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W3F1-2010-0083

November 23, 2010

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

SUBJECT: Supplemental Response to NRC Requests for Additional Information Regarding License Amendment Request for Leak-Before-Break of the Pressurizer Surge Line
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

REFERENCES:
1. W3F1-2010-0003, Entergy letter dated February 22, 2010, "License Amendment Request for Approval of Leak-Before-Break of the Pressurizer Surge Line" (ADAMS Accession No. ML100550606).
2. W3F1-2010-0064, Entergy Letter Dated August 12, 2010, "Response to NRC Requests for Additional Information Regarding License Amendment Request for Leak-Before-Break of the Pressurizer Surge Line" (ADAMS Accession No. ML102300176).

Dear Sir or Madam:

In letter dated February 22, 2010 (Reference 1), Entergy Operations, Inc. (Entergy) requested NRC review and approval of a proposed license amendment request to eliminate the dynamic protection requirements for the Waterford Steam Electric Station, Unit 3 (Waterford 3) pressurizer surge line. This request was prepared in accordance with General Design Criterion (GDC) 4, "Environmental and Dynamic Effects Design Bases" using the guidance of Standard Review Plan (SRP) 3.6.3, "Leak-Before-Break Evaluation Procedures" (NUREG-0800). The Waterford 3 pressurizer Leak-Before-Break (LBB) surge line analyses were provided in Westinghouse WCAP-17187-P, "Technical Justification for Eliminating Pressurizer Surge Line Rupture as the Structural Design Basis for Waterford Steam Electric Station, Unit 3 Using Leak-Before-Break Methodology."

On April 21, 2010, the NRC staff issued a request for additional information to Entergy in order to complete review of the license amendment request. Entergy provided responses to the NRC requests for additional information on August 12, 2010 (Reference 2). On September 15, 2010, the NRC provided an additional request for additional information containing two questions associated with the Waterford 3 leakage detection system. A

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conference call was conducted on October 25, 2010, with the NRC regarding the proposed responses. A meeting was subsequently conducted between Entergy and the NRC Staff on November 10, 2010 at NRC headquarters. Based on the proposed resolutions discussed in the November 10th meeting, Entergy is providing a response to the subsequent request for additional information as contained in Attachment 1.

The letter contains no new commitments and no information that is proprietary. If you have any questions or require additional information, please contact William J. Steelman at 504-739-6685.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 23, 2010.

Sincerely,

JAK/SAB

Attachments:
1. Supplemental Response to NRC Requests for Additional Information for License Amendment Request Regarding Leak-Before-Break of the Waterford 3 Pressurizer Surge Line

cc: Mr. Elmo E. Collins, Jr.
Regional Administrator
U. S. Nuclear Regulatory Commission
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NRC Senior Resident Inspector
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U.S. Nuclear Regulatory Commission
Attn: Mr. N. Kalyanam
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Attachment 1 to

W3F1-2010-0083

Supplemental Response to NRC Requests for Additional Information for License Amendment Request Regarding Leak-Before-Break of the Waterford 3 Pressurizer Surge Line

Supplemental Response to NRC Requests for Additional Information for License Amendment Request Regarding Leak-Before-Break of the Waterford 3 Pressurizer Surge Line

The NRC Plant Systems Branch issued a Request for Additional Information (RAIs) on September 15, 2010 as formalized on October 27, 2010, regarding Entergy's February 22, 2010 application to amend the Waterford 3 operating license for the elimination of dynamic affects of the Waterford 3 surge line based on the requirements of General Design Criteria (GDC) 4. The following provides Entergy's response to this NRC request. A NRC public meeting was conducted on November 10, 2010 regarding the Waterford 3 Pressurizer surge line leak-before-break license amendment request. Responses to NRC Questions raised during this meeting are also addressed.

NRC RAI 1

The licensee proposed crediting leak detection capabilities beyond those specified in RG 1.45 (e.g., sensitivity of 0.25 gallons per minute) without adequate supporting analysis.

