Entergy

Entergy Operations, Inc.
River Bend Station
5485 U.S. Highway 61
P. O. Box 220
St. Francisville, LA 70775
Tel 225 336 6225
Fax 225 635 5068

Rick J. King
Director
Nuclear Safety Assurance

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United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

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

Reference: 1) 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
2) Letter from Entergy Operations, Inc. to NRC dated May 1, 2001, "Additional Information Related to NRC Generic Letter 96-06," RBG -45728

File Nos.: G9.5, G9.33.4
RBF1-02-0008
RBG-45915

Ladies and Gentlemen:

This letter provides additional information concerning water hammer issues related to NRC Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions." References 1 and 2 provided response to NRC's request for additional information for this Generic Letter. In Reference 2, Entergy Operations, Inc. (EOI) discussed an ongoing evaluation associated with a (then) newly discovered potential to induce water hammer loads on the drywell unit coolers under certain post-accident scenarios. Attachment 1 to this letter provides EOI's original response related to this issue, as initially provided to NRC in Reference 2. Following review of Reference 2, NRC verbally requested to be advised of the results of the drywell unit cooler evaluation. This evaluation has been completed, and a summary of the results is contained in the Attachment 2. This letter contains no commitments.

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

I declare under penalty of perjury that the foregoing is true and correct.
February 19, 2002

Sincerely,

RJK/dnl
Attachments

cc: Mr. David J. Wrona, NRR Project Manager
U.S. Nuclear Regulatory Commission
M/S OWFN / 7D-1
Washington, DC 20555

NRC Resident Inspector
P.O. Box 1050
St. Francisville, LA 70775

U.S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

Note: "Question d" and "Response d" (below) were originally provided to NRC on May 1, 2001 (Reference 2). This information is repeated here for information only. Drywell unit coolers were discussed in "Response d," including a reference to ongoing analysis.

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.

<u>Summary of Drywell Unit Cooler Analysis</u>

Analysis of the impact of a LOP-LOCA event, with a postulated failure of the Division I diesel generator, on the drywell unit coolers and associated piping and valves has been completed This analysis included an evaluation of system response based on the sequence of events following the initiating event, calculation of heat transfer to the system during the event, calculation of pressurization in the system components, and an evaluation of the impact of pressurization on the structural integrity of the system components.

Due to the sequence of events and system response following the LOP-LOCA, there will be no service water flow in drywell piping and components for the first 40 seconds of the event. During this period, drywell temperature will rise to approximately 330° F. The objective of this analysis is to determine: a) if service water temperature reaches the boiling point during the event; b) void volume due to boiling; c) water hammer force generated due to the start of the Division III standby service water pump SWP-P2C; and d) the effect of water hammer force on the drywell unit coolers, piping and components.

Heat transfer due to convection, radiation and condensation was calculated. Due to the short period of the transient, voiding will occur only in the drywell unit cooler coil tubes. The methodology of NUREG/ CR-5220, Creare TM-1189 Vol. 1, "Diagnosis of Condensation-Induced Water Hammer" was applied, and a water hammer overpressure of 1,262 psi was calculated.

Piping inside the drywell was analyzed using equations 8 and 9 of ASME Code Section III Subsection ND. For the pressure surge of 1,262 psi; the calculated stress does not exceed the allowable faulted stress condition.

Drywell service water isolation valves were analyzed for 1,500 psi, and resulting stresses were found to be acceptable. Using the existing Seismic Stress Report Methodology for the relief valves in the system, a pressure surge of 1,262 psi was applied. The result indicates the maximum primary membrane stress is substantially smaller than the allowable stresses, thus meeting the requirements of ASME Section III, Appendix I.

Drywell unit cooler major components (tubes, header/nozzle, end plate, vent/drain, tube support, side casing and return bend) were analyzed for a pressure surge of 1,262 psi. The stresses did not exceed the allowable faulted stress condition for any of these components.

In summary, the analysis demonstrates that the water hammer force created by this scenario will not affect structural integrity of the drywell unit coolers, piping and components. Based on this analysis, the scenario will not result in a loss of ultimate heat sink (UHS) inventory or drywell leakage. Should a scenario actually occur that results in pipe or component failure, operator response based on system instrumentation and procedural guidance ensures a secure UHS basin inventory. In addition, system lineup and a higher standby service water system pressure will prevent any leakage from the drywell atmosphere to the environment during a postulated failure of this type.