



Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-16-074

April 22, 2016

10 CFR 50.55a

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

Watts Bar Nuclear Plant, Units 1 and 2  
Facility Operating License Nos. NPF-90 and NPF-96  
NRC Docket Nos. 50-390 and 50-391

Subject: **Watts Bar Nuclear Plant Units 1 and 2 - Request for Approval of an Alternative to the Inservice Examination Requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI Examination Methodology - Number WBN-1 & 2/PDI-4**

- References:
1. TVA letter to NRC, "Watts Bar Nuclear Plant (WBN) Unit 1 – Updated Inservice Inspection (ISI) Program for Second 10-Year Interval and Requests for Relief Nos. PDI-2, PDI-4 and SNBR-1," dated February 7, 2007 (ML070390010)
  2. NRC letter to TVA, "Watts Bar Nuclear Plant, Unit 1 – Safety Evaluation of Relief Requests PDI-2 and PDI-4 for the Second 10-Year Inservice Inspection Program for Reactor Pressure Vessel Weld Examinations (TAC Nos. MD4448 and MD4449)," dated February 29, 2008 (ML080630679)
  3. TVA letter to NRC, "Watts Bar Nuclear Plant (WBN) Unit 2 – Preservice Inspection Program and Requests for Relief No. WBN-2/PDI-4," dated October 30, 2008 (ML083090046)
  4. NRC letter to TVA, "Watts Bar Nuclear Plant, Unit 2 – Relief Request WBN-2/PDI-4 Related to Ultrasonic Examination of the Reactor Pressure Vessel Shell-to-Flange Welds," dated September 3, 2009 (ML092300608)

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, "Codes and Standards," paragraph (z)(1), Tennessee Valley Authority (TVA) is submitting for Nuclear Regulatory Commission (NRC) approval the enclosed request for an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Subsection IWA-2232, for ultrasonic examination of the reactor pressure vessel (RPV) shell-to-flange weld for the Watts Bar Nuclear Plant (WBN) Units 1 and 2. The ASME B&PV Code, Section XI, 2007 Edition through 2008 Addenda is the code of record for the third 10-year interval for WBN Unit 1 (scheduled to commence in May 2016) and the first 10-year interval for WBN Unit 2 (scheduled to commence in June 2016).

ASME Section XI, Subsection IWA-2232 states, "Ultrasonic examinations shall be conducted in accordance with Appendix I." Appendix I, Subsection I-2110(b) states, "Ultrasonic examination of reactor vessel-to-flange welds, closure head-to-flange welds, and integral attachment welds shall be conducted in accordance with Article 4 of Section V, except that alternative examination beam angles may be used. These examinations shall be further supplemented by Table-I-2000-1." ASME Section XI, Subsection IWA-2630, "Vessels," states, "The requirements of Appendix A of Article 4 are acceptable for vessels examined in accordance with Article 4 of Section V." ASME Section V, Article 4, Ultrasonic Examination Methods for Welds, addresses examinations of the RPV shell-to-flange weld.

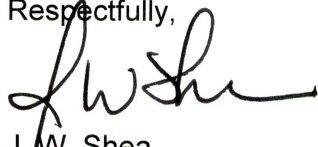
As an alternative, TVA proposes to use ASME Code, Section XI, Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," and the Electric Power Research Institute's (EPRI) Performance Demonstration Initiative (PDI) methodologies for performance of the ultrasonic examination of the RPV shell-to-flange welds in lieu of the requirements of Appendix I and the associated Article 4 of ASME Section V. The enclosure provides a description and assessment of the proposed request for alternative, and the basis as to why the proposed alternative provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(z)(1).

This alternative request is similar to the alternative request submitted by TVA for the WBN Unit 1 second 10-year ISI interval in Reference 1 and approved by the NRC in Reference 2. This request is also similar to the alternative request submitted by TVA for the WBN Unit 2 Preservice Inspection Program in Reference 3 and approved by the NRC in Reference 4. Additional precedents are identified in Section VII of the enclosure.

TVA requests approval of this request by February 1, 2017 to support the next WBN Unit 1 outage scheduled to commence on March 19, 2017.

