Entergy Nuclear South
Entergy Operations, Inc.
17265 River Road
Killona, LA 70057-3093
Tel 504 739 6685
Fax 504 739 6698
wsteelm@entergy.com

William J. Steelman
Acting - Licensing Manager
Waterford 3

W3F1-2010-0071

September 7, 2010

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Response to NRC Request for Additional Information Re: Nine-Month Supplemental (Post-Outage) Response to NRC Generic Letter 2008-01
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

REFERENCES:
1. NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," dated January 11, 2008. 2.
2. Entergy Letter W3F1-2008-0068 to the NRC, "Nine-Month Response to NRC Generic Letter 2008-01, Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," Dated October 14, 2008.
3. Entergy Letter W3F1-2010-0017 to the NRC, "Nine-Month Supplemental (Post-Outage) Response to NRC Generic Letter 2008-01," dated March 4, 2010.

Dear Sir or Madam:

By letter dated March 4, 2010, Entergy Operations, Inc (Entergy) provided the nine month supplemental response (Reference 3) to NRC Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling Decay Heat Removal, and Containment Spray Systems," (Reference 1). On July 29, 2010, the NRC issued a request for additional information (RAI) related to the responses (References 2 and 3) to the Generic Letter. The attachment to this letter provides the requested response to the RAI.

This letter contains no new NRC commitments.

Please contact Mr. William J. Steelman, acting Manager, Licensing at (504) 739-6685 if there are any questions concerning this matter.

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NRR

Sincerely,

WJS/MEM

Attachment: Entergy's Response to NRC Request for Additional Information

cc: Mr. Elmo E. Collins, Jr.
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
612 E. Lamar Blvd., Suite 400
Arlington, TX 76011-4125

NRC Senior Resident Inspector
Waterford Steam Electric Station Unit 3
P.O. Box 822
Killona, LA 70066-0751

U. S. Nuclear Regulatory Commission
Attn: Mr. N. Kalyanam
Mail Stop O8B1
Washington, DC 20555-0001

Attachment to

W3F1-2010-0071

Entergy's Response to NRC Request for Additional Information

REQUEST FOR ADDITIONAL INFORMATION

References:

1 Ruland, William H. "Preliminary Assessment of Responses to Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," and Future NRC Staff Review Plans," NRC letter to James H. Riley, Nuclear Energy Institute, ML091390637, May 28, 2009.

2 Riley, James H., "Generic Letter (GL) 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," Evaluation and 3 Month Response Template, "Letter to Administrative Points of Contact from Director, Engineering, Nuclear Generation Division, Nuclear Energy Institute, Enclosure 2, "Generic Letter 2008-01 Response Guidance," March 20, 2008.

The NRC staff recommended that the licensee consult Reference 1 (above) when responding to the following RAIs:

1. Discuss the surveillance criteria, surveillance methods, and surveillance locations for emergency core cooling system (ECCS), shutdown cooling system, and containment spray systems.

Entergy Response:

Periodic surveillance of the Emergency Core Cooling System (ECCS), the Shutdown Cooling System (SDC) and the Containment Spray (CS) systems is performed at Waterford 3 under OP-903-026, "Emergency Core Cooling System Valve Lineup Verification." In compliance with Technical Specification Surveillance Requirement 4.5.2.b.2, the ECCS piping is verified to be full of water at least once per 31 days.

At Waterford 3, the Shutdown Cooling System (SDC) is comprised of portions of the Low Pressure Safety Injection (LPSI) system, and the Shutdown Cooling Heat Exchanger, which is normally aligned to Containment Spray (CS), and the suction header from the Reactor Coolant System (RCS). Portions of the SDC suction header are included in the monthly surveillance conducted to verify the ECCS piping is full of water.

