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United States Nuclear Regulatory Commission
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Subject: River Bend Station
Docket No. 50-458
License No. NPF-47
Additional Information Related to NRC Generic Letter 96-06 (TAC M96858)

Reference: Letter from Entergy Operations, Inc. to NRC dated November 12, 1998, "Response to Request for Additional Information Related to NRC Generic Letter 96-06," RBG-44722

File Nos.: G9.5, G9.33.4

RBF1-01-0100
RBG-45728

Ladies and Gentlemen:

This letter provides additional information concerning water hammer and two-phase flow issues related to NRC Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions." The questions in this letter are related to the response to Question 1 in the referenced letter. River Bend Station's responses to your questions are contained in the attachment to this letter. This letter contains no commitments.

If you have any questions, please contact David Lorfing at (225) 381-4157.

Pursuant to 28 U.S.C.A. Section 1746, I declare under penalty of perjury that the foregoing is true and correct.

Executed on May 1, 2001.

Sincerely,

Rick J. King

RJK/dnl
Attachment

A072

cc: Mr. Robert E. Moody, NRR Project Manager
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**Question a**: With regard to Question 1 and restoration of chilled water to the containment unit coolers: For the accident scenarios of interest, are there any circumstances where the chilled water system would be restored to the non-safety related containment cooler? If so, describe when this would occur and the restoration steps that are included in the SOPs and followed to prevent the occurrence of condensate-induced waterhammer.

**Response a:**

Review of the Emergency Operating Procedures (EOPs) indicates that no instructions are provided for operating the non-safety related containment unit cooler. Chilled water is the only cooling water supply to the non-safety related containment unit cooler. It is isolated on a containment isolation (reactor level 2 / high drywell pressure) signal. Because there is no cooling water supply for the non-safety related containment unit cooler in an accident, it is not considered to be an available method for containment cooling. Thus, for the accident scenarios of interest, there are no circumstances where chilled water would be restored to the non-safety related containment cooler during the event.

**Question b**: During the accident scenarios of interest describe under what circumstances cooling water flow would be restored to the drywell coolers. Provide a detailed analysis (including bounding assumptions) of the worst-case condensate-induced waterhammer transient that could occur given the system conditions.

**Response b:**

In the event of a Loss of Coolant Accident (LOCA), the drywell unit coolers are automatically isolated. EOPs direct that the drywell unit coolers be manually placed in service when drywell temperature exceeds 145 degrees F. Previous evaluations indicated that the drywell unit coolers are susceptible to voiding at drywell temperatures exceeding 200 degrees F. As a result, the EOPs have been revised to prohibit manually placing the drywell unit coolers in service after drywell temperatures have exceeded 200 degrees F. EOPs continue to allow alignment of cooling water prior to reaching 200 degrees F during an event. If cooling water flow is established prior to reaching 200 degrees F, the unit cooler is allowed to remain in service independent of drywell temperature.

**Question c**: During a LOCA scenario, what is the longest time period for transitioning from chilled water to normal service water for cooling the safety-related containment coolers? During this time period, what is the minimum pressure that is reached in the containment cooler cooling coils and piping assuming the worst case failure? How does the saturation temperature at this pressure compare with the maximum containment temperature that is reached during this time period? If steam is expected to form in the safety-related containment cooler tubes and piping, provide a detailed analysis (including bounding assumptions) of the worst-case condensate-induce waterhammer transient that could occur given the system conditions.

Note: With regard to the condensate-induced waterhammer analyses that are referred to in (c) and (d), it is only necessary to provide the worst-case analysis that would be bounding for both situations.

**Response c:**

For the purposes of this response, the transition time from chilled water to service water is defined as the time from the chilled water valves reaching full closed to the service water valves starting to open. In order to maximize this transition time, the minimum (fastest) stroke time of the chilled water valves is used.

The chilled water motor operated containment isolation and safety related to non-safety related piping interface valves are signaled to close upon receipt of a reactor level 2 (L2) or a high drywell pressure (HDP) signal. The unit cooler service water supply and return motor operated valves are signaled to open on reactor level 1 (L1) or an HDP signal with a 60 second time delay.