Response to NRC RAI 1

In compliance with Standard Review Plan (SRP) 3.6.3 for meeting the Waterford 3 pressurizer surge line leak-before-break (LBB) requirements under GDC 4, Entergy credits a combination of containment sump level instrumentation and the procedurally controlled reactor coolant system (RCS) leakage monitoring program. The containment sump level instrumentation which includes a computer point on the Plant Monitoring Computer (PMC) is credited as one of the leakage detection instruments under Technical Specification (TS) Limiting Condition for Operation (LCO) 3.4.5.1. The application of the RCS leakage detection and leakage monitoring processes are consistent with the guidance of Regulatory Position C of Regulatory Guide (RG) 1.45 (Revision 1). The combination of these processes provides diverse means of detecting potential RCS unidentified leakage for a 0.25 gpm throughwall leak consistent with the analysis results per SRP 3.6.3.

In the February 22, 2010 license amendment request, Entergy discussed the sensitivity of the containment sump level computer point. Reference 9 in Attachment 2 of this letter provided details of an evaluation that was performed under Engineering Report (ER) W3-2004-0396-000 that discussed the ability of the containment sump level computer point to meet the one gpm per hour criteria for TS LCO 3.4.5.1. Waterford 3 License Amendment 197 (ADAMS Accession No. ML042150057) was issued on July 30, 2004 based on this containment sump level computer point being an acceptable instrument for detection of RCS leakage. A subsequent internal revision to the ER showed that the computer point has a sensitivity of $\leq$ 0.25 gpm. A summary of the evaluation was provided in the response to question N-1 of the NRC requests for additional information which was provided in our August 12, 2010 letter. Details of the Waterford 3 leakage monitoring program for trending and responding to RCS leakage at or below 0.1 gpm is based on the Pressurized Water Reactor Owners Group (PWROG) guidelines (WCAP-16465) which was also discussed in our February 22, 2010 license amendment request.

Entergy believes that based on our correspondence of February 22, 2010 and August 12, 2010, sufficient details have been provided to substantiate the Waterford 3 RCS leakage detection capability for complying with RG 1.45 (Revision 1) per SRP 3.6.3.

NRC RAI 2

Also, these capabilities were not proposed for inclusion as a Technical Specification LCO as required by Criterion 1 of 10 CFR 50.36(c)(2).

Response to NRC RAI 2

In order for a structure, system, or component to be governed by the TSs, it must meet one or more of the four criterion established in 10 CFR 50.36(c)(2)(ii). The current leakage detection system (LDS) capability under TS LCO 3.4.5.1 is provided to meet GDC 30 for minimizing the probability of rapidly propagating piping failures attributable to material degradation and gross rupture of the reactor coolant pressure boundary (RCPB). Since not all RCPB piping system materials, loads, and stresses have been analyzed to ensure that a flaw will not rapidly propagate to a rupture under LBB, this TS LCO is provided to mitigate the potential for a pipe rupture that could lead to a loss of coolant accident (LOCA).

The analyses performed under SRP 3.6.3 for compliance with GDC 4 requires that the design basis considerations of the piping segment be applied with certain analytical margins. These margins include a factor of 2 between the critical flaw size and the analyzed leakage flaw size (2.5 gpm) and an uncertainty margin of 10 for the calculated leak rate from the leakage flaw to establish a leak detection capability (0.25 gpm). This is reported in WCAP-17187-P as contained in the February 22, 2010 license amendment request. The analyses performed for these margins establish new design basis requirements for meeting the LBB assumptions under GDC 4. However, as discussed below these design requirements do not necessitate the need for a new TS limit since the existing TS LCO 3.4.5.2 limit of 1.0 gpm unidentified leakage rate appropriately bounds the analytical results (2.5 gpm) for compliance with GDC 4.