This verification is performed per Operation's Surveillance OP-903-026, which originally began performing periodic Ultra Sonic (UT) and manual venting in 1997 to address gas accumulation concerns. The acceptable gas volume criteria were established by completion of ER-W3-2002-468-000, Design LPSI Train "A" Discharge Piping for Voids, EC-P02-004, Water Hammer Analysis – LPSI "A" for ECCS train 'A', ER-W3-2003-0112-000, Design LPSI Train "B" Discharge Piping for Voids, EC-M97-002, Water Hammer Analysis – LPSI "B", and EC-13044, Determine Allowable Void Size Below SI-407A(B) For Incorporation Into OP-903-026. These allowable values are also included in the Operations Surveillance procedure OP-903-026. The following information documents the acceptable gas volume criteria:

- For LPSI A discharge
  - (For "Operable") A 0.7 ft^3 gas accumulation in each injection leg (at SI-133A and SI-1402A) and a 0.7 ft^3 gas accumulation in each injection leg (at SI-134A and SI-1412A) is acceptable as evaluated by ER-W3-2002-0468-000, Section 3.1, and Page 7, "Pressure Spike". This allowable applies to pump discharge piping in both the injection mode and in the Shutdown Cooling mode of operation. The specified allowable gas accumulation size is limited by the hydraulic transient force which would exceed the set pressure of relief valve SI-132A during shutdown cooling (pump discharge).

  - (For "Operable but Degraded") A 4 ft^3 gas accumulation was determined to be acceptable for the "A" loop per CR-WF3-2002-0818 and ECP-02-004. The 4 ft^3 gas accumulation may be at each penetration (38 and 39) or at each high point vent (SI-133A and SI-134A) simultaneously, but the total for each leg is still limited to 4 ft^3 total. This allowable applies to pump discharge piping in both the injection mode and in the Shutdown Cooling mode of operation.

- For LPSI B discharge,
  - (For "Operable") A 0.80 ft^3 "total" for discharge piping and the combined total of each injection leg is acceptable as evaluated by ER-W3-2003-0112-000, Page 7, "Pressure Spike". This allowable applies to pump discharge piping in both the injection mode and in the Shutdown Cooling mode of operation. The specified allowable gas accumulation size is limited by the hydraulic transient force which would exceed the set pressure of relief valve SI-132B during shutdown cooling (pump discharge).

  - (For "Operable but Degraded") A 1.802 ft^3 gas accumulation at Penetration 36 or 1.229 ft^3 gas accumulation at Penetration 37 was determined to be acceptable for the B train per ECM97-002. This allowable applies to pump discharge piping in both the injection mode and in the Shutdown Cooling mode of operation.

- For SDC train A suction line, the water level can be no lower than 8 feet below the disc of outside containment isolation valve.
  - Calculation ECM03-003, Shutdown Cooling Operations with Air Intrusion, evaluates normal operation and Loss of Coolant Accident (LOCA) (small break) with and without Reactor Coolant Pumps and finds that a maximum allowable gas accumulation size of 37.4 ft^3 at SI-405 (suction side for Shutdown Cooling) was acceptable.

- For SDC train B suction line, the water level can be no lower than 12 feet below the disc of outside containment isolation valve.
  - calculation ECM03-003 evaluates normal operation and LOCA (small break) with and without Reactor Coolant Pumps and finds that a maximum allowable gas accumulation size of 37.4 ft^3 at SI-405 (suction side for Shutdown Cooling) was acceptable

- For those areas not listed above the acceptance criteria is no gas accumulation.

- High Pressure Safety Injection (HPSI) has not historically been a system at Waterford which has experienced gas accumulation in either pump discharge or suction piping; therefore no allowable gas accumulation sizes have been calculated. Gas accumulation in the HPSI system pump suction has been evaluated as "Not a credible failure mechanism due to Refueling Water Storage Pool (RWSP) supply and system/injection operation" per CR-WF-2008-4161.

- For CS, the pump discharge was evaluated to be not susceptible to gas intrusion per the Pressurized Water Reactor Owners Group (PWROG) calculation FAI/08-78, Methodology for Evaluating Water-hammer in the Containment Spray Header and Hot Leg Switchover Piping, and EC-10775, Perform Plant-Specific Evaluation of Containment Spray Ring Header Piping in Accordance with PWROG Guidance Provided in Calculation FAI/08-78, no allowable gas accumulation sizes have been calculated. For gas accumulation to form in this piping, there would have to be leakage past the Containment Isolation Valves CS-125A (B) with only head pressure motive force, or gas accumulation would have to migrate from the Safety Injection Tanks (which is monitored for gas accumulation at LPSI injection), through the Shutdown Cooling Heat Exchangers and into the Containment Spray Pump discharge piping.

