April 30, 2025
PT-04302025-237

U.S. Nuclear Regulatory Commission

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EPRI Docket No. 99902021

Subject: ELECTRIC POWER RESEARCH INSTITUTE – SUBMITTAL OF RESPONSES TO THE US NRC's REQUEST FOR ADDITIONAL INFORMATION (JANUARY 2025) ON EPRI'S TECHNICAL REPORT 3002025288, "ENHANCED RISK-INFORMED CATEGORIZATION METHODOLOGY FOR PRESSURE BOUNDARY COMPONENTS".

By letter dated August 17, 2023 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML23234A266), as supplemented on November 30, 2023 (ADAMS Accession No. ML23334A210), and June 28, 2024 (ADAMS Accession No. ML24180A016), Electric Power Research Institute (EPRI) submitted EPRI Technical Report (TR) 3002025288, "Enhanced Risk-Informed Categorization Methodology for Pressure Boundary Components," dated June 2023, to the U.S. Nuclear Regulatory Commission (NRC) for review and approval. EPRI TR 3002025288 presents an enhanced methodology for categorizing pressure boundary components in support of 10 CFR 50.69 applications.

By letter dated July 11, 2024 (ADAMS Accession No. ML23352A054), the NRC staff accepted EPRI TR 3002025288 for review. During the review and discussions with the EPRI staff, NRC staff discussed a set of requests for additional Information (RAIs) shared in draft form with EPRI on December 18. During a March 6th, 2025, public meeting between NRC and EPRI (ML25060A001), the expectations on responding to the RAIs were discussed (EPRI had provided preliminary answers in advance of the public meeting, ML25063A249).

Subsequently, some information on the RAIs was revised by the NRC staff slightly in response to the discussion – the final RAIs were shared with EPRI via e-mail on January 15, 2025 (ML24352A471).

Please find attached EPRI's formal responses to the RAIs received on January 15, 2025. Per agreement with NRC staff, this package includes the responses to all RAIs, as well as a draft version of the modifications made to the EPRI TR 3002025288 in response to the RAIs (please note the RAI responses also discuss the modifications to be made in the report as well). While the final EPRI TR 3002025288 would be issued posterior to the completion of NRC's review of the document, the draft report is being submitted as a commitment to the changes made with respect to the NRC review (or any additional review/RAIs).

We recognize the time and effort made by the NRC staff in the review of EPRI TR 3002025288 and appreciate the opportunity to provide responses to the RAIs received on January 15, 2025. We are at your disposal to provide any clarifications to the RAI responses, the draft version of EPRI TR 3002025288, or any other clarifications needed with respect to the review of this report

Sincerely,

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PT-04302025-237

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ATTACHMENT 1 – RAI RESPONSES ON TR 3002025288

EPRI REPORT 3002025288, "ENHANCED RISK-INFORMED CATEGORIZATION METHODOLOGY FOR PRESSURE BOUNDARY COMPONENTS"

REQUESTS FOR ADDITIONAL INFORMATION (RAIS)

RAI 01 – Accounting for High Consequence Scenarios

Background/Issue:

EPRI report criteria 11-13 propose to categorize SSCs as LSS if their individual contribution to CDF is less than 10^{-6} per year, or if the SSC contribution to LERF is less than 10^{-7} per year without any consideration of consequences. Further, for CDF contribution between 10^{-6} per year and 10^{-8} per year or LERF contribution between 10^{-7} and 10^{-9} per year, a sliding scale of consequence consideration of conditional core damage probability (CCDP) or conditional large early release probability (CLERP) of 1.0 or greater than 0.1 or 0.01 is introduced for HSS categorization.

Based on a review of the documents in the audit, the NRC staff found SSCs with a CCDP of greater than 10^{-4} and a CDF contribution of less than 10^{-6} per year. Some internal flooding analyses have identified areas with CCDPs greater than 10^{-3} but would be LSS using the proposed 14 criteria. RISC-3 LSS SSCs would not be covered by American Society of Mechanical Engineers (ASME) Code or 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," requirements and can be repaired or replaced with uncodified nonmetallic repairs with no significant operating experience or lower-quality materials with unknown failure probabilities.

The staff notes that prior approved precedents (such as: EPRI TR-112657, "Revised Risk-Informed Inservice Inspection Evaluation Procedure" (ADAMS Accession No. ML013470102); ASME Code Case N-660, "Risk-Informed Safety Classification for Use in Risk-Informed Repair/Replacement Activities Section XI, Division 1," ASME Code Case N-752, "Risk-Informed Categorization and Treatment for Repair/Replacement Activities in Class 2 and 3 Systems Section XI, Division 1," ANO2-R&R-004, Rev. 1, "ANO-2 Risk-informed Repair and Replacement Methodology" (ADAMS Accession No. ML071150108) currently approved by the NRC for categorization of passive components) considered failure scenarios with a CCDP greater than 10^{-4} , or CLERP greater than 10^{-5} , as high consequence scenarios, resulting in HSS categorization for the corresponding SSCs. Additionally, these approved precedents were consequence-based evaluations, where only the consequences of a postulated passive component failure were evaluated, and the failure frequencies or contribution to CDF/LERF were not taken into account. In contrast to prior approved precedents, the proposed EPRI methodology uses products of CDF (LERF) and CCDP (CLERP) as a comparison to CDF (LERF) which can contain a pipe rupture frequency as low as 10^{-8} per year (10^{-9} per year for LERF and CLERP) coupled with a consequence (CCDP or CLERP) as high as 1.0 and still be categorized as LSS. The staff finds the change in CCDP/CLERP thresholds and the introduction of CDF/LERF contributions are insufficiently justified to categorically conclude that those SSCs would be LSS subject to alternative treatments.

Requests:

a. The staff has identified the issue above regarding potentially not adequately addressing high consequence failures, specifically consequence failures with CCDP greater than 10^{-4} or CLERP greater than 10^{-5}. Discuss how EPRI intends to modify the TR to address these areas. As discussed during the audit, please provide consideration of the following two options:

- Provide a description and justification of how high consequence SSCs with CCDP greater than 10^{-4} or CLERP greater than 10^{-5} are addressed.
- As an alternative to first item above, provide a clearly defined minimum set of requirements such as the repair methods of nationally recognized postconstruction codes and standards (e.g., ASME B31.1, ASME PCC-2) for SSCs with a CCDP of 10^{-4} and CLERP of 10^{-5} or higher.

EPRI RAI Response to 1a:

In determining whether a component is RISC-3, EPRI Technical Report 3002025288 (referred to as “TR 3002025288” in the rest of this response) uses a multi-step process consisting of prerequisites (including integrity management), a set of predetermined HSS components, and a plant-specific search for risk-significant passive components to address all passive SSCs.

The ten pre-determined risk-informed criteria are intended to capture common high consequence components building off decades of experience in risk-informing the pressure boundary. The EPRI streamlined RI-ISI methodology (ASME Code Case N-716 as endorsed in Regulatory Guide 1.147, ML21181A222) provides valuable insights for justifying the assignment of HSS for specific Class 2, Class 3 and non-safety related systems/subsystems in the context of in-service inspection (e.g., criteria 1, 2, 3, 4, 11). As discussed in the supplementary information provided by EPRI, valuable inputs were obtained from its application as well as other risk-informed pressure boundary applications (e.g., TR-112657 Rev B-A, WCAP-14572-A, 1006937). However, because of the breadth of 10 CFR 50.69, those insights could not be the sole basis for an enhanced categorization methodology. As such, additional risk-informed criteria were developed to specifically address the increased scope and content brought about by a 10 CFR 50.69 application (e.g., criteria 5, 6, 7, 8, 9 and 10).

Based on discussions from the March 6, 2025 public meeting, EPRI proposes a revision to clarify that internal flooding is a consideration in HSS criteria 5 and 8. Section 4.2 criteria 5 and 8 proposed revisions are as follows with new text in bold:

Criterion 5:
Portions of the ultimate heat sink (UHS) flow path (for example, service water) whose failures will fail both trains (that is, unisolable failure of the UHS function, **or loss of both trains due to spatial impacts (e.g. flood, spray)).** (Note: even if piping is isolated/independent, structures such as the service water pumphouse [for example, reservoir, bay] would be expected to be HSS.)

Criterion 8:
For PWR plants, low-volume, intermediate-safety systems that typically consist of two physically independent trains (for example, component cooling water [CCW]) that are, on a plant-specific

basis, physically connected. For example, loss of pressure boundary integrity of train A will drain train B as well **or loss of both trains due to spatial impacts (e.g. flood, spray)**.

Also, during the March 6, 2025 public meeting, the NRC staff and the EPRI team engaged in technical discussions regarding the risk criteria. Based on the insights obtained from this meeting, EPRI deleted criterion 12 (CDF*CCDP) and criterion 13 (CLERP*LERF) from TR 3002025288. Criterion 11 has been expanded to include metrics for both CDF/LERF and CCDP/CLERP. The revisions to criterion 11 are as follows:

> Any piping or component, including piping segments or components grouped or subsumed within existing plant initiating event groups (main feedwater breaks inside containment; main steam line breaks outside containment; service water flooding events; interfacing system LOCAs; failures of non-Class 1 RCPB connections, such as instrumentation lines) whose contributions to:
>
> - CDF is greater than 1E-06/year, or
> - LERF is greater than 1E-07/year,
>
> or whose:
>
> - CCDP is greater than 1E-02, or
> - CLERP is greater than 1E-03.
>
> This criterion is applied to a plant-specific PRA model that includes pressure boundary failures (for example, pipe whip, jet impingement, spray, and inventory losses).

> Note: The 1E-02 / 1E-03 values are similar to EPRI TR-112657, Rev B-A and deterministic single failure criteria, seismic margin analysis, fire protection (Appendix R) in that having a success path results in adequate protection for low frequency events.

Specifically, criterion 11[1] requires passive components with a CDF > 1E-6/year (or LERF > 1E-7/year) to be assigned HSS. The CDF and LERF in Criterion 11 is also used in N-716 for streamlined RI-ISI. The Grand Gulf (ML072430005) and DC Cook (ML11073A084) Safety Evaluation Reports for ASME Code Case N-716 relief request confirm these guidelines (CDF>1E-6/year and LERF >1E-7/year) are suitably small and consistent with the decision guidelines for CDF/LERF in RG 1.174. It is also consistent with the guidelines contained in EPRI TR-112657, Rev B-A. Criterion 11 is a defense-in-depth measure to capture plant-specific locations that are important to safety.

The expansion of criterion 11 to include CCDP and CLERP metrics also ensure that low frequency / high consequence scenarios are properly categorized.

It should be noted that "high consequence" was a term used to identify passive SSCs that exceed a particular CCDP/CLERP threshold, and this is not equivalent to high risk. When CCDP/CLERP is paired with frequency, as in licensee's internal flooding PRA models, decision-makers can obtain more holistic insights on both frequency of occurrence and consequences of

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[1] As a point of clarification on the background for RAI 1, criterion 11 does not propose to categorize SSCs as LSS if their individual contribution to CDF is less than 1E-6/year (LERF less than 1E-7/year). SSCs that meet the requirements of Criterion 11 are categorized as HSS.

pipe ruptures in assessing risk, without unduly biasing the results towards overly conservative treatment of SSCs that are not significant to risk as measured by CDF and LERF (RG 1.174).

EPRI TR-112657, WCAP-14572, and N-716 (all NRC approved RI-ISI methodologies) use failure frequencies and CDF/LERF in determining risk/safety significance. Furthermore, failure frequencies and CDF/LERF are an inherent part of risk-informed applications such as risk-informed Technical Specifications (e.g., surveillance frequencies and completion times).

On the prior supplementary information, submitted in June 2024, as part of the on-going NRC review of TR 3002025288 Attachment 4: Updated Chapter 5 Table 7, examples are provided that have improved plant safety through vulnerabilities identified from implementing criterion 11. Table 7 documents plant hardware modifications, procedure updates, and new NDE and inspection for risk-significant scenarios. Pipe segments with an internal flooding CDF/LERF of greater than 1E-6/year / 1E-7/year respectively are HSS.

Peer reviewed internal flooding PRA models that use industry experience derived failure rates/pipe rupture frequencies paired with plant-specific direct and indirect effects is consistent with the NRC's PRA Policy Statement that, "PRA evaluations should be as realistic as practical". Revision 5 of EPRI's *Pipe Rupture Frequencies for Internal Flooding Probabilistic Risk Assessment*, provides service experience through 2020 to determine the frequencies.

The expansion of criterion 11 ensures that the categorization process properly reviews and evaluates plant-specific outliers from both a CDF/LERF and CCDP/CLERP perspective and assigns these as HSS. For those components/segments that are binned as RISC-3, existing plant processes such as the corrective action programs, performance monitoring, and the procurement/design control remain in place to ensure reasonable confidence in equipment performance.

