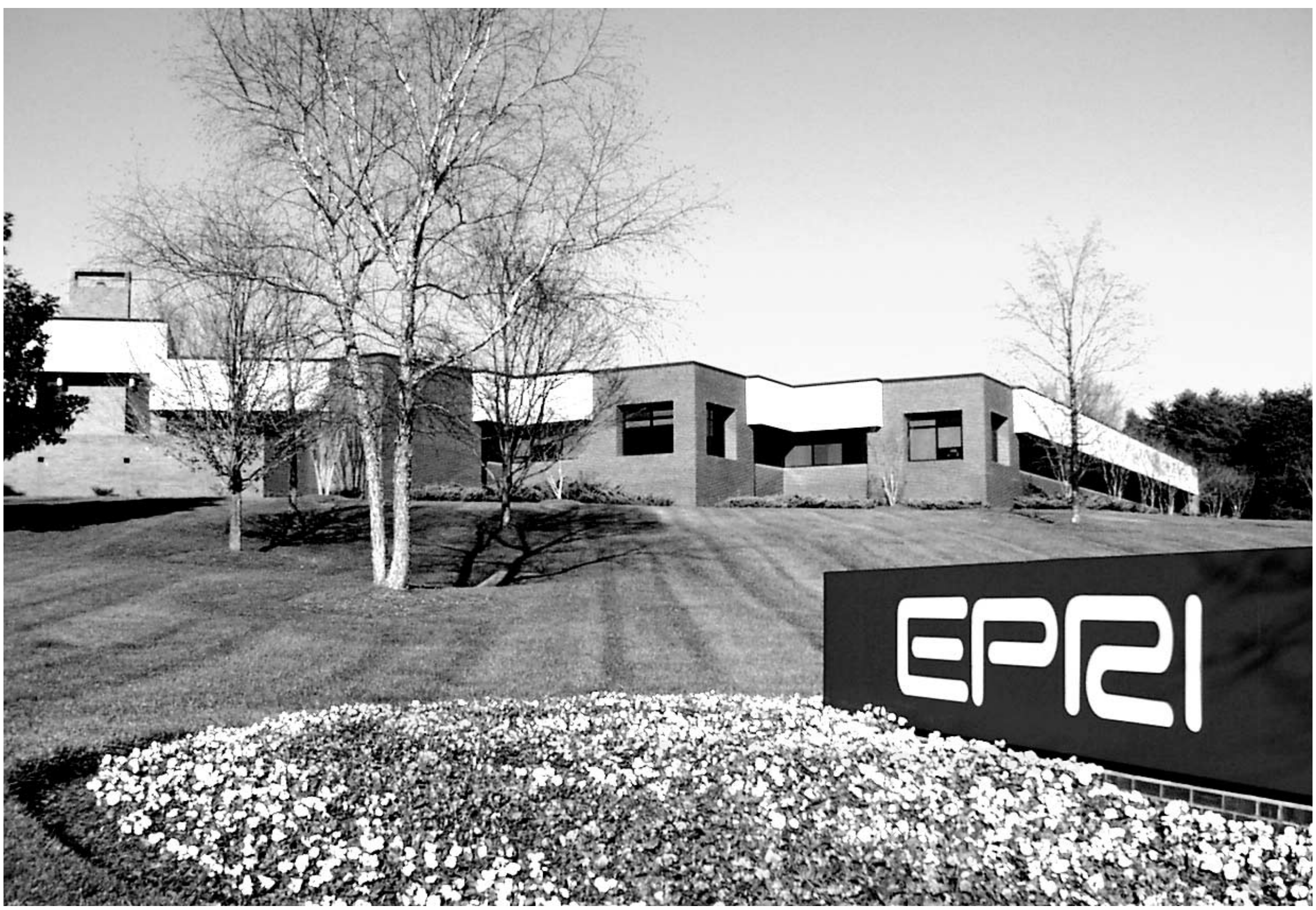
Extension of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs, Rev. 0-A

Technical Report



EPRI NDE Center

Extension of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs, Rev. 0-A

1006937

Final Report, August 2002

EPRI Project Manager
P. O'Regan

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ORDERING INFORMATION

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The report is a corporate document that should be cited in the literature in the following manner:

Extension of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs, *Rev. 0-A,* EPRI, Palo Alto, CA: 2002. 1006937.

REPORT SUMMARY

Since its USNRC acceptance in 1999, many nuclear plants have used the EPRI Risk-Informed Inservice Inspection (RI-ISI) procedure to categorize and select piping components for inspection based on risk significance. The EPRI RI-ISI methodology serves as an alternative to the inservice inspection requirements for piping cited in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI.

This report outlines EPRI's efforts to extend the RI-ISI methodology to break exclusion region (BER) piping and to secure USNRC acceptance.

Background

The updated RI-ISI program (specifically extended to BER programs) described in this report provides an alternative methodology for determining the number of augmented inspections required in the break exclusion region of plant piping.

This modified approach will be used by plant licensees to define the scope of a risk-informed inspection program for BER piping. It can be used in lieu of the inservice examination requirement for pipe welds in the BER augmented program. Program scope is defined by establishing piping segments, inspection element locations, inspection methods, examination volumes, and acceptance and evaluation criteria. Licensees using this methodology will incorporate the results of their risk-informed BER evaluation into plant-specific procedures that are consistent with performance-based implementation and monitoring strategies.

Objective

- To provide guidance that will support plant licensees' efforts to apply the updated RI-ISI methodology to their plant's BER inspection program

Approach

In 1999, the USNRC approved EPRI's *Revised Risk-Informed Inservice Inspection Evaluation Procedure* (TR-112657, Rev. B-A). This base methodology involved categorizing and selecting piping components for inspections based on their risk significance. It was offered as an alternative to the ASME Code, Section XI inservice inspection requirements for piping. After a comprehensive assessment of the base RI-ISI methodology for its applicability to BER programs, EPRI submitted a draft report to the USNRC in February 2001, seeking acceptance for the extension of the RI-ISI methodology to break exclusion region piping. After further discussion and exchange of information with the USNRC, EPRI was granted approval in June 2002.

This current report documents the conclusions, clarifications, enhancements, and agreements reached with the USNRC for the extension of the RI-ISI methodology to BER programs. When applying the RI-ISI evaluation process to a plant's BER program, the full EPRI RI-ISI methodology, together with the enhancements documented in this report, would need to be completed. This report outlines each step of the RI-ISI process and all changes necessary for BER application.

Results

EPRI received USNRC acceptance of the modified RI-ISI methodology and its application to BER programs in June 2002. This report represents publication of the final topical report that was accepted by the USNRC.

EPRI Perspective

Augmented inspections due to BER requirements limit the amount of burden reduction available through the application of RI-ISI technology. This report provides a vehicle to further realize the gains associated with RI-ISI technology. In addition, for many plants, this application can be implemented via the 10 CFR 50.59 process.

Keywords

Risk-informed inservice inspection
ISI
PRA
NDE
Break exclusion requirements
High energy line break

NRC ACCEPTANCE LETTER AND SAFETY EVALUATION

June 27, 2002

Mr. Gary L. Vine
Senior Washington Representative
Electric Power Research Institute
2000 L Street, N.W., Suite 805
Washington, DC 20036

SUBJECT: SAFETY EVALUATION OF TOPICAL REPORT TR-1006937, "EXTENSION OF THE EPRI RISK INFORMED ISI METHODOLOGY TO BREAK EXCLUSION REGION PROGRAMS" (TAC NO. MB1344)

Dear Mr. Vine:

By letter dated February 28, 2001, the Electric Power Research Institute (EPRI) submitted for NRC review, a draft report for the extension of the EPRI risk-informed inservice inspection (RI-ISI) process. The draft report provided the basis and process for extending the RI-ISI methodology as an acceptable alternative to augmented inspection programs for break exclusion requirements typically identified in Standard Review Plan Sections 3.6.1 and 3.6.2.

On April 4, 2002, EPRI submitted its final report TR-1006937, "Extension of the EPRI Risk Informed ISI Methodology to Break Exclusion Report Programs." By letter dated April 9, 2002, the staff issued a draft safety evaluation (SE) of this topical report.

The staff has completed its review of the final report and has found that EPRI Topical Report TR-1006937, "Extension of the EPRI Risk Informed ISI Methodology to Break Exclusion Region Programs," is acceptable for referencing in licensing applications to the extent specified and under the limitations delineated in the report and in the associated NRC safety evaluation (SE). The enclosed SE defines the basis for acceptance of the report.

We do not intend to repeat our review of the matters described in the subject report and found acceptable, when the report appears as a reference in license applications, except to ensure that the material presented applies to the specific plant involved. Our acceptance applies only to matters approved in the report.

In accordance with the guidance provided on the NRC web site, we request that EPRI publish an accepted version of this topical report within 3 months of receipt of this letter. The accepted version shall incorporate this letter and the enclosed safety evaluation between the title page and the abstract. It must be indexed such that information can be readily located. Also, it must contain in appendices, historical review information, such as questions and accepted responses, and original report pages that were replaced. The accepted version shall include a "-A" (designated accepted) following the report identification symbol or number.

If our criteria or regulations change so that our conclusions as to the acceptability of the report are no longer valid, EPRI and/or the applicants referencing the topical report will be expected to review and resubmit their documentation or submit justification showing that the topical report is held without revised documentation.

Sincerely,

/RA/

Cornelius F. Holden, Jr., Acting Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 669

Enclosure: Safety Evaluation

cc w/encl:
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ELECTRIC POWER RESEARCH INSTITUTE (EPRI) TOPICAL REPORT

TR-1006937, "EXTENSION OF THE EPRI RISK INFORMED ISI METHODOLOGY

TO BREAK EXCLUSION REGION PROGRAMS"

PROJECT NO. 669

1.0 INTRODUCTION

On October 28, 1999, the staff approved the EPRI methodology as documented in EPRI TR-112657, Rev. B-A, "Revised Risk-Informed Inservice Inspection (RI-ISI) Evaluation Procedure," (Reference 1). EPRI TR-112657, Rev. B-A (hereafter, EPRI-ISI-TR) provides technical guidance for categorizing and selecting piping components for inspection based on their risk significance as an alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, inservice inspection (ISI) requirements for piping.

On February 28, 2001, EPRI submitted its draft report, "Application of Risk and Performance Technology, Volume 1 - Break Exclusion Requirements" to extend the RI-ISI methodology to break exclusion region piping (Reference 2). Additional clarifying information was provided on December 17, 2001 (Reference 3). On April 4, 2002, EPRI submitted its final topical report (TR), EPRI TR-1006937, "Extension of the EPRI Risk Informed ISI Methodology to Break Exclusion Region Programs" (Reference 4). EPRI TR-1006937 (hereafter, EPRI-BER-TR) provides guidance on applying the EPRI-ISI-TR methodology to break exclusion region (BER) piping programs.

