December 4, 2007

10 CFR 50.55a

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

Gentlemen:

In the Matter of	)	Docket No. 50-390
Tennessee Valley Authority	)	

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - RISK INFORMED INSERVICE INSPECTION PROGRAM

Pursuant to 10 CFR 50.55a(a)(3)(i), the Tennessee Valley Authority (TVA) is proposing alternatives to 10 CFR 50.55a(g), "Inservice Inspection Requirements." TVA is proposing to modify the methodology for Risk Informed Inservice Inspection (RI-ISI) program previously approved by NRC in a safety evaluation dated January 24, 2002. The proposed RI-ISI program will be used for the second inservice inspection interval, which began May 27, 2007. TVA proposes to use the alternative methodology described in Electric Power Research Institute (EPRI) Technical Report TR-112657 Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," and the associated NRC Safety Evaluation. This program meets the intent and principles of NRC Regulatory Guides 1.174 and 1.178.

The relief request, 1-RI-ISI-03, provided in Enclosure 1, is in the NEI RI-ISI template format and describes the proposed WBN RI-ISI program. The proposed RI-ISI program supports the conclusion that the proposed alternative provides an acceptable level of quality and safety as required by 10 CFR 50.55a(a)(3)(i).

Enclosure 2 provides the list of commitments associated with this submittal. If you have any questions concerning this matter, please call me at (423) 365-1824.

Sincerely,

Original signed by

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ENCLOSURE 1
RISK-INFORMED INSERVICE INSPECTION PROGRAM PLAN
WATTS BAR NUCLEAR PLANT (WBN) Unit 1

Table of Contents

1. INTRODUCTION

Watts Bar Nuclear Plant (WBN) Unit 1 is currently in the second inservice inspection (ISI) interval as defined by the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Section XI Code for Inspection Program B. The second ISI interval for Watts Bar Unit 1 began on May 27, 2007, and TVA plans to implement this program during the first period of the interval. Pursuant to 10 CFR 50.55a(g)(4)(ii), the applicable ASME Section XI Code for the second ISI interval is the 2001 Edition with 2003 Addenda.

The objective of this submittal is to request a change to the ISI Program for Class 1 and 2 piping using a risk-informed inservice inspection (RI-ISI) program. The RI-ISI process used in this submittal is described in Electric Power Research Institute (EPRI) Topical Report (TR) 112657 Rev. B-A "Revised Risk-Informed Inservice Inspection Evaluation Procedure." The RI-ISI application was also conducted in a manner consistent with ASME Code Case N-578-1 "Risk-Informed Requirements for Class 1, 2, and 3 Piping, Method B."

1.1 Relation to NRC Regulatory Guides 1.174 and 1.178

As a risk-informed application, this submittal meets the intent and principles of Regulatory Guide 1.174 "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" and Regulatory Guide 1.178 "An Approach for Plant-Specific Risk-Informed Decision-making Inservice Inspection of Piping". Further information is provided in Section 3.6.2 relative to defense-in-depth.

1.2 PSA Quality

The WBN probabilistic safety assessment (PSA) model, Revision 4, was used to evaluate the consequences of pipe failures for the purpose of the RI-ISI program. The WBN PSA uses the RISKMAN® computer code (large event tree methodology) in calculating the Core Damage Frequency (CDF) and Large Early Release Frequency (LERF). The WBN PSA model represents accident and transient internal initiating events including internal flooding starting from power operation and continuing for a 24-mission time. Revision 4 of the PSA model reflects the plant configuration as of June 30, 2005.

The base case core damage frequency (CDF) is 1.26E-05 per reactor-year. The largest core damage contributor, with approximately a 45 percent contribution, is a very small loss of coolant accident (LOCA). The base case large early release frequency is 3.31E-07 per reactor-year and is dominated by steam generator tube rupture (SGTR). These quantification calculations for CDF and LERF used a truncation frequency of 1E-12. The WBN revision 4 model (WBN-REV4) was quantified using truncation frequencies that were varied from 1E-10 to 1E-13 and the results were plotted for both CDF and LERF. The results indicate that the CDF was converging and the unaccounted for (from failed sequences) was becoming minimized at a truncation frequency of 1E-12.

A Westinghouse Owners Group PRA PEER Review Team reviewed revision 3 to the WBN PSA. In general, the review team concluded that the WBN PRA could be used to support applications involving risk significance determinations once the Facts & Observations (F&Os) were addressed. The WOG PSA PEER review rated the WBN PSA elements at a minimum of grade 2, with most elements at grade 3C or 3. The remaining open findings in the PSA open item data base were reviewed and determined not to have an impact on the RI-ISI analysis.

Revision 4 to the PSA model was performed to incorporate changes to the model needed in support of the MSPI program. These changes included resolving the category A & B F&Os that impacted internal events; incorporating failure and unavailability data collected in support of the Maintenance Rule program; incorporating comments on the systems analysis made by plant personnel; and changes to permit the calculation of Fussel-Vesley importance values for certain maintenance alignments and components. The documentation of the WBN PSA model was also changed from the original IPE format. A series of notebooks were developed to document every aspect of the PSA model. These notebooks were designed to capture the Capability Category II requirements of ASME RA S-202, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications."

2. PROPOSED ALTERNATIVE TO CURRENT ISI PROGRAM REQUIREMENTS

2.1 ASME Section XI

ASME Section XI Examination Categories B-F, B-J, C-F-1 and C-F-2 currently contain the requirements for the nondestructive examination (NDE) of Class 1 and 2 piping components. The alternative RI-ISI program for piping is described in EPRI TR-112657. The RI-ISI program will be substituted for the currently approved program for Class 1 and 2 piping (Examination Categories B-F, B-J, C-F-1 and C-F-2) in accordance with 10 CFR 50.55a(a)(3)(i) by alternatively providing an acceptable level of quality and safety. Other non-related portions of the ASME Section XI Code will be unaffected. EPRI TR-112657 provides the requirements for defining the relationship between the RI-ISI program and the remaining unaffected portions of ASME Section XI.

