



Tennessee Valley Authority  
1101 Market Street, LP 3R  
Chattanooga, Tennessee 37402-2801

**R. M. Krich**  
Vice President  
Nuclear Licensing

May 4, 2011

10 CFR 50.4  
10 CFR 50.55a

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

Browns Ferry Nuclear Plant, Unit 2  
Facility Operation License No. DPR-52  
NRC Docket No. 50-260

**Subject: Response to NRC Request for Additional Information Regarding Relief Request 2-ISI-1, Updated Risk Informed Inservice Inspection Program**

- References:
1. NRC Letter to TVA, "Browns Ferry Nuclear Plant, Unit 2 - Request for Additional Information Regarding Relief Request 2-ISI-1, Updated Risk Informed Inservice Inspection Program (TAC No. ME3720)," dated March 28, 2011
  2. 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

On March 31, 2010, the Tennessee Valley Authority (TVA) submitted the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI Inservice Inspection Program for the Fourth Ten-Year Inspection Interval for Browns Ferry Nuclear Plant, Unit 2, which included Request for Relief 2-ISI-1 (Reference 2, Attachment 10 of 2-SI-4.6.G). By letter dated March 28, 2011, the NRC transmitted a Request for Additional Information regarding Relief Request 2-ISI-1, Updated Risk Informed Inservice Inspection Program (Reference 1).

The enclosure to this letter provides the TVA response to the Reference 1 request.

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The due date for this response was specified in Reference 1 as May 6, 2011.

There are no new regulatory commitments contained in this letter. Please direct any questions concerning this matter to Tom Matthews at (423) 751-2687.

Respectfully,

A handwritten signature in black ink, appearing to read 'R. M. Krich', written in a cursive style.

R. M. Krich

Enclosure: TVA Responses to NRC Request for Additional Information Questions

cc (Enclosure):

NRC Regional Administrator – Region II  
NRC Senior Resident Inspector – Browns Ferry Nuclear Plant

## ENCLOSURE

### Tennessee Valley Authority Browns Ferry Nuclear Plant, Unit 2

#### Request for Relief 2-ISI-1, Updated Risk Informed Inservice Inspection Program

#### TVA Responses to NRC Request for Additional Information Questions

##### **NRC Question 1**

*The March 31, 2010, submittal (Agencywide Documents Access and Management System Accession No. ML100920542) states that the revised risk-informed inservice inspection (RI-ISI) program represents a reduction in risk with regard to core damage frequency (CDF) and large early release fraction (LERF). There are other risk criteria in Section 4.4.2 of WCAP-14572, Revision 1-NP-A, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report," February 1999 (WCAP), that must also be met. Please provide the results of your evaluation that will allow you to state that the risk/safety evaluation criteria in 4.4.2 of the WCAP are met.*

##### **TVA Response**

There are four criteria listed in 4.4.2:

1. The total change in piping risk should be risk neutral or a risk reduction in moving from the Current Section XI to RI-ISI. This criterion is satisfied.
2. Dominant system contributors (>10% total risk) should be examined to identify where no improvement has been proposed. The dominant system contributors are Reactor Recirculation (Recirc) CDF and LERF, Reactor Water Clean Up (RWCU) LERF, and Residual Heat Removal (RHR) CDF and LERF. In each of these cases, an improvement was proposed. This criterion is satisfied.
3. The results should be reviewed to identify any system in which there is a risk increase. No such systems were identified. This criterion is satisfied.
4. If additional examinations are identified, the change in risk calculations should be revised. No additional examinations were identified. This criterion is satisfied.

See Attachment 1, *Evaluation against criteria in Section 4.4.2 of WCAP-14572, Revision 1-NP-A*, at the end of this document.

**NRC Question 2**

Attachment 10, page 6, of the submittal clearly lists 51 previous RI-ISI examinations for R1.16. The value(s) provided for the revised program are unclear. Please clarify how many examinations are listed as R1.16 for the revised RI-ISI program.

