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity During Design Basis Accident Conditions," dated September 30, 1996
3. Letter from OPPD (T. L. Patterson) to NRC (Document Control Desk) dated October 30, 1996 (LIC-96-0164)
4. Letter from OPPD (S. K. Gambhir) to NRC (Document Control Desk) dated January 24, 1997 (LIC-97-006)

SUBJECT: Revised Response to Generic Letter 96-06 (TAC Number M96813)

Generic Letter (GL) 96-06 requested addressees to determine: (1) if containment air cooler cooling water systems are susceptible to either waterhammer or two phase flow conditions during postulated accident conditions; and (2) if piping systems that penetrate the containment are susceptible to thermal expansion of fluid so that overpressurization of piping could occur. The Reference 4 submittal provided the Omaha Public Power District (OPPD) 120-day response to GL 96-06.

OPPD has determined that the attached revised response to GL 96-06 is necessary to document (1) final resolution of waterhammer issues, and (2) compliance with the current licensing basis (Updated Safety Analysis Report Appendix F stress criteria) for Fort Calhoun Station. The revised portions are identified by right margin revision bars in the sections entitled "Waterhammer" and "Overpressure of Piping." This letter supersedes the Reference 4 summary report from OPPD and is provided under oath as required by GL 96-06. Please contact me if you have any questions,

Sincerely,

S. K. Gambhir
Division Manager
Nuclear Operations

Attachments

TCM/tcm

c: E. W. Merschoff, NRC Regional Administrator, Region IV
L. R. Wharton, NRC Project Manager
W. C. Walker, NRC Senior Resident Inspector
Winston & Strawn

LIC-97-0132
Attachment 1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
Omaha Public Power District	)	Docket No. 50-285
(Fort Calhoun Station	)	
Unit No. 1)	)	

AFFIDAVIT

S. K. Gambhir, being duly sworn, hereby deposes and says that he is the Division Manager - Nuclear Operations of the Omaha Public Power District; that as such he is duly authorized to sign and file with the Nuclear Regulatory Commission the attached information concerning a revised response to the requirements of NRC Generic Letter 96-06; that he is familiar with the content thereof; and that the matters set forth therein are true and correct to the best of his knowledge, information and belief.

S. K. Gambhir
Division Manager
Nuclear Operations

STATE OF NEBRASKA)
) ss
COUNTY OF DOUGLAS)

Subscribed and sworn to before me, a Notary Public in and for the State of Nebraska on this 21st day of October, 1998.

Joan M. Hineline
Notary Public

GENERAL NOTARY-State of Nebraska
JOAN M. HINELINE
My Comm. Exp. Sept. 3, 2000

Omaha Public Power District (OPPD)
Revised Response to Generic Letter 96-06

Generic Letter (GL) 96-06 requested addressees to determine: (1) if containment air cooler cooling water systems are susceptible to either waterhammer or two phase flow conditions during postulated accident conditions; and (2) if piping systems that penetrate the containment are susceptible to thermal expansion of fluid so that overpressurization of piping could occur. A written summary report was requested within 120 days of the GL issuance, to include actions taken, conclusions reached, bases for continued operability of affected systems and components as applicable, and corrective actions taken or planned.

OPPD has evaluated applicable Fort Calhoun Station systems and components using the information contained in Generic Letter 96-06. The following report summarizes the results of that evaluation.

Containment Cooling Design

At Fort Calhoun Station (FCS), there are four containment air cooling units designed to operate in a post-accident situation. The two larger units are referred to as the containment air cooling & filtering units, which are equipped with HEPA and charcoal filters upstream of the air cooling coils. The two smaller units are known simply as the containment air cooling units, since they have no filtration capability upstream of the air cooling coils.