There are no regulatory commitments associated with this submittal. Please address any questions regarding this request to Mr. Gordon Arent at 423-365-2004.

Respectfully,



J. W. Shea  
Vice President, Nuclear Licensing

Enclosure: Request for Alternative Number WBN-1 & 2/PDI-4

cc (Enclosure):

NRC Regional Administrator - Region II  
NRC Senior Resident Inspector - Watts Bar Nuclear Plant  
NRR Project Manager - Watts Bar Nuclear Plant

## ENCLOSURE

### Tennessee Valley Authority Watts Bar Nuclear Plant, Unit 1 and Unit 2

#### Request for Alternative WBN-1 & 2/PDI-4

#### I. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Component(s) Affected

ASME Code Class	ASME Examination Category	Code Item No.	Component ID	Component Description	Exam Method
1	B-A	B1.30	Reactor pressure vessel (RPV) circumferential weld W06-07 <sup>1</sup>	RPV shell-to-flange weld	Ultrasonic testing (UT)

#### II. Applicable Code Edition and Addenda

The ASME B&PV Code, Section XI, 2007 Edition through 2008 Addenda will be the code of record for the third 10-year interval for the Watts Bar Nuclear Plant (WBN) Unit 1 (scheduled to commence in May 2016) and the first 10-year interval for WBN Unit 2 (scheduled to commence in June 2016).

#### III. Applicable Code Requirement

ASME Code Class 1, Table IWB-2500-1, "Examination Category B-A, Pressure Retaining Welds in Reactor Vessel," Item Number B1.30, "Shell-to-Flange Weld," that requires a volumetric examination of essentially 100 percent of the weld length.

ASME Section XI, Subsection IWA-2232 states, "Ultrasonic examinations shall be conducted in accordance with Appendix I."

Appendix I, Subsection I-2110(b) states, "Ultrasonic examination of reactor vessel-to-flange welds, closure head-to-flange welds, and integral attachment welds shall be conducted in accordance with Article 4 of Section V, except that alternative examination beam angles may be used. These examinations shall be further supplemented by Table I-2000-1."

ASME Section XI, Subsection IWA-2630, "Vessels," states, "The requirements of Appendix A of Article 4 are acceptable for vessels examined in accordance with Article 4 of Section V."

ASME Section V, Article 4, Ultrasonic Examination Methods for Welds, addresses examinations of the RPV shell-to-flange weld.

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<sup>1</sup> Refer to attached WBN Unit 2 drawings ISI-2068A-E-03 and ISI-2068A-E-15, which are similar to Unit 1

#### **IV. Reason for Request**

In accordance with 10 CFR 50.55a(a)(z)(1), Tennessee Valley Authority (TVA) is requesting an alternative from the requirements to perform the volumetric examination of the RPV shell-to-flange weld at WBN Units 1 and 2 in accordance with the requirements of Appendix I of ASME Section XI. The use of performance-based ultrasonic procedure, equipment, and personnel qualification has provided a more rigorous process from the prescriptive-based process of ASME Code, Section V, Article 4, for the qualification of UT procedures and performing examinations.

#### **V. Proposed Alternative and Basis for Use**

In lieu of the requirements of ASME Section XI, Appendix I and Article 4 of ASME Section V, TVA will use the techniques, personnel, and equipment qualified to meet the requirements of ASME Section XI Appendix VIII, Supplements 4 and 6 of the 2007 Edition through the 2008 Addenda, as administered by the Electric Power Research Institute's (EPRI) Performance Demonstration Initiative (PDI) processes. This proposed alternative allows for the use of improved methodology in qualification of equipment and personnel performing ultrasonic examinations. This methodology uses an examination process that provides greater quality and amount of coverage for the performance of the shell-to-flange weld examinations. Accordingly, the proposed alternative methodology provides an acceptable level of quality and safety. In addition, the proposed alternative results in lower personnel radiation exposure from not having to use a different methodology for the shell-to-flange weld.