2.2 Augmented Programs

The plant's augmented inspection programs listed below were considered during the RI-ISI application. It should be noted that this section documents only those augmented inspection programs that address common piping with the RI-ISI application scope (i.e., Class 1 and 2 piping).

- The augmented inspection program for flow accelerated corrosion (FAC) per Generic Letter 89-08 is relied upon to manage this damage mechanism but is not otherwise affected or changed by the RI-ISI program.

- An augmented inspection program has been implemented for certain piping welds with multiple weld repairs. While some of these welds were selected for examination under the RI-ISI program, the examinations under this augmented program will continue.

- An augmented inspection program has been implemented for Alloy 600 welds in accordance with NRC Order EA-03-009 and Business Practice BP-257, "Integrated Material Issues Management Plan". While some of these welds were selected for examination under the RI-ISI program, the examinations under this augmented program will continue.

3. RISK-INFORMED ISI PROCESS

The process used to develop the RI-ISI program conformed to the methodology described in EPRI TR-112657 and consisted of the following steps:

- Scope Definition
- Consequence Evaluation
- Failure Potential Assessment
- Risk Characterization
- Element and NDE Selection
- Risk Impact Assessment
- Implementation Program
- Feedback Loop

A deviation to the EPRI RI-ISI methodology has been implemented in the failure potential assessment for WBN. Table 3-16 of EPRI TR-112657 contains criteria for assessing the potential for thermal stratification, cycling and striping (TASCS). Key attributes for horizontal or slightly sloped piping greater than 1″ nominal pipe size (NPS) include:

1. Potential exists for low flow in a pipe section connected to a component allowing mixing of hot and cold fluids, or
2. Potential exists for leakage flow past a valve, including in-leakage, out-leakage and cross-leakage allowing mixing of hot and cold fluids, or
3. Potential exists for convective heating in dead-ended pipe sections connected to a source of hot fluid, or
4. Potential exists for two phase (steam/water) flow, or
5. Potential exists for turbulent penetration into a relatively colder branch pipe connected to header piping containing hot fluid with turbulent flow,

AND

$\Delta T > 50°F$,

AND

Richardson Number > 4 (This value predicts the potential buoyancy of stratified flow.)

These criteria, based on meeting a high cycle fatigue endurance limit with the actual ΔT assumed equal to the greatest potential ΔT for the transient, will identify all locations where stratification is likely to occur, but allows for no assessment of severity. As such, many locations will be identified as subject to TASCS where no significant potential for thermal fatigue exists. The critical attribute missing from the existing methodology that would allow consideration of fatigue severity is a criterion that addresses the potential for fluid cycling. The impact of this additional consideration on the existing TASCS criteria is presented below.

- **Turbulent penetration TASCS**

  Turbulent penetration typically occurs in lines connected to piping containing hot flowing fluid. In the case of downward sloping lines that then turn horizontal, significant top-to-bottom cyclic ΔTs can develop in the horizontal sections if the horizontal section is less than about 25 pipe diameters from the reactor coolant piping. Therefore, TASCS is considered for this configuration.

  For upward sloping branch lines connected to the hot fluid source that turn horizontal or in horizontal branch lines, natural convective effects combined with effects of turbulence penetration will keep the line filled with hot water. If there is no potential for in-leakage towards the hot fluid source from the outboard end of the line, this will result in a well-mixed fluid condition where significant top-to-bottom ΔTs will not occur. Therefore, TASCS is not considered for these configurations. Even in fairly long lines, where some heat loss from the outside of the piping will tend to occur and some fluid stratification may be present, there is no significant potential for cycling as has been observed for the in-leakage case. The effect of TASCS will not be significant under these conditions and can be neglected.

- **Low flow TASCS**

  In some situations, the transient startup of a system (e.g., RHR suction piping) creates the potential for fluid stratification as flow is established. In cases where no cold fluid source exists, the hot flowing fluid will rapidly displace the cold fluid in stagnant lines, while fluid mixing will occur in the piping further removed from the hot source and stratified conditions will exist only briefly as the line fills with hot fluid. As such, since the situation is transient in nature, it can be assumed that the criteria for thermal transients (TT) will govern.

- **Valve leakage TASCS**

  Sometimes a very small leakage flow can occur outward past a valve into a line with a significant temperature difference. However, since this is a generally a "steady-state" phenomenon with no potential for cyclic temperature changes, the effect of TASCS is not significant and can be neglected.

- **Convection heating TASCS**

  Similarly, there sometimes exists the potential for heat transfer across a valve to an isolated section beyond the valve, resulting in fluid stratification due to natural convection. However, since there is no potential for cyclic temperature changes in this case, the effect of TASCS is not significant and can be neglected.

In summary, these additional considerations for determining the potential for thermal fatigue because of the effects of TASCS provide an allowance for the consideration of cycle severity in assessing the potential for TASCS effects. The above criteria have previously been submitted by EPRI for generic approval (Letters dated February 28, 2001, and March 28, 2001, P.J. O'Regan (EPRI) to Dr. B. Sheron (USNRC), "Extension of Risk-Informed Inservice Inspection Methodology").

