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W3F1-2011-0014

February 16, 2011

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

SUBJECT: Request for Alternative W3-ISI-019, Inspection of Reactor Vessel Head  
In-Core Instrument Nozzles during the Third Ten-Year Inservice Inspection  
Interval  
Waterford Steam Electric Station, Unit 3  
Docket No. 50-382  
License No. NPF-38

- REFERENCES:
1. Entergy Letter to the NRC dated October 19, 2009, "Request for Alternative W3-ISI-015, Inspection of Reactor Vessel Head In-Core Instrument Nozzles during Third Ten-Year Inservice Inspection Interval, Waterford Steam Electric Station, Unit 3" (W3F1-2009-0056) [(ADAMS Accession No. ML092940241)]
  2. Entergy Letter to the NRC dated November 2, 2009, "Response to NRC Request for Additional Information Regarding Request for Alternative W3-ISI-015, Inspection of Reactor Vessel Head In-Core Instrument Nozzles during Third Ten-Year Inservice Inspection Interval, Waterford Steam Electric Station, Unit 3" (W3F1-2009-0059) [ADAMS Accession No. ML093080127]
  3. Entergy Letter to the NRC dated November 2, 2009, "Transmittal of Westinghouse WCAP-15815, Revision 1, Waterford Steam Electric Station, Unit 3" (W3F1-2009-0060) [ADAMS Accession No. ML093080342]
  4. NRC letter to Entergy dated July 6, 2010, Waterford Steam Electric Station, Unit 3 – "Request for Alternative W3-ISI-015, Inspection of Reactor Vessel Head In-Core Instrument Nozzles during Third 10-Year Inservice Inspection Interval" (TAC No. ME2401) [ADAMS Accession No. ML101600569]

Dear Sir or Madam:

Pursuant to 10 CFR 50.55a(a)(3)(ii), Entergy Operations, Inc (Entergy) requests an alternative to the inspection requirements of American Society of Mechanical Engineers

A047  
NRR

(ASME) Code Case N-729-1, as conditioned by 10 CFR 50.55a(g)(6)(ii)(D), for Waterford 3 Steam Electric Station, Unit 3 (Waterford 3) during the third 10-year inservice inspection (ISI) interval. Specifically, performing surface examinations to obtain essentially 100% coverage of the reactor pressure vessel (RPV) head In-Core Instrumentation (ICI) penetrations in accordance with the revised rule would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Effective October 10, 2008, the Nuclear Regulatory Commission (NRC) amended 10CFR50.55a to include ASME Code Case N-729-1, "Alternative Examination Requirements for Pressurized Water Reactor (PWR) Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1," with conditions. Once a licensee implements the code case, the First Revised NRC Order EA-03-009 (the Order) is no longer applicable and shall be deemed to be withdrawn.

Entergy was scheduled to replace the original steam generators and RPV head during the spring 2011 refueling outage (RF17). However, due to a discovered manufacturing condition, the replacement steam generators will not be available for installation during RF17. Replacement of the RPV head must utilize a construction opening in containment which will necessitate its replacement to be concurrent with the replacement steam generators now scheduled for the fall of 2012 (RF18). As a result of this deferral, the installed Waterford 3 RPV head will require continued examination in accordance with Code Case N-729-1 as conditioned by 10 CFR 50.55a(g)(6)(ii)(D) during the upcoming spring 2011 refueling outage. Therefore, Entergy is requesting the same ASME Code alternative to these examination requirements as was performed in RF16 under W3-ISI-015.

Performance Demonstration Initiative (PDI) qualification efforts for volumetric examination of the original Combustion Engineering (CE) ICI nozzle designs to comply with 10 CFR 50.55a(g)(6)(ii)(D)(4) was unsuccessful. Further progress to develop PDI qualified UT tooling and procedures for CE design ICI nozzles has not advanced in meeting the 10 CFR 50.55a(g)(6)(ii)(D)(4) requirements due to the planned near term replacement of the remaining CE RPV heads including that for Waterford 3. Therefore, PDI qualified UT examination equipment, procedures, and personnel for the Waterford-3 ICI nozzles are not available for the unexpected spring 2011 head examination. Entergy plans to employ a surface examination as specified in 10 CFR 50.55a(g)(6)(ii)(D)(3) along with the demonstrated volumetric leak path assessment of the J-groove weld. Automated eddy current testing (ECT) tooling through Waterford's RPV head examination vendor is available for examination of the inside diameter (ID) and the lower ICI nozzle face. However, automated ECT tooling is not available to perform examination of the outside surface of the ICI nozzles below the J-groove weld. As discussed in the attached ASME Code alternative (Attachment 1), examination of the RPV head ICI penetrations for the outside ICI nozzle surface to obtain essentially 100% coverage would result in a hardship without a compensating benefit in safety due to high personnel dose.