ASME Section V, Article 4, describes the required techniques to be used for the UT of RPV shell-to-flange welds, closure head-to-flange welds, and integral attachment welds and all other ferritic pressure vessels with wall thicknesses greater than two inches. The calibration techniques, recording criteria, and flaw sizing methods are based upon the use of a distance-amplitude-correction curve (DAC) derived from machined reflectors in a basic calibration block. The UT performed in accordance with Section V, Article 4, used recording thresholds of 50 percent DAC for the outer 80 percent of the required examination volume and 20 percent DAC from the clad/base metal interface to the inner 20 percent margin of the examination volume. Indications detected in the designated exam volume portions, with amplitudes below these thresholds, were therefore not required to be recorded. Use of the Appendix VIII PDI processes enhances the quality of the examination results reported because the detection sensitivity is more conservative and the procedure requires the examiner to evaluate all indications determined to be flaws regardless of their associated amplitude. The recording thresholds in Section V, Article 4, requirements are generic and somewhat arbitrary and do not take into consideration such factors as flaw orientation, which can influence the amplitude of UT responses.

EPRI Report NP-6273, "Accuracy of Ultrasonic Flaw Sizing Techniques for Reactor Pressure Vessels," dated March 1989, established that UT flaw sizing techniques based on tip diffraction are the most accurate. The qualified prescriptive-based UT procedures of ASME Section V, Article 4 have been applied in a controlled process with mockups of RPVs that contained real flaws and the results statistically analyzed according to the screening criteria in Appendix VIII of ASME Section XI. The results show that the procedures in Section V, Article 4, are less effective in detecting flaws than procedures qualified in accordance with Appendix VIII as administered by the PDI processes. The Appendix VIII PDI qualification procedures use the tip diffraction techniques for flaw sizing. The proposed alternative Appendix VIII PDI UT

methodology uses analysis tools based upon echo dynamic motion and tip diffraction criteria which has been validated, and is more accurate than the Section V, Article 4 processes.

The UT performed in accordance with the Section V, Article 4 processes requires the use of beam angles of 0°, 45°, 60°, and 70° with recording criteria that necessitates equipment changes. Performing these process changes is time consuming and results in increased radiation exposure for the examination personnel. Therefore, performing the ASME Section XI, Appendix I requirements for the RPV shell-to-flange weld, when the data is obtained using a less technically advanced process, results in an examination that does not provide a compensating increase in quality and safety for the higher costs and personnel exposures involved.

Procedures, equipment, and personnel qualified through the Appendix VIII, Supplements 4 and 6 PDI programs have shown to have a high probability of detecting flaws and are generally considered superior to the techniques employed earlier for RPV examinations, resulting in increased reliability of RPV inspections. Therefore, the proposed alternative methodologies provide an acceptable level of quality, and safety is provided with the proposed alternative methodologies. Accordingly, approval of this alternative evaluation process is requested pursuant to 10 CFR 50.55a(z)(1).

## **VI. Duration of Proposed Alternative**

This alternative request is needed to support the next WBN Unit 1 outage scheduled to start March 19, 2017. The alternative requirements of this request will be applied through the remaining inspections of the third 10-year interval for WBN Unit 1 and the first 10-year interval for WBN Unit 2.

## **VII. Precedents**

This alternative request is similar to one submitted by TVA for the WBN Unit 1 second 10-year ISI interval in Reference 1 and approved by the Nuclear Regulatory Commission (NRC) in Reference 2. This alternative request is also similar to one submitted by TVA for the WBN Unit 2 Preservice Inspection Program in Reference 3 and approved by the NRC in Reference 4.

This alternative request is also similar to one submitted by TVA for the Browns Ferry Nuclear Plant (BFN) Unit 1 in Reference 5 and approved by the NRC in Reference 6. This alternative request is also similar to one submitted by TVA for the BFN Unit 2 in Reference 7 and approved by the NRC in Reference 8. This alternative request is also similar to one submitted by TVA for the BFN Unit 3 in Reference 9 and approved by the NRC in Reference 10.

This alternative request is also similar to one submitted by TVA for the Sequoyah Nuclear Plant Units 1 and 2 in Reference 11 and approved by the NRC in Reference 12.