A leakage flaw is considered to be stable as long as the flaw does not enter a plastic material stress state where the leakage flaw could unpredictably propagate to a critical flaw that could lead to a LOCA. WCAP-17187-P reports the analyzed leakage flaw and critical flaw sizes in Tables 8-1 through 8-3. WCAP-17187-P demonstrates that a leakage flaw of 2.5 gpm will remain structurally stable, but does not specifically predict the period of time it would take for a leakage flaw to progress to a critical flaw. A study was performed in EPRI Materials Reliability Program (MRP)-109, *Alloy 82/182 Pipe Butt Weld Safety Assessment for US PWR Plant Designs* (January 2005), that shows the RCS surge line piping flaws for Alloy 82/182 welds propagate at a very slow rate.

The attached Figure 1 represents a curve of projected leakage flaw stability periods for Case N that bounds the Waterford 3 surge line. This figure is based on Westinghouse data that was provided as input into EPRI MRP-109 for Table 5-5 and Figure 5-68. The data demonstrates that stress corrosion cracking would take in excess of three years for an assumed leakage flaw of 2.5 gpm to reach critical flaw size. Similarly, a 1.0 gpm leak rate would take an additional two years to reach the analyzed leakage flaw. The plant operators will have ample response time under TS LCO 3.4.5.2 to mitigate the potential consequences of an RCS leakage flaw well ahead of the flaw becoming unstable and create a potential piping rupture. The existing unidentified leakage limit of 1.0 gpm per TS LCO 3.4.5.2 provides satisfactory margin for detecting a surge line leakage flaw before it would become a potential pipe rupture.

The Commission amended 10 CFR 50.36 (60 FR 36593, July 19, 1995) and codified four criteria to be used in determining whether a particular matter is required to be included in an LCO. Entergy has evaluated the leakage detection capability requirements for GDC 4 against the four criteria of 10 CFR 50.36(c)(2)(ii) and conclude that no new leakage detection instrumentation or lower RCS unidentified leakage detection limits are required for the Waterford 3 TSs. The four criteria are specifically addressed below.

Criterion 1: *Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.*

The purpose of GDC 30 is to assure that the leakage detection systems and instrumentation have the capability to promptly detect significant RCPB degradation in order to minimize the propagation of potential flaws that could lead to a gross rupture of the RCPB. The existing Waterford 3 TS LCO 3.4.5.1 provides the instrumentation necessary by RG 1.45 to detect RCS leakage for compliance with GDC 30. The leakage detection design requirements under GDC 4 assure that capability exists to detect an assumed leakage flaw (2.5 gpm) by a factor of 10 (0.25 gpm). This design capability is for the specifically analyzed Waterford 3 pressurizer surge line piping system under GDC 4 using deterministic fracture mechanics analysis. For compliance to SRP 3.6.3, Waterford 3 credits the containment sump level instrument which is one of the GDC 30 leakage detection instruments in TS LCO 3.4.5.1. Additionally, the Waterford 3 RCS leakage monitoring program provides supplemental detection at or below the leakage flaw detection capability margin of 0.25 gpm. The Waterford 3 RCS leakage monitoring program uses multiple RCS leakage detection sources and instruments for determining an RCS leakage baseline and subsequent increased leakage rates well below that required for TS compliance. However, this RCS leakage monitoring program as credited under GDC 4 does not provide the need for new instruments to be included for GDC 30 compliance under TS LCO 3.4.5.1. The existing leakage detection instruments contained in TS LCO 3.4.5.1 provide satisfactory RCS leakage detection instrument requirement for compliance with RG 1.45.

Criterion 2: *A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.*

Per the 1993 Final TS Policy Statement (58 FR 39132, July 22, 1993), this criterion includes those process variables that are specific values or ranges of values that have been chosen as reference bounds in the design basis accident or transient analyses and which are monitored and controlled during power operation such that process values remain within the analysis bounds.