2.0 BACKGROUND

General Design Criterion 4 (Reference 5) requires that structures, systems, and components (SCCs) important to safety shall be designed to accommodate the effects of postulated accidents, including appropriate protection against the dynamic and environmental effects of postulated pipe ruptures. The staff has issued a number of documents that provide criteria for implementing the above requirements. These include the scope of applicable systems, and locations to postulate breaks, methods of analyzing pipe whip forces and displacements, design of pipe whip restraints, methods of analyzing jet impingement forces and expansion zones, and methods for evaluating the integrity of components subjected to these dynamic effects. In determining the locations where breaks are to be postulated in high-energy piping, the staff also provides special criteria for excluding postulated breaks in a BER in the containment penetration areas.

The O'Leary letter (Reference 6) is an early NRC document that discusses situations where pipe breaks need not be postulated. Appendix A, Paragraph A.4, of the O'Leary letter states:

> For those portions of the piping passing through primary containment penetrations and extending to the first outside isolation valve, pipe breaks need not be postulated provided such piping is conservatively reinforced and restrained beyond the valve such that, in the event of a postulated pipe break outside containment, the transmitted pipe loads will neither impair the operability of the valve nor the integrity of the piping or the containment penetration. (A terminal end of such piping is considered to originate at this restraint location.)

Although details of the BER design criteria were not provided in this letter, the preceding paragraph summarizes the philosophy of the BER. It indicates that: (1) the BER extends to the first isolation valve outside containment, (2) a restraint needs to be placed beyond the isolation valve to protect the piping in the zone from the effects of a break outside the zone, and (3) the restraint is considered to be the terminal end break location.

In November 1975, the staff issued Standard Review Plan (SRP) Section 3.6.2 (Reference 7), and it is the primary document for determining the locations of postulated breaks. Branch Technical Position MEB 3-1 (BTP MEB 3-1), attached to SRP 3.6.2, states that breaks and cracks need not be postulated in BER piping provided they meet certain design and inspection criteria. Paragraphs B.1.b.(1) through (7) of BTP MEB 3-1 provide the details on the containment penetration BER design criteria including a criterion for augmented inservice inspection. This criterion states:

> A 100% volumetric inservice examination of all pipe welds should be conducted during each inspection interval as defined in IWA-2400, ASME Code, Section XI.

3.0 SUMMARY OF PROPOSED APPROACH

The methodology and procedures in EPRI-ISI-TR, as modified by EPRI-BER-TR, will be used by licensees to define the scope of a risk-informed inspection program for BER piping in lieu of the 100 percent volumetric inservice examination of all pipe welds in the BER. This scope is defined by establishing piping segments, inspection element locations, inspection methods, examination volumes, and acceptance and evaluation criteria. A licensee using this methodology will be expected to incorporate the results of its RI-BER evaluation into plant-specific program procedures that are consistent with the performance-based implementation and monitoring strategies specified in Regulatory Guide (RG) 1.178 (Reference 8), ASME Code, Section XI, and EPRI-ISI-TR.

The proposed risk-informed methodology will apply the risk-informed methodology described in EPRI-ISI-TR to the welds in the BER, except as discussed in the EPRI-BER-TR and approved in this safety evaluation (SE). Deviations from the NRC's "approved methodology" described in EPRI-BER-TR or in EPRI-ISI-TR need to be identified and submitted to the staff for review and approval prior to implementation. This is discussed in Section 4.5 of this SE.

4.0 EVALUATION

For this review, the NRC staff reviewed EPRI-RI-ISI methodology as modified by EPRI-BER-TR against the guidance contained in RG 1.178 (Reference 8) and SRP 3.9.8 (Reference 9). These documents describe the acceptable methodology, acceptance guidelines, and review process for proposed plant-specific, risk-informed changes to inservice inspection of piping programs. Further guidance is provided in RG 1.174 (Reference 10) and in SRP 19.0 (Reference 11) which contain general guidance for using probabilistic risk assessments (PRAs) in risk-informed decisionmaking.

4.1 Proposed Changes to BER Programs

A general description of the changes to the BER piping programs that would result from the proposed methodology is provided in EPRI-BER-TR. Specific piping systems, segments, and welds, as well as revisions to inspection scope, schedule, locations, and techniques, are plant-specific and, therefore, are not directly included in this evaluation.

Licensees will identify, evaluate, and implement changes to the weld inspection locations and the number of BER piping welds to inspect based on EPRI-BER-TR methodology. If the BER program is described in the final safety analysis report (FSAR), licensees may implement changes to the BER program according to the provisions of 10 CFR 50.59 (Reference 12). As applied to methodologies in the FSAR, prior NRC approval is not required if the change involves the use of a method approved by the NRC for the intended application. If the BER program is described in the technical specifications, the licensee must request a license amendment. Changes to weld inspection locations and changes to the percentage of welds to be inspected which are developed according to an ASME Section XI inspection program require a request for relief in accordance with 10 CFR 50.55(a) and may not be made under the provisions of 10 CFR 50.59. In cases where the licensee has been authorized by the NRC to implement a RI-ISI program in lieu of the ASME Code, Section XI, program and the BER piping overlaps with the piping in the RI-ISI program, changes to the RI-ISI program may be made without staff review provided no deviations or exceptions are taken to the methodology described in the licensee's RI-ISI submittal approved by the staff.

4.2 Engineering Analysis

According to the guidelines in RGs 1.174 and 1.178, licensees proposing a RI-ISI program should perform an analysis of the proposed changes using a combination of engineering analysis with supporting insights from a PRA. For the RI-ISI program methodology, an engineering analysis includes a determination of the scope of piping systems included in the program, establishing the methodology for defining piping segments, evaluating the failure potential of each segment, and determining the consequences of failure of piping segments. The methodology as approved for the EPRI-ISI-TR may be expanded to include the BER programs as described in EPRI-BER-TR.

The staff review of the RI-ISI methodology in EPRI-ISI-TR determined that extension of the implementation of the RI-ISI methodology to BER piping is not expected to affect existing safety analyses, meets the current regulations, is consistent with defense-in-depth philosophy, maintains sufficient safety margins, provides reasonable assurance that risk increases (if any) resulting from the proposed change are small and consistent with the intent of the Commission's Safety Goal Policy Statement, and will be monitored using performance-based strategies. Expansion of the applicable methodology as described in EPRI-BER-TR does not affect the staff findings on the basic methodology. Details of the changes to the engineering analysis of the risk-based evaluations that are needed during the application of the methodology to the BER welds are discussed in the following sections.

4.2.1 Scope of Program

As discussed in the EPRI-ISI-TR and in the staff's corresponding safety evaluation, the staff has determined that full-scope and partial-scope options are acceptable for RI-ISI programs for piping. However, complete flexibility in selecting the scope was not accepted by the staff. Instead, the staff found that an acceptable scope definition must be based upon existing SSC classification such as ASME Section XI, code class and/or system designation.

EPRI has proposed to apply its EPRI-ISI-TR methodology, as modified by EPRI-BER-TR to the BER piping. The methodology has been developed to replace the existing BER augmented ISI program with a risk-informed program, either as an independent RI-BER ISI program or in combination with an NRC staff authorized RI-ISI program developed as an alternative to the ASME Section XI, ISI requirements. However, as stated in Section 2.2 of EPRI-BER-TR, if the methodology is applied to the BER, it must be applied to all piping and welds within the scope of the existing BER program. Therefore, the staff concurs with EPRI-BER-TR provision that all welds in the original BER program be evaluated in the new program to fully incorporate the risk-informed approach and ensure that the disposition of all the welds in a plant's BER comport with the approved risk-informed methodology and associated guidelines.

4.2.2 Piping Segments

Section 3.5.1 of EPRI-ISI-TR provides the definition for pipe segments. Pipe segments are defined as lengths of pipe that are exposed to the same degradation mechanism and whose failure leads to the same consequence. That is, some lengths of pipe whose failure would lead to the same consequences are split into two or more segments when two or more regions are exposed to different degradation mechanisms. Similarly, lengths of pipe exposed to the same degradation mechanism whose failure would lead to different consequences are split into two or more segments.

The definition of pipe segments will not change for the analysis of the BER piping. The staff finds that the definition of segments based on the general characteristics outlined in EPRI-ISI-TR is sufficient and applicable to the BER piping.

4.2.3 Piping Failure Potential

The purpose of the piping failure potential estimation is to differentiate among the piping segments, the basis of the potential failure mechanism and the postulated consequences. The relative failure potential of piping segments provides insights for defining the scope of inspection for the RI-BER program. Determination of piping failure potential is discussed in Section 3.4 of EPRI-ISI-TR. The basis for this assessment includes evaluating the degradation mechanisms for each pipe segment using the attributes and evaluation criteria for the degradation mechanisms listed in the EPRI-ISI-TR, followed by categorizing the potential for a large pipe failure according to the degradation category.

The EPRI-BER-TR methodology was applied to two plants (Reference 2). The results showed that the degradation mechanisms identified in the EPRI-ISI-TR are sufficient and applicable to the BER piping welds. Therefore, the staff finds that the definition and use of degradation mechanism in the EPRI-ISI-TR are applicable to the BER piping and that, if any new mechanisms are identified, the methodology has a process to assess and include the new degradation mechanism.

4.2.4 Consequence of Failure

The consequences of the postulated pipe segment failures are considered primarily in Section 2.3 of EPRI-BER-TR and include direct and indirect effects of the failure. Direct effects include the loss of a train or system and associated possible diversion of flow or an initiating event, such as a loss-of-coolant accident (LOCA), or both. Indirect effects include dynamic effects arising from pipe whip or jet impingement and other spatial effects, such as from floods and spray, that may affect adjacent SSCs. It should be noted that the consequence of failure of the BER piping is not performed as part of the design nor is it protected against in the same manner as for non-BER piping. Therefore, the consequence evaluation as it relates to the determination of the potential dynamic effects is the principle difference between the methodology approved in EPRI-ISI-TR and EPRI-BER-TR.

In the areas of the plant not included in the BER, high-energy pipe failures have been evaluated using the SRP guidelines and, if needed, mitigation devices were added. Because of the SRP 3.6.2 evaluation in areas of the plant not included in the BER, an evaluation of the potential consequences in support of RI-ISI as developed and documented by each licensee is sufficient to support the reduction and relocation of examination locations in the RI-ISI program. Within the BER however, pipe failures were excluded and mitigation devices such as pipe whip restraints and jet impingement shields were not constructed. Therefore, a detailed consequence evaluation comparable to, or more conservative than, that described in SRP 3.6.2 is needed to evaluate the impact of pipe failures more likely to affect containment integrity and the operability of nearby equipment due to the lack of mitigative hardware in the break exclusion region.