Entergy proposes to perform an alternate examination which will reduce or eliminate this hardship based on supplemental volumetric examinations of the ICI nozzle tube in lieu of performing the outside surface examination. An ASME Code alternative was sought for the fall 2009 refueling outage as requested in Reference 1 and supplemented in Reference 2 and 3. The NRC staff approved this Code alternative in Reference 4. Entergy proposes to perform the same RPV head ICI nozzle examinations in the upcoming RF17 outage. In applying the NRC accepted alternative during RF16 using the supplemental volumetric and ECT examination, the required nozzle coverage was satisfactorily obtained.

The supplemental volumetric examination of the Waterford-3 ICI nozzles in RF16 was focused on a specific volume of interest that ensures potential axial flaws in the unexamined volume of the nozzle will not propagate through the pressure boundary within a cycle of operation. This volume of interest is the portion of the nozzle from the top (root) of the J-groove weld down for one inch below the top of the J-groove weld as previously provided in Reference 2. During the most recent examination for RF16 in the fall of 2009, the volumetric examination was able to obtain quality UT data for essentially 100 percent of this volume of interest. The UT examinations proposed for RF17 in the spring 2011 will also achieve this examination coverage for each ICI nozzle, or manual surface examination of the OD surface of that ICI nozzle will be performed. In summary, the RF16 ICI nozzle examinations did not identify any PWSCC degradation which is consistent with previous Waterford 3 ICI nozzle examinations. Therefore, Entergy concludes that these alternate examinations effectively ensure the integrity of the ICI nozzle pressure boundary against PWSCC degradation that might be experienced during the following cycle of operation.

Entergy requests approval of the attached Alternative W3-ISI-019 by April 6, 2011 in order to support timely completion of the Waterford 3 RPV head examinations during the spring 2011 refueling outage.

This letter contains two new commitments as provided in Attachment 2.

If you have any questions or require additional information, please contact me at 504-739-6685.

Sincerely,

A handwritten signature in black ink, appearing to read "William Stubb". The signature is fluid and cursive, with a large initial "W" and "S".

WJS/SAB

Attachments:

1. Request for Alternative W3-ISI-019, Inspection of Reactor Vessel Head In-Core Instrument Nozzles during the Third Ten-Year Inservice Inspection Interval
2. List of Regulatory Commitments

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cc: Mr. Elmo E. Collins, Jr.  
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U. S. Nuclear Regulatory Commission  
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NRC Senior Resident Inspector  
Waterford Steam Electric Station, Unit 3  
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U.S. Nuclear Regulatory Commission  
Attn: Mr. N. Kalyanam  
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**Attachment 1 to W3F1-2011-0014**

**Request for Alternative W3-ISI-019,  
Inspection of Reactor Vessel Head In-Core Instrument Nozzles  
During the Third Ten-Year Inservice Inspection Interval**

**Entergy Operations, Inc.**  
**Waterford Steam Electric Station, Unit 3**

**Request for Alternative W3-ISI-019**  
**Inspection of Reactor Vessel Head In-Core Instrument Nozzles**  
**During the Third Ten-Year Inservice Inspection Interval**

**I. ASME CODE COMPONENT AFFECTED**

Waterford Steam Electric Station, Unit 3 (Waterford 3) has one hundred-two (102) ASME Class 1 reactor pressure vessel (RPV) head penetration nozzles comprised of ninety-one (91) Control Element Drive Mechanism (CEDM) nozzles, ten (10) In-Core Instrument (ICI) nozzles, and one (1) vent line nozzle. This request pertains to the ICI nozzles only.