**TVA Response**

See Attachment 2 for the revised table. In the revised RI-ISI program, column R1.16 has a total of 48 R1.16 examinations summarized below:

<b>System</b>	<b>Revised R1.16</b>	<b>No.</b>
Recirc	1 Cat A, 17 Cat C, and 6 Cat E	24
RWCU	5 Cat A, 1 Cat D, and 3 Cat E	9
RHR	4 Cat C, 1 Cat D, and 2 Cat G	7
CS	8 Cat C	8
		<b>Total = 48</b>

**NRC Question 3.A**

Attachment 10, page 3, of the submittal states:

*“A new Delta Risk Evaluation was performed, and the revised RI-ISI program continues to represent a risk reduction when compared to the last deterministic ASME Section XI inspection program. The revised RI-ISI program represents a reduction of 1.869E-05 in regards to CDF and 1.596E-07 in regards to LERF.”*

- A) *Per letter dated October 16, 2000, the Tennessee Valley Authority reported an increase in CDF and LERF for the previous RI-ISI program when compared to the last deterministic American Society of Mechanical Engineers (ASME), Section XI inspection program. The estimated change in risk was in the third and fourth significant digits for the estimated LERF and CDF; therefore, the RI-ISI program was considered risk neutral. Please clarify the above statement to properly reflect the change in risk of the previous RI-ISI program.*

**TVA Response**

Please see the response to question 3.B below. For clarification, the quoted paragraph from Request for Relief, 2-ISI-1 (2-SI-4.6.G, Attachment 10), page 3 of 6 (Reference 2) is revised to read:

*“A new Delta Risk Evaluation was performed, and the revised RI-ISI program continues to represent a risk reduction when compared to the last deterministic ASME Section XI inspection program and a risk neutral position when compared to a combination of the last deterministic ASME Section XI inspection program and the augmented programs. See the attached table.”*

<b>Program</b>	<b>Piping CDF</b>	<b>Piping LERF</b>
Base Case (without ISI)	1.926E-05	1.7919E-07
Section XI	1.923E-05	1.788E-07
Augmented	5.253E-07	1.913E-08
Risk-Informed	5.260E-07	1.918E-08

**NRC Question 3.B**

*B) Please provide additional information and clarification for how a decrease in volumetric examinations associated with thermal fatigue and intergranular stress corrosion cracking, when compared to the last RI-ISI program, can produce a very significant risk decrease when compared to the last deterministic ASME, Section XI inspection program. In addition, please provide a table comparing CDF and LERF for “without ISI”, “Section XI”, and “Risk-Informed” programs.*

**TVA Response**

The TVA letter to NRC on October 16, 2000, states “Each of these systems represents reduction in risk compared to current Section XI and risk neutrality compared to the combination of current Section XI and augmented programs.” The specific details are provided in the following table (from Table 3.10-2 in the June 1, 2000 submittal):

<b>2000 Program</b>	<b>Piping CDF</b>	<b>Piping LERF</b>
Base Case (without ISI)	2.155E-05	7.329E-06
Section XI	2.154E-05	7.328E-06
Augmented	1.325E-05	4.508E-06
Risk-Informed	1.325E-05	4.508E-06

The current submittal exhibits similar characteristics. See the table below:

<b>2009 Program</b>	<b>Piping CDF</b>	<b>Piping LERF</b>
Base Case (without ISI)	1.926E-05	1.7919E-07
Section XI	1.923E-05	1.788E-07
Augmented	5.253E-07	1.913E-08
Risk-Informed	5.260E-07	1.918E-08

There have been multiple significant changes to the plant and the program between the two submittals, including implementation of hydrogen water chemistry greatly reducing the failure probability with resultant reduction in CDF and LERF for welds subject to intergranular stress corrosion cracking, and a completely new Probabilistic Risk Assessment (PRA), including a change in PRA technique. These have greatly affected the welds examined under both Augmented and RI-ISI programs, while having minimal impact on the previous deterministic Section XI.

## ATTACHMENT 1

### **Evaluation against criteria in Section 4.4.2 of WCAP-14572, Revision 1-NP-A, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report"**