The criteria for EPRI-BER-TR consequence evaluation is provided in Section 2.3 of EPRI-BER-TR. This criteria deals with postulation of pipe failures for the consequence evaluation, the dynamic effects of these pipe breaks on pipes and other structures and equipment. For risk-informing the inspections of BER piping, EPRI stated that the criteria for postulating and analyzing pipe whip and jet impingement impacts are to be consistent with existing plant high-energy pipe break analyses (e.g., SRP 3.6.2, if that is the plant's basis for analyses). Both circumferential and longitudinal breaks are postulated at each weld for BER piping for evaluating the consequence of postulated pipe failures. EPRI stated that SRP 3.6.2 may be used to evaluate unrestrained whipping pipe and its potential impact on SSCs. For example, an unrestrained whipping pipe is assumed to fail a smaller line and its penetration. Circumferential and longitudinal breaks are postulated for the smaller line except where analytical or experimental data, or both, for the expected range of impact energies demonstrate the capability of the target to withstand the impact without rupture. An unrestrained whipping pipe is considered capable of developing through-wall cracks in equal or larger nominal pipe size with thinner wall thickness except where analytical or experimental data, or both, for the expected range of impact energies demonstrate the capability of the target to withstand the impact without rupture. In lieu of SRP 3.6.2, plant specific criteria and analyses may be used and conservative assumptions or engineering judgments derived from plant design and analyses may be used. For example, the determination of pipe whip potential including potential for developing a hinge may be derived from plant analyses of similar configurations. Furthermore, if a structural target is designed similar to another structural target already analyzed for a similar pipe whip impact load and found to be acceptable, this may be used as a reasonable basis to demonstrate the capability of the subject structure to withstand the impact without rupture.

With respect to the evaluation of jet impingement impact, EPRI stated that SRP 3.6.2 may be used to evaluate the potential impact of jet impingement on SSCs. In lieu of SRP 3.6.2, plant-specific criteria and analyses may be used, and conservative assumptions or engineering judgments derived from plant design and analyses may be used. For example, electrical or active equipment within the jet expansion zone is assumed to fail unless otherwise qualified. If a structural or passive component type of target is designed similar to another target already analyzed for a similar jet impingement load and found to be acceptable, this may be used as a reasonable basis to demonstrate the capability of the subject structure or component to withstand the impact of the jet impingement load.

The staff finds that Section 2.3 of EPRI-BER-TR provides clear guidance for evaluating the dynamic effects of postulated BER piping failures. Since this guidance is consistent with or more conservative than guidance previously approved by the staff to evaluate the effects of pipe ruptures, the staff finds this guidance acceptable.

4.2.5 Consequence Categorization

The methodology requires that the consequence of each piping segment failure be placed into one of four categories: high, medium, low, and none. Once the spatial effects are appropriately determined, the consequence categorization methodology as approved by the staff in the EPRI-ISI-TR is equally acceptable to the BER piping. There are no unique effects of piping failures in the BER that cannot be appropriately evaluated and included within the risk-informed framework approved in EPRI-ISI-TR.

4.2.6 Probabilistic Risk Assessment

The scope, level of detail, and quality of a PRA and the general methodology for using PRA in regulatory applications is discussed in RG 1.174. RG 1.178 provides guidance that is more specific to ISI. The SE approving EPRI-ISI-TR notes that "the licensee is responsible for developing, and retaining on site for potential NRC audit, justification that the PRA is of sufficient quality and that there is reasonable assurance that the general results and conclusion of the proposed change are valid."

Section 2.8 of EPRI-BER-TR discusses the quality of the PRA used to support a change in the BER program. During the review of RI-ISI relief requests, the staff has not reviewed a PRA used to support a RI-ISI program relief request to assess the accuracy of the quantitative PRA estimates. Quantitative results of the PRA are used, in combination with a quantitative characterization of the pipe segment failure likelihood, to support the assignment of segments into broad safety significance categories reflecting the relative importance of pipe segment failures on core damage frequency (CDF) and large early release frequency (LERF), and to provide an illustrative estimate of the change in risk. Inaccuracies in the models or assumptions large enough to invalidate the analyses developed to support RI-ISI should have been identified in the licensee's or the staff's reviews. Minor errors or inappropriate assumptions will only affect the consequence categorization of a few segments and will not invalidate the general results or conclusions.

During the review of 10 CFR 50.55(a) RI-ISI relief requests, the quality of the PRA is judged sufficient to support a RI-ISI application using the methodology described in the EPR-ISI-TR after the licensee reviews comments, limitations, and possible weaknesses that have been identified by previous, independent reviews of the PRA (including the staff evaluation report issued on the individual plant examination) that might influence the results of the analyses. Section 2.8 of EPRI-BER-TR instructs the licensee to perform this review of comments and, if necessary, incorporate or otherwise disposition, all comments that could influence the results. The staff finds that this stipulation is consistent with the current acceptable practice for determining that the PRA is of sufficient quality to support a 10 CFR 50.55(a) relief request and, therefore, acceptable for use when changing the BER program using the methodology described in EPRI-ISI-TR as modified by EPRI-BER-TR.

4.2.7 Safety Significance Determination

The safety significance of an individual pipe segment is based on categorizing the consequence of the segment failure as high, medium, low, or none; and categorizing the failure potential of the piping as high, medium, or low. In EPRI-ISI-TR, these combinations define the basis for categorizing the pipe segments into Risk Categories 1 through 7. As discussed in Section 4.3.1 of this SE, the risk category determines the percentage of welds that should be inspected.

Once the spatial effects are appropriately determined, consequence categorization methodology as approved by the staff in EPRI-ISI-TR is equally acceptable to the BER piping. There is no unique failure potential or effect from piping failures in the BER that cannot be appropriately evaluated and included within the risk-informed framework approved for EPRI-ISI-TR.

4.2.8 Change in Risk Resulting From the Change in ISI Programs

RG 1.178 provides that any risk increases that might result from the proposed RI-ISI program and their cumulative effects be small and not exceed NRC safety goals. The EPRI method does not develop the number of locations to be inspected on the basis of quantitative risk results. Instead, the method categorizes the risk significance of the piping segments and then specifies the percentage of the welds to be inspected in each of the various categories as discussed in EPR-ISI-TR. The change in risk evaluation in the EPRI method is a final screening to ensure that a licensee wishing to replace a BER inspection program, or a RI-ISI program and a BER program, with a risk-informed inspection program, investigates the potential change in risk resulting from that change and implements it only upon determining with reasonable confidence that it is acceptable.

Currently, 100 percent of the BER welds are inspected. This percentage will be reduced with implementation of a risk-informed BER inspection program. The methodology approved in EPRI-ISI-TR includes system level and plant level changes in risk guidelines. These system level guidelines provide assurance that the risk from individual system failures will be kept small and dominant risk contributors will be avoided. EPRI-BER-TR methodology continues to apply these guidelines on the system and plant level when the BER program change is implemented together with a RI-ISI program. EPRI-BER-TR also applies these same guidelines to the estimated change in risk at the system level and plant level within the BER scope regardless of whether the BER program is changed alone or together with a RI-ISI program change. Application of these guidelines within the BER scope limits the estimated risk increase on CDF and LERF, due to the discontinuation of weld inspection within each system in the BER scope, to 1E-7/year and 1E-8/year, respectively. The total change in estimated CDF and LERF due to the modified BER inspection program should be less than 1E-6/year and 1E-7/year, respectively.

Application of the system level and plant level guidelines to the estimated change in risk within the BER program scope limits the magnitude of risk increases from discontinued inspection locations within the BER program scope that can be offset by risk decreases from new inspection locations outside of the BER program scope. The staff finds that applying the guidelines with the BER program scope is consistent with the sensitive location, lack of mitigative devices, and uncertainties in the methodologies used to rank the segments and estimate the change in risk and, therefore, is acceptable.

4.3 Integrated Decisionmaking

RG 1.178 and SRP 3.9.8 guidelines describe an integrated approach that should be utilized to determine the acceptability of the proposed RI-ISI program by considering in concert the traditional engineering analysis, risk evaluation, and the implementation and performance monitoring of piping under the program.

EPRI RI-ISI methodology is a process-driven approach; that is, the process identifies risk-significant pipe segment locations to be inspected without reliance on an expert panel. However, the element selection results are subjected to a multi-discipline plant review to verify the final risk results and element selections as discussed in Section 3.6.5 of EPRI-ISI-TR. The methodology for selection of welds for inspection described in EPRI-ISI-TR is applicable to the EPRI RI-BER ISI program and is acceptable for use in the BER evaluation. This is discussed further in the following section.

4.3.1 Selection of Examination Locations

Evaluation of the selection of piping segment elements to be examined as part of the RI-ISI program is addressed in Section 3.6 of EPRI-ISI-TR. For piping segments that are in Risk Category 1, 2, or 3 (high risk), the number of inspection locations in each risk category should be 25 percent of the total number of elements in each risk category each ISI interval. For Risk Categories 4 and 5 (medium risk), the number of inspection locations in each category should be 10 percent of the total number of elements in each risk category. Volumetric examinations are not required for those segments determined to be in Risk Category 6 or 7 (low risk).

Section 2.6 of EPRI-BER-TR addresses the required element selection percentages from the population of welds within the BER. That is, 25 percent of the population of welds in high risk segments and 10 percent of the population of welds in the medium risk segments within the BER region are selected for inspection. If a situation occurs where a significant number of elements are assigned low risk categories to the point that BER inspections fall below 10 percent of the total BER weld population, the basis for the low risk ranking shall be investigated as outlined in EPRI-BER-TR. The staff finds that these constraints provide reasonable assurance that the welds within the BER scope retain a level of inspection consistent with the greater likelihood of severe consequences caused partly by the sensitive location and partly by fewer mitigative devices.

If the BER program is coupled with a RI-ISI program, the BER weld inspections may be credited in the total population of welds selected for inspection for each risk category and each system.

4.3.2 Examination Methods

Evaluation of degradation mechanisms to determine the potential for piping failure is provided in Section 3.4 of EPRI-ISI-TR. The associated mechanism-specific examination volumes and methods for the selected piping structural elements are provided in Section 4 of EPRI-ISI-TR. Table 3-14 of EPRI-ISI-TR provides a summary of the degradation mechanism-specific non-destructive examination (NDE) methods and the associated acceptance standards, evaluation standards, and inspection frequencies. These inspection volumes and methods approved by the staff for EPRI-ISI-TR are applicable to the BER zone because the materials, degradation mechanisms, and operating characteristics of this region are not inherently different between the BER and the balance of the plant.

4.4 Implementation and Monitoring

The objective of this element of RGs 1.174 and 1.178 is to assess performance of the affected piping systems under the proposed RI-ISI program by implementing monitoring strategies that confirm the assumptions and analysis used in developing the RI-ISI program. As specified in EPRI-ISI-TR and approved by the staff, a licensee using this methodology will be expected to incorporate the results of its BER evaluation into plant-specific program procedures that are consistent with the performance-based implementation and monitoring strategies specified in RG 1.174 and, to the extent applicable, RG 1.178.

4.5 Conformance to Regulatory Guide 1.174

RG 1.174 describes an acceptable method for assessing the nature and impact of licensing basis changes by a licensee when the licensee chooses to support these changes with risk information. The staff found that the methodology described in EPRI-ISI-TR conforms to the RG 1.174 approach. The expansion of the applicability of the EPRI-ISI-TR methodology to include the BER scope does not change any of the techniques or guidelines relied upon in the original methodology to conform to RG 1.174. Pipe segments in the BER scope introduce no new failure modes, consequences, degradation mechanism, or analytic techniques that could change the basis for the staff finding that the methodology conforms to RG 1.174.