The containment air cooling & filtering units and the containment air cooling units are supplied with Component Cooling Water (CCW) to remove heat from containment during normal operating and accident conditions. The CCW system is a closed cooling water system which transfers heat from radioactive or potentially radioactive fluids to the ultimate heat sink (via the Raw Water system). The CCW system is equipped with a surge tank which has a nitrogen overpressure.

Heat removal by the containment air coolers is credited for maintaining containment peak pressure below the design value of 60 psig for a Main Steam Line Break (MSLB) scenario in which offsite power remains available and a single failure occurs in the feedwater system. If offsite power is lost, or the required feedwater system single failure does not occur, heat removal by any of the four containment air coolers is not required to keep peak containment pressure below 60 psig for the MSLB event. The peak containment pressure for the MSLB event occurs very early in the event. By the time containment spray is operating for a MSLB event, the peak containment pressure has passed. Once the containment spray system is operating, it reduces containment pressure substantially and heat removal by any of the four containment air coolers is no longer required for containment pressure reduction.

Heat removal by any of the four containment air coolers is not required to maintain containment peak pressure below 60 psig for the design basis Loss Of Coolant Accident (LOCA) as long as containment spray is available. The post-LOCA containment hydrogen generation analysis credits the availability of the containment air coolers for long-term containment heat removal after termination of containment spray; however, containment temperatures will be substantially below peak values during the long-term cooling phase.

The CCW system and containment air coolers are intended to function in a post-accident situation in spite of a Loss of Offsite Power (LOOP) occurring coincident with an accident. To accomplish this, the CCW pumps and containment air cooling fans are included in the Engineered Safeguards Features (ESF) loads served by the emergency diesel generators. If there is a LOOP coincident with a DBA, the equipment is started by the ESF sequencers after the emergency diesel generators have started and are ready to accept the ESF loads. Although the emergency diesel generators are maintained in a ready standby condition, they take approximately ten seconds to automatically start and reach the proper speed to supply ESF loads. After another 1-2 seconds to close the DG breakers, the ESF load sequence begins. The ESF loads are sequenced on the diesel generators in steps (i.e., load groups) so as not to load all safety-related equipment on the diesel generators at one time and cause a degraded voltage condition. CCW pumps AC-3A and AC-3B are in the first ESF load group (2.0-3.5 seconds), and AC-3C is in the second load group (7.5 - 11 seconds). The containment air cooling & filtering unit fans are in the third load group (15 - 21 seconds), and the containment air cooling unit fans are in the fifth load group (44 - 50 seconds).

One CCW pump is typically in service during normal plant power operation. At least one containment air cooling & filtering unit is usually in service during normal plant operation to provide cooling of the containment and recirculation/filtration of the containment atmosphere. Upon a loss of offsite power, the in-service CCW pump and containment air cooling & filtering unit fan(s) will coast down. The coastdown time of a CCW pump is approximately 7.6 seconds, and a cooling & filtering unit fan takes approximately one minute to coast down. (Times are based on field and control room instrument observations during the 1996 refueling outage.) Approximately twelve seconds after the LOOP, the emergency diesel generators will be operating, the DG breakers will be closed, and the automatic ESF load sequence will begin. CCW pumps AC-3A and AC-3B will automatically start on their respective diesel generators in the first ESF load group, which occurs 2.0-3.5 seconds after the automatic ESF load sequence begins. The maximum time interval between the LOOP and CCW pump restart is therefore 15.5 seconds. During the interval between the LOOP and the auto-start of the CCW pumps, the containment air cooling coils will be exposed to containment atmospheric conditions, which can involve an elevated temperature air/steam mixture for a LOCA or MSLB inside containment.

Waterhammer

OPPD utilized the services of consulting engineers (Sargent & Lundy) to perform heat transfer analysis for a loss of offsite power coincident with a LOCA or MSLB. This analysis reflected contemporaneous plant design and operating bases at FCS. Results of the heat transfer analysis indicated that the containment temperature response for the design basis LOCA would result in vaporization of CCW in the containment air cooling coils before restart of the CCW pumps, assuming 20 psig nitrogen overpressure in the CCW surge tank and 41" surge tank water level (the lower end of its normal operating range). For the same surge tank conditions, the heat transfer analysis for the design basis MSLB containment temperature response indicated that no vaporization would occur in the containment air cooling coils prior to CCW pump restart. Thus, the potential for waterhammer was limited to the LOCA scenario.