While RISC-3 SSCs may be exempted from certain special treatment requirements, it is important to note that when components are repaired or replaced, including those using 10 CFR 50.69 allowances, the repair/replacement must comply with the station licensing and design bases. Generally, stations prefer to perform like-for-like repairs or replacements as these are typically less resource intensive. When like-for-like is not feasible and/or cost-effective, the repair/replacement is evaluated against the station's design and licensing basis in accordance with the station's Design Control process. Changes to SSCs (e.g. repairs or replacements) are evaluated using various technical products depending on the degree of change as identified via a Fit, Form, and Function (FFF) analysis of the component. Evaluations increase in complexity commensurate with the degree of change to ensure all aspects of the design are evaluated. Design tasks are performed in a planned and controlled manner. These evaluations are sufficiently detailed as to purpose, method, assumptions, design input, references, and units such that a person technically qualified in the subject can review and understand the design analysis and verify its adequacy. Applicable design inputs, such as design bases, regulatory requirements, codes and standards, are identified, documented, and their selection reviewed and approved. As an example, design input requirements include the following (but the list is not all inclusive):

- Basic functions of SSCs
- Performance requirements such as capacity, rating, and system output
- Codes and standards
- Design conditions, such as pressure, temperature, and voltage
- Loads, such as seismic, thermal, and dynamic
- Environmental conditions anticipated during operation

- Operational requirements under various plant conditions

Control of design basis and plant configuration is important to ensure that the plant's design, operation, maintenance, and modifications remain consistent with the facility's design and licensing-basis documents (e.g. UFSAR, etc.). The 10 CFR 50.59 process for changes to an SSC (or the facility in general) is used to determine if a change to the plant is permitted as a licensee directed activity or if prior NRC approval is required.

To further confirm the performance and establishing reasonable confidence for RISC-3 components, the PWROG developed the document titled, *Supply Chain, Procurement Engineering, and Design Engineering Roadmap for Procurement of RISC-3 Items.* This document provides standard industry alignment for supply chain, procurement engineers, and design engineers within procurement and configuration control process for RISC-3 SSCs. The document defines RISC-3 Like-for-Like (industrial grade physically and functionally the same as previously supplied for safety related use), RISC-3 Equivalent Items (industrial grade that is physically different than item supplied under Appendix B), and RISC-3 Design Equivalent Item (industrial grade that are not like for like or design-equivalent but meet system design requirements and associated site-specific implemented procedure or equivalent). The document provides further guidance on procurement to ensure reasonable confidence expectations can be met, including:

- RISC-3 Procurement (General)
  - Prior to making a RISC-3 Procurement, it is necessary for a cognizant individual to determine availability of an industrial grade item.
  - Is the item currently purchased as Commercial Grade and dedicated for use in safety related applications? Under a RISC-3 Procurement, the items can be purchased and not dedicated; therefore, these items meet the definition of RISC-3 Like-for-Like Items, provided the same items are purchased
  - Will the OEM manufacture the same item out of equivalent materials without imposing special treatment requirements (e.g., make the same item from corresponding ASTM materials in lieu of ASME materials and without imposing any special treatment requirements, such that it is interchangeable with no effect on function)? If so, this would be a RISC-3 Like-for-Like Item and not require further evaluation
- RISC-3 Procurement Using Standard Item Equivalency Process (SIEP) or Standard Design Process (SDP)
  - Determining reasonable confidence is more involved when trying to approve an item that is physically and/or functionally different than the original. The nuclear industry has developed a Standard Item Equivalency Process and Standard Design Process for use in evaluating items that are physically and/or functionally different from the original, regardless of safety class. Use of the SIEP, SDP, or equivalent processes to evaluate replacement items that are physically and/or functionally different than the original (including addressing seismic and/or environmental conditions, as applicable), in conjunction with the other requirements of 10 CFR 50.69, provides reasonable confidence that the items will perform their design basis safety related function.
  - In general, RISC-3 Equivalent Items and RISC-3 Design Equivalent Items can be purchased in the same manner as RISC-3 Like-for-Like Items from non-Appendix B suppliers and without 10 CFR Part21 reportability requirements.
- Procurement Considerations:

- Prior to procurement of RISC-3 Equivalent Items or RISC-3 Design Equivalent Items, engineering review and/or evaluation is required to ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety-related functions under design basis conditions, including seismic conditions and environmental conditions, as applicable, throughout their service life.
- Technical requirements (e.g. temperature/pressure rating, size, voltage, amps, current rating, mounting consideration, material specifications, initial qualification requirements, etc.) the item must meet may need to be specified differently for purchase of functional replacement items, in lieu of referencing existing drawings, specifications, etc.

Furthermore, candidate RISC-3 segments are subjected to a sensitivity study, which increases the failure rate by a factor of 3 as required by Section 4.4 (previously this was Section 4.3, as a new section 4.3 is added as part of the response for RAI 2b) of TR 3002025288 (and consistent with currently approved guidance in NEI 00-04). Any segment(s) that exceeds the RG 1.174 acceptance criteria will be provided to the IDP as candidate HSS. The remaining RISC-3 segments will be presented to the IDP as candidate LSS.

Consistent with the guidance in NEI 00-04 (and summarized in Table 1 on TR 3002025288) once passive segments are categorized as HSS (meeting any one of the eleven criteria), the IDP is not allowed to change HSS to LSS. The IDP, serving as a multi-disciplinary review panel, ensures all attributes of the evaluations are fully addressed to provide a valid risk-informed conclusion or decision that addresses the maintenance of defense-in-depth and adequate safety margin. This is explicitly covered in existing industry instruction documents and templates developed and maintained by the Nuclear Energy Institute (NEI), under the suite of documents covering the implementation of 10 CFR 50.69 (titled “Risk Informed Engineering Programs” (under RIEP-NEI-16-005):

When applying the methodology in TR 3002025288:

- The IDP shall ensure the prerequisites in Section 4.1 of TR 3002025288 are met
- The IDP shall confirm the assignment of HSS components (from the results of using criteria 1 through 11) is appropriate.
- The IDP shall confirm that the assignment of HSS criteria is valid in the context of other hazards (fire, seismic, other hazards).

For those segments that receive a final LSS assignment, the prerequisites shall continue to be met, i.e.:

- PRA technical adequacy requirements, which include periodic maintenance and updates of the inputs, quality, and results that can impact applications such as 10 CFR 50.69.
- Integrity management programs (e.g. localized corrosion programs for raw-water cooling systems), feedback and process adjustment.
- Additionally, per 10 CFR 50.69(d)(2), the licensee will continue to be required to meet the following requirements:
    - Shall ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety related functions under design basis conditions, including

seismic conditions and environmental conditions and effects throughout their service life.

- The treatment of RISC-3 SSCs must be consistent with the categorization process.
- Inspection and testing, and corrective action shall be provided for RISC-3 SSCs.

Any segment assigned as LSS will have a negligible impact on plant risk consistent with US NRC risk-informed decision making criteria (even if CDF and LERF were not previously directly used in 50.69 passive categorization), as there is no change to plant design basis or system configuration (e.g. a two-train system with a specific required flow rate will remain a two-train system without any reduction in redundancy), defense in depth is maintained, and the prerequisites of Section 4.1 in TR 3002025288 and the requirements of 10 CFR 50.69(d)(2) will ensure that these components shall continue to reliably perform their safety related function under design basis conditions.

Because of:

- The robust assessment of the overall risk,
- The multiple criteria that pre-determine HSS categorization for specific SSCs (e.g., all Class 1 are HSS without any considerations for changing to LSS),
- The use of CDF/LERF/CCDP/CLERP thresholds that are consistent with risk-informed guidance,
- Required sensitivity analysis, increasing the failure rate of candidate RISC-3 components by a factor of 3, and
- Licensee's programs and processes, and 10 CFR 50.69 rule requirements, to ensure RISC-3 SSCs continue to meet design function.

It is deemed that the alternative of imposing additional commitments to specific codes and standards is not needed, and would represent a deviation from the SOC for 50.69:

> *Through this rulemaking, RISC–3 SSCs are removed from the scope of these requirements and instead are subject to the requirements in § 50.69(d)(2). For the reasons discussed in Section III.4.0, the Commission has determined that for low safety significant SSCs, it is not necessary to impose the specific detailed provisions of the Code, as endorsed by NRC, and these requirements can be replaced by the more "high-level" alternative treatment requirements, which allow greater flexibility to licensees in implementation.*

RAI 02 – SSC Categorization as a Single Plant Unit

Background/Issue: 10 CFR 50.69(c)(1)(v) requires that the 10 CFR 50.69 categorization process "be performed for entire systems and structures, not for selected components within a system or structure." The final rule's SoC explain that

> This required scope ensures that all safety functions associated with a system or structure are properly identified and evaluated when determining the safety significance of individual components within a system or structure and that the entire set of components that comprise a system or structure are considered and addressed.

EPRI TR 3002025288 Section 4.4, Alternative Treatment Requirements Under 10 CFR 50.69(d)(2), states that

> this enhanced methodology defines the pressure boundary function of each individual plant unit as a system for 10 CFR 50.69 categorization and alternative treatment purposes. Consistent with 10 CFR 50.69 rule language and several citations in the final rule's SoC, the system boundaries for the pressure boundary function are limited to pressure retention. Therefore, there will be no other important functions that would escape categorization and appropriate assignment of safety significance. As covered in the Statements of Condition, this ensures that all safety functions in the selected system are properly identified and categorized regarding their safety significance.

Further, Table 7 of the TR, "Comparison to 10 CFR 50.69(c)(1)" states that the "enhanced methodology requires categorization of all systems providing a pressure boundary function."

The statements in the TR appear to imply that all the pressure-retaining components in the plant are considered as one system and that only the pressure-retaining function will be used to define the "system." The staff does not find the TR provides sufficient explanation on how the proposed passive categorization will be implemented in the overall 50.69 categorization and did not find sufficient justification to support the statement that "all safety functions in the selected system are properly identified and categorized regarding their safety significance."

Figure 1 of the TR, "Categorization process overview", depicts the overall 50.69 categorization process as intended to be implemented, and shows that the passive categorization is performed in parallel to the other aspects of the categorization, such as considerations based on PRA and other qualitative consideration. All these aspects are considered for the preliminary categorization step, per the guidance in Nuclear Energy Institute (NEI) 00-04 Section 7. The guidance in NEI 00-04 Section 7 states that SSCs that support multiple functions should be assigned the highest risk significant of any function that the SSC, or part thereof, supports. Finally, the inputs from the preliminary categorization are provided to the integrated decision-making panel (IDP). Table 1 of the TR states that the IDP cannot change categorization from HSS to LSS for passive components.

Requests:

a. Clarify what is meant by that statements that the methodology "defines the pressure boundary function of each individual plant unit as a system." Describe how the EPRI methodology proposes to organize passive components in systems for the purpose of the passive component categorization. Describe how system functions are defined per Section 4 of NEI 00-04, "10 CFR 50.69 SSC Categorization Guideline in the context of passive SSCs."

EPRI Response to RAI 2a:

The system boundaries for the pressure boundary function are limited to pressure retention. By only considering the passive/pressure retaining function, no active functions are categorized as part of implementing TR 3002025288. Categorization of active functions/components will continue to follow the guidance in NEI 00-04. For consistent application of TR 3002025288, the wording in Section 4.6 is revised as follows:

> This enhanced methodology for passive categorization requires an evaluation of the pressure retention function of all systems. In this enhanced approach the pressure boundary function is treated as a system for 10 CFR 50.69 categorization and alternative treatment purposes, whereas the traditional passive methodology is applied on a system-by-system basis. Treating the pressure boundary function as a system is consistent with 10 CFR 50.69 rule language and several citations in the final rule's Statement of Considerations (the boundaries for the pressure boundary system are limited to pressure retention) in that there will be no other important functions that would escape categorization and appropriate assignment of safety significance. When categorizing a system that contains active and passive (pressure boundary) components, active components (e.g., non-pressure retaining functions) must follow the existing process for categorization in NEI 00-04 which ensures that all safety functions are properly identified and categorized regarding their safety significance.
>
> Categorizing the pressure retention function as one system is consistent with 10 CFR 50.69 and NRC's approval of the ANO RI-RRA applications [ML21118B039, ML21132A279]. That is, RI-RRA categorization and treatment are limited to the pressure retaining function. For example, using a risk-informed approach to categorization, a motor-operated valve body can be categorized as LSS without categorizing its active functions (for example, *valve fails to open* or *valve fails to close*). This is further documented in the NRC's letter to Vogtle Units 1 and 2 - Issuance of Amendments RE: Use of 10 CFR 50.69 (ML14237A034) as summarized below:
>
>> In the response, the licensee confirmed that the failure of a passive component (e.g., motor operated valve body) that supports an HSS active function may be assigned LSS by the passive categorization methodology if confirmed LSS by the IDP. This can occur because, for example, there are no common cause failures (CCF) among passive components (i.e., multiple and simultaneous pipe ruptures are not expected), so an active function may be HSS due to CCF considerations but the individual pressure retaining components whose individual failures do not fail the function can be LSS. The NRC staff finds that risk assessments generally do not consider the very unlikely simultaneous multiple failures of passive components (except for external hazard events impacts that should be included in the external hazard evaluation) and therefore the proposed method is acceptable.

> Similarly, alternative repair/replacement activities can be applied to the LSS pressure-retaining function of the valve body, and the active function will continue to be maintained through existing practices.

The statements in the TR are not intended to designate pressure-retaining components in the plant as one system in a way that would impact the categorization of active functions per the current guidance in NEI 00-04. Because the enhanced passive categorization uses the experience of categorizing passive functions in various previously approved applications by the US NRC, pre-determined criteria provide an upfront categorization for certain pressure-retaining components. This is in distinction to the current approach in NEI 00-04, where once a system is chosen both the active and passive functions are categorized by the licensee.

