Attachment B
(Non-Proprietary)

Responses to the NRC RAIs Regarding Comanche Peak Unit 1 Extension of Required Inspection Frequency for Reactor Vessel Inlet Nozzle Dissimilar Metal Welds from 7 to 9 Calendar Years

Portions of this report contain proprietary information. Proprietary information is identified and bracketed. For each of the bracketed sections, the reasons for the proprietary classification are provided using superscripted letters "a", "c", and "e". These letter designations are:

a. The information reveals the distinguishing aspects of a process or component, structure, tool, method, etc. The prevention of its use by Westinghouse's competitors, without license from Westinghouse, gives Westinghouse a competitive economic advantage.

c. The information, if used by a competitor, would reduce the competitor's expenditure of resources or improve the competitor's advantage in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

e. The information reveals aspects of past, present, or future Westinghouse- or customer-funded development plans and programs of potential commercial value to Westinghouse.

Responses to the NRC RAIs Regarding Comanche Peak Unit 1 Extension of Required Inspection Frequency for Reactor Vessel Inlet Nozzle Dissimilar Metal Welds from 7 to 9 Calendar Years

The NRC submitted the RAIs shown below (Reference 1) to Comanche Peak Unit 1, after the Staff performed a review of the Comanche Peak Unit 1 relief request (Reference 2) to defer the required reactor vessel inlet nozzle dissimilar metal (DM) weld from Spring 2016 RFO to the Spring 2019 RFO.

The RAI responses provided in this letter report are based on a supporting Westinghouse flaw tolerance evaluation developed for Comanche Peak Unit 1 to extend the volumetric examination interval for the inlet nozzle DM weld (Reference 3). The fracture mechanics technical basis in Reference 3 confirms that the DM weld inspection interval can be extended from Spring 2016 RFO to Spring 2019 RFO. The axial and circumferential crack growth evaluations performed in Reference 3 are plant specific to Comanche Peak Unit 1, and provide the necessary technical justification to extend the inspection interval from 7 years to 9 years.

The NRC RAIs based on Reference 1 are shown below, and the responses are given in the subsequent pages.

By letter dated April 20, 2015, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15119A216), as supplemented by letter dated October 15, 2015 (ADAMS Accession No. ML15300A013), Luminant Generation Company, LLC (the licensee), proposed an alternative to Title 10 of the Code of Federal Regulations (10 CFR), Paragraph 50.55a(g)(6)(ii)(F) for Comanche Peak Nuclear Power Plant, Unit 1. This regulation, in part, defines the inspection frequency requirement for the reactor vessel inlet butt welds in accordance with American Society of Mechanical Engineer's Boiler and Pressure Vessel Code Case N-770-1, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR [Pressurized Water Reactor] Piping and Vessel Nozzle Butt Welds Fabricated With UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities, Section XI, Division 1" with U. S. Nuclear Regulatory Commission (NRC) conditions. The licensee is requesting an extension of the required inspection frequency from once every 7 calendar years to once every 9 calendar years.

The NRC staff has reviewed and evaluated the information provided by the licensee and has determined that the following information is needed in order to complete its review of the relief request.

Discussion on Flow Tolerance (Page 3 of 7 of the Letter Dated October 15, 2015)

A discussion of flaw tolerance is provided as part of the technical basis to support the relief request. The licensee states, in part,

> *Based on the circumferential crack growth results, even for the most conservative case (high temperature with a 25% weld repair), a flaw with a depth of 15% of the wall thickness would not grow to the maximum allowable ASME flaw size in less than 10 years of continued operation.*

Additionally, Figure 4 of Attachment 9.1 of letter dated April 20, 2015, shows that a "Long SE [Safe End] 25% Repair AR [Aspect Ratio] =10, High Temp" flaw would grow from 10% through-wall to the ASME Code allowable flaw depth of 75% through-wall in approximately 20 years.

NRC staff performed a series of independent calculations and determined these values are not conservative. Additionally, the NRC staff did not identify a sufficient technical basis to address the potential of axial flaw growth. Therefore, the NRC staff requests the following;

1. *The axial and hoop weld residual stresses (WRS) at operating temperature of the subject welds. If a generic WRS is used, include a basis for the WRS being conservative. (e.g. 50% weld repair, WRS validation used, safe end length, etc.)*

2. *Piping loads for the subject welds to include pressure, deadweight, 100% power normal operating thermal expansion, seismic events, and Loss of Coolant Accident (LOCA).*

3. *Weld dimensions for the subject welds include outside diameter and weld thickness.*

NRC RAI 1: The axial and hoop weld residual stresses (WRS) at operating temperature of the subject welds. If a generic WRS is used, include a basis for the WRS being conservative. (e.g. 50% weld repair, WRS validation used, safe end length, etc.)