3.1 Scope of Program

The systems included in the RI-ISI program are provided in Table 3.1. The piping and instrumentation diagrams and additional plant information including the existing plant ISI program were used to define the Class 1 and 2 piping system boundaries. Segments were defined as continuous runs of piping whose failure would result in the same consequence.

3.2 Consequence Evaluation

The consequence(s) of pressure boundary failures were evaluated and ranked based on their impact on core damage and containment performance (isolation, bypass and large, early release). The impact on these measures due to both direct and indirect effects was considered using the guidance provided in EPRI TR-112657.

3.3 Failure Potential Assessment

Failure potential estimates were generated utilizing industry failure history, plant specific failure history and other relevant information. These failure estimates were determined using the guidance provided in EPRI TR-112657, with the exception of the previously stated deviation.

Table 3.3 summarizes the failure potential assessment by system for each degradation mechanism that was identified as potentially operative for WBN.

3.4 Risk Characterization

In the preceding steps, each run of piping within the scope of the program was evaluated to determine its impact on core damage and containment performance (isolation, bypass and large, early release) as well as its potential for failure. Given the results of these steps, risk groups are then defined as welds within a single system potentially susceptible to the same degradation mechanism and whose failure would result in the same consequence. Risk groups are then ranked based upon their risk significance as defined in EPRI TR-112657.

The results of these calculations are presented in Table 3.4.

3.5 Element and NDE Selection

In general, EPRI TR-112657 requires that 25% of the locations in the high-risk region and 10% of the locations in the medium risk region be selected for inspection using appropriate NDE methods tailored to the applicable degradation mechanism. In addition, per Section 3.6.4.2 of EPRI TR-112657, if the percentage of Class 1 piping locations selected for examination falls substantially below 10%, then the basis for selection needs to be investigated. As depicted below, a 10% sampling of the Class 1 elements has been achieved. No credit was taken for any FAC or other existing augmented inspection program (e.g., high-energy line break) locations in meeting the sampling percentage requirements. A brief summary is provided below and the results of the selection are presented in Table 3.5. Section 4 of EPRI TR-112657 was used as guidance in determining the examination requirements for these locations.

Watts Bar Unit 1 Element Selection									
Cat	Butt Weld			Socket Weld			Total		
	population	selected	%	population	selected	%	population	selected	%
B-F	22	10	45%	0	0	n/a%	22	10	45%
B-J	495	44	9%	471	60	13%	966	104	11%
total	517	54	10%	471	60	13%	988	114	12%

Note

1. All in-scope piping components, regardless of risk classification, will continue to receive Code required pressure testing, as part of the current ASME Section XI program. VT-2 visual examinations are scheduled in accordance with the station's pressure test program that remains unaffected by the RI-ISI program.

3.5.1 Additional Examinations

The RI-ISI program in all cases will determine through an engineering evaluation the cause of any unacceptable flaw or relevant condition found during examination. The evaluation will include the applicable service conditions and degradation mechanisms to establish that the element(s) will still perform their intended safety function during subsequent operation. Elements not meeting this requirement will be repaired or replaced.

The evaluation will include whether other elements in the segment or additional segments are subject to the same root cause conditions. Additional examinations will be performed on those elements with the same root cause conditions or degradation mechanisms. The additional examinations will include high-risk significant elements and medium risk significant elements, if needed, up to a number equivalent to the number of elements required to be inspected on the segment or segments during the current outage. If unacceptable flaws or relevant conditions are again found similar to the initial problem, the remaining elements identified as susceptible will be examined. No additional examinations will be performed if there are no additional elements identified as being susceptible to the same root cause conditions.

3.5.2 Program Relief Requests

An attempt has been made to select RI-ISI locations for examination such that a minimum of >90% coverage (i.e., Code Case N-460 criteria) is attainable. However, some limitations will not be known until the examination is performed, since some locations may be examined for the first time by the specified techniques.

It is expected that all the RI-ISI examination locations that have been selected provide >90% coverage. In instances where locations are found at the time of the examination that do not meet the >90% coverage requirement, the process outlined in EPRI TR-112657 will be followed.

3.6 Risk Impact Assessment

The RI-ISI program has been conducted in accordance with Regulatory Guide 1.174 and the requirements of EPRI TR-112657, and the risk from implementation of this program is expected to remain neutral or decrease when compared to that estimated from current requirements.

This evaluation identified the allocation of segments into High, Medium, and Low risk regions of the EPRI TR-112657 and ASME Code Case N-578-1 risk-ranking matrix, and then determined for each of these risk classes what inspection changes are proposed for each of the locations in each segment. The changes include changing the number and location of inspections within the segment and in many cases improving the effectiveness of the inspection to account for the findings of the RI-ISI degradation mechanism assessment. For example, for locations subject to thermal fatigue, examinations will be conducted on an expanded volume and will be focused to enhance the probability of detection (POD) during the inspection process.

3.6.1 Quantitative Analysis

Limits are imposed by the EPRI methodology to ensure that the change in risk of implementing the RI-ISI program meets the requirements of Regulatory Guides 1.174 and 1.178. The EPRI criterion requires that the cumulative change in core damage frequency (CDF) and large early release frequency (LERF) be less than 1E-07 and 1E-08 per year per system, respectively.