The use of EPRI-ISI-TR, as supplemented by EPRI-BER-TR, to determine the number of augmented inspections in the BER changes the inspection of welds from 100 percent to a risk-informed selection. In order to make this change to the BER program, the licensee must identify the appropriate change process to be used. If the BER program is described in the FSAR, the change process would be 10 CFR 50.59. In applying the evaluation criteria of 10 CFR 50.59 to this change, the use of the approved methodology in EPRI-ISI-TR, as supplemented by EPRI-BER-TR, would not be a "departure from a method of evaluation" (and thus would not require prior NRC approval) because it is a method approved by the NRC for the intended application. Proposed changes to a BER program that are described in the FSAR and that are not governed by 10 CFR 50.55a may be changed with the appropriate use of the 10 CFR 50.59 process. If there are ASME Class 1 or Class 2 piping welds in the BER only scope program, and the ASME XI inspections are being risk-informed for that piping (i.e., <25 percent for Class 1 and <7.5 percent for Class 2), then the licensee must still submit a relief request.

5.0 CONCLUSIONS

According to the methodology approved by the staff in EPRI-ISI-TR, the licensees will identify those aspects of the plants' licensing bases that may be affected by the proposed change, including rules and regulations, the FSAR, technical specifications, and license conditions. In addition, the licensees will identify all changes to commitments that may be affected, as well as the particular piping systems, segments, and welds that are affected by the change in the BER program. Specific revisions to inspection scope, schedules, locations, and techniques will also be identified, as will plant systems and functions that rely on the affected piping.

As previously noted, changes to a licensee's BER program, as described in the FSAR, may be made under 10 CFR 50.59 if the evaluation criteria are met. As applied to methodologies in the FSAR, prior NRC approval is not required if the change involves the use of a method approved by the NRC for the intended application. This SE is the staff's approval of a risk-informed method for determining the inspection locations and number of welds to be examined for BER piping.

The methodology conforms to the guidance provided in RGs 1.174 and 1.178 in that no significant risk increase should be expected from the changes to the ISI program resulting from applying the methodology to the BER alone, or the ASME piping and the BER.

The EPRI procedure for subdividing piping systems into segments is predicated on identifying portions of piping having the same consequences of failure and the same potential degradation mechanisms. The impact on risk attributable to piping pressure boundary failure considers both direct and indirect effects. Consideration of direct effects includes failures that cause initiating events or disable single or multiple components, trains or systems, or a combination of these effects. The methodology described in EPRI-BER-TR, further defines the methods to be applied to determine the indirect consequences of pipe failures in the BER. This refinement is an appropriate reflection that mitigation devices such as pipe whip restraints or jet impingement shields were not constructed in the plant design for BER piping. It also reflects the safety significance of ensuring the integrity of the containment and the operability of the isolation valves.

The results of the different elements of the engineering analysis are considered in an integrated decisionmaking process. In accordance with RG 1.174 guidelines, the impact of the proposed change in the BER program or the BER program and an ISI program is founded on the adequacy of the engineering analysis, acceptable change in plant risk, and the adequacy of the proposed implementation and performance monitoring plan.

The EPRI methodology also considers implementation and performance-monitoring strategies. Inspection strategies ensure that failure mechanisms of concern have been addressed, and there is adequate assurance of detecting damage before structural integrity is affected. The risk significance of piping segments is taken into account in defining the inspection scope for the BER program.

EPRI-ISI-TR, as applied to BER programs in EPRI-BER-TR, provides the methodology for conducting an engineering analysis of the proposed changes using a combination of engineering analysis with supporting insights from a PRA. Defense-in-depth and quality are not degraded in that the methodology provides reasonable confidence that any reduction in existing inspections will not lead to degraded piping performance when compared to existing performance levels. Inspections are focused on locations with active degradation mechanisms as well as selected locations that monitor the performance of system piping.

Safety margins used in design calculations are not changed. Piping material integrity is monitored to ensure that aging and environmental influences do not significantly degrade the piping to unacceptable levels.

Assurance of the quality of the PRA used to support a BER evaluation is consistent with the assurance required to support a RI-ISI program. The risk-ranking methodology and the change in risk guidelines are the same as those required to develop a RI-ISI program. The methodology and guidelines are applied to the BER scope regardless of whether the BER program is changed in isolation from, or together with, a RI-ISI program.

Consistent with 10 CFR 50.59, if modification to the BER program is made using the 10 CFR 50.59 process, the staff is not requesting any additional submittals. Changes to inspection locations caused by incorporation of the BER scope into an existing RI-ISI program do not need to be submitted when the previously approved RI-ISI methodology is not modified. In accordance with the approved RI-ISI methodology, the staff expects the following list of retrievable onsite documentation, taken from Section 5.2 of EPRI-ISI-TR, be maintained by licensees that implement a RI-BER piping inspection program.

1. scope definition,
2. segment definition,
3. failure/damage mechanism assessment,
4. consequence evaluation,
5. PRA model runs for the RI-BER piping inspection program,
6. risk evaluation,
7. element and NDE method selection,
8. change in risk evaluation,
9. PRA quality review, and

10. continual assessment forms as program changes in response to inspection results.

In summary, the staff concludes that the EPRI-BER-TR is acceptable for referencing in licensing applications subject to the limitations previously discussed.

6.0 REFERENCES

1. EPRI TR-112657 Rev. B-A, Revised Risk-Informed Inservice Inspection Evaluation Procedure, December 1999.

2. EPRI Report, "Application of Risk and Performance Technology, Volume 1 - Break Exclusion Requirements," February 28, 2001.

3. Response to RAI, E-mail from P. O'Regan to L. N. Olshan, dated December 17, 2001 (ADAMS Accession Number ML020530407).

4. EPRI TR-1006937, "Extension of the EPRI Risk Informed ISI Methodology to Break Exclusion Region Programs," April 4, 2002.

5. General Design Criterion 4 of 10 CFR 50, Appendix A, "Environmental and Dynamic Effects Design Bases."

6. Letter from J.F. O'Leary, Director of Licensing, USNRC dated July 12, 1972.

7. Standard Review Plan (SRP) Chapter 3.6.2, "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping," NUREG-0800, November 1975.

8. NRC Regulatory Guide 1.178, "An Approach for Plant-Specific Risk-Informed Decision Making: Inservice Inspection of Piping," September 1998.

9. Standard Review Plan (SRP) Chapter 3.9.8, "Standard Review Plan for Trial Use for the Review of Risk-Informed Inservice Inspection of Piping," NUREG-0800, September 1998.

10. NRC Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," July 1998.

11. Standard Review Plan Chapter 19.0, "Use of Probabilistic Risk Assessment in Plant-Specific, Risk-Informed Decisionmaking: General Guidance," NUREG-0800, July 1998.

12 NRC Regulatory Guide 1.187, "Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments," November 2000.

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ABSTRACT

In 1999, the USNRC approved EPRI's *Revised Risk-Informed Inservice Inspection Evaluation Procedure* (TR-112657, Rev. B-A). This base RI-ISI methodology involves categorization and selection of piping components for inspection based on their risk significance. It was offered as an alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, inservice inspection requirements for piping. To maximize the benefit of the RI-ISI evaluation procedure for plant licensees, EPRI began the process of seeking USNRC approval for extending the RI-ISI evaluation to a plant's break exclusion region (BER) piping.

After numerous interactions with the USNRC and industry staff, USNRC review and comments on the original submittal (February 2001), USNRC requests for additional information (RAIs), and responses to those RAIs, the USNRC granted EPRI approval to extend the RI-ISI methodology to BER programs in June 2002.

The final version of the February 2001 submittal was revised to reflect the conclusions, clarifications, and enhancements of this report, as well as their impact on the application to the three plants evaluated. The final version of the February 2001 submittal will be documented in EPRI report 1006837, *Applications of Risk and Performance Technology, Volume 1: Application of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs.* This report outlines each step of the RI-ISI process and all changes necessary for BER application.

CONTENTS

LIST OF FIGURES

1 INTRODUCTION AND PURPOSE

This report documents the conclusions, clarifications, enhancements, and agreements reached with the USNRC for the extension of the EPRI Risk-Informed Inservice Inspection (RI-ISI) methodology [1] to Break Exclusion Region (BER) programs. It is the culmination of numerous interactions with USNRC and industry staff, the USNRC's review and comments on the February 2001 submittal [2], USNRC Requests for Additional Information (RAIs) [3], and EPRI's response to those RAIs [4].

The February 2001 submittal was the end product of:

- A comprehensive assessment of the base RI-ISI methodology for its applicability to BER programs
- Identification of required enhancements and clarifications to the base RI-ISI methodology
- Application of the updated methodology to three units (both BWR and PWR designs)
- A third-party review of the methodology extension and its application to the three plants

The final version of the February 2001 submittal was revised to reflect the conclusions, clarifications, and enhancements of this report, as well as their impact on the application to the three plants evaluated. The final version of the February 2001 submittal will be documented in EPRI report 1006837, *Applications of Risk and Performance Technology, Volume 1: Application of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs.*

2
ADAPTATION OF THE RI-ISI EVALUATION PROCESS

2.1 Adaptation of the RI-ISI Process to BER Programs

This section identifies those portions of the base risk-informed inservice inspection (RI-ISI) evaluation process [1] that will require clarification and/or enhancement in order to support its application to Break Exclusion Region (BER) inspection programs. All other portions of the EPRI RI-ISI process remain unchanged and in effect. The EPRI RI-ISI method is defined in detail in EPRI report TR-112657, Rev. B-A, *Revised Risk-Informed Inservice Inspection Evaluation Procedure*. The full EPRI RI-ISI methodology, together with the enhancements documented in this report, needs to be met to fulfill its application to BER programs. In this section, each step of the RI-ISI process is presented and the change (if required) is identified.

2.2 Definition of Program Scope

Application of RI-ISI to BER programs requires an understanding of the traditional RI-ISI scope that is or has been previously applied. It also requires an understanding of the existing plant BER program including its scope and licensing basis. Application of this methodology requires that the entire scope of the BER program be included in the RI-ISI evaluation.

2.3 Consequence Evaluation

In contrast to traditional RI-ISI applications, which are intended to be best-estimate evaluations, application to BER programs provides for bounding estimates and assumptions. This conservative application reduces the need to conduct resource-intensive analyses and computations, thereby reducing their accompanying uncertainty.

By definition, BER piping is normally pressurized (the "Operating" configuration in Table 3-1 of EPRI report TR-112657, Rev. B-A, *Revised Risk-Informed Inservice Inspection Evaluation Procedure*); therefore, the "Initiating" and "Combination" impact groups (in Table 3-1) should be evaluated.