Component Numbers: Ten (10) RPV Head ICI Nozzles [02-T-92 through 02-T-101]

Code References: (1) ASME Section XI 2001 Edition through 2003 Addenda  
(2) ASME Code Case N-729-1, as conditioned by  
10CFR50.55a(g)(6)(ii)(D)

Examination Category: Code Case N-729-1 in lieu of Table IWB-2500-1 Exam Category  
B--P

Item Number: B4.20

Description: Proposed Alternative to Table 1 of ASME Code Case N-729-1 as  
conditioned by 10 CFR 50.55a(g)(6)(ii)(D)

Unit/Inspection Waterford 3 / Third (3<sup>rd</sup>) 10-year inspection interval

Interval Applicability: May 31, 2008 thru July 2017

**II. APPLICABLE CODE REQUIREMENT**

The Code of Federal Regulations (Rule) 10 CFR 50.55a(g)(6)(ii)(D)(3) requires:

*Instead of the specified 'examination method' requirements for volumetric and surface examinations in Note 6 of Table 1 of Code Case N-729-1, the licensee shall perform volumetric and/or surface examination of essentially 100 percent of the required volume or equivalent surfaces of the nozzle tube, as identified by Figure 2 of ASME Code Case N-729-1. A demonstrated volumetric or surface leak path assessment through all J-groove welds shall be performed. If a surface examination is being substituted for a volumetric examination on a portion of a penetration nozzle that is below the toe of the J-groove weld [Point E on Figure 2 of ASME Code Case N-729-1], the surface examination shall be of the inside and outside wetted surface of the penetration nozzle not examined volumetrically.*

Code Case N-729-1 (Reference 1) requires that components shall be examined as specified in Table 1 of the code case.

### **III. REASON FOR REQUEST**

Pursuant to 10CFR50.55a(a)(3)(ii), Entergy Operations, Inc (Entergy) requests an alternative to the requirements of Code Case N-729-1 as conditioned by 10 CFR 50.55a(g)(6)(ii)(D) for the spring 2011 Waterford 3 refueling outage.

Prior to the Rule change, Entergy Operations, Inc. (Entergy) performed volumetric examination of the ICI nozzle tube and a leak path assessment of the J-groove welds in accordance with NRC First Revised Order EA-03-009 (Reference 2). These examinations were not qualified to requirements of paragraph 10 CFR 50.55a(g)(6)(ii)(D). In addition, Entergy supplemented these base examinations with automated eddy current examination (ECT) of the inside diameter (ID) and lower nozzle end penetration surfaces.

Volumetric examination of the CEDM nozzles and J-groove weld leak path assessment techniques have been successfully demonstrated at the Electric Power Research Institute (EPRI). However, qualification of volumetric examination techniques in accordance with 10 CFR 50.55a(g)(6)(ii)(D)(4) for inspection of ICI nozzle tubes was not successful. As a result, compliance with current regulations requires leak path assessment of the ICI J-groove weld and surface examination of the required exam volume on the ICI nozzle tube inside and outside wetted surfaces.

Entergy will perform a demonstrated leak path assessment of all ICI J-groove welds and remote ECT examination of the ICI penetration inside and lower end surfaces. Entergy will also perform a bare metal visual (BMV) inspection of the RPV head surface in accordance with Code Case N-729-1 during the spring 2011 RF17 refueling outage. However, examination of the ICI nozzle tube outer surface below the J-groove weld cannot be performed remotely, which introduces a radiological hardship. In order to maintain radiological dose as low as reasonably achievable (ALARA), Entergy proposes to perform an alternative examination such that examination of the ICI nozzle tube OD wetted surface would not provide a compensating increase in the level of component quality and public safety.

The ICI penetration tube OD wetted surface is formed by a short extension of the tube below the J-groove weld. The length of this extension varies azimuthally around the penetration and from one penetration to another. These variations were introduced by tolerances in allowable J-groove weld reinforcement during original fabrication. Dimensional variations and the elliptical cross-section which results from conforming the lower end to the spherical head surface has impeded development of remotely controlled examinations.

Manually delivered ECT examination of the nozzle tube outside diameter (OD) would have to be performed using a hand held transducer. The estimated extension of Waterford 3 nozzle tubes below the ICI J-groove weld is approximately 1-inch. Surface coverage in accordance with Code Case N-729-1 as conditioned by 10 CFR 50.55a(g)(6)(ii)(D) would require under head manual delivery for the ICI nozzle penetrations not receiving essentially 100% coverage. New ECT tooling was developed by the NDE vendor which contains a larger probe head that, if required, would be used to perform manual scanning of the ICI nozzle OD. However, this tool has not been previously used on the Waterford RPV head for collecting ECT data.. Additionally, the Waterford 3 head stand is elevated such that manual delivery would require additional time for accessing the ICI nozzle OD.