The analyses performed under WCAP-17187-P establish new design requirements for the pressurizer surge line under LBB methodologies. A factor of 2 is provided to assure that there is substantial margin against approaching a critical flaw which is the analyzed point that the flaw could become unstable and potentially propagate into an RCPB failure. WCAP-17187-P concludes that based on fracture mechanics analysis, the surge line would remain structurally stable for a leakage flaw of 2.5 gpm. Based on representative industry data under EPRI MRP-109, the stability periods between a leakage flaw of 2.5 gpm and the critical flaw are conservatively assumed to be in excess of three years. Similarly, a flaw leaking at one gpm leakage would provide an additional two years of detection time prior to the flaw reaching the leakage flaw of 2.5 gpm. Therefore, the existing Waterford 3 unidentified RCS leakage TS LCO 3.4.5.2 limit of 1.0 gpm provides

ample control room operator response time for detection of an initial RCS pressure boundary leak prior to reaching the analysis leakage value of 2.5 gpm and prior to it becoming a potential RCPB safety concern.

The establishment of a factor of 10 below the leakage flaw size provides conservative leakage detection sensitivity for meeting the guidance of SRP 3.6.3, but does not establish the need for a lower detection requirement as a new design basis limiting condition. Hence, the RCS leakage detection capability requirement in accordance with the guidance of SRP 3.6.3 does not represent a "significant degradation" of the RCPB that would require reduced leakage detection sensitivity in the technical specifications. Therefore, the 0.25 gpm leakage detection capability for compliance to GDC 4 does not constitute a process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis.

Criterion 3: *A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.*

The surge line piping provides a passive barrier for the RCS pressure boundary. Active functions performed by the surge system are unaffected by the proposed change as a result of eliminating dynamic protection under the guidance of SRP 3.6.3 for meeting GDC 4. Therefore, this criterion is not applicable for the function of the RCS leakage detection system.

Criterion 4: *A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.*

Operating experience has shown that the likelihood of failure of large bore Class 1 piping systems is extremely low. The analysis performed under WCAP-17187-P substantiates the robustness of the Waterford 3 surge line from experiencing piping flaws that would result in gross RCS boundary failures. Therefore, this criterion is not applicable to the Waterford 3 RCS leakage detection system for LBB of the surge line.

In conclusion, Entergy does not believe that the criteria for determining whether a new leakage detection system TS LCO has been met in accordance with 10 CFR 50.36(c)(2)(ii). However, the appropriate regulatory change process has been applied by proposing a change to the licensing basis in the Updated Final Safety Analysis Report (UFSAR).

Responses to NRC Questions during November 10, 2010 Public Meeting Regarding the Waterford 3 Pressurizer Surge Line Leak-Before-Break License Amendment Request

1. Provide the original purpose of the whip restraint on the surge line (i.e., safety basis of the restraint).

   Entergy Response: In the Waterford 3 license amendment request of February 22, 2010, Entergy requested that the Waterford 3 pressurizer surge line dynamic protection be eliminated based on the analysis performed under WCAP-17187-P. The Waterford 3 surge line pipe whip restraint system (eight whip restraints) was installed to address the postulated high energy line break locations at each weld joint of the surge line piping from the RCS hot leg surge line nozzle to the pressurizer surge line nozzle in accordance with RG 1.46, "Protection Against Pipe Whip Inside Containment" (May 1973)[Withdrawn]. A review of the

Waterford 3 license licensing and design basis documents confirms that the surge line whip restraint system does not perform any secondary mechanistic protective functions beyond preventing damage to adjacent plant equipment from the surge line pipe whip movements. The application of LBB methodology removes the requirement to postulate breaks in the surge line through deterministic analysis which demonstrates that sufficient margins exist in accordance with SRP 3.6.3 evaluation criteria.

2. Discuss how the actions taken within the existing TS 3.4.5.1 and 3.4.5.2 will assure that the plant will be shut down or instruments will be repaired in a timely manner, with special emphasis on the inventory balance controls under Surveillance Requirement 4.4.5.2.1.