1. PWROG calculation methodology FAI/08-78, Methodology for Evaluating Water-hammer in the Containment Spray Header and Hot Leg Switchover Piping, and EC-10775, Perform Plant-Specific Evaluation Of Containment Spray Ring Header Piping In Accordance With PWROG Guidance Provided In Calculation FAI/08-78.

    - For CS, the pump suction piping in the injection mode (from the RWSP) is not likely to be susceptible to gas intrusion during normal system operation since there are no drivers for gas accumulation in this piping except for maintenance during fill and vents; therefore no allowable gas accumulation sizes have been calculated.

Operations Surveillance procedure OP-903-026, provides operations with guidance to perform UT Surveillance of the locations, or to manually vent the locations. The use of UT for the performance of the surveillance is preferred such that an accurate measurement of the gas accumulation can be made. A review of the periodic surveillances conducted by operations indicates that operators predominantly utilize the UT method for the surveillance.

Operations has been qualified on the use of UT Equipment which is utilized for the UT surveillance method. The UT equipment is utilized to determine if there is a gas/water interface in the piping. If there is an interface, a gas accumulation exists, and the arc length of the gas accumulation is measured in horizontal piping. In vertical piping the distance from the interface to a specific point is measured and the volume calculated. The gas accumulation volume is dependent upon the pipe diameter, pipe thickness, length of pipe at the location and the arc length. As such, a table is provided in OP-903-026 which relates an arc length to gas accumulation volume, based upon the location where the gas accumulation was found.

The performance of periodic UT or manual venting of the ECCS piping began in 1997 to address gas accumulation concerns. The surveillance locations in OP-903-026 are areas known to have historically contained gas volumes, as well as areas that have the potential for containing gas volumes due to the system piping configuration.

The surveillance procedure includes the following locations:

- Cold leg injection lines at the containment penetrations for both LPSI and HPSI. These locations are between the injection flow control valve and the inside containment check valves.
- HPSI pump discharge headers at the high point
- LPSI pump discharge headers at the high point
- The SDC suction piping downstream of the outside containment isolation valve. This valve is in a vertical run of piping, and gas can accumulate below the valve.
- LPSI SDC warm-up line piping
- HPSI and CS suction from the Safety Injection Sump

As noted above, the CS pump suction piping in the injection mode (from the RWSP) is not likely to be susceptible to gas intrusion during normal system operation since there are no drivers for gas accumulation in this piping except for maintenance during fill and vents. The pump discharge and spray header piping from the containment isolation valves to the spray nozzles was determined not to be susceptible to gas intrusion per PWROG calculation methodology FAI/08-78 and EC-10775. The CS system is not a system with gas overpressures, and is not aligned with a pressurized system (such as Safety Injection Tanks) inside containment. There are no known drivers for gas intrusion and accumulation in the system during normal operation of the plant; therefore, these locations are not included in the periodic surveillance of ECCS piping discussed above.

Waterford 3 has experienced gas accumulation in the Containment Spray (CS) system specifically related to the use of the Shutdown Cooling Heat exchanger during plant outages (as evaluated and corrected in CR-WF3-2002-1539). Removal of gas/gas entrained water from the affected piping is accomplished through the use of System Operating Procedure OP-009-001, "Containment Spray" as identified in ER-WF3-2005-0491-000, "Recommended Reduction in Venting Following SDC Train Operation". The removal of gas entrained water and gas accumulations is required to be performed when Containment Spray has been restored to service from Shutdown Cooling operations in accordance with System Operating Procedure OP-009-005, "Shutdown Cooling". A series of flushes and UT/venting of the CS and LPSI Systems is utilized to remove this gas entrained water from the systems and is included in model work orders.

