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:
Mr. James Lang
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Dr. Theodore U. Marston
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Palo Alto, CA 94304

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

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 <u>Selection of Examination Locations</u>

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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