Condition Report 199601351 was generated during the 1996 refueling outage as a result of these findings. On November 11, 1996, a 4-hour report was made to the NRC per 10 CFR 50.72(b)(2)(i). This was followed up by Licensee Event Report 96-12, issued December 11, 1996.

Calculations performed by Sargent & Lundy indicate that for the LOOP/LOCA scenario, vaporization of CCW will not occur in the containment air cooling coils prior to CCW pump restart if CCW surge tank nitrogen overpressure is at least 32 psig (assuming tank water level of 41"). As interim corrective actions prior to startup from the 1996 refueling outage, OPPD implemented administrative and hardware changes to increase the minimum nitrogen overpressure in the CCW surge tank to 34 psig. Maintaining the required minimum pressure in the CCW surge tank precludes vaporization of CCW in the containment air cooling coils for the limiting LOOP/LOCA scenario, which in turn precludes waterhammer upon restart of the CCW pumps. Therefore, the containment air coolers and CCW system are considered to be operable based upon the minimum 34 psig pressure requirement for the CCW surge tank. This basis for operability was documented in Safety Analysis for Operability (SAO) No. 96-02. OPPD evaluated options for permanent corrective actions to prevent waterhammer in the CCW system. The elected option was to make permanent the use of increased CCW surge tank overpressure as described above, allowing cancellation of SAO No. 96-02. This was implemented prior to startup from the spring 1998 refueling outage.

Two-Phase Flow

With regard to two-phase flow, OPPD has determined that subcooled conditions would exist at the exit of the containment air coolers under post-DBA operating conditions. The containment air cooling & filtering units are located at a significantly higher elevation than other components in the CCW system; therefore, the minimum subcooling margin exists at the exits of those units. CCW flow from the containment air coolers is not throttled during post-accident operation, because the isolation valves receive an auto-open accident signal. For conservatism, the subcooling assessment assumed substantially degraded CCW pump hydraulic performance and subcooling was determined with respect to peak post-DBA CCW temperatures. CCW system alignments in the injection (short-term) and recirculation (long-term) post-accident phases were addressed, including effects of loss of instrument air and a single failure of an emergency diesel generator or loss of the CCW surge tank nitrogen blanket. Subcooling margin will increase as the containment temperature and CCW exit temperature from the air coolers decreases.

OPPD has identified no two-phase flow conditions after a DBA for the CCW system and containment air coolers which would adversely affect their ability to perform their credited accident-mitigating function.

Overpressure of Piping

During OPPD's Design Basis Reconstitution effort which began in the late 1980s, issues were identified involving the potential for thermal overpressure due to heatup of liquid between closed containment isolation valves. These issues were tracked by Open Items for the Auxiliary Feedwater and the Containment Design Basis Documents (DBD). Details and resolution of the Auxiliary Feedwater issue were reported in Licensee Event Report 90-09. OPPD performed an engineering analysis (EA-FC-90-082) to document review of possible overpressurization in water-filled containment pipe penetrations due to a large heat load accident inside containment. The Containment DBD open item was closed based on EA-FC-90-082.

EA-FC-90-082 contains an itemized evaluation of mechanical containment penetrations. Revision 2 of this engineering analysis demonstrates compliance with existing USAR Appendix F, Table F-1 stress criteria for primary membrane and bending stresses. The analysis concludes that the structural integrity of the piping pressure boundary will be maintained during the post-DBA temperature transient, thereby resolving the issue pertaining to potential overpressure of containment piping penetrations at Fort Calhoun Station.