As such, a licensee may submit for approval to implement 10 CFR 50.69 and choose not to categorize any system (neither active, nor passive function) or choose a small subset of specific systems and not categorize other systems. Defining upfront categorization (which can include an HSS determination) assigns a result (HSS or LSS) across the plant and, if the plant proceeds in categorizing a system(s) further, both the active and passive functions need to be considered per the current guidance (no change).

The pre-determined categorization of pressure retaining functions does not impact the active function categorization (i.e., there is no allowance to categorize the passive function as LSS and automatically assign the LSS categorization to the active function). In the current method, if the licensee chooses to categorize several systems, they will need to have both active and passive functions considered, with the difference under the enhanced methodology being that all of the pressure-retaining components will have been categorized as HSS/LSS. The active function will be categorized via the approved NEI 00-04 guidance (and alternate treatments remain the same as TR 3002025288 does not change any of the alternate treatment requirements, which still remain in place for RISC-3 items).

More importantly, because the pre-determined criteria are strictly applicable to the pressure-retaining portion of the passive categorization, no change in special treatment for RISC-3 components is allowed until all aspects of the enhanced methodology and relevant portions of NEI 00-04 are completed (prerequisites, criteria 1-11, sensitivity study, and IDP) and an LSS categorization is confirmed by the IDP. While a pressure boundary component may have a HSS or LSS categorization via the enhanced methodology, no change in the active function special treatment is allowed from the current safety-related treatment. Only if the guidance in NEI 00-04 for active functions were to be followed, and the safety-related active function were to be identified as LSS (i.e., binned as RISC-3) following the current approach in NEI 00-04 would the potential for alternate treatments of the active function be allowed.

As such, the guidance does not imply, nor does it provide any options for the active function of a safety-related (or non-safety-related) component to be categorized as LSS without complying with the current NEI 00-04 guidance. Doing so would not follow guidance in TR 3002025288 and NEI 00-04, for active functions, which are not in scope of TR 3002025288.

A peer reviewed internal flooding model that meets the ASME/ANS PRA Standard (consistent with US NRC technical adequacy expectations) is part of the enhanced categorization methodology. The internal flooding model is intended to identify plant-specific HSS components using a plant-specific PRA of pressure boundary failures. This includes impacts of the pressure boundary failure, impacts of the pressure boundary failure on the active system it supports, as well as impacts of the pressure boundary failure on any other plant SSC (i.e., all relevant active and passive functions). This includes direct effects (e.g. loss of the flow path) of the component failure and indirect effects of the component failure (e.g. flooding, spray, pipe whip, loss of inventory). This comprehensive assessment of total plant impact (i.e., active and passive functions) caused by a postulated pressure boundary component failure is then used to determine the HSS or LSS assignment of that pressure boundary component. As such, there are no safety functions (i.e., active or passive) associated with other components or systems that would not be properly identified and evaluated and therefore improperly determine the safety significance of the pressure boundary components under evaluation even before the guidance in TR 3002025288 is implemented.

In other words, implementation of the enhanced categorization methodology ensures the licensee develops a wider understanding of the implication of passive failures than the current approach. From a practical perspective, this effort is very similar to the initial RI-ISI pilot plant applications (i.e., Millstone Unit 3, Surry Units 1 & 2, ANO Unit 2, and Fitzpatrick) which were all full-scope applications. As such, the enhanced methodology is a full scope risk-informed categorization effort and provides more insights into understanding the plant's passive failures than currently required.

b. As indicated in Figure 1 of the TR, the passive categorization is one aspect of the systematic and integrated categorization process outlined in NEI 00-04. Describe further how the passive categorization will be executed part of the overall integrated categorization process. Describe how the guidance in NEI 00-04 Section 7 for preliminary categorization will be implemented for passive components. How will all aspects of the categorization process be considered for the preliminary categorization of SSCs (both active and passive) that will be provided to the IDP?

EPRI Response to RAI 2b:

As stated in part (a), the passive categorization will continue to follow the applicable guidance outlined in NEI 00-04, with the addition of the prerequisites, the pre-determined set of HSS components (criteria 1-10) and the plant-specific review for risk-significant components (criterion 11). TR 3002025288 does not change active function categorization process.

Exercising the process in TR 3002025288 would allow for pre-determined criteria to be applied upfront to the pressure-retaining function as described in Section 4.2. When using TR 3002025288, the existing integrated categorization process (e.g., NEI 00-04) would remain in place for components with active functions (i.e., no change in the active function or the integrated approach).

NEI 00-04 Section 7 is relevant for active functions and components. As a passive only methodology, TR 3002025288 only categorizes the pressure retention function. When using the enhanced passive methodology, similar to the existing passive methodology, Section 7 will continue to be followed for active functions and components.

Consistent with the existing approach (ANO-2, ML090930246) fire, seismic and other hazards need to be considered. Please see the proposed edits to the TR inserted as a new section, Section 4.3, to clarify these expectations.

4.3 External Events Evaluation

The preliminary HSS / LSS assignments shall be reviewed and adjusted to reflect the pressure boundary failure's impact on the mitigation of external events. The effect of external events on core damage and containment performance shall be evaluated from two perspectives, as follows:

• External events that can cause a pressure-boundary failure (e.g., seismic events); and

• External events that do not affect likelihood of pressure-boundary failure, but create demands that might cause pressure-boundary failure and events (e.g., fires)

The purpose of this review is to confirm (and adjust as necessary) that the assignment of HSS criteria is valid in the context of other hazards (fire, seismic, other hazards).

From a practical implementation perspective, the passive/pressure boundary categorization will be presented to the IDP as a complete package (e.g., the full plant evaluation of the pressure retention function, that is all safety related and non-safety related pressure boundary components) for final categorization. After this categorization, as new systems are categorized – each system results will include the active and passive functions for IDP review and concurrence. The active functions will continue to be categorized consistent with guidance in NEI 00-04 as currently performed. This sequence assures the IDP can assess the entire pressure boundary system at the beginning (IDP panel specific to categorization based on TR 3002025288) and also assures that each subsequent system characterization (that is active and pressure boundary functions) also reflect the entire NEI 00-04 process.

To fully address the systematic and integrated categorization interactions with NEI 00-04, the following new section is added to chapter 4 of TR 3002025288 (Section 4.5 NEI 00-04 Integrated Decision Making Panel Guidance) as follows:

After the performance of the evaluations required by sections 4.1 (prerequisites), 4.2 (Determination of HSS Passive SSCs), 4.3 (external events evaluation), and 4.4 (acceptably small increases to CDF and LERF) a preliminary (candidate) HSS / LSS assignment of all safety related and non-safety related pressure retaining components has been completed.

As required by Section 9.2 of NEI 00-04, the IDP is responsible for reviewing candidate HSS and LSS assignments and determining the final HSS and LSS assignment. Consistent with past practice any candidate HSS assignment (i.e., components meeting any one of the 11 criteria or determined to be HSS by a non-PRA external hazard evaluation) cannot be assigned LSS by the IDP. Per NEI 00-04, the IDP may determine a function/SSC has not been appropriately characterized and may be re-evaluated based on insights from the IDP. Also, NEI 00-04 allows for more detailed characterization of the SSC associated with a safety-significant function. This can be performed after the initial IDP, but the basis for that re-categorization must be considered and discussed in a follow up IDP session.

For application of the enhanced categorization methodology for pressure boundary components the IDP shall also confirm that all steps in the process have been followed.

- *The IDP shall ensure that the prerequisites cited in Section 4.1 are met.*

- *The IDP shall confirm the assignment of HSS components (from the results of using criteria 1 through 11) is appropriate.*

- *The IDP shall confirm that the assignment of HSS criteria is valid in the context of other hazards (fire, seismic, other hazards).*

c. Describe IDP's role in addressing both the passive and active functions of SSCs. Confirm the intent in TR Table 1 that IDP will not change HSS categorization of passive components.

<u>EPRI Response to RAI 2c:</u>

See part of the response in (b) for a detailed description of the IDP's role in passive function categorization. Additionally, as required by Section 9.2 of NEI 00-04, the IDP is responsible for reviewing candidate HSS and LSS assignments and determining the final HSS and LSS assignment.

The key aspect is that the IDP cannot change a HSS classification for passive function categorization. This is consistent with industry practices in that passive HSS assignment (i.e. components meeting any one of the 11 criteria or determined to be HSS by a non-PRA external hazard evaluation) cannot be assigned LSS by the IDP in the final 50.69 categorization process.

d. Justify how the approach taken in EPRI TR 3002025288 for passive pressure boundary SSC categorization complies with 10 CFR 50.69(c)(1)(v) and the associated statements of considerations to ensure that "all safety functions associated with a system or structure are properly identified and evaluated when determining the safety significance of individual components within a system or structure and that the entire set of components that comprise a system or structure are considered and addressed."

<u>EPRI Response to RAI 2d:</u>

10 CFR 50.69(c) requires a categorization process that determines if an SSC (structures, systems and components) performs one or more safety significant functions and identifies those functions. In particular, 10 CFR 50.69(c)(1)(v) requires that the categorization "be performed for entire systems and structures, not for selected components within a system or structure." However, 10 CFR 50.69, the statements of considerations for the final rule (SOC), NEI 00-04 and Reg Guide 1.201 do not provide a prescriptive definition for a system or its boundaries.

As discussed in the SOC, the concern is that by limiting the categorization to isolated components within a complex system, all of the safety functions associated with that complex system might not be properly identified and evaluated and, therefore, potentially introduce the possibility for improper determination of the safety significance of the isolated component(s) under evaluation.

It is also noted in the SOC that this requirement should be understood to exclude entire support systems (e.g., if system A is categorized as RISC-3, but is dependent on system B components which in turn have been categorized as RISC-1, then system A is understood not to include the system B components and is not to be categorized as RISC-1).

As discussed in Section 4.5 (previously Section 4.4) of TR 3002025288, this enhanced methodology defines the pressure boundary function as a system for 10 CFR 50.69 categorization and alternate treatment purposes. When applying the enhanced methodology, in particular criteria 9, 10, and 11, all of the impacts on active and passive functions caused by the loss of the pressure retention function need to be accounted for, consistent with the ASME/ANS PRA Standard (which requires that "both direct effects" and "indirect effects" be considered for internal flooding) and Regulatory Guide 1.200 (which endorses the approach in the ASME/ANS PRA Standard). This includes impacts of the pressure boundary failure, impacts of the pressure boundary failure on the active system it supports, as well as impacts of the pressure boundary failure on any other plant SSC (i.e., all relevant active and passive functions). More specifically, direct effects need to account for impacts such as loss of the flow path of the component, while indirect effects of the component failure needs to account for phenomena such as flooding, spray, pipe whip, and loss of inventory. This comprehensive assessment of total plant impact (i.e., active and passive functions) caused by a postulated pressure boundary component failure is then used to determine the HSS versus LSS assignment of that pressure boundary component. As such, there are no safety functions (i.e., active or passive) associated with other components or systems that would not be properly identified and evaluated and therefore improperly determine the safety significance of the pressure boundary components under evaluation.

This approach is consistent with a number of prior regulatory precedents. For example, it is consistent with the incorporation of ASME Case N-660 into RG 1.147, Revision 14 in 2005, NRC approval of draft N-752 at ANO-2 for RI-repair/replacement activities in 2009, NRC approval of ASME Case N-752 at ANO 1 and 2 in 2021, NRC approval of ASME Case N-752 at Oconee in 2023, NRC approval of ASME Case N-752 at NextEra in 2024 and NRC approval of N-752 at Entergy in 2024 in that alternate treatment may be applied to pressure boundary components (e.g., repair / replacement activities, quality assurance) without requiring the categorization of supported active functions. These NRC precedents allow for limiting the categorization to only those pressure boundary components within a single supported active system and in many cases allow for limiting the categorization to individual pressure boundary components within a single supported active system. As such, the enhanced methodology is more conversative than these NRC precedents because the enhanced methodology requires that all pressure boundary components within the "pressure boundary system" (i.e., all safety related and non-safety related pressure boundary components) be categorized thereby increasing the likelihood that RISC-2 components will be identified.

Note: 10 CFR 50.69(f)(2) requires that Licensees shall update their final safety analysis report (FSAR) to reflect which systems have been categorized.

e. Can the proposed methodology create a situation where a component is only categorized for its passive function, but the associated active function is left uncategorized? If so, explain why this is acceptable. Also, if the proposed methodology can create situations where a single SSCs receives different categorization based on its active and passive functions, describe and justify such scenarios and the mechanisms on how that would occur. For each scenario, describe and justify how it is ensured that an active HSS function would not be impacted by the LSS designation of a passive SSC that supports that function. Describe the guidance and approach for resolving differences.

EPRI Response to RAI 2e:

Yes, as discussed in (a), the methodology is applied so that a component is only categorized for its passive (pressure retaining) function and the associated active function(s) are left uncategorized. The function(s) will remain uncategorized, and the associated SSCs will not be subject to alternate treatment and therefore will continue to reliably perform its safety related active function.