   Entergy Response: The existing Waterford 3 TS specified Operability limits for Leakage Detection Instrumentation and Operational Leakage ensure that RCS leakage will be detected and addressed in a timely manner. Surveillance Requirement (SR) 4.0.1 requires that all SRs be met during Modes or other specified conditions in the Applicability of the LCOs. Failure to meet the surveillance, whether during the performance, between performances, or exceeding the interval, is failure to meet the LCO. Under TS LCO 3.4.5.1, if the LBB credited containment sump level instrument cannot meet its channel check which is performed every 12 hours in accordance with SR 4.4.5.1.b, the instrument will be declared inoperable and the LCO Action statement will be entered in accordance with SR 4.0.1. To comply with the associated LCO Action Statement, an RCS water inventory balance is to be performed every 24 hours as required by SR 4.4.5.2.1. If after 30 days, the level instrument is not returned to Operable status, the unit will be taken to Cold Shutdown within the next 36 hours.

   In accordance with TS LCO 3.4.5.2.b, if the 1.0 gpm Unidentified Leakage limit is exceeded, the LCO Action statement will be entered and the unit will be required to be in Cold Shutdown within the next 40 hours for non-Pressure Boundary Leakage. If Pressure Boundary Leakage has been identified, then LCO 3.4.5.2.a is entered and the unit is required to be in Cold Shutdown within the next 36 hours. Additionally, SR 4.4.5.2.1 requires an RCS water inventory balance (after reaching steady state operation) to be performed every 72 hours to ensure that Operational Leakage is within its specified limits. However, if this SR cannot be performed or met, the associated LCO Action statements are entered in accordance with SR 4.0.1. Therefore, the RCS water inventory balance is treated as part of the RCS Leakage Detection Instrumentation and Operational Leakage requirements within the Waterford 3 TSs for RCS Operability.

3. Provide the basis and assumptions that support the conclusion that the stability periods for Electric Power Research Institute (EPRI) "Materials Reliability Program: Alloy 82/182 Pipe Butt Weld Safety Assessment for US PWR Plant Designs: Westinghouse and CE Design Plants (MRP-109)," July 2004, bound the WCAP-17187-P stability.

   Entergy Response: The crack growth rates for Alloy 82/182 welds as reported in EPRI MRP-109 for primary water stress corrosion cracking [PWSCC] are higher than fatigue flaw growth rates for similarly loaded stainless steel. Experience and lab testing have shown that PWSCC creates higher crack growth rates than those for fatigue cracking growth rates. The evaluations performed in Section 5.5 of EPRI MRP-109 considered both fatigue and PWSCC affects on crack growth. PWSCC crack growth rate of Alloy 82/182 is intensified by higher operating temperatures. The results show that for high temperature nozzles, such as the pressurizer nozzle, that the PWSCC crack growth rate is the limiting mechanism. Therefore, the EPRI MRP-109 Alloy 82/182 stability periods bound both stainless steel fatigue stability

periods as well as PWSCC rates for Waterford 3 surge line. The two Waterford 3 pressurizer surge line Alloy 82/182 welds have received preemptive full structural weld overlays.