This request for alternative is also similar to alternative requests for RPV shell-to-flange welds approved by the NRC for the Donald C. Cook Nuclear Plant Unit 1 (Reference 13), the Palisades Nuclear Plant (Reference 14), the Seabrook Station Unit No. 1 (Reference 15), the St. Lucie Nuclear Plant Unit 2 (Reference 16), and the Indian Point Nuclear Generating Unit No. 3 (Reference 17).

## VIII. References

1. TVA letter to NRC, "Watts Bar Nuclear Plant (WBN) Unit 1 – Updated Inservice Inspection (ISI) Program for Second 10-Year Interval and Requests for Relief Nos. PDI-2, PDI-4 and SNBR-1," dated February 7, 2007 (ML070390010)
2. NRC letter to TVA, "Watts Bar Nuclear Plant, Unit 1 – Safety Evaluation of Relief Requests PDI-2 and PDI-4 for the Second 10-Year Inservice Inspection Program for Reactor Pressure Vessel Weld Examinations (TAC Nos. MD4448 and MD4449)," dated February 29, 2008 (ML080630679)
3. TVA letter to NRC, "Watts Bar Nuclear Plant (WBN) Unit 2 – Preservice Inspection Program and Request for Relief No. PDI-4," dated October 30, 2008 (ML083090046)
4. NRC letter to TVA, "Watts Bar Nuclear Plant, Unit 2 – Relief Request WBN-2/PDI-4 Related to Ultrasonic Examination of the Reactor Pressure Vessel Shell-to-Flange Welds," dated September 3, 2009 (ML092300608)
5. TVA letter to NRC, "Browns Ferry Nuclear Plant (BFN) - Unit 1 - American Society of Mechanical Engineers (ASME) Section XI, Inservice Inspection (ISI) and System Pressure Test (SPT) Programs for the Second Ten-Year Inspection Interval," dated May 27, 2008 (ML081510265)
6. NRC letter to TVA, "Browns Ferry Nuclear Plant Unit 1 – Inservice Inspection Program Relief Request PDI-4 (TAC No. MD8798)," dated October 3, 2008 (ML082630051)
7. TVA letter to NRC, "American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Inservice Inspection Program for the Fourth Ten-Year Inspection Interval," dated March 31, 2010 (ML100920542)
8. NRC letter to TVA, "Browns Ferry Nuclear Plant Unit 2 – Safety Evaluation for Relief Request 2-PDI-40, for the Fourth 10-Year Inservice Inspection Interval (TAC No. ME3719)," dated March 30, 2011 (ML110240474)
9. TVA letter to NRC, "Browns Ferry Nuclear Plant (BFN) - Unit 3 - American Society of Mechanical Engineers (ASME), Section XI, Inservice Inspection Program for the Third Ten-Year Inspection Interval," October 19, 20005 (ML052930160 and ML052930161)
10. NRC letter to TVA, "Browns Ferry Nuclear Plant Unit 3 – Relief from American Society of Mechanical Engineers Boiler, Section XI Requirements for the Third Inservice Inspection Interval (TAC Nos. MC8791 and MC8793)," dated August 22, 2006 (ML062080744)
11. TVA letter to NRC, "American Society of Mechanical Engineers Request for Alternative 1,2-PDI-4," dated November 20, 2012 (ML12333A238)
12. NRC letter to TVA, "Sequoyah Nuclear Plant, Units 1 and 2 – Request for Alternative 1,2-2/PDI-4 Regarding Volumetric Examination of Reactor Pressure Vessel Circumferential Shell-to-Flange Welds (TAC Nos. MF0076 and MF0077)," dated November 5, 2013 (ML092300608)