Following these evolutions, no additional monitoring is conducted, unless specifically requested due to system monitoring and parameters. A review of the drivers for gas accumulations in a system shows that gas accumulations in the CS discharge piping is not likely to occur, and therefore these locations are not included in the periodic surveillance.

2. Discuss the pump void acceptance criteria for ECCS, shutdown cooling system, and containment spray systems.

Entergy Response:

For SDC operation, the void acceptance criteria have been established to protect the LPSI pump which is utilized for SDC. Calculation ECM03-003 evaluates normal operation and small break LOCA with and without Reactor Coolant Pumps and finds that a maximum allowable gas accumulation size of 37.4 ft^3 at the suction side for SDC is acceptable. This gas accumulation will be compressed by Reactor Coolant System pressure when SDC suction valves are opened, resulting in a void measuring 2.8 ft^3. This gas void will not be sufficient in size to statically gas bind the system, which would "starve" the LPSI pump and lead to gas binding of the pump. This calculation is currently being reviewed and updated due to system modifications. Changes to this calculation will consider the below noted industry guidance for pump acceptance criteria. For the ECCS and CS, no gas is allowed in the suction piping.

Waterford 3 intends to establish pump void acceptance criteria, when necessary, with Engineering Change Evaluations and/or an Engineering Calculation. The criteria used in these evaluations should not exceed generally accepted limits as established by the Westinghouse Electric Co., WCAP-16631-NP Rev 0 Volumes 1 & 2, "Testing and Evaluation of Gas Transport to the Suction of ECCS Pumps", and WCAP-17271 Rev 0 Volumes 1, 2 and 3, "Air Water Transport in large Diameter Piping Systems: Analysis and Evaluation of Large Diameter Testing Performed at Purdue University Volumes 1 – 3" and NEI 09-10, "Guidelines for Effective Prevention and management of System Gas Accumulation". Waterford 3 intends to analyze any deviations from the criteria established by the industry documents in the Engineering Change and/or an Engineering Calculation. In addition, Entergy follows industry activities related to the development of acceptance criteria on allowable gas volume limits for pumps and piping. As new industry information becomes available, Waterford 3 intends to evaluate the need for revised acceptance criteria in established calculations.

3. **Training was not identified in the GL 2008-01 but is considered to be a necessary part of applying procedures and other activities when addressing the issues identified in the GL 2008-01. Briefly discuss training.**

Entergy Response:

Nuclear Energy Institute (NEI) has recently developed training slides for gas accumulation specifically for Engineering, Operations and Maintenance. Waterford-3 has issued Training Evaluation Action Requests for each of the departments to evaluate the NEI developed training slides, and to incorporate as necessary into the training program.

Historically, training has been provided as understanding of this issue has evolved. For Engineering, Lesson Plan W3-SEM-ESPC-98100 covered Significant Operating Experience Report (SOER) 97-01, "Potential Loss of High Pressure Injection and Charging Capability from Gas Intrusion," which addressed potential to gas bind pumps providing safety injection or boron injection function and additional design, operating and maintenance issues that have resulted in actual or potential gas intrusion events, in continuing training in 1998. The SOER 97-01 is also included in initial training lesson plan W3-LP-ESPO-INEXP and the

Entergy Operations Incorporated (EOI) Operating Experience workbook includes training for SOER 97-01 in initial training for new engineers. Additionally, the SOER was added to the Engineering Support Personnel Program Guide TQ-104 to evaluate periodically for continuing training need. As a result of Significant Event Report (SER) 2-05, Gas Intrusion in Safety System, additional training was provided in Engineering Support Personnel Program Engineering Cycle Training in 2008, discussing SER 2-05, Generic Letter 2008-01 and SOER 97-01.

SOER 97-01 has been incorporated into the Chemical Volume Control lesson plan W-3-LP-OPS-CVC00, used for initial and re-qualification training for operations.

SOER 97-01 has been incorporated into the Swagelok lesson plan W-3-LP-GMAD-0000 since some of the plant instrumentation susceptible to this issue are installed using this type fitting. Continuing training on this SOER is provided in lesson plan W-3-LP-GMCT-001, Shutdown Cooling, for maintenance and craft personnel prior to every refueling outage.