SYSTEM		No ISI				XI		Aug		RI		Comparison of RI to XI		Dominant System?	
#	NAME	CDF	LERF	%CDF	%LERF	CDF	LERF	CDF	LERF	CDF	LERF	CDF	LERF	CDF	LERF
001	MS	3.47E-09	1.48E-09	0.02%	0.83%	3.47E-09	1.48E-09	3.47E-09	1.48E-09	3.47E-09	1.48E-09	neutral	neutral	No	No
003	FW	1.35E-08	7.06E-09	0.07%	3.94%	1.35E-08	7.06E-09	1.35E-08	7.06E-09	1.35E-08	7.06E-09	neutral	neutral	No	No
063	SLC	3.09E-09	4.97E-11	0.02%	0.03%	3.09E-09	4.97E-11	3.09E-09	4.97E-11	3.09E-09	4.97E-11	neutral	neutral	No	No
068	RECIRC	1.04E-05	8.35E-08	53.99%	46.63%	1.04E-05	8.35E-08	4.83E-08	3.88E-10	4.83E-08	3.88E-10	decrease	decrease	Yes	Yes
069	RWCU	4.95E-07	1.90E-08	2.57%	10.63%	4.95E-07	1.90E-08	2.57E-08	6.16E-09	2.56E-08	6.16E-09	decrease	decrease	No	Yes
070	RBCCW	1.51E-14	1.88E-14	0.00%	0.00%	1.51E-14	1.88E-14	1.51E-14	1.88E-14	1.51E-14	1.88E-14	neutral	neutral	No	No
071	RCIC	4.13E-10	5.72E-11	0.00%	0.03%	4.13E-10	5.72E-11	3.71E-10	4.98E-11	4.13E-10	5.72E-11	neutral	neutral	No	No
073	HPCI	6.33E-09	1.43E-10	0.03%	0.08%	6.33E-09	1.43E-10	6.21E-09	8.62E-11	6.33E-09	1.43E-10	neutral	neutral	No	No
074	RHR	8.34E-06	6.74E-08	43.29%	37.65%	8.29E-06	6.71E-08	4.23E-07	3.53E-09	4.24E-07	3.53E-09	decrease	decrease	Yes	Yes
075	CS	1.80E-09	3.20E-10	0.01%	0.18%	1.80E-09	3.20E-10	1.79E-09	3.17E-10	1.79E-09	3.17E-10	decrease	decrease	No	No
085	CRD	2.48E-12	3.10E-12	0.00%	0.00%	2.48E-12	3.10E-12	2.48E-12	3.10E-12	2.48E-12	3.10E-12	neutral	neutral	No	No
	GRAND TOTALS	1.93E-05	1.79E-07			1.92E-05	1.79E-07	5.25E-07	1.91E-08	5.26E-07	1.92E-08	decrease	decrease		

**ATTACHMENT 2**

**STRUCTURAL ELEMENT SELECTION RESULTS AND COMPARISON TO ORIGINAL PROGRAM AND PREVIOUS RI-ISI PROGRAM**

System		# Segs		Original Program (1989 ASME & GL88-01)								Previous RI-ISI Program (a) (b) (c)								Revised RI-ISI Program (a) (b) (c)																						
				ASME XI Elements (d)				Augmented Elements				RI-ISI Examinations								# Segs	RI-ISI Examinations																					
				B-F	B-J	C-F-1	C-F-2	A	C	D	E	G	Dual Credit (XI & Aug)	FAC (e)	R1.1 1	R1.16	R1.18	A	C		D	E	G	R1.1 1	R1.16	R1.18	A	C	D	E	G											
001	MS	56		32		10														295	2 Cl 2			4						30	2 Cl 2			4								
003	FW	46		18																321	2 Cl 1			10						32	2 Cl 1			12								
063	SLC	5																											5													
068	RECIRC	16		21			10	58		10																			16			1	A			1	65			10		
069	RWCU	19		6			1	8	2	3																			4			5	A			5	4		4	3		
070	RBCCW	17																											2													
071	RCIC	13		2		6																							11	1 Cl 2												
073	HPCI	11		5	5	14																							10	4 Cl 1												
074	RHR	31	1	9	2	37		29	1	2	2																		28	4 Cl 2	4	C				29	3		2	2		
075	CS	15	8	5	6	12		14		1																			15			8	C				14			1		
085	CRD	31				6				3																			14										4			
Total Examinations			9	98	13	85	11	109	6	16	2																															
Total Elements			9	392	173	940																																				

**Notes**

- (a) System pressure test requirements and VT-2 visual examinations shall continue to be performed in all ASME Code Class 1, 2, and 3 systems.
- (b) Augmented programs including FAC and Reactor Nozzle Thermal Fatigue Cracking (NUREG-0619) continue
- (c) Augmented program for IGSCC Categories C through G (VIP-075, GL88-01, NUREG-0313) continues.
- (d) The current ASME Section XI ISI Program examines a minimum of 25% of the Class 1 and a minimum of 7.5% of the Class 2 elements
- (e) The FAC Augmented Program examines approximately 10% of the identified locations each refueling outage.