13. NRC letter to Indiana Michigan Power Company, "Donald C. Cook Nuclear Plant, Unit 1 (CNP-1) -Relief Request (ISIR-26) Related to Reactor Pressure Vessel Shell-to-Flange Weld Examination (TAC No. MD9998)," dated May 22, 2009 (ML083570013)
14. NRC letter to Entergy Nuclear Operations, Inc., "Palisades - Relief from the Requirements of the ASME Code for the Third 10-Year Inservice Inspection Interval (TAC No. ME6150)," dated March 12, 2012 (ML120670463)
15. NRC letter to NextEra Entergy Seabrook, LLC, "Seabrook Station, Unit No. 1 - Relief Request, 3IR-3, for Reactor Pressure Vessel Shell to Flange Weld Examination for the Third Inservice Inspection Interval (TAC No. ME7259)," dated March 29, 2012 (ML120740580)
16. NRC letter to Florida Power and Light Company, "St. Lucie Unit No. 2 - Relief From the Requirements of the ASME Code, Relief Request No. 12 (TAC No. ME6745)," dated March 23, 2012 (ML12062A146)
17. NRC letter to Entergy Nuclear Operations, Inc., "Indian Point Nuclear Generating Unit No. 3 - Relief Request (RR) No. RR-3-47(I) for Reactor Vessel Weld Examination (TAC No. ME0413)," April 20, 2009 (ML090920046)

**IX. Attachments**

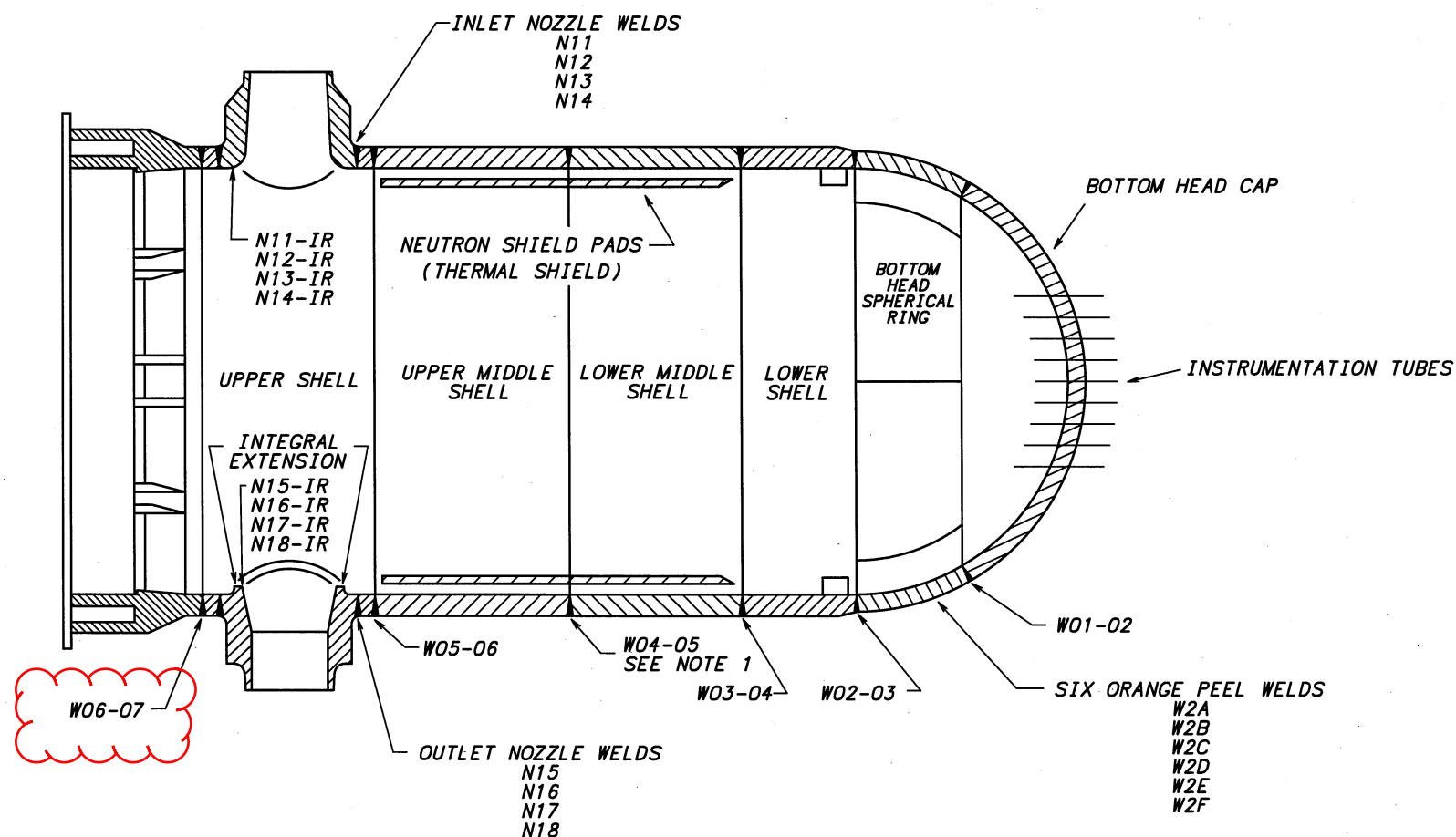
1. Drawing ISI-2068A-E-03, Watts Bar Nuclear Plant Unit 2 – Reactor Vessel (Seam Welds)
2. Drawing ISI-2068A-E-15, Watts Bar Nuclear Plant Unit 2 – Reactor Vessel Weld Seams