The consequence of failure of each circumferential weld in the BER scope is evaluated in the RI-ISI process (that is, pipe whip, jet impingement, and other impacts). Both circumferential and longitudinal breaks are postulated at each weld. This is more conservative than the Standard Review Plan (SRP) requirement, which requires that only terminal ends and some higher-stressed locations be evaluated. In addition, as BER piping is almost exclusively low-stress piping, only terminal end breaks will need to be postulated due to SRP requirements. The RI-ISI evaluation requires that each BER weld be assessed. A double-ended guillotine pipe break (DEGB) is conservatively assumed for each weld. The criteria for postulating and analyzing pipe whip and jet impingement impacts are to be consistent with the criteria for existing plant high-energy pipe break analyses (for example SRP 3.6.2, if that is the plant's basis for analyses). However, the consequences of pipe breaks are to be consistent with a risk-informed approach. For example, single failure criteria do not have to be considered explicitly, and structures, systems, and components are allowed to fail. The importance of single failure criteria and the protection of equipment are encompassed in the risk-informed approach (for example, estimates of conditional core damage probability (CCDP) and conditional large early release probability (CLERP), and the delta risk assessment acceptance criteria, ensure an adequate level of safety).

BER programs vary throughout the industry. The following guidelines, related to the consequence evaluation process, are defined and should be applied to each BER weld in order to ensure consistent application.

1. Containment performance is an important aspect of using the BER assumption in design basis (for example, single failure relative to containment isolation). Postulated breaks outside containment should not take credit for the outside containment isolation valve or other isolation valves in the vicinity unless there is plant design and/or analysis that supports equipment operability during an event. Likewise, breaks inside containment should not credit equipment inside the containment unless plant design and/or analysis provide justification.

2. The containment penetration is assumed to fail (containment bypass) if the penetration is not designed and analyzed for a DEGB. Note that design features can be utilized to preclude DEGB loads on the penetration (for example, encapsulated pipe designed to preclude a DEGB load on a penetration). When failure of the penetration is assumed (for example, no design or analysis information demonstrates otherwise), the leakage around the penetration failure is assumed to be large enough to satisfy the *large release* portion of CLERP in the consequence evaluation, unless analysis can justify smaller releases.

3. An unrestrained whipping pipe is not considered capable of causing a circumferential break in pipe of equal or larger nominal pipe size (SRP 3.6.2 [5]). The penetration of the equal or larger impacted pipe is also assumed not to fail. Through-wall cracks are postulated if the impacted pipe has thinner wall thickness, except where analytical and/or experimental data for the expected range of impact energies demonstrate the capability to withstand an impact without rupture (for example, SRP 3.6.2).

4. An unrestrained whipping pipe is assumed to fail a smaller line and its penetration, unless it is demonstrated capable by design or analysis. Circumferential and longitudinal breaks are postulated for the smaller line except where analytical and/or experimental data for the expected range of impact energies demonstrate the capability to withstand an impact without rupture (for example, SRP 3.6.2).

5. SRP 3.6.2 can be used to evaluate unrestrained whipping pipe and its potential physical impact on structures, systems, and components. In lieu of SRP 3.6.2, plant-specific criteria and analyses can be used. Conservative assumptions or engineering judgments derived from plant design and analyses can be used as follows:
   a. Conservatively apply unrestrained piping length to identify potential targets.
   b. If a structural target is designed similar to another structural target that has already been analyzed for pipe whip impact with similar loads, then this can be used as a reasonable basis. Otherwise, the structural target (for example, common wall with adjacent area) is assumed to fail.
   c. Equipment with active functions or electrical equipment, such as a motor- or air-operated valve, is assumed to fail (valve is assumed to fail in its normal position prior to the break). Check valves can be treated like piping (as described above).
   d. The determination of pipe whip potential (for example, potential for developing a hinge) can be derived from plant analyses of similar configurations.
6. Jet Impingement – SRP 3.6.2 can be used to evaluate jet impingement targets and potential load impact on structures, systems, and components. In lieu of SRP 3.6.2, plant-specific criteria and analyses can be used, and conservative assumptions and engineering judgments derived from plant design and analysis can be used as follows:
   a. Electrical or active equipment within the zone of influence of the break is assumed to fail (for example, an active valve is assumed to fail in its normal position prior to break) unless otherwise qualified. The typical zone of influence is 10 to 20 pipe diameters (see NUREG/CR-2913 [6]).
   b. If a structural or passive component-type of target is designed similar to another target, already analyzed and found to be acceptable for similar loads, then this can be used as a reasonable basis. Otherwise, the target (for example, common wall with adjacent area) is assumed to fail.
   c. Plant analyses of jet impingement can be used to derive insights into potential impacts. For example, the jet impingement impact from another analyzed pipe that has a similar zone of influence can be used.
7. Other Spatial Impacts (indirect effects) – Structures, systems, and components in the area of the break are assumed to fail as a result of the break unless design basis/analysis or appropriate engineering judgment, based on plant design and spatial evaluations, justifies otherwise. The following provides additional guidance:
   a. Physical separation can be credited with regard to the containment structure and isolation. For example, equipment inside containment can be credited with isolating a break outside containment. For high-energy line breaks, only automatic isolation can be credited and it must be qualified per design basis.
   b. Equipment Qualification (EQ) – Equipment in affected areas might have been qualified as part of an EQ program. If this equipment is to be credited in the RI-ISI evaluation, then the harsh environment identified as part of the EQ profile (temperature, pressure

humidity, jet impingement, and pipe whip) will need to envelope (or equal) the environment created by the assumed RI-ISI break. Caution should be applied because the RI-ISI break will always assume that the equipment available to isolate the break has an inherent unreliability. That is, the RI-ISI evaluation looks at both successful and unsuccessful isolation (and the resultant environments).

   c. Temperature, pressure, water spray, flooding, and compartment pressure must be considered when evaluating the impacts previously described. Electrical equipment in the break area is assumed to fail unless a technical basis and/or qualification are available. Engineering judgments based on plant design can be used to evaluate whether compartment pressure can cause catastrophic failure of the room. An isolated room should be assumed to fail unless analysis can demonstrate otherwise.

8. Spatial Propagation – When postulating propagation to adjacent areas (for example, adjacent wall failure due to pipe whip), both the isolation success and failure case must be considered where applicable. For the failure-to-isolate case, the consequences are likely to be unanalyzed (beyond design basis), thus, spatial propagation impacts must be analyzed or core damage assumed (CCDP = probability of isolation failure). For the isolation success case, the environmental impacts might be similar to analyzed cases. Engineering judgment can be used based on plant design and analysis that is consistent with Probabilistic Risk Assessment (PRA)/Individual Plant Examination for External Events (IPEEE) studies, such as the following examples:

   a. Equipment in the vicinity of the propagation path (on the other side of a door or wall failure) is assumed to fail unless qualified or protected from the break (similar to design basis or SRP 3.6.2).

   b. For the isolation failure case, spatial propagation must be evaluated relative to impacts and equipment and is assumed to fail unless qualified or protected (similar to design basis or SRP 3.6.2). Secondary propagation paths have to be considered as propagation continues to other areas.

   c. For the successful isolation case, impacts beyond the immediate vicinity of the propagation path depend on distance, size of the adjacent room or area, and vent path (for example, openings to an adjacent room or upper elevations).

2.4 Degradation Mechanism Evaluation

EPRI report TR-112657, Rev. B-A, *Revised Risk-Informed Inservice Inspection Evaluation Procedure* identifies those degradation mechanisms that need to be evaluated in support of a RI-ISI application, including a review of plant-specific service history. These mechanisms and criteria for assessing susceptibility to the mechanisms are unchanged by this application.

2.5 Risk Characterization

Although no change to the risk-ranking process is required, the results derived by applying RI-ISI to BER programs might be different with respect to traditional RI-ISI results. Thus, a plant, which applies the RI-ISI process to BER programs after completion of a traditional RI-ISI application, shall revisit the risk ranking of all welds in the RI-ISI application (for example, the Section XI scope plus BER scope). As a final step, the risk ranking shall also be summarized for the *BER Only* scope to support element selection as described in the next section.

2.6 Inspection Element Selection

While no changes to the element selection process are required, explicit consideration shall be given to the size of the final inspection population. If a plant is applying RI-ISI to BER programs after completion of the traditional RI-ISI, the risk category population sizes may change for BER systems because some welds might move to higher risk categories (for example, from Risk Category 6 to 4). In addition, the element selection process must consider the BER scope independent of the traditional RI-ISI scope, to ensure that the BER scope is appropriately covered during the element selection process.

Similar to traditional RI-ISI application to Class 1 piping (see Section 3.6.4.2 of EPRI report TR-112657, Rev. B-A, *Revised Risk-Informed Inservice Inspection Evaluation Procedure*), BER piping will likely be grouped into three subsets. The first subset evolves because of the exceptional performance history of BER piping, coupled with its typical high consequence of failure (which results in a large number of elements being assigned to Risk Category 4 [10% inspection size]). A second subset involves a 25% sampling, chosen because a number of elements were identified as potentially susceptible to some degradation mechanism (for example, Risk Category 2, due to thermal fatigue). The third subset consists of those elements assigned to Risk Category 6 or 7, which do not require volumetric NDE. As such, it is anticipated that unless plant-specific design features control, inspection populations for BER programs to be approximately 10% of the current population.

If a situation occurs where a very large number of elements are assigned to low-risk categories (that is, Risk Category 6 or 7), and to the point that BER inspections fall below 10% of the BER piping population, the basis for the low-risk ranking shall be investigated. Although BER piping is typically highly reliable (that is, low failure potential), inspection percentages that are significantly below 10% should not be expected unless plant design features have been incorporated to specifically address assumed breaks in the BER region.

This 10% trigger value is consistent with previous RI-ISI applications for important piping (EPRI TR-112657 [1]), ASME Code Case N560 [7], and the performance-based criteria for BWR stainless steel piping in BWR reactor coolant systems [8], which have been approved by the USNRC.

Figure 2-1 provides a flowchart of the process that must be followed to ensure that the final BER inspection population is consistent with the intent of this methodology.