The proposed enhanced methodology meets the intent of the rule because it has a process in place to prevent the miscategorization between active and passive functions and, ultimately, it is not intended to change the active categorization by only considering the passive function. While the vast majority of passive components only perform a pressure retaining function, there are a number of components (e.g., valves) that perform both active and passive (pressure retaining) functions. As such, it is possible when applying the 10 CFR 50.69 process for an SSC to have an active HSS and passive LSS categorization. As discussed, and docketed during the Oconee N-752 relief request review (2023), this question was addressed in the Vogtle pilot plant review for 10 CFR 50.69 implementation in RAI 29 and specifically discussed in the NRC Safety Evaluation for that application. The Vogtle response (ML14122A364) is provided below with minor edits for clarification.

> Vogtle Response (adapted): The NEI 00-04 categorization methodology assigns risk at the component level. Per the methodology, a component gets assigned final risk if any of the following risks is HSS: active risk, passive risk, or defense in depth. Active risk is determined using insights from the PRA and other qualitative considerations. Passive risk is determined using a passive component categorization methodology. Risk associated with defense in depth is determined using guidance provided in the NEI 00-04 categorization methodology. The final risk of a component is the highest of these three risks. Then the critical attributes are identified for each HSS components to further understand the reason(s) for being HSS. For example, an HSS Motor Operated Valve (MOV) may have a critical attribute of fail to close because that is what made it HSS. However, the same valve may be LSS for passive risk (i.e., pressure boundary retention) assuming there is sufficient redundancy to respond to the event of interest and LSS from a defense in depth evaluation.

Further, the following words are taken directly from the Safety Evaluation written by NRC staff on the Vogtle 10 CFR 50.69 LAR (ML18180A062):

> In the response, the licensee confirmed that the failure of a passive component (e.g. motor operated valve body) that supports an HSS active function may be assigned LSS by the passive categorization methodology if confirmed LSS by the IDP. This can occur because, for example, there are no common cause failures (CCF) among passive components (i.e., multiple and simultaneous pipe ruptures are not expected), so an active function may

be HSS due to CCF considerations but the individual pressure retaining components whose individual failures do not fail the function can be LSS. The NRC staff finds that risk assessments generally do not consider the very unlikely simultaneous multiple failures of passive components (except for external hazard events impacts that should be included in the external hazard evaluation) <u>and therefore the proposed method is acceptable</u>.

Additionally, as discussed above, the application of the enhanced methodology is consistent with a number of NRC precedents (e.g., N-660, ANO-2, Oconee, Entergy, NextEra) in that all safety related and non-safety related components must be categorized using the enhanced methodology, as well as subject to the prerequisites of Section 4.1, thereby increasing the likelihood of identifying RISC-2 components as compared to NRC endorsed precedent.

- August 2005 – NRC endorsement of ASME Code Case N660 into revision 14 of Reg Guide 1.147.

- 2009 – Arkansas Nuclear One, Unit 2 – Approval of Request for Alternative ANO2-R&R-004, Revision 1, Request to Use Risk-Informed Safety Classification and Treatment for Repair/Replacement Activities in Class 2 and 3 Moderate and High Energy Systems (TAC NO. MD5250), April 22, 2009, ML090930246.

- 2014 – Vogtle Electric Generating Plant, Units 1 and 2 – Issuance of Amendments Re: Use of 10 CFR 50.69 (TAC NOS. ME9472 AND ME9473), dated December 17, 2014 (ADAMS Accession No. ML14237A034).

    - Vogtle Electric Generating Plant - Unit 1 and Unit 2 Pilot 10 CFR 50.69 License Amendment Request, Response to Request for Additional Information, dated May 2, 2014.

- 2021 – Arkansas Nuclear One, Units 1 and 2 – Approval of Request for Alternative from Certain Requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (EPID L-2020-LLR-0076), May 19, 2021, ML21118B039.

- 2023 – Oconee Nuclear Station, Units 1, 2, and 3 – Re: Authorization of Alternative to Use RR-22-0174, “Risk-Informed Categorization and Treatment for Repair/Replacement Activities in Class 2 and 3 Systems Section XI, Division 1” (EPID L-2022-LLR-0060), December 13, 2023, ML23262A967.

    - Second Response to Request for Additional Information (RAI) Regarding Proposed Alternative to Use American Society of Mechanical Engineers Code Case N-752, “Risk-Informed Categorization and Treatment for Repair/Replacement Activities in Class 2 and 3 Systems Section XI, Division 1” dated October 20, 2023.

- 2024 – Entergy EN-RR-22-0011 for Grand Gulf Nuclear Station, River Bend Station, Waterford 3 (ML22181B114, ML23111A213, ML24012A196, ML24101A388) approved in NRC SE dated May 30, 2024 (ML24060A219, ML24151A238).

- 2024 – NextEra FRR-23-011 for St. Lucie Units 1 & 2, Turkey Point Units 3 & 4, Seabrook Station, Point Beach Units 1 & 2 (ML23074A155) approved in SE dated June 12, 2024 (ML24149A286, ML24164A193).

RAI 03 – Addressing Uncertainty and Other Events in Individual Assessments

Background/Issue: Paragraph 50.69(c)(1)(i) states that the SSC categorization process must "consider results and insights from the plant-specific PRA. This PRA must, at a minimum, model severe accident scenarios resulting from internal initiating events occurring at full power operation. The PRA must be of sufficient quality and level of detail to support the categorization process and must be subjected to a peer review process assessed against a standard or set of acceptance criteria that is endorsed by the NRC." In response, Table 7 of TR 3002025288, "Comparison to 10 CFR 50.69(c)(1)", further states,

> As stated previously, the plant needs to have a robust internal events PRA, including IF [internal flooding], that addresses failure of all pressure boundary components (main steam line breaks, main feedwater line breaks, internal flooding events, interfacing system LOCA [loss of coolant accident], and so on). Because this methodology is being used in support of 10 CFR 50.69 applications, the plant-specific PRA needs to be sufficient to support the license amendment request approval process, including consideration of PRA assumptions and sources of uncertainty.

Requests:

a. Criteria 11-13 are the only criteria in the methodology that involves a direct use of the licensee's PRA model-of-record. From Figure 3, "CCDP versus CDF threshold" and Figure 4, "CLERP versus LERF threshold", it appears that each of the three criteria have "hard" risk thresholds. Explain how uncertainty is taken into account within the use of these thresholds to categorize a passive pressure-retaining component. Also, explain how the potential cumulative impact of changes is addressed.

EPRI response to 3a:

All pressure boundary failures that are plant initiating events are modeled in the PRA, as required per the NRC-endorsed ASME/ANS PRA Standard. As discussed in Section 4.1.1 Prerequisite 1: PRA Technical Adequacy, the licensee must have a plant-specific internal events and internal flooding PRA of sufficient quality (peer reviewed against the ASME/ANS PRA Standard) to support the LAR approval process. Pressure boundary failures, such as pipe ruptures, are evaluated quantitatively per criterion 11 of the enhanced methodology. Regarding uncertainty within the use of the thresholds to categorize a passive pressure-retaining component, NUREG-1855 and the two companion EPRI reports (1016737 and 1026511) provides the methodology for assessing and addressing uncertainties in PRA models used in risk-informed decision making.

In implementing TR 3002025288, the list of assumptions and sources of uncertainty needs to be reviewed to identify those which would be significant for the risk-informed categorization of the pressure boundary. If the plant-specific PRA model uses non-conservative treatments, or uses methods not commonly accepted, the underlying assumption or source of uncertainty would need to be reviewed to determine its impact on the risk-informed categorization of the pressure boundary. Only those assumptions or sources of uncertainty that could significantly impact the categorization risk calculations (i.e., could change a categorization outcome) would be considered key for this application. An example is shown in Table 1.

Table 1

Supporting Requirement	Finding Description	Disposition
IF-C2b Now IFSN-A4	Appendix E appears to take credit for drains, however calculation of drain capacity was not evident.	A formal analysis of drain capacities has not been performed. The internal flood notebook provides a discussion of flood scenarios in Flood Zone XX. A drain capacity of 60,000 gallons was estimated and credited based on discussion with engineers and review of plant drawings. A probabilistic estimate of drainage failure is provided to address uncertainties in the drainage capacity. With the exception of Flood Zone RBFLZZ, floor drains were not credited to conservatively estimate the time available for operator intervention. A conservative estimate was used for floor drain credit, which primarily impacts the associated human action importance; therefore, specific analysis is expected to improve the analysis and will have no material impact on the pressure boundary categorization process.

In addition, and consistent with Section 4.4 (previously Section 4.3) of TR 3002025288, a sensitivity study must be conducted by increasing the failure rates of candidate RISC-3 pressure boundary components. Candidate RISC-3 pressure boundary components that exceed the Regulatory Guide 1.174 acceptance criteria shall be candidate HSS (as stated in NEI 00-04, Section 8.1, “cumulative changes in CDF and LERF computed in such sensitivity studies should be compared to the risk acceptance guidelines of Reg. Guide 1.174 as a measure of their acceptability”). Since this sensitivity is being conducted for all RISC-3 components it also accounts for the cumulative impact.

To ensure the importance of properly considering and addressing uncertainty is underscored, an additional consideration to prerequisite 1 was added in Section 4.1.1 to look for potential non-conservatisms or uncommon methods as outlined below:

> *The analyst must review key assumptions and sources of model uncertainty in the context of this application. For example, prior to using the enhanced categorization methodology, any non-conservatisms or the use of methods not commonly accepted for risk-informed applications must be reviewed to determine their impact, if any, on the risk-informed categorization of the pressure boundary.*

To ensure a sensitivity analysis is performed appropriately and not by-passed (which would not be in line with the overall NEI 00-04 guidance), the following modification is made to the third paragraph of Section 4.4 (previously Section 4.3) of TR 3002025288:

> *For this effort, passive RISC-3 SSCs (i.e., those pressure boundary components modeled in the internal events or internal flooding PRA) shall have their failure rates (such as pipe break frequency) increased by a factor of 3 and their CDF and LERF quantified so that the cumulative impact of any potential alternate treatment is assessed. As previously covered, due to the requirements of this enhanced methodology and the requirements that RISC-3 SSCs continue to perform their safety-related functions under design basis conditions, this type of degradation is extremely unlikely for any single component, let alone entire groups of components. Therefore, the factor of 3 is a conservative bound on the potential impact*

of alternative treatment and is consistent with industry application of NEI 00-04 Section 8.1.

In addition to the multiple steps in the process that ensure proper characterization (e.g., prerequisites, pre-determined categorization, risk criteria, IDP review, alternate treatment for RISC-3 SSCs that must continue to meet 10 CFR 50.69 expectations, continued monitoring of RISC-3 SSCs, corrective action), the enhanced methodology is required to be performed on the entire plant's pressure retention system (i.e., the pressure boundary), as opposed to single systems or a combined subset of systems (as allowed per the current approved guidance in NEI 00-04). As such, the sensitivity analysis will be cumulative of the entire pressure boundary function in that all pressure boundary RISC-3 components modeled in the PRA will be included, providing a more comprehensive overall consideration of the impact of uncertainties and sensitivities than currently done.

The guidance in TR 3002025288 is built upon the statements above in NEI 00-04 Section 8.1 (and further supported by Section 12.4), which are considered still applicable to the enhanced passive categorization approach (i.e., it is not expected that RISC-3 passive SSCs would violate any of the expectations in NEI 00-04 regarding significant negative changes in performance). Based on the more comprehensive evaluation of passive SSCs in TR 3002025288, prior experience with the sensitivities performed and submitted by individual licensees to the NRC under the current process, and experience with failure rates for passive SSCs, TR 3002025288 suggests a factor of 3 as sufficient for the sensitivity analysis. As stated in NEI 00-04, "3 to 5" are provided as examples (not specific factors to be used). The factor of 3 has been applied in approximately 70 approved 10 CFR 50.69 licensee applications to date.

b. Discuss and justify how current risk thresholds for Criteria 11-13 take into account cases of lower initiating event frequencies coupled with higher failure consequences. Discuss how these higher failure consequences are considered.

<u>EPRI response to 3b:</u>

Criterion 11 (i.e. 1E-6/year and 1E-7/year risk thresholds for CDF and LERF respectively) is consistent with Regulatory Guide 1.174 risk-informed decision-making acceptance criteria regarding what constitutes low values of risk importance, this has been used in a number of risk-informed applications or in applications where risk insights are used to further the understanding of the acceptability of a plant change/activity.

As discussed in the response to RAI 1, EPRI has expanded criterion 11 and eliminated criteria 12 and 13. The revised criterion 11 is summarized below. Any segment meeting the CDF, LERF, CCDP or CLERP criteria is candidate HSS.

- CDF is greater than 1E-06/year, or
- LERF is greater than 1E-07/year, or
- CCDP is greater than 1E-02, or
- CLERP is greater than 1E-03.

With expanding Criterion 11 to also include a CCDP/CLERP threshold, this ensures that low-frequency/high consequences scenarios are properly accounted for.

c. As a risk-informed process, discuss how the preservation of defense-in-depth and maintenance of safety margins are accounted for in using Criteria 11-13. Also elaborate on the assessment of qualitative criteria and defense-in-depth for passive categorization, and if any additional guidance is required for the IDP when applying the methodology in EPRI TR 3002025288.