WBN conducted a risk impact analysis per the requirements of Section 3.7 of EPRI TR-112657. The analysis estimates the net change in risk due to the positive and negative influence of adding and removing locations from the inspection program. A risk quantification was performed using the "Simplified Risk Quantification Method" described in Section 3.7 of EPRI TR-112657. The conditional core damage probability (CCDP) and conditional large early release probability (CLERP) used for high consequence category segments was based on the highest evaluated CCDP (1.18E-02) and CLERP (1.37E-04), whereas, for medium consequence category segments, bounding estimates of CCDP (1E-04) and CLERP (1E-05) were used. The likelihood of pressure boundary failure (PBF) is determined by the presence of different degradation mechanisms and the rank is based on the relative failure probability. The basic likelihood of PBF for a piping location with no degradation mechanism present is given as x_o and is expected to have a value less than 1E-08. Piping locations identified as medium failure potential have a likelihood of $20x_o$. These PBF likelihoods are consistent with References 9 and 14 of EPRI TR-112657. In addition, the analysis was performed both with and without taking credit for enhanced inspection effectiveness due to an increased POD from application of the RI-ISI approach.

Table 3.6 presents a summary of the RI-ISI program versus ASME Section XI Code Edition program requirements and identifies on a per system basis each applicable risk category. The presence of FAC was adjusted for in the performance of the quantitative analysis by excluding its impact on the risk ranking. FAC is excluded in the risk ranking and therefore in the determination of the change in risk, because FAC is a damage mechanism managed by a separate, independent plant augmented inspection program. The RI-ISI Program credits and relies upon this augmented plant inspection program to manage this damage mechanism. The plant FAC Program will continue to determine where and when examinations shall be performed. Hence, since the number of FAC examination locations remains the same "before" and "after" and no delta exists, there is no need to include the impact of FAC in the performance of the risk impact analysis. However, in an effort to be as informative as possible, for those systems where FAC is present, the information in Table 3.6 is presented in such a manner as to depict what the resultant risk categorization is both with and without consideration of FAC. This is accomplished by enclosing the FAC damage mechanism, as well as all other resultant corresponding changes (failure potential rank, risk category and risk rank), in parenthesis. Again, this has only been done for information purposes, and has no impact on the assessment itself. The use of this approach to depict the impact of degradation mechanisms managed by augmented inspection programs on the risk categorization is consistent with that used in the delta risk assessment for the Arkansas Nuclear One, Unit 2 pilot application. An example is provided on the following page.

System	Risk		Consequence Rank	Failure Potential	
	Category	Rank (1)		DMs	Rank
FWS	5 (3)	Medium (High)	Medium	TASCS, TT, (FAC)	Medium (High)

In this example if FAC is not considered, the failure potential rank is "medium" instead of "high" based on the TASCS and TT damage mechanisms. When a "medium" failure potential rank is combined with a "medium" consequence rank, it results in risk category 5 ("medium" risk) being assigned instead of risk category 3 ("high" risk).

In this example if FAC were considered, the failure potential rank would be "high" instead of "medium". If a "high" failure potential rank were combined with a "medium" consequence rank, it would result in risk category 3 ("high" risk) being assigned instead of risk category 5 ("medium" risk).

Note

1. The risk rank is not included in Table 3.6 but it is included in Table 5-2.

As indicated in the following tables, this evaluation has demonstrated that unacceptable risk impacts will not occur from implementation of the RI-ISI program, and satisfies the acceptance criteria of Regulatory Guide 1.174 and EPRI TR-112657.

WBN Unit 1 Risk Impact Results

System(1)	ΔRisk$_{CDF}$		ΔRisk$_{LERF}$	
	w/ POD	**w/o POD**	**w/ POD**	**w/o POD**
RCS	2.18E-09	5.90E-11	-4.30E-11	6.83E-13
CVCS	-9.20E-09	-5.42E-09	-1.06E-10	-6.28E-11
RHR	-6.37E-09	2.36E-10	2.73E-12	2.73E-12
SIS	-2.74E-09	-2.74E-09	-3.44E-11	-3.44E-11
CI	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CSS	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AFW	-1.20E-11	0.00E+00	-1.20E-12	0.00E+00
FWS	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MSS	1.18E-09	1.18E-09	1.37E-11	1.37E-11
Total	**-1.50E-08**	**-6.69E-09**	**-1.69E-10**	**-8.01E-11**

Note

1. Systems are described in Table 3.1.

3.6.2 Defense-in-Depth

The intent of the inspections mandated by ASME Section XI for piping welds is to identify conditions such as flaws or indications that may be precursors to leaks or ruptures in a system's pressure boundary. Currently, the process for picking inspection locations is based upon structural discontinuity and stress analysis results. As depicted in ASME White Paper 92-01-01 Rev. 1, "Evaluation of Inservice Inspection Requirements for Class 1, Category B-J Pressure Retaining Welds," this method has been ineffective in identifying leaks or failures. EPRI TR-112657 and Code Case N-578-1 provide a more robust selection process founded on actual service experience with nuclear plant piping failure data.

This process has two key independent ingredients, that is, a determination of each location's susceptibility to degradation and secondly, an independent assessment of the consequence of the piping failure. These two ingredients assure defense-in-depth is maintained. First, by evaluating a location's susceptibility to degradation, the likelihood of finding flaws or indications that may be precursors to leaks or ruptures is increased. Secondly, the consequence assessment effort has a single failure criterion. As such, no matter how unlikely a failure scenario is, it is ranked high in the consequence assessment, and at worst medium in the risk assessment (i.e., Risk Category 4), if as a result of the failure, there is no mitigative equipment available to respond to the event. In addition, the consequence assessment takes into account equipment reliability, and less credit is given to less reliable equipment.

All locations within the Class 1 and 2 pressure boundaries will continue to receive a system pressure test and visual VT-2 examination as currently required by the Code regardless of its risk classification.

4. IMPLEMENTATION AND MONITORING PROGRAM

Upon approval of the RI-ISI program, procedures that comply with the guidelines described in EPRI TR-112657 will be prepared to implement and monitor the program. The new program will be implemented for the second inservice inspection interval. No changes to the Updated Final Safety Analysis Report are necessary for program implementation.