Entergy has estimated the total personnel dose for performing these manual OD nozzle scans to be between 1.0 to 3.0 Rem. Liquid penetrant examination of the same surfaces would be expected to result in significantly larger personnel exposures.

#### **IV. PROPOSED ALTERNATIVE AND BASIS FOR USE**

##### Proposed Alternative

Entergy proposes to remotely perform a demonstrated volumetric ICI J-groove weld leak path assessment, ECT surface examination of the interior diameter (ID) and bottom face surface of each ICI nozzle, and a BMV inspection of the RPV head in accordance with Code Case N-729-1 as conditioned by 10 CFR 50.55a(g)(6)(ii)(D). The required examination of the ICI penetration tube OD surface will not be performed. Entergy proposes to supplement the ECT examinations by performance of a volumetric examination of the ICI nozzle tube using UT equipment and techniques demonstrated under the NRC First-Revised Order EA-03-009 from 1.5 inches above the J-groove weld to the detectable extent of the nozzle tube below the J-groove weld. Improvements in data acquisition and analysis that were developed during PDI qualification of Control Element Drive Mechanism (CEDM) volumetric examinations will be incorporated in the proposed ICI examinations.

The proposed alternate volumetric examination will include Time-of-Flight-Diffraction (TOFD) examination from the ID surface and from the lower end surface similar to the areas previously examined under NRC First-Revised Order EA-03-009. As described in the Basis below, examination of essentially 100% of the penetration tube volume extending downward from the J-groove weld root to one inch below the J-groove weld root is necessary for ensuring quality and the reactor coolant system (RCS) pressure boundary are not compromised. Therefore, UT TOFD data collected will be reviewed for consistency with current data quality standards to ensure exam quality. If the TOFD data is determined to have unacceptable quality from the root of the J-groove weld to 1 inch below the root of the J-groove weld, then a manually delivered ECT examination of the ICI penetration tube OD surface will be performed. As a result, this would comply with Code Case N-729-1, as conditioned by 10 CFR 50.55a(g)(6)(ii)(D).

UT technology and tooling for examination of CEDMs and ICI penetration tubes are essentially the same. A significant difference between successful qualification of CEDM and ICI volumetric examination techniques appears to be due to misalignment of the open housing probe as a result of insufficient guide cone engagement and not applying the laser alignment process used by the Waterford 3 vendor. Additionally, penetration geometry and the effects of weld induced distortion in low restraint areas of the lower end of the ICI penetrations likely contributed to the failure to gain examination qualification. Tooling used at Waterford uses complete alignment techniques and the Waterford ICI nozzles have not experienced significant data quality concerns as a result of nozzle tube weld induced distortion. Therefore, UT data obtained during RF17 is expected to compare favorably with previous outage data. Despite the inability to qualify volumetric examination of ICI penetrations in support of Waterford 3's spring 2011 refueling outage examinations, those techniques remain capable of detecting defects when quality UT data is obtained.

### Basis for Use

The short extension of the ICI penetration below the J-groove weld has no structural function and cracks that are confined to this volume have no significance to quality or pressure boundary integrity. For PWSCC to develop into a RCS pressure boundary defect, a crack must grow upward through the penetration volume adjacent to the J-groove weld and extend above it, or it must grow through the J-groove weld itself. The risk of PWSCC within the J-groove weld is managed at Waterford 3 by using demonstrated leak path assessment examinations in accordance with 10 CFR 50.55a(g)(6)(ii)(D)(3).

The time required for a throughwall, axial crack to grow from the bottom of an ICI penetration tube upward to reach the root of the J-groove weld has been calculated using finite element flaw tolerance methodologies documented in WCAP-15815, Revision 1 (Reference 3). A proprietary version of this report was provided to the NRC in coordination with Reference 4. Based on this report, the limiting case for an axial flaw, located in the nozzle tube at the toe of the J-groove weld, to grow to the root of the weld (approximately 1 inch) would take in excess of one operating cycle. Surface examinations of the ID and bottom end of the penetration preclude the possibility of throughwall cracks. Therefore, the throughwall crack growth rates assumed in this analysis conservatively bound potential crack growth. Circumferentially oriented PWSCC cracking below the J-groove weld does not pose an RCS pressure boundary concern since they are not projected to grow into the J-groove weld. A complete severance of the nozzle tube would have to occur for a loose part to be displaced. The ID ECT scan will be able to detect any throughwall flaws.