EPRI response to 3c:

While criterion 11 is an important component of the overall enhanced categorization methodology contained in TR 3002025288, it should not be viewed in isolation. Criterion 11 coupled with criteria 1 through 10, the prerequisites contained in Section 4.1.1 (PRA Technical Adequacy), 4.1.2 (robust program assuring pressure boundary integrity management), and 4.1.3 (barriers against internal flood propagation), 4.1.4 (reflect the as built / as operated plant) together with the assurance of only acceptably small increases in risk consistent with Regulatory Guide 1.174 and meeting the requirements on 10 CFR 50.69(d)(2) assures that implementation of TR 3002025288 will not adversely impact the preservation of defense in depth or maintenance of safety margins. Further implementation of the methodology contained in TR 3002025288 does not impact defense-in-depth (DID) and safety margins because there is no change to the design or design basis functions of RISC-3 SSCs. Additionally, 10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, that components categorized as LSS (RISC-3 SSCs) remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service.

The qualitative criteria of the existing process is addressed by the enhanced methodology as provided in the second set of supplemental information provided on June 28, 2024. As detailed in Table 2 (below), these considerations are addressed by the enhanced methodology.

Additionally, as discussed in the response to RAI 2 it is proposed to add a new Section 4.5 (Section 4.5 Integrated Decision Making Panel Guidance) which provides additional IDP responsibilities when implementing the enhanced methodology.

Table 2

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Enhanced Methodology
I-3.2 Classification	Piping is assigned a RISC value of HSS or LSS. Piping segments determined to fall into the HIGH consequence category shall be considered HSS. Piping segments determined to fall into the Medium, Low, or none category shall be determined to be HSS or LSS by considering the 10 additional considerations (evaluated below).	The proposed methodology uses the same designation of HSS and LSS. The existing and the new proposed methodology defines components RISC determination as only HSS or LSS and does not use the high, medium, low or none categories to evaluate the components.
I-3.2.2 (b) (1) Classification Considerations: Additional considerations:	Evaluate the additional considerations: 1. Failure of the pressure retaining function of the segment will not fail a basic safety function.	Components whose failure could fail a basic safety function are outlined in the pre-determined HSS criterion. Any pressure boundary failure that could fail a safety function is considered a high consequence (HSS). Criterion 5 (loss of ultimate heat sink), Criterion 6 (loss of ECCS), Criterion 7 (loss of secondary cooling in a PWR), and Criterion 8 (loss of CCW in a PWR), and Criterion 11address loss of safety functions. This consideration is still evaluated through the proposed methodology, just in a different approach.
I-3.2.2 (b) (2) Classification Considerations: Additional considerations:	Evaluate the additional considerations: 2. Failure of the pressure retaining function of the segment will not prevent the plant from reaching or maintaining safe shutdown conditions; and the pressure retaining function is NOT significant to safety during mode changes or shutdown.	Key functions that would prevent the plant from reaching or maintaining safe shutdown conditions include a total loss of reactor pressure control, reactor coolant inventory control, decay heat removal, or the loss of vital auxiliaries (e.g., instrumentation or AC/DC power). These functions are addressed through the proposed methodology in that any pressure boundary failure that could fail these basic safety functions is considered a high consequence (HSS). Criterion 5 (loss of ultimate heat sink), Criterion 6 (loss of ECCS), Criterion 7 (loss of secondary cooling in a PWR), and Criterion 8 (loss of CCW in a PWR), and Criterion 11 address loss of safety functions (including loss of power due to a pressure boundary failure). This consideration is still evaluated through the proposed methodology, just in a different approach.

Table 2

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Enhanced Methodology
I-3.2.2 (b) (3) Classification Considerations: Additional considerations:	Evaluate the additional considerations: The pressure retaining function of the segment is not called out or relied upon in the plant Emergency/Abnormal Operating Procedures or similar guidance as the sole means for the successful performance of operator actions required to mitigate an accident or transient.	The BWROG and PWROG have evaluated the standard plant Emergency Operating Procedures. No instances of any components were found to be the sole means for successful performance of actions required to mitigate and accident or transient. Further, the PRA model scope includes the equipment needed to successfully mitigate an accident or transient which could lead to core damage or a large early release. If failure of one component leads directly to core damage or large, early release, then its contribution to risk is evaluated in the proposed methodology (please see criterion 11). This consideration is still evaluated through the proposed methodology, just in a different approach.
I-3.2.2 (b) (4) Classification Considerations: Additional considerations:	Evaluate the additional considerations: The pressure retaining function of the segment is NOT called out or relied upon in the plant Emergency/Abnormal Operating Procedures or similar guidance as the sole means for assuring long term containment integrity, monitoring of post-accident conditions, or offsite emergency planning activities.	The BWROG and PWROG have evaluated the standard plant Emergency Operating Procedures. No instances of any components were found to be the sole means for assuring long term containment integrity, monitoring of post-accident conditions, or offsite emergency planning activities. Further, any pressure boundary failure that could fail these basic safety functions is considered a high consequence (HSS). Criterion 5 (loss of ultimate heat sink), Criterion 6 (loss of ECCS), Criterion 7 (loss of secondary cooling in a PWR), and Criterion 8 (loss of CCW in a PWR), and Criterion 11 address loss of safety functions for maintaining containment integrity. This consideration is still evaluated through the proposed methodology, just in a different approach.

Table 2

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Enhanced Methodology
I-3.2.2 (b) (5) Classification Considerations: Additional considerations:	Evaluate the additional considerations: Failure of the pressure retaining function of the segment will not result in an unintentional release of radioactive material that would result in the implementation of offsite radiological protective actions.	The proposed methodology requires all Class 1 SSCs be HSS. Class 1 components compose one of the key fission product barriers. Further, criterion #9 ensures components that could lead to containment bypass are HSS. Any other component failures which would lead to LERF, and potentially offsite radiological protective actions, would be identified through Criterion 11. This consideration is still evaluated through the proposed methodology, just in a different approach.
I-3.2.2 (b) (6) Classification Considerations: Defense-in-Depth	Evaluate the Defense-in-Depth considerations: 6. Reasonable balance is preserved among prevention of core damage, prevention of containment failure or bypass, and mitigation of an offsite release.	10 CFR 50.69 categorization does not change the design, design basis or operation of plant components. Therefore, reasonable balance is preserved among prevention of core damage, prevention of containment failure or bypass, and mitigation of an offsite release as there is no change to the design, design basis or operation of plant components. Additionally, the PRA consequence assessment of the methodology requires an evaluation and ranking of postulated failures on core damage and containment performance (e.g., bypass, LERF). Finally, with implementation of the 50.69 process for plant components, the RISC-3 components are still safety-related and are still required to reliably perform their safety-related function (per the rule). The inherent process maintains this defense-in-depth attribute. No further evaluation is required when implementing the proposed methodology.

Table 2

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Enhanced Methodology
I-3.2.2 (b) (7) Classification Considerations: Defense-in-Depth	Evaluate the Defense-in-Depth considerations: 7. There is no over-reliance on programmatic activities and operator actions to compensate for weaknesses in the plant design.	The proposed methodology evaluation reflects the as-operated / as-designed plant (per prerequisite #4). This evaluation does not increase the reliance on programmatic activities or operator actions. Operator actions, when credited, are credited consistent with the NRC endorsed PRA standard. The inherent process maintains this defense-in-depth attribute. No further evaluation is required when implementing the proposed methodology.
I-3.2.2 (b) (8) Classification Considerations: Defense-in-Depth	Evaluate the Defense-in-Depth considerations: 8. System redundancy, independence, and diversity are preserved commensurate with the expected frequency of challenges, consequences of failure of the system, and associated uncertainties in determining these parameters.	System redundancy, independence, and diversity are preserved as there is no change to the design, design basis or operation of plant components by the risk categorization of the plant components. RISC-3 components will still be required to reliably perform their safety-related function as designed by the plants licensing basis. The inherent process maintains this defense-in-depth attribute. No further evaluation is required when implementing the proposed methodology.
I-3.2.2 (b) (9) Classification Considerations: Defense-in-Depth	Evaluate the Defense-in-Depth considerations: 9. Potential for common cause failures is taken into account in the risk analysis categorization.	Common cause is a fundamental aspect of the PRA consequence evaluation methodology and therefore is taken into account. The inherent process maintains this defense-in-depth attribute. No further evaluation is required when implementing the proposed methodology.
I-3.2.2 (b) (10) Classification Considerations: Defense-in-Depth	Evaluate the Defense-in-Depth considerations: 10. Independence of fission-product barriers is NOT degraded.	The proposed methodology makes no changes to plant design, including independence of fission-product barriers. The inherent process maintains this defense-in-depth attribute. No further evaluation is required when implementing the proposed methodology.

d. In computing the CDF/LERF and CCDP/CLERP for Criteria 11-13, discuss how various embedded events in PRA models such as recovery actions (i.e., FLEX) and human reliability analyses are taken into account.

EPRI response to 3d:

Human actions/recovery actions credited in the PRA must satisfy the requirements of the ASME/ANS PRA Standard. The technical element – Human Reliability Analysis (HR) of Part 2 of the ASME/ANS PRA Standard outlines the requirements for human actions including that the action(s) must be proceduralized, must address plant-specific and scenario-specific influences on human performance, as well as consider the timing and availability of cues. Recovery actions shall only be modeled if the action is plausible and feasible.

Additionally, for internal flooding, the following additional supporting requirements apply, specifically:

- IFQU-A5 (i.e., ensuring additional human failure events are in accordance with the human reliability requirements in Part 2) and
- IFQU-A6 (i.e., accounting for flood scenario-specific performance shaping factors such as additional workload and stress, cue availability, effect of flood on mitigation, timing and recovery actions, etc.).

For HRA, in addition to the ASME/ANS PRA Standard requirements for FLEX, the NRC has issued a memo (May 6, 2022; ML22014A084) on modeling of FLEX actions that need to be considered. In the NRC memo, the NRC updated its assessment of NEI 16-06, "Crediting Mitigating Strategies in Risk-Informed Decision Making" originally published in a 2017 memo.

With respect to FLEX actions, most licensee credited actions are fed through loss of offsite power (LOOP) events that go to station blackout (SBO) with late failures or direct SBO. Most pressure boundary initiators are generally mapped to transients (e.g., reactor trip or loss of cooling system initiators). For pressure boundary failures, multiple non-pressure retaining related failures would need to occur before typical FLEX actions would be credited (likely near the truncation of the internal flood model).

e. For plants which have a high seismic contribution to pipe rupture, discuss how the results of various analyses (e.g., seismic PRA, Seismic Margins Analysis) are taken into account for Criteria 11-13. If these considerations are addressed qualitatively, please explain how they will be addressed. If these considerations are addressed solely by the IDP, explain how this is communicated to the IDP and what guidance is available for the IDP.

EPRI response to 3e:

See response to RAI 2b for treatment of external events. In summary, seismic insights need to be considered in the categorization process to ensure the HSS/LSS criteria is valid from a seismic perspective. With respect to the enhanced passive categorization approach in TR 3002025288, the same guidance applies: external hazards such as seismic need to be accounted for. Insights from seismic analyses (for example SMA, SPRA, tiered approach in EPRI 3002017583) need to be considered. If any approach indicates that a specific pressure boundary SSC may be critical, then an HSS categorization needs to be considered. For plants that may have a high seismic contribution to pipe rupture, these plants likely have a SPRA. Insights from developed SPRAs indicated that small LOCA and very small LOCAs may be important. RCPB piping is already HSS per criteria 1.

RAI-04 – Qualitative Considerations for Shutdown Operations and External Events

Background/Issue: Section 2 of EPRI TR 3002025288 describes how the 10 CFR 50.69 categorization process is performed in accordance with NEI 00-04, Revision 0, as endorsed in Regulatory Guide (RG) 1.201, “Guidelines for Categorizing Structures, Systems, and Components in Nuclear Power Plants According to Their Safety Significance,” Revision 1. Figure 1 of EPRI TR 3002025288, “Categorization process overview” shows passive categorization as a “separate path” for preliminary categorization of pressure-retaining components, prior to IDP review and final categorization. The NRC notes that the guidance in NEI 00-04 includes considerations for fire, seismic, and other external hazards, which may be assessed qualitatively, as well as additional qualitative criteria and requirements for assessment of defense-in-depth. (These are also shown in Figure 1.) The NRC notes that the NRC approved methodology for passive categorization in ANO2-R&R-004, Revision 1, also includes considerations for assessing shutdown operations, external events, and DID.

Requests:

a. It is unclear how the methodology in EPRI TR 3002025288, whether independently or in conjunction with the guidance in NEI 00-04, requires the assessment of shutdown operations and external events, including external events that do not affect likelihood of pressure boundary failure but create demands that might cause pressure boundary failure and events (e.g., fires), for potential impact on the categorization of passive, pressure-retaining components. Please explain how these considerations are addressed. If these considerations are addressed solely by the IDP, explain how this is communicated to the IDP and what guidance is available for the IDP.

EPRI response to 4a:

See the response for RAI 2b for assessment of seismic considerations and other hazards.