For a main steam line break and a recirculation line break, high drywell pressure occurs at the same time as the scram, or "t" equals 0. The chilled water containment isolation valves are fully closed at "t" equals 21.1 seconds. The service water supply and return valves to the unit coolers begin to open at "t" equals 60 seconds, giving a transition time of 38.9 seconds. Alternatively, using only reactor level signals, an L2 occurs at "t" equals 3 seconds and the chilled water containment isolation valves are closed at "t" equals 24.1 seconds. An L1 signal occurs at "t" greater than or equal to 6 seconds with the service water supply and return valves opening at "t" equals 66 seconds. This provides a transition time of 41.9 seconds. The maximum containment temperature from "t" equals 0 to "t" equals 200 seconds is less than or equal to 125 degrees F. The minimum pressure in the unit coolers when chilled water is isolated is greater than or equal to 87 psig. The minimum pressure in the unit cooler coils when supplied by service water is greater than or equal to 66 psig.

The saturation temperature of water at 66 psig is 298.8 degrees F. As the containment temperature is significantly less than the saturation temperature, there will be no vapor formed in the containment unit coolers. The single component failures listed in the Failure Modes and Effects Analysis (FMEA) were reviewed. The effect of worst case single component failures is a loss of function of the associated unit cooler. Should a single failure occur, the other redundant 100 percent capacity unit cooler would be used to provide heat removal. Thus, any pressure reduction in the out of service unit cooler would not result in a water hammer event, as this unit would not be used.

**Question d**: During a LOCA with loss-of-offsite power, what is the longest time period for transitioning from chilled water to standby service water? During this period of time, what is the minimum pressure that is reached in the containment cooler cooling coils and piping assuming the worst case failure? How does the saturation temperature at this pressure compare with the maximum containment temperature that is reached during this time period? If steam is expected to form in the safety-related containment cooler tubes and piping, provide a detailed analysis (including bounding assumptions) of the worst-case condensate-induced waterhammer transient that could occur given the system conditions.

**Response d:**

For the purposes of this response, the transition time from chilled water to standby service water is defined as the time from the chilled water valves reaching full closed to the service water valves starting to open. In order to maximize this transition time, the minimum (fastest) stroke time of the chilled water valves is used.

The longest transition time from chilled water to standby service water for a LOCA with a loss-of-offsite power (LOP) is 38.9 seconds. The transition from chilled water to standby service water begins at "t" equals10 seconds, rather than at "t" equals 0 seconds as described in the response to question "c." The containment unit cooler service water supply and return valves, and the last started standby service water pump discharge valves begin to open at "t" equals 70 sec. The maximum containment temperature from "t" equals 0 to "t" equals 200 seconds is less than or equal to 125 degrees F.

The minimum pressure in the containment unit cooler coils and connecting piping prior to opening the service water supply and return valves is 5 psig. The minimum pressure in the service water piping is greater than 4 psia without crediting operation of the air injection system. The saturation pressure of water at 125 degrees F is 1.958 psia. As the pressure in the unit cooler coils, connecting piping and service water piping is greater than the saturation pressure, there will be no vapor formed in the containment unit coolers and no condensate induced water hammer.

Based on a recently revised FMEA for the standby service water (SSW) system, the worst case scenario with respect to a LOP-LOCA is a failure of the Division I diesel generator. This causes valves SWP-MOV4A and SWP-MOV5B to fail in the open position, and allows flow through the drywell unit coolers upon a start of the Division III SSW pump, SWP-P2C. This is postulated to cause a pressure transient on the drywell unit coolers and the downstream piping due to condensate induced water hammer. This resultant pressure transient is identical to that described in our referenced 1998 letter. Our evaluation indicates that the magnitude of this transient is bounded by the case of simultaneous starting of two SSW pumps with air present in the system, which is part of the current system design basis. Additional analysis is ongoing and being tracked in the corrective action program. Because of the functioning of the Division II air injection system, there is no adverse impact anticipated to the operation of the Division II containment unit cooler.

This pressure transient is primarily a concern with respect to ultimate heat sink (UHS) inventory, should the drywell unit cooler fluid boundary fail. This would be detected by a SSW flow mismatch or decrease in UHS inventory. Procedural provisions for monitoring these parameters are in place.