The applicable aspects of the ASME Code not affected by this change would be retained, such as inspection methods, acceptance guidelines, pressure testing, corrective measures, documentation requirements, and quality control requirements. Existing ASME Section XI program implementing procedures will be retained and modified to address the RI-ISI process, as appropriate.

The monitoring and corrective action program will contain the following elements:

A. Identify

B. Characterize

C. (1) Evaluate, determine the cause and extent of the condition identified

   (2) Evaluate, develop a corrective action plan or plans

D. Decide

E. Implement

F. Monitor

G. Trend

The RI-ISI program is a living program requiring feedback of new relevant information to ensure the appropriate identification of high safety significant piping locations. As a minimum, risk ranking of piping segments will be reviewed and adjusted on an ASME period basis. In addition, significant changes may require more frequent adjustment as directed by NRC Bulletin or Generic Letter requirements, or by industry and plant specific feedback.

5. PROPOSED ISI PROGRAM PLAN CHANGE

A comparison between the RI-ISI program and ASME Section XI Code program requirements for in-scope piping is provided in Tables 5-1 and 5-2. Table 5-1 provides a summary comparison by risk region. Table 5-2 provides the same comparison information, but in a more detailed manner by risk category, similar to the format used in Table 3.6.

6. REFERENCES/DOCUMENTATION

EPRI TR-112657, "Revised Risk-Informed Inservice Inspection Evaluation Procedure, Rev. B-A"

ASME Boiler and Pressure Vessel Code Section XI, 2001 Edition with 2003 Addenda

ASME Code Case N-578-1, "Risk-Informed Requirements for Class 1, 2, and 3 Piping, Method B, Section XI, Division 1"

Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis"

Regulatory Guide 1.178, "An Approach for Plant-Specific Risk-Informed Decision-making Inservice Inspection of Piping"

Supporting Onsite Documentation

WBN-MEB-MDN1999-000049, “RI-ISI Piping Segment Direct Consequence Definition”

WBN-MEB-MDN1999-990026, “RI-ISI Piping Indirect Consequence Evaluation for Watts Bar”

WBN-MEB-MDN1999-990043, “RI-ISI PSA Consequence Evaluation”

WBN-MEB-MDN0019992007116, “RI-ISI Consequence Categorization”

WBN-MEB-MDN0019992007119, “RI-ISI Degradation Mechanism Analysis”

WBN-MEB-MDN0019992007118, “RI-ISI Risk Ranking”

WBN-MEB-MDN0019992007117, “Risk Impact Analysis”

ROC-001, “Element Selection Meeting”

Table 3.1

WBN Unit 1 - System Selection and Segment / Element Definition

System Description	ASME Code Class	Number of Segments	Number of Elements
RCS – Reactor Coolant System	Class 1	40	262
CVCS – Chemical and Volume Control System	Class 1	40	958
SIS – Safety Injection System	Class 1 and 2	74	1239
RHR – Residual Heat Removal System	Class 1 and 2	20	415
CI – Containment Isolation System	Class 2	45	315*
CSS – Containment Spray System	Class 2	11	212
AFW – Auxiliary Feedwater System	Class 2	18	163
MSS – Main Steam System	Class 2	12	143
FWS – Feedwater System	Class 2	26	291
Totals		**286**	**3998**

***CI elements not defined in Section XI, estimated @ 7 elements per penetration**

Table 3.3 WBN Unit 1 - Failure Potential Assessment Summary											
System[1]	Thermal Fatigue		Stress Corrosion Cracking				Localized Corrosion			Flow Sensitive	
	TASCS	TT	IGSCC	TGSCC	ECSCC	PWSCC	MIC	PIT	CC	E-C	FAC
RCS	X	X				X					
CVCS	X	X									
SIS			X								
RHR	X		X								
CI											
CSS											
AFW	X	X									X
MSS											
FWS	X	X									X

Note

1. Systems are described in Table 3.1.

Table 3.4 WBN Unit 1 Number of Risk Groups* by Risk Category With and Without Impact of FAC														
System[1]	High Risk Region						Medium Risk Region				Low Risk Region			
	Category 1		Category 2		Category 3		Category 4		Category 5		Category 6		Category 7	
	With	Without	With	Without	With	Without	With	Without	With	Without	With	Without	With	Without
RCS	0	0	5	5	0	0	1	1	0	0	0	0	1	1
CVCS	0	0	3	3	0	0	1	1	0	0	2	2	1	1
RHR	0	0	2	2	0	0	1	1	0	0	1	1	0	0
SIS	0	0	1	1	0	0	1	1	1	1	1	1	1	1
CI	0	0	0	0	0	0	0	0	0	0	1	1	1	1
CSS	0	0	0	0	0	0	0	0	0	0	1	1	1	1
AFW	0	0	0	0	2	0	0	0	2	1	0	3	0	2
FWS	0	0	0	0	1	0	0	0	2	0	0	2	0	1
MSS	0	0	0	0	0	0	1	1	0	0	1	1	0	0
Total	0	0	11	11	3	0	5	5	5	2	7	12	5	8

* A Risk Group is defined as welds within a single system potentially susceptible to the same degradation mechanism and whose failure would result in the same consequence

Notes

1. Systems are described in Table 3.1.

Table 3.5
WBN Unit 1 Number of Elements Selected for Inspection by Risk Category Excluding Impact of FAC