For all stations, shutdown risk is evaluated consistent with NUMARC 91-06 (ML14365A203) with a focus on protecting decay heat removal defense in depth. In the enhanced methodology, any pressure boundary failure that could fail a safety function is considered HSS per the specific criteria: Criterion 1 (reactor pressure boundary), Criterion 2 (applicable portions of the shutdown cooling pressure boundary function), Criterion 5 (loss of ultimate heat sink), Criterion 6 (loss of ECCS), Criterion 7 (loss of secondary cooling in a PWR), Criterion 8 (loss of CCW in a PWR) and Criterion 9 (heat exchangers that interface with RCS). These systems are relied upon during shutdown conditions and also for decay heat removal. Hence, the guidance sufficiently covers specific losses of safety functions that could impact shutdown operations.

RAI 05 - Plant Design Scope for Methodology

Background/Issue: EPRI TR 3002025288 states that plant-specific 10 CFR 50.69 system categorization was verified for robustness through evaluation of several boiling water reactor (BWR) and pressurized water reactor (PWR) plants. This group of plants is described as consisting of multiple designs and "included earlier-vintage and later-vintage designs." No basis is given for the generic applicability of the EPRI TR to other designs, including ones not yet designed. No limitation is presented in the report regarding which designs the report may be applied.

EPRI clarified, during the audit, that the methodology was not verified for designs such as the NuScale US600 or Westinghouse AP1000. The NRC staff needs this clarified on the docket.

Requests:

a. If the methodology was not meant to include such designs, or other future PWR and BWR designs, provide revisions limiting the use of the methodology to the designs for which it was verified.

b. If the methodology is meant to include designs other than those evaluated, clarify how this was verified and how it is controlled within the methodology.

EPRI response to 5a&b:

The methodology in TR 3002025288 is limited to plants currently or previously licensed via the 10 CFR 50 framework and plants with renewed licenses under the 10 CFR 54 framework. Because the basis of the methodology in TR 3002025288 is built on Generation II plant designs (i.e., not including NuScale US600 or Westinghouse AP1000), it has not been verified for extended applicability to such designs (which does not imply a verification may not be performed in the future for applicability – only that the methodology in TR 3002025288, at this stage, is not intended for use beyond the currently or previously licensed plants under 10 CFR 50 and/or 10 CFR 54.

To fully address the staff's comments, the last paragraph of Section 1 (Introduction) is expanded to include:

To that end, this report provides an enhanced approach for categorizing pressure boundary components for use in 10 CFR 50.69 applications. This methodology is based on decades of experience with risk-informing the pressure boundary, currently focused on plants licensed under 10 CFR 50 and plants with renewed licenses under 10 CFR 54. The methodology in this report is not currently applicable beyond the scope of plants for which the existing experience was used as part of the basis for methodology development.

RAI 06 - Clarification for Required Prerequisite Programs to the Methodology

Background/Issue: EPRI TR 3002025288 includes, in Section 4.1, that “robust program[s]” for localized corrosion, flow accelerated corrosion (FAC), and erosion must be ensured before implementing the categorization in Section 4.2 of the methodology. The necessary quality and effectiveness of such programs is verified through, “self-assessment, benchmarking, or peer review” for localized corrosion; and reference to EPRI reports for FAC and erosion. The descriptions include optional language such as “should.”

During the audit EPRI provided an example “application” that relied on referencing individually identified EPRI guidance documents and an NEI bulletin. Further, it was clarified that applicants changing their programs may fall outside of the methodology, despite this not being explicitly controlled in the methodology. The NRC staff needs this clarified on the docket.

Requests:

a. It is unclear within the methodology whether an applicant must meet the descriptions of the three programs or what alternatives would be acceptably similar. Clarify how this should be determined and whether optional elements of the descriptions (those including language like “should”) are genuinely optional.

EPRI response to RAI 6a:

In order to use the enhanced passive categorization methodology, a licensee must have programs that address localized corrosion, flow-accelerated corrosion, and erosion that follow the guidance and recommendations contained in TR 3002025288 or identify alternatives that would be described in a plant-specific LAR.

b. On what basis are the cited programs, or alternatives chosen by an applicant, determined to be sufficiently “robust,” and what would constitute an indication that these programs were insufficiently robust in implementation or due to future alterations?

EPRI response to 6b:

Programs utilizing the integrity management guidance cited in TR 3002025288 have been developed over the past 20 years. These programs are well established and grounded in operating experience, an understanding of degradation mechanisms, and how the degradation can evolve over time and the factors (e.g. material, environment) that influence that evolution.

This guidance has been peer reviewed by US and international industry subject matter experts and is updated as additional operating experience is obtained and response strategies (e.g. online monitoring versus periodic NDE) evolve.

In addition, each of these integrity management programs is regularly assessed via NRC inspections (Inspection Procedure 49001 (Inspection of Erosion-Corrosion-Flow-Accelerated Corrosion Monitoring Programs), Inspection Procedure 93810 (Service Water System Operational Performance Inspection), and Inspection Procedure 71002 (License Renewal Inspection), etc.) that provide continued assurance the programs are being sufficiently implemented and maintained to manage these degradation mechanisms.

During the March 6, 2025 public meeting, a question was asked regarding if CDF/LERF risk insights are considered in any of these integrity management programs to determine inspections, monitoring, etc., or are these programs based strictly on degradation mechanism susceptibility. In general, inspection and monitoring requirements for these programs are determined and implemented based primarily on degradation mechanism susceptibility. However, consequence of failure is also considered in the evaluation process in some cases, such as small-bore piping ($\leq$2 inches) susceptible to FAC. To further clarify, a note has been added in Section 4.1.2 of TR 3002025288 stating that "CDF/LERF risk insights alone should not be used to relax testing/inspection/monitoring of highly susceptible locations."

As stated in TR 3002025288, the licensee(s) must have living programs that address localized corrosion, flow-accelerated corrosion, and erosion that follow the guidance and recommendations contained in TR 3002025288 or identify alternatives that would be described in a plant-specific LAR.

An example is provided below that demonstrates how conformance with the Prerequisite 2 integrity management requirement to have robust programs in place that address (i) localized corrosion, (ii) flow-accelerated corrosion, and (iii) erosion could be met.

(i) Localized Corrosion: Plant X has programs that address localized corrosion (e.g., pitting and microbiologically influenced corrosion). The programs follow the guidance in the following EPRI technical reports:

- *Service Water System Corrosion and Deposition Sourcebook* (TR-103403),
- *Engineering and Design Considerations for Service Water Chemical Addition Systems* (3002003190),
- *Guide for the Examination of Service Water System Piping* (TR-102063),
- *Service Water Piping Guideline* (1010059), and
- *Recommendations for an Effective Program to Control the Degradation of Buried and Underground Piping and Tanks* (3002018352) which is an update to 1016456

Therefore, Plant X meets the prerequisite to have a robust program that addresses localized corrosion.

(ii) Flow-Accelerated Corrosion (FAC): Plant X follows the guidance in the industry standard document, EPRI 3002000563 (NSAC 202L-R4, *Recommendations for an*

Effective Flow-Accelerated Corrosion Program). Additionally, the FAC programs implement the use of standardized health reporting that is consistent with those developed out of NEI Efficiency Bulletin 16-34, "Streamline Program Health Reporting."

Therefore, Plant X meets the prerequisite to have a robust program that addresses FAC.

(iii) Erosion: Erosion in FAC-susceptible systems is addressed by the FAC Program. Erosion in non-FAC susceptible systems is addressed by the respective system owner unless another program (such as GL 89-13) addresses erosion in a particular system. Inspections are selected based on plant experience and engineering judgment and are performed and analyzed in accordance with the guidance in EPRI 3002023786 (*Recommendations for an Effective Program Against Erosive Attack: Revision 1).*

c. The methodology does not explicitly require that these programs continue after implementation of the methodology.

  1. How is this controlled in the methodology if these programs were discontinued or modified?

  2. How would an applicant referencing this methodology determine whether modifications supported a sufficiently robust program?

EPRI response to 6c:

As stated in Section 4.1 of TR 3002025288, licensees must ensure the integrity management prerequisite for having robust programs for localized corrosion, flow-accelerated corrosion, and erosion have been met before implementing the categorization process described in Section 4.2. If any of these integrity management programs are discontinued or modified such that this prerequisite is no longer fulfilled, then application of the categorization process using this enhanced passive methodology is not allowed.

To clarify this, an additional concluding paragraph in Section 4.1.2 of TR 3002025288 has been added to confirm that integrity management programs are expected to be maintained:

> *Consistent with 10 CFR 50.69(e) Feedback and Process Adjustment, the licensee is required to review changes to the plant, operational practices, applicable plant and industry operational experience, and, as appropriate, update the PRA and SSC categorization and treatment processes. This requirement equally applies to implementing and maintaining integrity management programs.*

d. The methodology references specific revisions of EPRI reports as necessary "robust" programs. Describe the process of how an applicant using the methodology will do if or when those references were updated?

EPRI response to 6d:

Applicants would need to assess the impact of any updated references on meeting the prerequisite for robust programs via the feedback and adjustment process of 10 CFR 50.69(e). Please see the response to RAI 6c that added additional text on how integrity management programs advancements should be considered.

e. Would the 50.69 categorization need to be revisited if the referenced EPRI reports are revised and/or otherwise become insufficiently robust?

EPRI response to 6e:

Applicants would need to assess the impact of any updated references on meeting the prerequisite for robust programs via the feedback and adjustment process of 10 CFR 50.69(e). Please see the response to RAI 6c that added additional text.

RAI 07 - Reference to Industry Guidance for Quantitative Assessment

Background/Issue: EPRI TR 3002025288 includes, in Section 4.2 under Criteria 11-13, that users should rely on "industry guidance" for a number of risk impacts. It is unclear if NRC review and approval is being sought to generically accept use of unspecified "industry guidance" (examples are given but are not required) as being sufficient for regulatory review of performance of Criteria 13.

During the audit, EPRI stated that this could be clearer to refer to Prerequisite 4.1.1. The NRC staff needs this clarified on the docket.

Requests:

a. Please confirm or clarify if this was the intent.
b. Please clarify what "industry guidance" is meant and for which purpose it is to be used.

EPRI response to 7a&b:

The intent of the paragraph was to state that regardless of whether a pipe segment is determined to be HSS or LSS by criteria 1 through 10, the pipe segment must still be assessed against criterion 11 (to include CDF/LERF and CCDP/CLERP metrics). Criterion 11 uses the plant-specific PRA (internal events and internal flood) to determine if there are any pipe segments that exceed the thresholds provided in criteria 11. The term "industry guidance" in the existing paragraph was intended to reflect the requirements as stated in Prerequisite 4.1.1, in that the plant-specific PRA must be subjected to a peer review assessed against a standard or set of acceptance criteria endorsed by the NRC. This is further clarified by changes to Section 4.2 as follows:

Existing words from section 4.2
For purposes of applying criteria 11–13, the definition of a pipe segment is not a function of whether it was categorized as HSS or LSS according to criteria 1–10. That is, even if a piping segment or a portion of a pipe segment is HSS according to one of the first 10 of the preceding criteria, the impact on risk due to its postulated failure is determined consistent with industry guidance (such as the PRA standard, EPRI 1019194). Also, even if a piping segment or a portion of a pipe segment is LSS according to all of the first 10 criteria, the impact on risk due to its postulated failure is determined consistent with industry guidance.

Changes to section 4.2
For purposes of applying criterion 11, the definition of a pipe segment is not a function of whether it was categorized as HSS or LSS according to criteria 1–10. That is, even if a piping segment or a portion of a pipe segment is HSS according to one of the first 10 of the preceding criteria, the impact on risk due to its postulated failure is determined using the plant-specific PRA (see Prerequisite 4.1.1). Also, even if a piping segment or a portion of a pipe segment is LSS according to the first 10 criteria, the impact on risk due to its postulated failure is determined using the plant-specific PRA (see Prerequisite 4.1.1).

RAI 08 - Clarification of Reactor Coolant Boundary Categorization

Background/Issue: EPRI TR 3002025288 Criteria 1 differentiates components based on whether the components can be isolated from the reactor coolant system by two valves in series. Table 3, "HSS criteria: considerations", amends this to note that the piping between these two valves may be medium/low consequence. It is unclear how a valve whose function is dependent on a lower classification can retain a higher classification function as a matter of categorization.

During the audit EPRI stated that this could have been more clearly worded and provided a proposed revision. The NRC staff needs this clarified on the docket.

Requests:

a. Submit the proposed revision, similar equivalent, or otherwise clarify why such is not needed.

EPRI response to 8a:

The proposed revision is as follows:

This is a conservative portrayal of the safety significance of some of the Class 1 components, as experience using the existing methodology has shown that the Class 1 piping between the first and second isolation valve is typically a low consequence rank (e.g., CCDP less than 1E-06). In this enhanced methodology, all Class 1 components are categorized as HSS regardless of risk information.

RAI 09 - Sensitivity Calculation to Account for Uncertainty

Background/Issue: EPRI TR 3002025288 section 4.3 states that analysis using a factor of 3 reduction in reliability for systems categorized as RISC-3 is conservative and appropriate, citing NEI 00-04. It is unclear why this factor is conservative and appropriate in the reversed context of this methodology, where components are presumed LSS by default, in contrast to the traditional 50.69 methodology which presumes components are HSS by default. Notably, the proposed methodology is relatively simplified compared to the traditional use of NEI 00-04 for supporting 10 CFR 50.69 applications which includes a relatively fine-grained assessment of subject systems.