**Attachment 1**

**Drawing ISI-2068A-E-03, Watts Bar Nuclear Plant Unit 2 – Reactor Vessel  
(Seam Welds)**



# ATTACHMENT 1



REFERENCE DRAWINGS  
VENDOR TECHNICAL MANUAL  
VTD-W120-1470

MATERIAL SPECIFICATIONS  
SEE SHEET 2

ASME CC-1 (EQUIVALENT)

## NOTES:

1. W04-05, IS A BELTLINE REGION WELD.
2. FOR CONTINUATION OF MAIN LOOP REACTOR COOLANT PIPING SEE ISI-2068-W-01.
3. THIS ISI DRAWING IS BASED ON THE DESIGN AND CLASSIFICATION OF THE BOUNDARIES OUTLINED ON THE WBN UNIT 2 FLOW DIAGRAMS TO ESTABLISH THE BASIS FOR THE INTERRELATIONSHIP WITH TVA CLASSIFICATION OF COMPONENTS AND ASME SECTION XI INSPECTION ACTIVITIES AS DESCRIBED IN TECHNICAL POSITION TP-1, OF WBN-2 PRESERVICE INSPECTION PROGRAM PLAN.

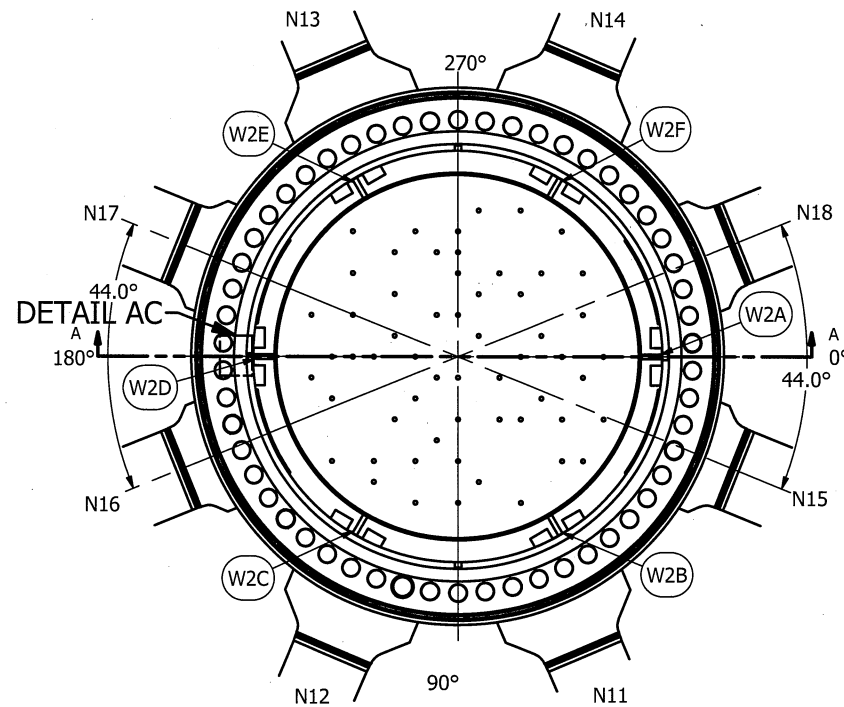
02	PHB	N/A	BTM	BTM	8-19-15
REVISE REFERENCE DRAWINGS					
01	PHB	N/A	ERB	BTM	3-20-14
REMOVE "SEE NOTE 1" FROM W05-06 AND W03-04					
REV.	BY	CHECKED	SUBMITTED	APPROVED	DATE
TENNESSEE VALLEY AUTHORITY					
WATTS BAR NUCLEAR PLANT					
UNIT 2					
REACTOR VESSEL					
(SEAM WELDS)					
DRAWN:	PHB	DATE:	3-31-10	SCALE:	NOT TO SCALE
CHECKED:	N/A	APPROVED:	DT	CAD MAINTAINED DRAWING	REV
SUBMITTED:	JTL	ISI-2068A-E-03			02