System[1]	High Risk Region						Medium Risk Region				Low Risk Region			
	Category 1		Category 2		Category 3		Category 4		Category 5		Category 6		Category 7	
	Total	Selected	Total	Selected	Total	Selected	Total	Selected	Total	Selected	Total	Selected	Total	Selected
RCS	0	0	44	12	0	0	206	21	0	0	0	0	12	0
CVCS	0	0	13	4	0	0	114	12	0	0	746	0	85	0
RHR	0	0	17	5	0	0	130	13	0	0	268	0	0	0
SIS	0	0	28	7	0	0	675	68	14	2	409	0	113	0
CI	0	0	0	0	0	0	0	0	0	0	21*	0	294*	0
CSS	0	0	0	0	0	0	0	0	0	0	152	0	60	0
AFW	0	0	0	0	0	0	0	0	4	1	105	0	54	0
FWS	0	0	0	0	0	0	0	0	0	0	236	0	55	0
MSS	0	0	0	0	0	0	23	3	0	0	120	0	0	0
Total	0	0	102	28	0	0	1148	117	18	3	2057	0	673	0

***CI elements not defined in Section XI, estimated @ 7 elements per penetration**

Notes
1. Systems are described in Table 3.1.

Table 3.6
WBN Unit 1 - Risk Impact Analysis Results

System(1)	Category	Consequence Rank	Failure Potential		Inspection Locations			CDF Impact(3)		LERF Impact(3)	
			DMs	Rank	Section XI(2)	RI-ISI	Delta	w/ POD	w/o POD	w/ POD	w/o POD
RCS	2	High	TT, PWSCC	Medium	1	1	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RCS	2	High	PWSCC	Medium	13	8	-5	5.90E-09	5.90E-09	6.83E-11	6.83E-11
RCS	2	High	TASCS	Medium	0	2	2	-4.24E-09	-2.36E-09	-4.91E-11	-2.73E-11
RCS	2	High	TASCS, TT	Medium	1	1	0	-1.41E-09	0.00E+00	-1.64E-11	0.00E+00
RCS	2	High	TT	Medium	1	0	-1	7.07E-10	1.18E-09	8.19E-12	1.37E-11
RCS	4	High	None	Low	41	20	-21	1.24E-09	1.24E-09	1.43E-11	1.43E-11
RCS	7a	Low	None	Low	0	0	0	negligible	negligible	negligible	negligible
RCS Total								**2.18E-09**	**5.90E-11**	**-4.30E-11**	**6.83E-13**
CVCS	2	High	TASCS	Medium	0	1	1	-2.12E-09	-1.18E-09	-2.46E-11	-1.37E-11
CVCS	2	High	TASCS, TT	Medium	0	1	1	-2.12E-09	-1.18E-09	-2.46E-11	-1.37E-11
CVCS	2	High	TT	Medium	0	2	2	-4.24E-09	-2.36E-09	-4.91E-11	-2.73E-11
CVCS	4	High	None	Low	0	12	12	-7.07E-10	-7.07E-10	-8.19E-12	-8.19E-12
CVCS	6a	Medium	None	Low	32	0	-32	negligible	negligible	negligible	negligible
CVCS	6b	Low	TT	Medium	0	0	0	negligible	negligible	negligible	negligible
CVCS	7a	Low	None	Low	0	0	0	negligible	negligible	negligible	negligible
CVCS Total								**-9.20E-09**	**-5.42E-09**	**-1.06E-10**	**-6.28E-11**
RHR	2	High	IGSCC	Medium	1	3	2	-2.36E-09	-2.36E-09	-2.73E-11	-2.73E-11
RHR	2	High	TASCS	Medium	0	2	2	-4.24E-09	-2.36E-09	-4.91E-11	-2.73E-11
RHR	4	High	None	Low	17	13	-4	2.36E-10	2.36E-10	2.73E-12	2.73E-12
RHR	6a	Medium	None	Low	23	0	-23	negligible	negligible	negligible	negligible
RHR Total								**-6.37E-09**	**2.36E-10**	**2.73E-12**	**2.73E-12**
SIS	2	High	IGSCC	Medium	1	7	6	-6.00E-11	-6.00E-11	-6.00E-12	-6.00E-12
SIS	4	High	None	Low	22	68	46	-2.71E-09	-2.71E-09	-3.14E-11	-3.14E-11
SIS	5a	Medium	IGSCC	Medium	5	2	-3	3.00E-11	3.00E-11	3.00E-12	3.00E-12
SIS	6a	Medium	None	Low	33	0	-33	negligible	negligible	negligible	negligible
SIS	7a	Low	None	Low	6	0	-6	negligible	negligible	negligible	negligible
SIS Total								**-2.74E-09**	**-2.74E-09**	**-3.44E-11**	**-3.44E-11**