NEI 00-04 does not state that a factor of 3 is appropriate, rather it provides a range of values useful in conducting sensitivity studies of an analysis. No basis is given for this range in NEI 00-04 beyond that it would provide “trend” insights for the consequences of reductions in reliability due to reduced treatments. The factor of 3 is generally used when assessing sensitivity to uncertainty as it is an approximation of the likely “tail” of a distribution for active systems. When altering the general approach (e.g. changing from HSS treatment to LSS treatment for passive systems), it is unclear why it is reasonable to assess the future distribution (LSS treatment) as matching the prior distribution (HSS treatment).

Addressing this uncertainty is particularly important in the context of other relaxations in treatment that may occur due to changes in ASME code requirements, for example, that may be implemented separately and concurrently with this methodology. This is particularly important in understanding whether the factor chosen genuinely informs regarding uncertainties in the context of passive systems and the performance monitoring associated with such.

The NRC staff needs a justification of the use of a factor of 3 provided on the docket.

Requests:

a. Clarify on what basis a factor of 3 is determined to be conservative. In particular, provide any operating experience meta-analysis and/or data distributions supporting that a factor of 3 is conservative, or realistic for passive systems.

EPRI response to 9a:

As noted in response to RAI 1, passive components with low frequency / high consequence events are more robustly treated by expanding the risk criteria that are categorized as HSS. Passive components/pipe segments are HSS if any of the following are met from plant-specific review of the PRA, including (new criteria are bolded):

- CDF is greater than 1E-06/year, or
- LERF is greater than 1E-07/year, or
- **CCDP is greater than 1E-02, or**
- **CLERP is greater than 1E-03.**

After going through the process in TR 3002025288, the RISC-3 segments would have been determined to be low safety significant and not risk-significant by multiple steps and assessments that include the above limit as well as other considerations to ensure an inappropriate categorization is avoided (e.g., applying an LSS categorization for segments that would be HSS if the process was properly applied). In addition, for segments that are candidate

RISC-3, the failure rate is increased by a factor of 3, to provide insights on the *potential* trend in CDF and LERF. As discussed in the answer to RAI 3(a), the factor of 3 has been applied in approximately 70 approved 10 CFR 50.69 licensee applications to date.

As stated in NEI 00-04, Section 8.1, the purpose of utilizing a factor of 3 is that it *could* provide an indication of the potential trend in CDF and LERF, *if* there were a degradation in the performance of all RISC-3 SSCs. Such degradation is extremely unlikely for an entire group of components. It is even more remote for implementation of TR 3002025288 in that the prerequisites that must be implemented as part of the enhanced methodology has shown that these programs coupled with licensees' corrective action programs would see a rise in failure events and corrective actions would be taken long before even a small population of RISC-3 items see degradation, let alone the entire population of RISC-3 items experienced such degradation. As such, while there is some possibility that an individual item could see variations in performance on this order, it is exceedingly unlikely that the performance of a large group of items would all shift in an unfavorable manner at the same time.

As stated in TR 3002025288, the supplemental information packages previously provided to NRC staff, public meetings held with NRC on the enhanced methodology, and numerous other industry / NRC interactions (e.g., docketed licensee submittals, public meetings, ACRS meetings, etc.) it is expected that RISC-3 components will not see an increase in failure rates. This expectation is supported by the fact that 10 CFR 50.69(d)(2) requires that the license ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that alternate treatment, if applied, be consistent with the categorization process.

In summary, utility corrective action programs would see a substantial rise in failure events and corrective action would be taken long before an entire population experienced such degradations in performance (as stated in NEI 00-04; see for example Section 12.4). If performance degradation is observed, the licensee is required to adjust the categorization or alternate treatments so that the categorization and results are maintained and valid.

To provide further context, an example was selected from Appendix A-1 (PWR Service Water Data Tables) of EPRI 3002024904, "Pipe Rupture Frequencies for Internal Flooding Probabilistic Risk Assessments: Revision 5," for 4-inch, 10-inch and 24-inch pipe sizes that represent spray and double ended guillotine breaks. A comparison table is provided below between an increased mean value multiplied by a factor (i.e., failure rates increased by factor of 3) and a 95% confidence level for such piping. The results are shown below the 95th percentile of the uncertainty distribution which has been used in sensitivity analyses. Note that the table below does not include the resulting impact to the plant due to a piping failure (i.e., CCDP). As discussed in earlier RAI responses, there would be additional margin as a limit on CCDP > 0.01 is defined such that HSS is assigned to any segments above this limit – i.e., there will be no change in performance for such segments as they cannot be assigned an LSS categorization).

Pipe Size (in.)	Flow rate @ 70psig[1] (gpm)	EBS (in.)	CBF Mean	RF	95th	3x Mean
4	100	0.63	9.60E-07	10.8	3.64E-06	2.88E-06
4	4503	4.24	7.47E-08	15.3	2.89E-07	2.24E-07
10	100	0.63	3.49E-07	12.3	1.34E-06	1.05E-06
10	18012	8.49	2.08E-08	21.8	7.83E-08	6.23E-08
24	100	0.63	9.75E-08	6.2	3.27E-07	2.93E-07
24	128083	22.63	3.90E-10	54.3	1.11E-09	1.17E-09

ATTACHMENT 2 – MODIFIED DRAFT TR 3002025288

Enhanced Risk-Informed Categorization Methodology for Pressure Boundary Components

3002025288

Final Report, TBD 2025

EPRI Project Manager
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All or a portion of the requirements of the EPRI Nuclear Quality Assurance Program apply to this product. YES NO ✓

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ACKNOWLEDGMENTS

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This report describes research sponsored by EPRI.

EPRI acknowledges the contributions of Jim Chapman who consulted on earlier versions of this report. EPRI would also like to thank Jennifer Varnedoe (Duke Energy) and Carrie Gilbreath (Southern Nuclear) for their input and expertise throughout this process.

This publication is a corporate document that should be cited in the literature in the following manner: *Enhanced Risk-Informed Categorization Methodology for Pressure Boundary Components.* EPRI, Palo Alto, CA: 2025. 3002025288.

ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) amended its regulations to provide an alternative approach for establishing the requirements for treatment of systems, structures, and/or components (SSCs) for nuclear power reactors using a risk-informed method of categorizing SSCs according to their safety significance. The NRC's 10 CFR 50.69 process allows a plant to categorize the safety significance of its SSCs using a robust categorization process defined in Nuclear Energy Institute's NEI 00-04, *10 CFR 50.69 SSC Categorization Guideline,* as endorsed by the NRC in Regulatory Guide 1.201. The risk-informed categorization process helps focus attention on SSCs that are the most important to plant safety while allowing increased operational flexibility for less important SSCs. As experience has been gained with 10 CFR 50.69 categorization efforts, questions have arisen as to whether the existing methodology for pressure boundary components is excessively conservative and/or overly resource-intensive relative to the value of insights developed.

This report is an update to 3002025288 (published June 2023). This report incorporates technical updates based on EPRI's submittal into the topical review process, audit, and request for additional information (RAI).

Objective

- To develop an enhanced methodology for categorizing pressure boundary components in support of 10 CFR 50.69 applications

Approach

EPRI initiated an effort to assess the existing methodology to determine if it was indeed excessively conservative and/or overly resource-intensive. This effort included assessment of the existing process, looking for excess conservatism or steps that were overly time-consuming given the level of insights obtained. We investigated whether additional guidance could be developed or enhanced by training, or if the existing process could be modified to address known issues. Based on the results of the investigations, an enhanced and streamlined approach for categorizing pressure boundary components was proposed.

Results

An enhanced methodology has been developed that provides several advantages over the existing approach for categorizing pressure boundary components. These include improvements in plant safety, reduced cost of categorization, and greater stability in the overall process.

Keywords

10 CFR 50.69 Passive categorization
Pressure boundary categorization
Risk-informed categorization

EXECUTIVE SUMMARY

Deliverable Number: 3002025288

Product Type: Technical Report

Product Title: Enhanced Risk-Informed Categorization Methodology for Pressure Boundary Components

Primary Audience: Individuals responsible for developing and implementing 10 CFR 50.69 programs

Secondary Audience: Individuals responsible for performing categorization using the 10 CFR 50.69 process

KEY RESEARCH QUESTION

Can an alternative process be developed to streamline the 10 CFR 50.69 categorization process for pressure boundary components?

RESEARCH OVERVIEW

The existing methodology for categorizing pressure boundary components was assessed to determine if there were improvement opportunities. This effort included assessment of the existing process, looking for excess conservatism and steps that were overly time-consuming given the level of insights obtained. Investigations were conducted into whether additional guidance or enhanced training could be developed or whether modification to the existing process could address the issue. Depending on the results of the investigations, the potential for developing a new and streamlined approach for categorizing pressure boundary components would also be investigated.

KEY FINDINGS

- It was determined that an enhanced methodology for categorizing pressure boundary components can be developed.
- The enhanced categorization methodology can be applied in a manner that reduces the cost of implementing 10 CFR 50.69 compared with the existing process.
- The enhanced categorization methodology also provides safety improvements that can be readily and cost-effectively identified and implemented.

- Because the enhanced categorization methodology identifies high-safety-significant and low-safety-significant (LSS) components upfront, plant-specific application of alternative treatment to LSS components is significantly improved. For example:
  - Emergent issues on LSS components can be responded to more quickly compared to waiting for each individual system to be categorized.
  - Capital project planning will know in advance which components are LSS and therefore available for alternative treatment.

WHY THIS MATTERS

The new, enhanced categorization process for pressure boundary components will reduce the cost of implementing a 10 CFR 50.69 program as compared with the existing categorization process. The new process will improve plants' ability to implement alternative treatment (that is, cost reductions) on LSS components by saving calendar time in conducting the categorizations, thereby allowing more flexibility in responding to emergent issues, and by allowing for more long-term planning. The new enhanced categorization process will also allow plants to more cost-effectively improve plant safety as compared to the existing categorization process.

HOW TO APPLY RESULTS

Plants should compare their applicable plant programs to the prerequisites identified in Section 4.1. Once these prerequisites are confirmed to have been met, plants can implement the methodology contained in Section 4.2. Note: Applicable licensee interactions with the plant's respective regulator might be required.

LEARNING AND ENGAGEMENT OPPORTUNITIES

- Periodic workshops on 10 CFR 50.69 related topics are being held.

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PROGRAMS: Nuclear Power, P41, and Risk and Safety Management, P41.07.01

IMPLEMENTATION CATEGORY: Reference

ACRONYMS AND ABBREVIATIONS

AFW	auxiliary feedwater
ANO	Arkansas Nuclear One
ASME	American Society of Mechanical Engineers
BWR	boiling water reactor
CCDP	conditional core damage probability
CCW	component cooling water
CDF	core damage frequency
CFR	Code of Federal Regulations
CLERP	conditional large early release probability
CR	control room
CST	condensate storage tank
CVCS	chemical and volume control system
DID	defense in depth
ECCS	emergency core cooling system
EFW	emergency feedwater
FAC	flow-accelerated corrosion
HELB	high-energy line break (synonymous with *break exclusion region*)
HPCS	high-pressure core spray
HSS	high-safety-significant
HVAC	heating, ventilation, and air conditioning
IDP	integrated decision-making panel
IF	internal flooding
IPEEE	individual plant examination of external events
LAR	license amendment request

LERF	large early release frequency
LOCA	loss-of-coolant accident
LSS	low-safety-significant
MOV	motor-operated valve
NDE	nondestructive evaluation
NEI	Nuclear Energy Institute
NNS	nonnuclear safety
NPS	nominal pipe size
NRC	U.S. Nuclear Regulatory Commission
PRA	probabilistic risk assessment
PWR	pressurized water reactor
RAW	risk achievement worth
RCS	reactor coolant system
RCPB	reactor coolant pressure boundary
RG	Regulatory Guide (NRC)
RI-ISI	risk-informed in-service inspection
RI-RRA	risk-informed repair/replacement activities
RISC-1	risk-informed safety classification 1 (HSS and safety related)
RISC-2	risk-informed safety classification 2 (HSS and non-safety related)
RISC-3	risk-informed safety classification 3 (LSS and safety-related)
RISC-4	risk-informed safety classification 4 (LSS and non-safety-related)
RPV	reactor pressure vessel
RWST	refueling water storage tank
SP	suppression pool
SSC	system, structure, and/or component
UHS	ultimate heat sink

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) amended its regulations to provide an alternative approach for establishing the requirements for treatment of systems, structures, and/or components (SSCs) for nuclear power reactors using a risk-informed method of categorizing SSCs according to their safety significance. The 10 Code of Federal Regulations (CFR) 50.69 process [1] allows a plant to categorize SSCs according to their safety significance. A categorization process defined in Nuclear Energy Institute (NEI) 00-04 Rev. 0, *10 CFR 50.69 SSC Categorization Guideline* [2], has been endorsed, with clarifications by the NRC in Regulatory Guide (RG) 1.201 [3]. The risk-informed categorization process helps focus attention on SSCs that are the most important to plant safety while allowing increased operational flexibility for less important SSCs.