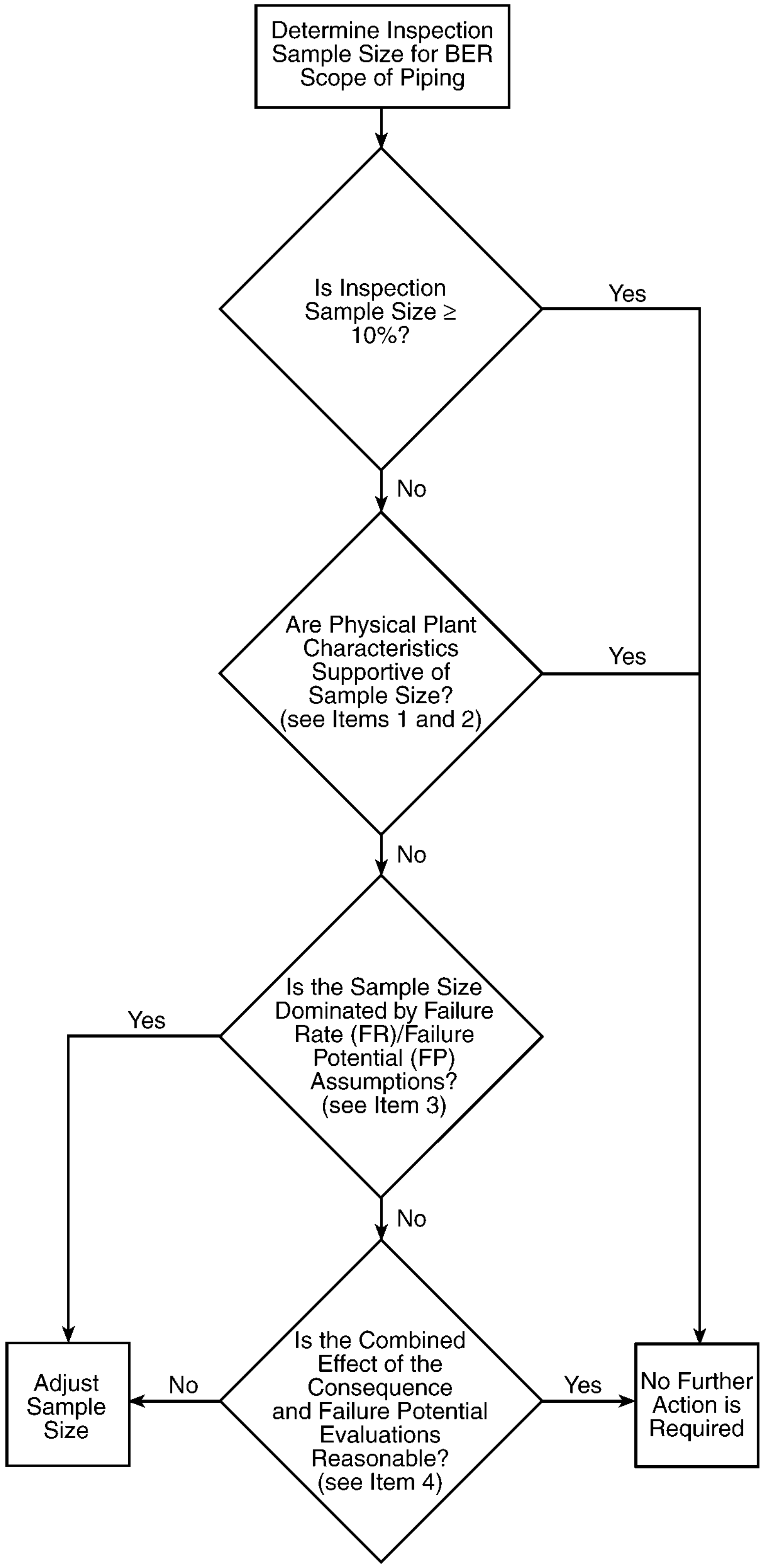

Figure 2-1
Minimum Element Selection Evaluation Process

The required element selection process is described as follows:

Item 1: Are there a number of welds included in the BER program scope that are physically located outside the BER boundaries as defined in SRP 3.6.2 (for example, beyond the containment isolation valve (and boundary restraint)? A number of cases have been identified where plants conservatively extended the BER boundary beyond SRP requirements. Therefore, many of these *non-BER* welds, located beyond the isolation valve (and boundary restraint), will not result in BER-type consequences. Provided that there are no other plant unique issues, these welds would be expected to be of lower importance from a **consequence** perspective.

Item 2: For some plants, the piping within the BER program was also provided with break-limiting devices/analyses. In the cases where pipe whip restraints, jet shields, vent opening, and/or analyses are available, the consequence of postulated failure should be reduced. It is important to note that these analyses and plant hardware need to be designed to respond to the BER break of interest (for example, high-energy line breaks versus seismic design requirements).

Summary of Items 1 and 2: If plant-specific physical characteristics do not support a smaller sample size, then further evaluation is necessary to understand the basis for the limited sample size. Item 3 and Item 4 provide examples of this type of evaluation.

Item 3: The EPRI RI-ISI methodology analyzes failure potential and the consequence of failure independently. As such, the final results (that is, the risk significance) are not adversely impacted by conservatisms in either of the supporting analyses. However, as with the consequence analysis discussed in Items 1 and 2, if inspection populations fall below 10%, then the failure potential evaluation should be re-assessed. This evaluation should ensure that plant-specific and industry operating experience with this type of piping has been appropriately factored into the analysis (for example, by comparing to similar plant designs), and that no degradation mechanisms have been inadvertently screened in or out.

Item 4: A key insight from probabilistic risk assessments pertains to the concept of common mode (common cause) failure. BER piping provides a classic example of the potential for one postulated failure to impact more than one key safety function (that is, a cascading effect). As such, from a consequence perspective, larger bore BER piping is expected to result in a high consequence of failure. If the evaluation identifies any of the large bore piping as medium to low consequence, a distinct evaluation shall be conducted to assure robustness in the consequence assignment. This evaluation shall include one or more of the following:

- Identification of the plant-specific hardware (whip restraints, jet shields, penetration designs, separation) supporting the lower consequence assignment
- Identification of additional, unaffected equipment that will reliably perform the same safety function (for example, reactor coolant system (RCS) inventory control,

injection, heat removal, containment isolation and heat removal, and fission product scrubbing)

– Comparison to other similar units based upon a conditional consequence (as opposed to core damage frequency [CDF]/large early release frequency [LERF]) that shows the analysis is realistic/conservative

In summary, the element selection process should satisfy the following criteria:

- The percentage requirements for high risk (25%) and medium risk (10%) must be satisfied for the complete RI-ISI program scope population, including BER.
- The percentage requirements for high risk (25%) and medium risk (10%) must be satisfied for the *BER Only* scope population.
- The number of BER inspections should not be significantly less than 10% of the BER scope unless plant design features justify otherwise.

2.7 Risk Impact Assessment

The risk impact assessment that shall be conducted will be a function of the scope of application.

If a licensee implements a BER-only application, then the risk impact assessment shall be conducted on a system-by-system basis for each system in the BER program. Each system must meet system level criteria of 1E-07 for CDF and 1E-08 for LERF and a cumulative total impact of less than 1E-06 for CDF and 1E-07 for LERF.

If a licensee implements a traditional RI-ISI, together with a BER application, then the risk impact assessment shall be conducted in two steps. The first step shall be to include the BER scope of piping with the traditional RI-ISI application (for example, Class 1 and Class 2 piping), and to conduct the risk impact evaluation in accordance with EPRI report TR-112657, Rev. B-A, *Revised Risk-Informed Inservice Inspection Evaluation Procedure*. The second step shall be conducted for the BER-only scope, on a system-by-system basis, with each system in the BER program meeting system level criteria of 1E-07 for CDF and 1E-08 for LERF, and having a cumulative total impact of less than 1E-06 for CDF and 1E-07 for LERF.

2.8 Plant-Specific Submittals

BER programs are typically defined in the Updated Final Safety Analysis Report (UFSAR). Changes to the UFSAR need to be conducted consistent with an individual licensee's UFSAR change control process. Typically, this will include a 10 CFR 50.59 evaluation [9,10].

It is envisioned that upon USNRC generic approval of this report, licensees will conduct evaluations consistent with this document and use that evaluation (together with this report) as the technical basis for supporting a 50.59 evaluation.

As the plant-specific probabilistic risk assessment (PRA) will be an important input into this analysis, the quality of the PRA should be assessed. If there is a previously approved RI-ISI program, then the PRA quality basis for that application should be reviewed to confirm that it is applicable to the risk-informed BER (RI-BER) program. If there is not an approved RI-ISI program at the plant, where the USNRC has already accepted the use of the PRA in its RI-ISI application, the licensee should review the results of previous independent reviews of the PRA (including the staff review of the Individual Plant Examination [IPE]) and ensure that any comments that could influence the results of the RI-BER program are incorporated or otherwise dispositioned.

Given the 50.59 process, no formal submittal of the RI-BER evaluations or a template to the USNRC is expected. However, the USNRC would be notified of the adoption of a RI-BER program through the licensee's periodic 50.59 summary report. Appendix A provides an example 50.59 process for RI-BER applications contained in a licensee's UFSAR.

Changes to other licensing basis documents or commitments (for example, Technical Specifications), might require review and approval by the USNRC. Licensees therefore need to review all relevant documentation and notify the USNRC as appropriate.

3
SUMMARY AND CONCLUSIONS

This report documents the conclusions, clarifications, enhancements, and agreements reached with the USNRC for the extension of the EPRI Risk-Informed Inservice Inspection (RI-ISI) methodology [1] to Break Exclusion Region (BER) programs. It is the culmination of numerous interactions with USNRC and industry staff, the USNRC's review and comments on the February 2001 submittal [2], USNRC Requests for Additional Information (RAIs) [3], and EPRI's response to those RAIs [4].

The February 2001 submittal was the end product of:

- A comprehensive assessment of the base RI-ISI methodology for its applicability to BER programs
- Identification of required enhancements and clarifications to the base RI-ISI methodology
- Application of the updated methodology to three units (both BWR and PWR designs)
- A third-party review of the methodology extension and its application to the three plants

Appendix A provides an example 50.59 process for RI-BER applications contained in a licensee's UFSAR. Changes to other licensing basis documents or commitments (for example, Technical Specifications) might require review and approval by the USNRC. Licensees, therefore, need to review all relevant documentation and notify the USNRC as appropriate.

The final version of the February 2001 submittal was revised to reflect the conclusions, clarifications, and enhancements of this report, as well as their impact on the application to the three plants evaluated. The final version of the February 2001 submittal will be documented in EPRI report 1006837, *Applications of Risk and Performance Technology, Volume 1: Application of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs.*

4
REFERENCES

4.1 Specific References Used in This Report

1. *Revised Risk-Informed Inservice Inspection Evaluation Procedure.* EPRI, Palo Alto, CA: December 1999. TR-112657, Rev. B-A.

2. Letter from Patrick O'Regan, EPRI to Dr. Brian Sheron, Associate Director for Project Licensing and Technical Analysis, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, "Extension of Risk-Informed Inservice Inspection (RI-ISI) Methodology," dated February 28, 2001.

3. Memorandum from Terence Chan and Mark P. Rubin to Herbert N. Berkow, "Comments and Request for Additional Information Related to Electric Power Research Institute Extension of Risk-Informed Inservice Inspection Methodology," dated November 2001.

4. EPRI's response to the USNRC's Request for Additional Information, December 2001.

5. U.S. Nuclear Regulatory Commission. *Determination of Rupture Locations and Dynamic Effects Associated With the Postulated Rupture of Piping,* Standard Review Plan 3.6.2, Rev. 1, July 1981.

6. U.S. Nuclear Regulatory Commission. *Two-Phase Jet Loads.* NUREG/CR-2913, January 1983.

7. ASME Code Case N-560, *Alternative Examination Requirements for Class 1 Piping Welds,* Section XI, Division 1, American Society of Mechanical Engineers.