Although EPRI qualification of the volumetric examination techniques proposed for ICI penetrations were unsuccessful, previous exam data quality for ICI J-groove welds has proven to be effective for the Waterford 3 ICI nozzle examinations. The qualifications performed at EPRI for CEDM volumetric examinations identified improvements to the previous examination techniques. Entergy proposes to perform volumetric examination of ICI penetrations incorporating technique improvements developed for CEDMs. These examinations will reduce the possibility of undetected PWSCC. All acceptable UT data produced during the proposed supplemental examinations will be analyzed for indication of defects.

The proposed alternatives will minimize the radiological consequence of examinations at Waterford 3 to as low as reasonably achievable while providing confirmation that the structural integrity of the ICI nozzle tube is acceptable.

In addition to the proposed alternate and compensatory examinations, Waterford 3 has implemented a program for enhanced monitoring of RCS leakage consistent with the September 2006 Pressurized Water Reactor Owners Group industry initiatives. This leakage monitoring program is designed to detect and respond to increased RCS leakage at levels well below Technical Specification limits.

Therefore, use of manual surface examination of the OD to determine the pressure boundary integrity of the Waterford 3 ICI nozzles would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Pursuant to 10 CFR 50.55a(a)(3)(ii), Entergy requests an alternative to the requirements of Code

Case N-729-1 as conditioned by 10CFR50.55a(g)(6)(ii)(D) for the spring 2011 Waterford 3 refueling outage.

#### **V. DURATION OF PROPOSED ALTERNATIVE**

The proposed alternative will apply to the existing RPV head for the spring 2011 (RF17) Waterford 3 refueling outage ICI examinations. Entergy is scheduled to replace the RPV head during the fall 2012 refueling outage.

#### **VI. PRECEDENT**

This same alternative was requested by Entergy on November 2, 2009 (Reference 4) and approved by NRC Safety Evaluation dated July 6, 2010 (Reference 5) for Waterford 3's Alternative W3-ISI-015.

#### **VII. REFERENCES**

1. ASME Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1", Approved March 28, 2006.
2. First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors, issued on February 20, 2004 [ML040220181]
3. WCAP-15815, Revision 1, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Waterford Unit 3 and ANO Unit 2" dated March 2002
4. Entergy Letter to the NRC dated November 2, 2009, Response to NRC Request for Additional Information Regarding Request for Alternative W3-ISI-015, Inspection of Reactor Vessel Head In-Core Instrument Nozzles during Third Ten-Year Inservice Inspection Interval, Waterford Steam Electric Station, Unit 3 (W3F1-2009-0059) (ML093080127)
5. NRC letter to Entergy dated July 6, 2010, Waterford Steam Electric Station, Unit 3 – "Request for Alternative W3-ISI-015, Inspection of Reactor Vessel Head In-Core Instrument Nozzles during Third 10-Year Inservice Inspection Interval" (TAC No. ME2401) [ML101600569]

**Attachment 2 to W3F1-2011-0014**

**List of Regulatory Commitments**

**List of Regulatory Commitments**

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE  (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
Entergy will perform eddy current examinations of the inside diameter and the nozzle tube lower face in accordance with Code Case N-729-1 as conditioned by 10CFR50.55a(g)(6)(ii)(D). Entergy will also acquire and analyze ICI ultrasonic data from a minimum of 1.5 inches above the J-groove weld to the detectable extent of the nozzle tube below the J-groove weld. (Improvements in data acquisition and analysis that were developed during qualification of CEDM volumetric examinations will be incorporated in the proposed ICI examinations).	X		Spring 2011 Refueling Outage
If ultrasonic (TOFD) data is determined to have unacceptable quality in the nozzle tube from the root of the J-groove weld to 1 inch below the root of the J-groove weld, then a manually delivered eddy current examination of the ICI penetration tube OD surface will be performed.	X		Spring 2011 Refueling Outage