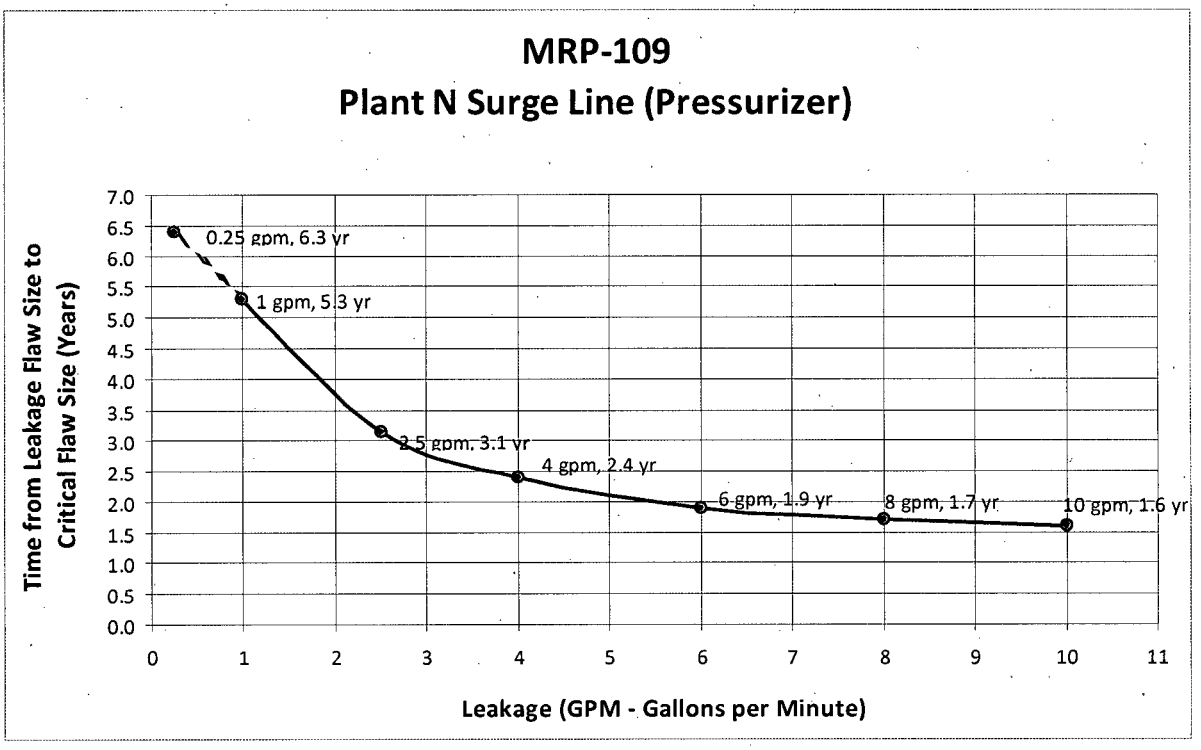
4. Provide the basis why the leakage monitoring actions contained in the proposed FSAR insert do not represent an action that should reside in the TSs.

   Entergy Response: In the February 22, 2010 license amendment request, Entergy proposed an insert to the UFSAR that included action levels for the control room RCS leakage monitoring program consistent with the PWROG guidance under WCAP-16465. The Waterford 3 RCS leakage monitoring program includes specific action levels including actions for unidentified leakage as low as 0.1 gpm. These action levels further ensure that early changes in RCS unidentified leakage are addressed well ahead of reaching the 1.0 gpm unidentified leakage TS limit. These reduced leakage monitoring and action levels are consistent with the guidance of RG 1.45 (Revision 1) which states that plant procedures should specify operator action in response to leakage rates less than the limits set forth in the plant TSs. These leakage detection action levels establish procedural controls for early detection well below the TS limits of 1.0 gpm unidentified leakage. Therefore, reduced TS leakage limits are not necessary to protect the public health and safety. Instead, the design basis leakage detection capability of 0.25 gpm and RCS leakage monitoring program action levels are being appropriately controlled in the UFSAR.

5. Clarify the responses for Criterion 1 of Title 10 of the *Code of Federal Regulations* (10 CFR) paragraph 50.36(c)(2)(ii) for that which is leakage detection instrumentation versus Criterion 2 regarding process variables.

   Entergy Response: Responses to 10 CFR 50.36(c)(2)(ii) criteria have been clarified as provided in response to NRC RAI 2.

Figure 1


MRP-109
Plant N Surge Line (Pressurizer)
Time from Leakage Flaw Size to Critical Flaw Size (Years)
Leakage (GPM - Gallons per Minute)
0.25 gpm, 6.3 yr
1 gpm, 5.3 yr
2.5 gpm, 3.1 yr
4 gpm, 2.4 yr
6 gpm, 1.9 yr
8 gpm, 1.7 yr
10 gpm, 1.6 yr
7.0
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