8. *BWR Vessel and Internals Project, Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules (BWRVIP-75).* EPRI, Palo Alto, CA: 1999. TR-113932.

9. Nuclear Energy Institute 99-04, *Guidelines for Managing NRC Commitment Changes,* July 1999.

10. U.S. Nuclear Regulatory Commission. *Managing Regulatory Commitments Made by Power Reactor Licensees To The NRC Staff.* USNRC Regulatory Issue Summary 2000-17, September 21, 2000.

4.2 General References

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American Society of Mechanical Engineers. ASME Code Case N578, *Risk-Informed Requirements for Class 1, 2, or 3 Piping,* Method B Section XI, Division 1, September 1997.

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State-of-the-Art Weld Repair Technology for High Temperature and Pressure Parts. EPRI, Palo Alto, CA: November 1996. TR-103592-V1.

U.S. Nuclear Regulatory Commission. *Foundation for the Adequacy of the Licensing Bases*. NUREG-1412, December 1991.

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U.S. Nuclear Regulatory Commission. *Relaxation in Arbitrary Intermediate Pipe Rupture Requirements*. Generic Letter 87-11, June 1987.

U.S. Nuclear Regulatory Commission. *Report of the U.S. Nuclear Regulatory Commission Piping Review Committee, Volumes 1 Through 5*. NUREG-11061, various dates.

U.S. Nuclear Regulatory Commission. Standard Review Plan 3.6.1, *Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment*, Rev. 1, July 1981.

U.S. Nuclear Regulatory Commission. Standard Review Plan 6.6, *Inservice Inspection of Class 2 and 3 Components*, Rev. 1, July 1981.

A
EXAMPLE 10 CFR 50.59 PROCESS

10 CFR 50.59 APPLICABILITY DETERMINATION			
Part 1 – Initiation			
Implementing Document No. **USAR 3.6A.2.1.5 AND 6.6.8**	Revision **13**	Title **Update to UFSAR sections 3.6 and 6.6 to allow the use of risk-informed technology in determining the number of augmented piping inspections in the break exclusion region (BER).**	
(Check one proposed activity type only): ☐ *Unit 1* ☒ *Unit 2* ☐ *Common*		(Check one proposed activity type only): ☒ *Permanent* ☐ *Temporary*	

Part 2 – Applicable Regulations/Criteria			
Address the questions below for all aspects of the Proposed Activity. See NAI-DSE-01, Section 4.2 for a discussion of regulatory requirements and controls. If the answer is "YES" for any portion of the activity, apply the identified regulation/process(es) to that portion of the activity. (Note: It is common to have more than one regulation/process apply to a proposed activity.)			
A.	Is the regulatory authority, controlling the proposed activity, any of the following?		
	1. 10CFR50.90 (Operating License, Technical Specifications or Environmental Protection Plan)	☐ YES ☒ NO	If "Yes," process change per NIP-LPP-01
	2. 10CFR50.54(a) (QA Program Description)	☐ YES ☒ NO	If "Yes," process change per NIP-LPP-01.
	3. 10CFR50.54(p) (Security Plans)	☐ YES ☒ NO	If "Yes," process change per NIP-LPP-01.
	4. 10CFR50.54(q) (Emergency Plan)	☐ YES ☒NO	If "Yes," process change per NIP-LPP-01.
	5. 10CFR50.55a(f) and (g) (IST/ISI Requirements)	☐ YES ☒ NO	If "Yes," process change per NIP-LPP-01.
	6. 10CFR Part 20 (Standards for Radiation Protection)	☐ YES ☒ NO	If "Yes," process change per NIP-PRO-02 or NIP-PRO-03.
	7. 10CFR50.65(a)(4) (Maintenance Rule) • Maintenance activities and associated procedures. • Temporary Alteration (facility or procedure) supporting maintenance that will be installed not longer than 90 days at power.	☐ YES ☒ NO	If "Yes," maintenance activity is assessed under NIP-OUT-01 or GAP-PSH-03, and procedure change(s) process per NIP-PRO-03 and NIP-PRO-04.
	8. 10 CFR 50.46 ECCS Model (changes and errors)	☐ YES ☒ NO	If "Yes," process per NIP-IRG-01
B.	Does the proposed activity change plant-specific programs (ODCM or COLR,) that are controlled by the Technical Specifications?	☐ YES ☒ NO	If "Yes," process change per NIP-LPP-01.
C.	Does the proposed activity involve an editorial or administrative change to the UFSAR update as described in Section 4.2.3 of NAI-DSE-01?	☐ YES ☒NO	If "Yes," process change per NIP-LPP-01.
D.	Does the proposal have an effect on the environment (e.g., changes to nonradiological gaseous or liquid effluents, power level, or thermal effluents), **OR** involve construction activities that introduce measurable nonradiological environmental effects to onsite areas that were NOT previously disturbed during site preparation and construction?	☐ YES ☒ NO	If "Yes," an Environmental Evaluation may be required. Contact Supervisor Environmental Protection.
E.	Does the proposed activity involve a Fire Protection Program change?	☐ YES ☒ NO	If "Yes," process change per NIP-LPP-01 and the applicable Unit License Condition.
F.	Does the proposed change or activity change or negate an existing NRC commitment?	☐ YES ☒ NO	If "Yes," process per NIP-IRG-01.

Part 3 – Conclusions (Check Conclusion A or B):		
A.	☐	All aspects of the proposed activity are controlled by one or more of the processes above; therefore, **10 CFR 50.59 is not applicable** and a 10 CFR 50.59 Screening is **not** required. Proceed with change per applicable procedures/processes.
B.	☒	Activity only partially covered by other regulations. Proceed with covered change(s) per applicable procedure/process. Initiate 10CFR 50.59 Screening for aspects not covered.

Part 4 – Preparer (Include Completed Applicability Determination with Implementing Document or Activity Package)	
Preparer - (Print/Initial)	Date Prepared

10 CFR 50.59 SCREENING FORM

Part 1 - Initiation [Upon Completion of Screen – Attach to Implementing Document/Package]

Implementing Document No.	Revision	Title
UFSAR 3.6A.2.1.5 and 6.6.8	**13**	**Updated Safety Analysis Report**

(Check one proposed activity type only):

☐ *Unit 1* ☒ *Unit 2* ☐ *Common*

(Check one proposed activity type only):

☒ *Permanent* ☐ *Temporary*

(Check one proposed activity type only):

☐ *Procedure Activity* ☐ *Design Activity* ☐ *Test or Experiment* ☐ *Temporary Alteration* ☒ *Other*

Part 2 - Brief description of the proposed activity*: Check one:*

A) ☐ Immediate Change to a Technical Procedure (Type 1 PCE) controlled by NIP-PRO-04. If checked, go to Part 10. (N/A Part 3, 4, 5, 6, 7, 8, and 9)

B) ☒ Other, provide written description of activity: **UFSAR change to include the Risk-Informed Inservice Inspection process for the Break Exclusion Region piping welds.**

Part 3 - Technical Specifications/License Conditions *N/A* ☐

1. ☐ YES ☒ NO Does the *proposed activity* require/involve a change to the Technical Specifications/License Conditions?

If "**NO**," continue with the screening. If "**YES**," a license amendment is required. Exit Screen and prepare a License Document Change Request (LDCR) per NIP-LPP-01.

Part 4 - General *N/A* ☐

1. Is the *proposed activity* an Interim Compensatory Action to address a non-conforming/degraded condition?

☐ YES If "**YES,**" (reference ESA # if applicable ______) go to Part 6 (skip Part 5).

☒ NO If "**NO,**" go to Part 5 (skip Part 6).

Part 5 - Changes to Facility/Procedures *N/A* ☐

1. ☐ YES ☒ NO Does the *proposed activity* involve a modification, addition to, or removal from, the facility that adversely affects <u>any</u> UFSAR described design function**?**
2. ☐ YES ☒ NO Does the *proposed activity* involve a modification, addition to, or removal from, a procedure that adversely affects how <u>any</u> UFSAR described design functions are performed or controlled?

Justify "**NO**" answers below: **No physical change to any design function. No change to procedures that affect how design functions are performed or controlled.**

Why are UFSAR described design functions <u>not</u> adversely affected? **The only change is to the methodology used to define the number of augmented piping inspections required to be conducted in the break exclusion region.**

Part 6 - Changes to Facility/Procedure (Interim Compensatory Actions) N/A ☒

1. ☐ YES ☐ NO Does the *proposed activity* involve a modification, addition to, or removal from, the facility that adversely affects UFSAR described design functions other than those design functions that are degraded/nonconforming?

2. ☐ YES ☐ NO Does the *proposed activity* involve a modification, addition to, or removal from, a procedure that adversely affects how UFSAR described functions are performed or controlled other than those design functions that are degraded/nonconforming?

Justify "**NO**" answers below:

Why are other UFSAR described design functions not adversely affected?

Part 7 - Changes to Evaluation Methodologies N/A ☐

1. ☒ YES ☐ NO Does the *proposed activity* involve revising or replacing an UFSAR described Method of Evaluation, used in establishing the Design Bases or in the Safety Analyses?

Justify "**NO**" answer below:

Justification: **The proposed activity provides an alternative to the current UFSAR section 3.6 methodology for determining the number of augmented inspections required in the break exclusion region.**

Part 8 - Tests and Experiments N/A ☐

1. ☐ YES ☒ NO Does the *proposed activity* involve conducting a test or experiment, not described in the UFSAR, where an SSC is utilized or controlled in a manner that is outside the reference bounds of the design bases as described in the UFSAR, or is inconsistent with the analyses or descriptions in the UFSAR?

Justify "**NO**" answer below: **These examinations are described in the UFSAR, and therefore are not new.**

Justification: **Only the number of inspections, which are based upon EPRI TR-1006937 Rev. 0-A and Nuclear Engineering Report NER-2A-025, are changing.**

If **ANY** Part 5, 6, 7 or 8 answers are "**YES,**" a 10 CFR 50.59 Evaluation **is** required. Discontinue Screen, prepare Evaluation

If **ALL** Part 5, 6, 7 or 8 answers are "**NO,**" a 10 CFR 50.59 Evaluation is **not** required. Proceed to Part 9.

Part 9 - Relevant UFSAR/Tech Spec Sections N/A ☐

UFSAR Sections reviewed where relevant information was found:	Tech Spec Sections reviewed where relevant information was found:
3.6A.2.1.5 **6.6.8**	**N/A**

Part 10 - Conclusion and Signoff [Upon completion of Screen - Attach to Implementing Document /Package]
Based upon all Part 5, 6, 7, and 8 answers being "NO," a 10CFR50.59 Evaluation is NOT required.
Preparer: ______________________ Date ____________ [Requal Date:__________] Print Name and Sign Reviewer: ______________________ Date ____________ [Requal Date:__________] Print Name and Sign

10 CFR 50.59 EVALUATION FORM

50.59 Evaluation No: Draft: Revision:

Plant: (Unit 1, Unit 2, or Common) **Unit 2**

Affected Systems: **Multiple**

Title: **Update to UFSAR sections 3.6 and 6.6 to allow the use of risk-informed technology in determining the number of augmented piping inspection in the break exclusion region (BER).**

Mod/Temp Mod/SDC/Procedure No:

Duration: ☒ Permanent or ☐ Temporary

Based on the attached discussion, does the *Proposed Activity*:

☐ YES ☒ NO Require a License Amendment for a change to the Technical Specifications/License Conditions.
☐ YES ☒ NO Require a License Amendment because it meets one (or more) of the eight (8) criteria of 10CFR50.59(c)(2).