## **Attachment 2**

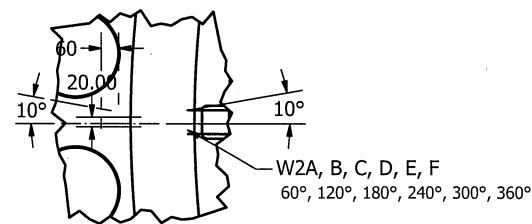
**Drawing ISI-2068A-E-15, Watts Bar Nuclear Plant Unit 2 – Reactor Vessel Weld Seams**

ASSUMED NORTH

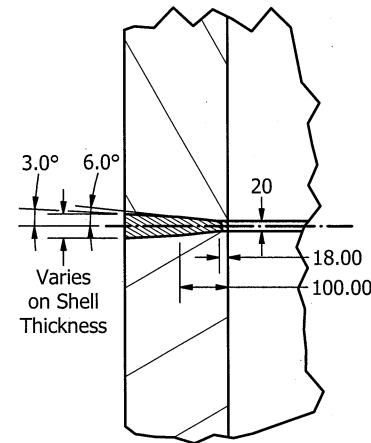
# ATTACHMENT 2



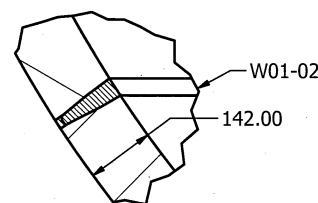
REACTOR VESSEL AZIMUTH SHOWN.  
USE REACTOR VESSEL 0° AZIMUTH FOR  
REFERENCE POINT