Table 3.6 (cont.) WBN Unit 1 - Risk Impact Analysis Results											
System[1]	**Category**	**Consequence Rank**	**Failure Potential**		**Inspection Locations**			**CDF Impact[3]**		**LERF Impact[3]**	
			DMs	**Rank**	**Section XI[2]**	**RI-ISI**	**Delta**	**w/ POD**	**w/o POD**	**w/ POD**	**w/o POD**
CI	6a	Medium	None	Low	0	0	0	negligible	negligible	negligible	negligible
CI	7a	Low	None	Low	0	0	0	negligible	negligible	negligible	negligible
CI Total								**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
CSS	6a	Medium	None	Low	3	0	-3	negligible	negligible	negligible	negligible
CSS	7a	Low	None	Low	13	0	-13	negligible	negligible	negligible	negligible
CSS Total								**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
AFW*	5a (3)	Medium (High)	TASCS (FAC)	Medium	1	1	0	-1.20E-11	0.00E+00	-1.20E-12	0.00E+00
AFW*	6a	Low	None (FAC)	Low	8	0	-8	negligible	negligible	negligible	negligible
AFW	6a (3)	Low (High)	None (FAC)	Low	1	0	-1	negligible	negligible	negligible	negligible
AFW	6b (5b)	Low (Medium)	TASCS, TT (FAC)	Medium	1	0	-1	negligible	negligible	negligible	negligible
AFW*	7a	Low	None (FAC)	Low	4	0	-4	negligible	negligible	negligible	negligible
AFW	7a (5b)	Low (Medium)	None (FAC)	Low	1	0	-1	negligible	negligible	negligible	negligible
AFW Total								**-1.20E-11**	**0.00E+00**	**-1.20E-12**	**0.00E+00**
FWS	6a (3)	Low (High)	None (FAC)	Low	14	0	-14	negligible	negligible	negligible	negligible
FWS	6b (5b)	Low (Medium)	TASCS, TT (FAC)	Medium	2	0	-2	negligible	negligible	negligible	negligible
FWS	7a (5b)	Low Medium)	None (FAC)	Low	3	0	-3	negligible	negligible	negligible	negligible
FWS Total								**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
MSS	4	High	None	(High)	23	3	-20	1.18E-09	1.18E-09	1.37E-11	1.37E-11
MSS	6a	Low	None	(High)	120	0	-120	negligible	negligible	negligible	negligible
MSS Total								**1.18E-09**	**1.18E-09**	**1.37E-11**	**1.37E-11**
Grand Total								**-1.50E-08**	**-6.69E-09**	**-1.69E-10**	**-8.01E-11**

*AFW <4NPS added in Interval 2. Section XI locations estimated at 7.5% of population

Notes

1. Systems are described in Table 3.1-1.
2. Only those ASME Section XI Code inspection locations that received a volumetric examination in addition to a surface examination are included in the count. Inspection locations previously subjected to a surface examination only were not considered in accordance with Section 3.7.1 of EPRI TR-112657.
3. Per Section 3.7.1 of EPRI TR-112657, the contribution of low risk categories 6 and 7 need not be considered in assessing the change in risk. Hence, the word “negligible” is given in these cases in lieu of values for CDF and LERF Impact. For those cases in high, medium or low risk region piping where the change in risk calculation produces a value of zero for CDF or LERF Impact, "no change" is listed.

Table 5-1
WBN Unit 1 - Inspection Location Selection Comparison Between ASME Section XI Code and EPRI TR-112657 by Risk Region

System[1]	Code Category[2]	High Risk Region					Medium Risk Region					Low Risk Region				
		Weld Count	ASME Section XI		EPRI TR-112657		Weld Count	ASME Section XI		EPRI TR-112657		Weld Count	ASME Section XI		EPRI TR-112657	
			Vol/Sur	Sur Only	RI-ISI	Other[3]		Vol/Sur	Sur Only	RI-ISI	Other[3]		Vol/Sur	Sur Only	RI-ISI	Other[3]
RCS	B-F	14	14	0	9		8	8	0	1		0	0	0	0	
RCS	B-J	30	2	4	3		198	33	0	20		12	0	3	0	
CVCS	B-J	13	0	7	4		97	0	26	11		113	0	21	0	
CVCS	C-F-1	0	0	0	0		17	0	0	1		718	34	22	0	
RHR	B-J	17	1	0	5		42	7	5	7		21	7	0	0	
RHR	C-F-1	0	0	0	0		88	10	0	6		247	16	1	0	
SIS	B-J	28	1	10	7		271	9	54	47		124	16	15	0	
SIS	C-F-1	0	0	0	0		418	18	0	23		398	23	5	0	
CI	C-F-2	0	0	0	0		0	0	0	0		315*	0	0	0	
CSS	C-F-1	0	0	0	0		0	0	0	0		212	16	3	0	
AFW	C-F-2	0	0	0	0		4	1	0	1		159	15	0	0	
FWS	C-F-2	0	0	0	0		0	0	0	0		291	19	0	0	
MSS	C-F-2	0	0	0	0		23	1	0	3		120	10	0	0	
Total	B-F	14	14	0	9		8	8	0	1		0	0	0	0	
	B-J	88	4	21	19		608	49	85	85		270	23	39	0	
	C-F-1	0	0	0	0		523	28	0	30		1575	89	31	0	
	C-F-2	0	0	0	0		27	2	0	4		885	44	0	0	

*CI elements not defined in Section XI, estimated @ 7 elements per penetration

Notes

1. Systems are described in Table 3.1.
2. The ASME Code Category is based on the 2001 Edition with 2003 Addenda of the ASME Section XI Code. Starting with the 1989 Addenda, piping dissimilar metal welds (DMWs) are classified as Category B-J instead of B-F. Category B-F pertains only to vessel dissimilar metal welds, which for WBN, consists of the Pressurizer Surge, Spray, and two Safety nozzles.
3. The column labeled “Other” is generally used to identify augmented inspection program locations credited per Section 3.6.5 of EPRI TR-112657. The EPRI methodology allows augmented inspection program locations to be credited if the inspection locations selected strictly for RI-ISI purposes produce less than a 10% sampling of the overall Class 1 weld population. As stated in Section 3.5 of this template, WBN Unit 1 achieved greater than a 10% sampling without relying on augmented inspection program locations beyond those selected by the RI-ISI process. The “Other” column has been retained in this table solely for uniformity purposes with the other RI-ISI application template submittals.