**************************** REVIEW, APPROVAL AND CONCURRENCE**************************

1. PREPARED BY: ____________________/____________ ____________
Qualified Evaluator Signature Requal Date Date

2. REVIEWED BY: ____________________/____________ ____________
Qualified Reviewer Signature Requal Date Date

3. REVIEWED BY: ____________________ ____________
Branch Manager Date

4. SORC APPROVAL RECOMMENDATION:

SORC: ☐ As Submitted ☐ As Revised ____________ ____________
SORC Meeting No. Date

5. APPROVAL: ______________________________ ____________
Plant Manager or Designee (both Plant Managers if common) Date

______________________________ ____________
Plant Manager or Designee (both Plant Managers if common) Date

6. SRAB: Meeting Number: ____________ ☐ Concurs ☐ Does Not Concur

50.59 Evaluation No.: _____	**Page 2 of**
Part A - Description:	
1. Reason for Activity:	Provide an alternative methodology for determining the number of augmented inspections for the break exclusion region (BER).
2. Function(s) of affected SSC:	Pressure boundary integrity
Part B - Analysis	
1. Applicable Criteria:	UFSAR section 3.6 provides criteria for postulated piping breaks. In particular, section 3.6 also defines the requirements that need to be met in order to not postulate piping breaks. One of the criterion involves defining the number of augmented piping inspections that need to be performed on the BER piping. These UFSAR criteria are consistent with Standard Review Plan (section 3.6) criteria.
2. Conformance:	The proposed activity implements an NRC approved alternative methodology for defining the number of augmented piping inspections to be performed on the BER piping.

UFSAR Sections reviewed where relevant information was found:	Tech Spec Sections reviewed where relevant information was found:
UFSAR section 3.6A.2.1.5 defines the methodology for postulating piping breaks. UFSAR section 6.6.8 defines the piping inspection program including augmented piping inspections.	N/A

PART C – Evaluation (NOTE: If the proposed activity only affects a "method of evaluation," only evaluation question 8 need be evaluated. If the proposed activity does not affect a "method of evaluation'" only questions 1 through 7 need be evaluated.

Does the proposed activity:

1. ☐ YES ☐ NO — Result in more than a minimal increase in frequency of occurrence of an accident previously evaluated in the UFSAR?

Justification:

2. ☐ YES ☐ NO — Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system or component (SSC) important to safety previously evaluated in the UFSAR?

Justification:

3. ☐ YES ☐ NO — Result in more than a minimal increase in the consequences of an accident previously evaluated in the UFSAR?

Justification:

4. ☐ YES ☐ NO — Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the UFSAR?

Justification:

5. ☐ YES ☐ NO — Create a possibility for an accident of a different type than any previously evaluated in the UFSAR?

Justification:.

10 CFR 50.59 EVALUATION FORM (Cont)

50.59 Evaluation No.: _____	**Page 3 of**

6. ☐ YES ☐ NO — Create a possibility for a malfunction of an SSC important to safety with a different result than any previously evaluated in the UFSAR?

Justification:

7. ☐ YES ☐ NO — Result in a design basis limit for a fission product barrier as described in the UFSAR being exceeded or altered?

Justification:

8. ☐ YES ☒ NO — Result in a departure from a method of evaluation described in the UFSAR used in establishing the design bases or in the safety analyses?

Justification: The proposed activity allows the use of an alternate method for determining the number of augmented piping inspections required to meet the criteria of UFSAR 3.6. UFSAR 3.6 is based upon the criteria contained in section 3.6.2 of the Standard Review Plan (Determination of Rupture Locations and Dynamic Effects Associated With the Postulated Rupture of Piping) and specifically Branch Technical Position MEB 3-1 (Postulated Rupture Locations In Fluid System Piping Inside And Outside Containment). The proposed activity implements a methodology approved by the NRC for this intended application and as such, per NAI-DSE-01 (section 6.2.8), is not a departure from a method of evaluation described in the UFSAR used in establishing the design bases or in the safety analyses.

The NRC approved this alternate method in Safety Evaluation Report Related to "Extension of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs" (EPRI 1006937, Rev. 0-A). The NRC SER concluded that the methodology was applicable to all NSSS designs and all terms and conditions as stipulated in the SER are met by this proposed activity.

Part D – Conclusions *The proposed activity implements an NRC approved methodology as an alternative to existing UFSAR requirements. All terms and conditions as stipulated in the SER are met by this proposed activity.*

Part E – References ***(1) EPRI TR-112657 Rev. B-A, Risk-Informed Inservice Inspection Evaluation Procedure,***

(2) EPRI 1006937, Rev. 0-A, Extension of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs

(3) Nuclear Engineering Report NER-2A-025

Part F – Attachments

LICENSING DOCUMENT CHANGE REQUEST	**LDCR Number**	**Rev.**
	2 — 0 1 — U F S — X X X	0 0

PART 1 – INITIATION *(ORIGINATOR)* Page A-10 of ___

A. Affected Doc	OPL	UFS	Plans &	Programs
☐ Unit 1 X Unit 2 ☐ Site	☐ Facility Operating License ☐ Technical Specifications ☐ Technical Specification Bases ☐ Environmental Prot. Plan	X UFSAR	☐ Site Emergency Plan (SEP) ☐ Security Plans (SPS) ☐ Process Control Program (PCP) ☐ Offsite Dose Calc. Manual (ODM)	☐ ISI Program Plan (ISI) ☐ IST Program Plan (IST) ☐ Core Operating Limits Report (COL) ☐ QA Topical Report (QAT)

B. Description X **Permanent** ☐ **Temporary; Expected Duration:** _

Change to the wording in Sections 3.6A.2.1.5 and 6.6.8 to read as attached.

C. Page	Section, Figure, Table	Page	Section, Figure, Table
3.6A-14 **6.6-3**	**3.6A.2.1.5** **6.6.8**		

D. Source of Change; References

EPRI Topical Report 1006937 Rev. 0-A, "Extension of the EPRI Risk-Informed Inservice Inspection (RI-ISI) Methodology to Break Exclusion Region (BER) Programs" and Nuclear Engineering Report NER-2A-025.

E. NIP–SEV–01 Review	☐ Applicability Review No.: ☐ Safety Evaluation No.:	F. Originator *(Print)*	Date 12/11/01

● **FORWARD TO LICENSE DOCUMENT OWNER FOR FURTHER PROCESSING** ●

A. Independent Review *(Print / Initial / Date)* ☐ Obtained per NIP–IRG–01	B. Effectiveness Review ☐ N/R ☐ Attached	C. SORC ☐ N/R Mtg. No.: Mtg. Date:
D. SRAB ☐ N/R Mtg. No.: Mtg. Date:	E. Plant Mgr. ☐ N/R *(UFSAR Only)* ☐ Obtained per Doc Coversheet ☐ Obtained per NIP–IRG–01 ☐ Obtained per NIP–SEV–01	
F. NRC *(NIP–IRG–01 Submittal Required)* ☐ N/R ☐ Letter No. / Date: ☐ NRC Appl. Date:	G. LDO Branch Manager / Designee *(Print / Initial)*	Date

PART 2 – REVIEW AND APPROVAL *(LDO)*

PART 3 – IMPLEMENTATION *(LDO)* **PART 4 – CLOSURE *(LDO)***

A. OPL Only: Affected Documents Updated ☐	A. ☐ Incorporated into License Document, Revision / Amendment: ______	**OR** B. ☐ Not Incorporated into License Document
B. UFS Only: Need "As–Built" or Affected Document ☐	C. Closed by *(Print / Initial)*	Date
C. Other: ________________ ☐		

3.6A.2.1.5 Postulated Pipe Break Locations

h. For these portions of high-energy fluid system piping, preservice and subsequent inservice examinations are performed in accordance with the requirements specified in ASME Section XI. During each inspection interval, as defined in IWA-2400, an ISI is performed on all nonexempt ASME Code Section XI circumferential and longitudinal welds within the break exclusion region for high-energy fluid system piping. These inspections consist of augmented volumetric examinations (nominal pipe size greater than or equal to 4 in) and augmented surface examinations (nominal pipe size less than 4 in) such that 100 percent of the previously defined welds are inspected at each interval **or as required per the Risk-Informed process for piping outlined in EPRI Topical Report 1006937.** The break exclusion zone consists of those portions of high-energy fluid system piping between the moment limiting restraint(s) outside the outboard containment isolation valve and the moment limiting restraint(s) beyond the inboard containment isolation valve. The choice of the restraint(s) that define the limits of the break exclusion zone is based upon those restraint(s) that are necessary to ensure the operability of the primary containment isolation valves.

6.6.8 Augmented Inservice Inspection to Protect Against Postulated Piping Failures

No augmented ISI will be required for ASME Class 2 and 3 systems and components since there is no ASME Class 2 or 3 high-energy piping between containment isolation valves. As indicated in Table 1.9-1, Note 12, Difference 3, B31.1 Class 2 and Class 3 piping exists between the containment isolation valve and the associated first restraint. During each inspection interval, as defined in IWA-2400, an ISI is performed on all nonexempt ASME Code, Section XI circumferential and longitudinal welds within the break exclusion region for B31.1 Class 2 and 3 high-energy fluid system piping. These inspections consist of augmented volumetric examinations (nominal pipe size greater than or equal to 4 in) and augmented surface examinations (nominal pipe size less than 4 in) such that 100 percent of the previously defined welds are inspected at each interval **or as required per the Risk-Informed process for piping outlined in EPRI Topical Report 1006937.** The break exclusion zone consists of those portions of high-energy fluid system piping between the moment limiting restraint(s) outboard of the outside primary containment isolation valve and the moment limiting restraint(s) beyond the inside primary containment isolation valve. The criteria that determine which restraint(s) are chosen to determine the limits of the break exclusion zone are based upon those restraints which are necessary to ensure the operability of the primary containment isolation valves.

Target:
Nuclear Power

About EPRI

EPRI creates science and technology solutions for the global energy and energy services industry. U.S. electric utilities established the Electric Power Research Institute in 1973 as a nonprofit research consortium for the benefit of utility members, their customers, and society. Now known simply as EPRI, the company provides a wide range of innovative products and services to more than 1000 energy-related organizations in 40 countries. EPRI's multidisciplinary team of scientists and engineers draws on a worldwide network of technical and business expertise to help solve today's toughest energy and environmental problems.

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