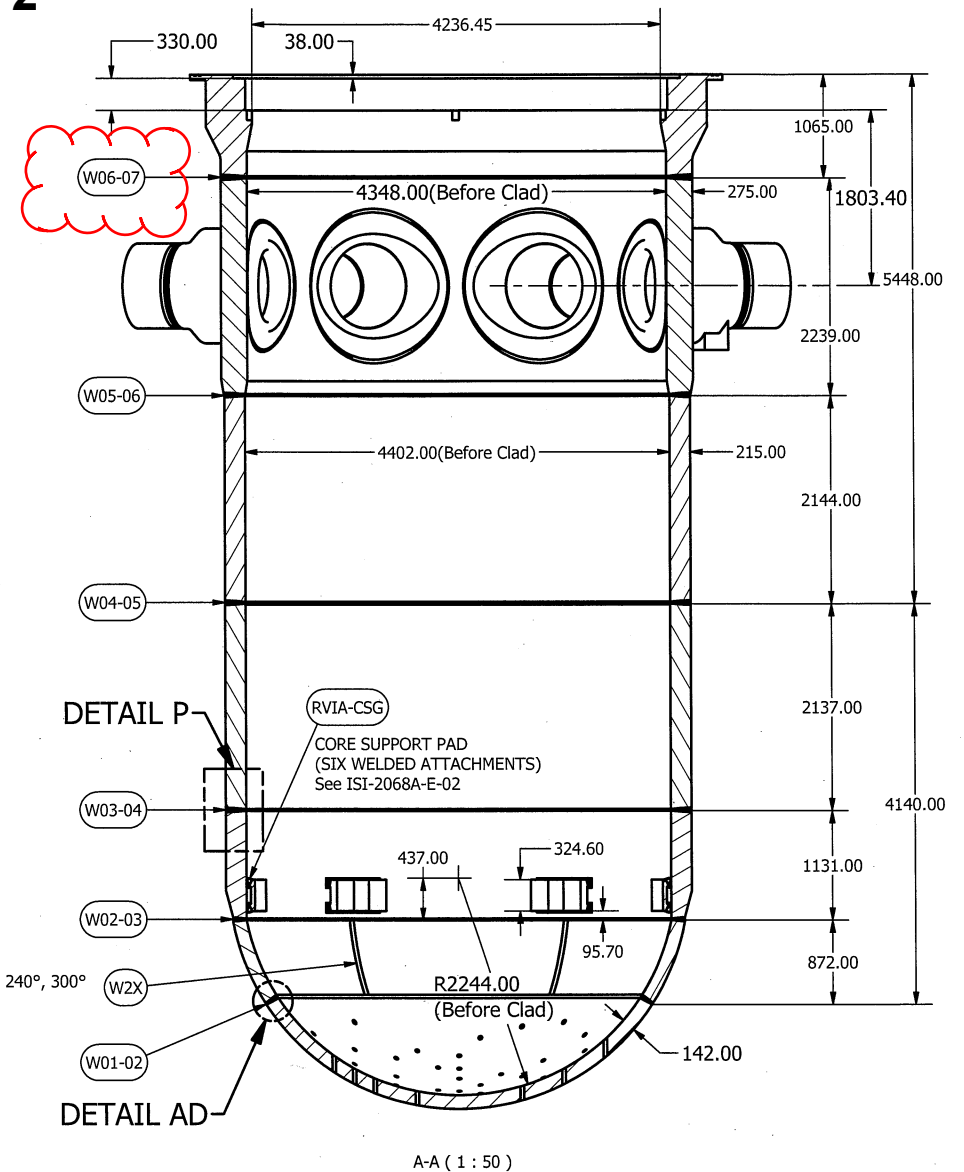
DETAIL AC  
SCALE 1 : 10



DETAIL P  
Typical Shell Course  
Weld Prep



DETAIL AD  
Head Weld Prep Inverted  
Compared to Shell



## NOTES:

- 3D VESSEL MODEL CONSTRUCTED USING WESTINGHOUSE 30738 SERIES DRAWINGS. UNIT TWO DRAWINGS ARE MARKED WITH VESSEL ID 30750 AND LISTED ON 30738-1555.
- VESSEL SEAM DIMENSIONS TAKEN FROM WESTINGHOUSE LETTER WAT-D-9385 FIGURE 7-18
- CLADDING 4.00 mm NOM. 3.2 MIN.
- DIMENSIONS FROM DEVELOPED 3D CAD MODEL THAT IS BASED ON REFERENCE DRAWINGS, TOLERANCES APPLY.

## REFERENCE DRAWING LISTING:

General Arrangement - 30738-1510-2

Shell Course #1 - 30738-1511, -1531, -1532  
Shell Course #2 - 30738-1512  
Shell Course #3 - 30738-1513  
Shell Course #4 - 30738-1514  
Shell Course #5 - 30738-1515  
Shell Course #6 - 30738-1516  
Shell Course #7 - 30738-1517

CNL-16-074

03	PHB	N/A	CRB	BTM	8-19-15
REVISE REFERENCE DRAWING					
02	PHB	N/A	ERB	BTM	6-12-14
ADD DETAIL NOTATION AND ASSUMED NORTH ARROW					
01	PHB	N/A	ERB	BTM	3-20-14
CORRECT WELD ID LOCATIONS, ADD DETAIL CONTINUATION SHEET AND VESSEL ORIENTATION NOTE					
REV.	BY	CHECKED	SUBMITTED	APPROVED	DATE
TENNESSEE VALLEY AUTHORITY					
WATTS BAR NUCLEAR PLANT UNIT 2 REACTOR VESSEL WELD SEAMS					
DRAWN:	PHB	DATE:	6-1-11	SCALE:	NOT TO SCALE
CHECKED:	RAS	APPROVED:	DT	CAD MAINTAINED DRAWING	REV
SUBMITTED:	JTL	ISI-2068A-E-15			03