Westinghouse Response:

The axial and hoop welding residual stress (WRS) at normal operating pressure and temperature are given in Figure 1 based on the information provided in Reference 3. The welding residual stresses are performed based on the guidelines in MRP-287 (Reference 4); thus, the finite element model used in the generation of the WRS assumes a 360° inside surface weld repair with a repair depth of 50% through the DM weld thickness. The WRS are calculated for an identical inlet nozzle to Comanche Peak Unit 1, which has the same DM welding geometry, material, configuration, and safe end length. A full discussion of the WRS is provided in Section 4.0 of Reference 3.

a,c,e

Figure 1: Reactor Vessel Inlet Nozzle DM Weld 100% Normal Operating Recommended Residual Stress Profiles Through DM Weld with 50% Inside Surface Weld Repair

NRC RAI 2: Piping loads for the subject welds to include pressure, deadweight, 100% power normal operating thermal expansion, seismic events, and Loss of Coolant Accident (LOCA).

Westinghouse Response:

The Comanche Peak Unit 1 piping loads are given in Table 1 below based on the information provided in Reference 3.

Table 1: Comanche Peak Unit 1 Reactor Vessel Inlet Nozzle Piping Loads

Loading	Forces (kips)	Moments (in-kips)		
	Fx (Axial)	Mx (Torsion)	My (Bending)	Mz (Bending)
Deadweight	0.29	-180.42	51.67	-451.26
Pressure*	1333.5			
100% Normal Thermal Expansion	2.5	-5500.74	386.92	-9764.41
OBE (Operational Basis Earthquake)	137	1752	4893	1496
SSE (Safe Shutdown Earthquake)	164	2133	6267	1754
LOCA/Pipe Break	514	1192	6281	2291

*Axial force due to normal operating pressure of 2.25 ksi

NRC RAI 3: Weld dimensions for the subject welds include outside diameter and weld thickness

Westinghouse Response:

The weld dimensions are given in Table 2 below based on the information provided in Reference 3.

Table 2: Comanche Peak Unit 1 Reactor Vessel (RV) Inlet Nozzle Geometry

RV Inlet Nozzle	Dimension
Outside Diameter (in)	33.05
Inside Diameter (in)	27.47
Thickness (in)	2.79

Conclusion

It is recommended that the above NRC RAI responses be reviewed along with the supplemental fracture mechanics evaluation performed in Reference 3 for Comanche Peak Unit 1 RV inlet nozzle DM weld. The results and conclusions based on the letter report in Reference 3 provide technical justification to defer the volumetric examination for the Comanche Peak Unit 1 RV inlet nozzle DM welds from the Spring 2016 RFO to the Spring 2019 RFO.

References

1. NRC Email from Balwant Singal (NRC) to Timothy Hope (Luminant Power), Subject: "Draft Request for Additional Information - Relief Request 1B3-3 for Comanche Peak Nuclear Power Plant, Unit 1 (CAC No. MF6125)," dated January 12, 2016.

2. Letter from Luminant Generation Company LLC to NRC, TXX-15139, "Comanche Peak Nuclear Power Plant Docket No. 50-445 Revision to Relief Request 1B3-3 for Unit 1 Inservice Inspection for Application of an Alternative to the ASME Boiler and Pressure Vessel Code Section XI Examination Requirements for Reactor Pressure Vessel Cold Leg Weld Inspection Frequency (2007 Edition of ASME Code, Section XI, 2008 Addenda Third Interval Start Date: August 13, 2010 Third Interval End Date: August 12, 2020)," October 15, 2015. *[ADAMS Accession Number ML15300A013]*

3. Westinghouse Letter Report, LTR-PAFM-16-2-NP, Revision 0. "Technical Justification to Support Extended Volumetric Examination Interval for Comanche Peak Unit 1 Reactor Vessel Inlet Nozzle to Safe End Dissimilar Metal Welds." February 2016.

4. Materials Reliability Program: Primary Water Stress Corrosion Cracking (PWSCC) Flaw Evaluation Guidance (MRP-287), EPRI, Palo Alto, CA: 2010, 1021023.