System(1)	Risk		Consequence Rank	Failure Potential		Code Category(2)	Weld Count	Section XI		EPRI TR-112657	
	Category	Rank		DMs	Rank			Vol/ Sur	Sur Only	RI-ISI	Other(3)
RCS	2	High	High	TT, PWSCC	Medium	B-F	1	1	0	1	
RCS	2	High	High	PWSCC	Medium	B-F	13	13	0	8	
RCS	2	High	High	TASCS	Medium	B-J	16	0	4	2	
RCS	2	High	High	TASCS, TT	Medium	B-J	7	1	0	1	
RCS	2	High	High	TT	Medium	B-J	7	1	0	0	
RCS	4	Medium	High	None	Low	B-F	8	8	0	1	
						B-J	198	33	20	20	
RCS	7a	Low	Low	None	Low	B-J	12	0	3	0	
CVCS	2	High	High	TASCS	Medium	B-J	1	0	1	1	
CVCS	2	High	High	TASCS, TT	Medium	B-J	3	0	2	1	
CVCS	2	High	High	TT	Medium	B-J	9	0	4	2	
CVCS	4	Medium	High	None	Low	B-J	97	0	26	11	
						C-F-1	17	0	0	1	
CVCS	6a	Low	Medium	None	Low	B-J	72	0	18	0	
						C-F-1	668	32	21	0	
CVCS	6b	Low	Low	TT	Medium	B-J	6	0	1	0	
CVCS	7a	Low	Low	None	Low	B-J	35	0	2	0	
						C-F-1	50	2	1	0	
RHR	2	High	High	IGSCC	Medium	B-J	9	1	0	3	
RHR	2	High	High	TASCS	Medium	B-J	8	0	0	2	
RHR	4	Medium	High	None	Low	B-J	42	7	5	7	
						C-F-1	88	10	0	6	
RHR	6a	Low	Medium	None	Low	B-J	21	7	0	0	
						C-F-1	247	16	1	0	
SIS	2	High	High	IGSCC	Medium	B-J	28	1	10	7	
SIS	4	Medium	High	None	Low	B-J	257	4	54	45	
						C-F-1	418	18	17	23	
SIS	5a	Medium	Medium	IGSCC	Medium	B-J	14	5	0	2	
SIS	6a	Low	Medium	None	Low	B-J	106	12	15	0	
						C-F-1	303	21	2	0	
SIS	7a	Low	Low	None	Low	B-J	18	4	0	0	
						C-F-1	95	2	3	0	

Table 5-2 (cont.) WBN Unit 1 - Inspection Location Selection Comparison Between ASME Section XI Code and EPRI TR-112657 by Risk Category											
System(1)	Risk		Consequence Rank	Failure Potential		Code Category(2)	Weld Count	Section XI		EPRI TR-112657	
	Category	Rank		DMs	Rank			Vol/ Sur	Sur Only	RI-ISI	Other(3)
CI	6a	Low	Medium	None	Low	C-F-2	21	0	0	0	
CI	7a	Low	Low	None	Low	C-F-2	294	0	0	0	
CSS	6a	Low	Medium	None	Low	C-F-1	152	3	3	0	
CSS	7a	Low	Low	None	Low	C-F-1	60	13	0	0	
AFW	5a (3)	Medium (High)	Medium	TASCS (FAC)	Medium (High)	C-F-2	4	1	0	1	
AFW	6a	Low	Medium	None	Low	C-F-2	100	8	0	0	
AFW	6a (3)	Low (High)	Medium	None (FAC)	Low (High)	C-F-2	3	1	0	0	
AFW	6b (5b)	Low (Medium)	Low	TASCS, TT (FAC)	Medium (High)	C-F-2	2	1	0	0	
AFW	7a	Low	Low	None	Low	C-F-2	52	4	0	0	
AFW	7a (5b)	Low (Medium)	Low	None (FAC)	Low (High)	C-F-2	2	1	0	0	
FWS	6a (3)	Low (High)	Medium	None (FAC)	Low (High)	C-F-2	194	14	0	0	
FWS	6b (5b)	Low (Medium)	Low	TASCS, TT (FAC)	Medium (High)	C-F-2	42	2	0	0	
FWS	7a (5b)	Low (Medium)	Low	None (FAC)	Low (High)	C-F-2	55	3	0	0	
MSS	4	Medium	High	None	Low	C-F-2	23	1	0	3	
MSS	6a	Low	Medium	None	Low	C-F-2	120	10	0	0	

***CI elements not defined in Section XI, estimated @ 7 elements per penetration**

Notes

1. Systems are described in Table 3.1-1.
2. The ASME Code Category is based on the 2001 Edition with 2003 Addenda of the ASME Section XI Code. Starting with the 1989 Addenda, piping dissimilar metal welds (DMWs) are classified as Category B-J instead of B-F. Category B-F pertains only to vessel dissimilar metal welds, which for WBN, consists of the Pressurizer Surge, Spray, and two Safety nozzles.
3. The column labeled “Other” is generally used to identify augmented inspection program locations credited per Section 3.6.5 of EPRI TR-112657. The EPRI methodology allows augmented inspection program locations to be credited if the inspection locations selected strictly for RI-ISI purposes produce less than a 10% sampling of the overall Class 1 weld population. As stated in Section 3.5 of this template, WBN Unit 1 achieved greater than a 10% sampling without relying on augmented inspection program locations beyond those selected by the RI-ISI process. The “Other” column has been retained in this table solely for uniformity purposes with the other RI-ISI application template submittals.

Enclosure 2
List of Commitments

1. Upon approval of the RI-ISI program, procedures that comply with the guidelines described in EPRI TR-112657 will be prepared to implement and monitor the program. The new program will be implemented for the second inservice inspection interval.