The process defined in NEI 00-04 requires that all functions supported by the SSCs be categorized. With respect to categorization of SSCs having only a pressure-retaining function or the pressure-retaining function of active components, NEI 00-04 recommends using the process in American Society of Mechanical Engineers (ASME) Code Case N-660, “Risk-Informed Safety Classification for Use in Risk-Informed Repair/Replacement Activities” [4]. However, industry experience using N-660 identified the process as impractical, and it was determined that additional guidance needed to be developed. To that end, Arkansas Nuclear One (ANO), Unit 2, volunteered to be an industry pilot plant demonstrating an updated methodology for categorizing pressure boundary components (that is, risk-informed repair/replacement activities [RI-RRA] methodology) [5, 6]. In this method, the component failure is assumed with a probability of 1.0, and only the consequence evaluation is performed. This methodology also applies deterministic considerations consistent with risk-informed decision-making principles (for example, defense in depth [DID] and safety margins) in determining the final safety significance of the component. This method was initially approved for use in 10 CFR 50.69 applications by the NRC in the final safety evaluation for Vogtle Units 1 and 2, dated December 17, 2014 [7]. Since then, each applicant for a 10 CFR 50.69 license amendment request (LAR) has used this process for categorizing pressure boundary components.

As a broader cross-section of the industry has gained experience, questions have arisen as to whether the existing methodology is too conservative and/or too resource-intensive for the level of insights developed. In response, the Electric Power Research Institute (EPRI) initiated an effort to assess the existing methodology to determine if it was indeed producing overly conservative results or requiring excessive resources.

This report is an update to 3002025288 (published June 2023). This report incorporates technical updates based on EPRI’s submittal into the topical review process, audit, and request for additional information (RAI). The following shows a timeline of the process:

- On August 17, 2023 EPRI submitted 3002025288 as a topical report (ML23234A266)
- Supplementary information was provided on November 30, 2023 (ML23334A210)

- EPRI supported NRC public meetings prior to acceptance in both February 2024 (ML24054A006) and April 2024 (ML24117A279).
- EPRI provided supplementary information June 28, 2024 (ML24180A01)
- Topical report acceptance was received on July 19, 2024 (ML23352A054)
- The enhanced passive methodology underwent an NRC audit starting September 2024 through January 2025 (ML24241A173)
- The RAIs were issued to EPRI on January 14, 2025 (ML24352A481)
- EPRI support additional public meetings in March 2025 (NRC slides under ML25054A001 and EPRI slides under ML25060A001) and in April 2025 (ML25092A071)
- EPRI provided a formal response to the RAIs (ML number TBD).

To that end, this report provides an enhanced approach for categorizing pressure boundary components for use in 10 CFR 50.69 applications. This methodology is based on decades of experience with risk-informing the pressure boundary, currently focused on plants licensed under 10 CFR 50 and plants with renewed licenses under 10 CFR 54. The methodology in this report is not currently applicable beyond the scope of plants for which the existing experience was used as part of the basis for methodology development.

2 10 CFR 50.69 CATEGORIZATION

2.1 10 CFR 50.69 Categorization Process

Rev. 0 of NEI 00-04 [2], as endorsed in RG 1.201 [3], is one acceptable method for conducting a risk-informed categorization of SSCs that provides evidence and confidence that SSCs will be categorized in a robust and integrated process consistent with 10 CFR 50.69(c)(1)(iv) [1]. The categorization process is performed for entire systems, one or more systems at a time, to ensure that all functions (which are primarily a system-level attribute) for a given component within a given system are appropriately considered.

The process described in NEI 00-04 and illustrated in Figure 1 contains several key elements, which are described in detail in the EPRI report *10 CFR 50.69 Categorization Guidance Document* [8] and summarized as follows:

- Full-power internal events probabilistic risk assessment (PRA)
- Internal and external hazards
- Seven qualitative criteria in Section 9.2 of NEI 00-04
- DID assessment
- Passive categorization methodology

These elements are used to arrive at a preliminary component categorization (that is, high-safety-significant [HSS] or low-safety-significant [LSS]).

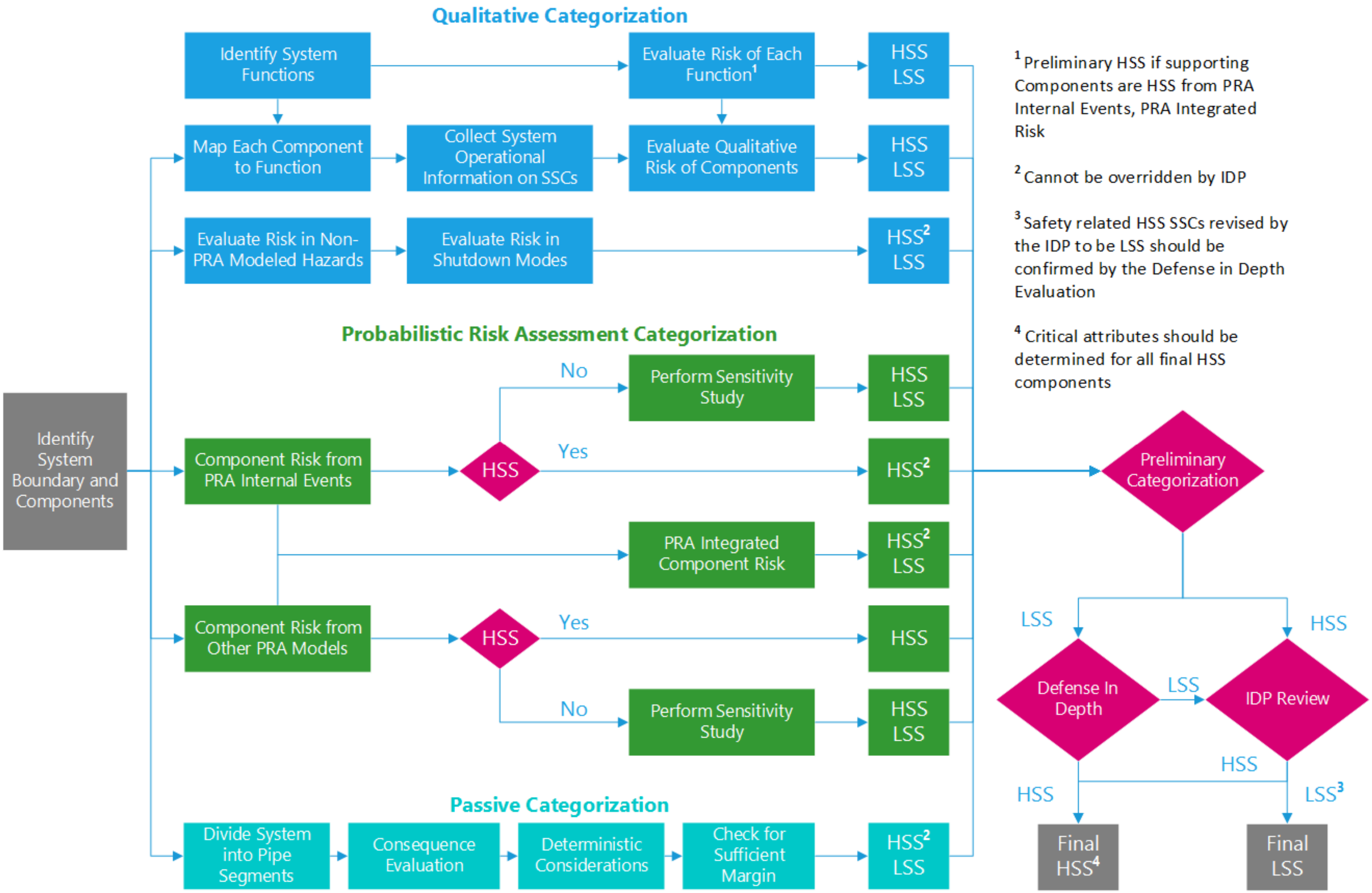


Figure 1
Categorization process overview [2]

The analyses that can be used to address the hazards in the first two items in the preceding list include:

- **Internal event risk analysis**. Full-power internal events PRA, including internal flooding (IF).
- **Internal fire events**. EPRI Fire-Induced Vulnerability Evaluation [9] screening process or fire PRA.
- **Seismic events**. A success path component list (a term used interchangeably in many seismic individual plant examination of external events [IPEEE] documents with *safe shutdown equipment list*) from an IPEEE seismic margin analysis, seismic PRA, or screening if the seismic PRA's core damage frequency (CDF) is a small fraction of the internal events CDF (that is, <1%).
- **Other external events** (for example, tornados and external floods). External (hazard) PRA model and/or IPEEE screening process.
- **Low power and shutdown risks**. Qualitative DID shutdown model for shutdown configuration risk management based on the framework for DID in NUMARC 91-06, "Guidance for Industry Actions to Assess Shutdown Management" [10].

With respect to the seven qualitative criteria in Section 9.2 of NEI 00-04, the purpose of these considerations is to determine whether these functions/SSCs are not implicitly depended on to maintain safe shutdown capability, prevent core damage, and maintain containment integrity. Specifically, consideration is given to whether:

- Failure of the active function/SSC will not directly cause an initiating event that was originally screened out of the PRA based on an anticipated low frequency of occurrence.
- Failure of the active function/SSC will not cause a loss of reactor coolant pressure boundary (RCPB) integrity resulting in leakage beyond normal makeup capability.
- Failure of the active function/SSC will not adversely affect the DID remaining to perform the function.
- The active function/SSC is not called out or relied on in the plant emergency/abnormal operating procedures or similar guidance as the sole means for the successful performance of operator actions required to mitigate an accident or transient.
- The active function/SSC is not called out or relied on in the plant emergency/abnormal operating procedures or similar guidance as the sole means of achieving actions for ensuring long-term containment integrity, monitoring of post-accident conditions, or offsite emergency planning activities.
- Failure of the active function/SSC will not prevent the plant from reaching or maintaining safe shutdown conditions, and the active function/SSC is not significant to safety during mode changes or shutdown.

- Failure of the active function/SSC that acts as a barrier to fission product release during plant operation or severe accidents would not result in the implementation of offsite radiological protective actions.

As covered in Sections 6 and 9 of NEI 00-04 [2], in cases where the component is safety-related and found to be of low risk significance, it is appropriate to confirm that DID is preserved. This includes consideration of the events mitigated, the functions performed, the other systems that support those functions, and the complement of other plant capabilities that can be relied on to prevent core damage and large, early release. Specific criteria are provided for assessing core damage DID, including preventing core damage and limiting the frequency of the events being mitigated (see NEI 00-04, Section 6.1) as well as containment DID, including containment bypass, containment isolation, early hydrogen burns, and long-term containment integrity (see NEI 00-04, Section 6.2).

According to NEI 00-04, DID is maintained if the following occurs:

- A reasonable balance is preserved among prevention of core damage, prevention of containment failure or bypass, and mitigation of consequences of an offsite release.
- There is no overreliance on programmatic activities and operator actions to compensate for weaknesses in the plant design.
- System redundancy, independence, and diversity are preserved commensurate with the expected frequency of challenges, consequences of failure of the system, and associated uncertainties in determining these parameters.
- The risk analysis categorization considers the potential for common-cause failures.
- The overall redundancy and diversity among the plant's systems and barriers is sufficient to ensure that no significant increase in risk would occur.

Finally, using the existing process, pressure boundary components (that is, passive components and the passive function of active components) are evaluated using a consequence assessment approach where the component failure is assumed with a probability of 1.0 and only the consequence evaluation is performed. It relies on the conditional core damage and large early release probabilities associated with postulated ruptures. Compared to including the rupture frequency in the categorization, this approach is conservative because it does not take into account the hazard frequency. Deterministic considerations (for example, DID and safety margins) are then also applied to determine the final safety significance from a passive perspective. Component supports are assigned the same safety significance as the highest passively ranked component within the bounds of the associated analytical pipe stress model.

By following the process described in the preceding, the safety significance determined through the various elements previously identified is considered to provide a robust and integrated categorization of SSCs. The results of these elements are used as inputs to arrive at a preliminary component categorization (that is, HSS or LSS) that is then presented to the integrated decision-making panel (IDP), a multidisciplinary panel of experts who review the results of the initial categorization and finalize the categorization of the SSCs/functions. Note that the terms *preliminary HSS* and *preliminary LSS* are synonymous with the NEI 00-04 terms *candidate HSS* and *candidate LSS*. A component or function is preliminarily categorized as HSS if any element of the process results in a preliminary HSS determination in accordance with Table 1. Consistent with NEI 00-04, the categorization of a component or function will be *preliminary* only until it has been confirmed by the IDP. Once the IDP confirms that the categorization process was followed appropriately, the final risk-informed safety classification (RISC) can be assigned.

Table 1
IDP changes from preliminary HSS to LSS

Element	Categorization Step—NEI 00-04 Section	Evaluation Level	IDP Change HSS to LSS	Drives Associated Functions
Risk (PRA modeled)	Internal Events Base Case—Section 5.1	Component	Not allowed	Yes
	Fire, Seismic, and Other External Events Base Case		Allowable	No
	PRA Sensitivity Studies		Allowable	No
	Integral PRA Assessment—Section 5.6		Not allowed	Yes
Risk (non-modeled)	Fire, Seismic and Other External Hazards	Component	Not allowed	No
	Shutdown—Section 5.5	Function/ component	Not allowed	No
DID	Core Damage—Section 6.1	Function/ component	Not allowed	Yes
	Containment—Section 6.2	Component	Not allowed	Yes
Qualitative criteria	Considerations—Section 9.2	Function	Allowable	N/A
Passive	Passive—Section 4	Segment/ component	Not allowed	No

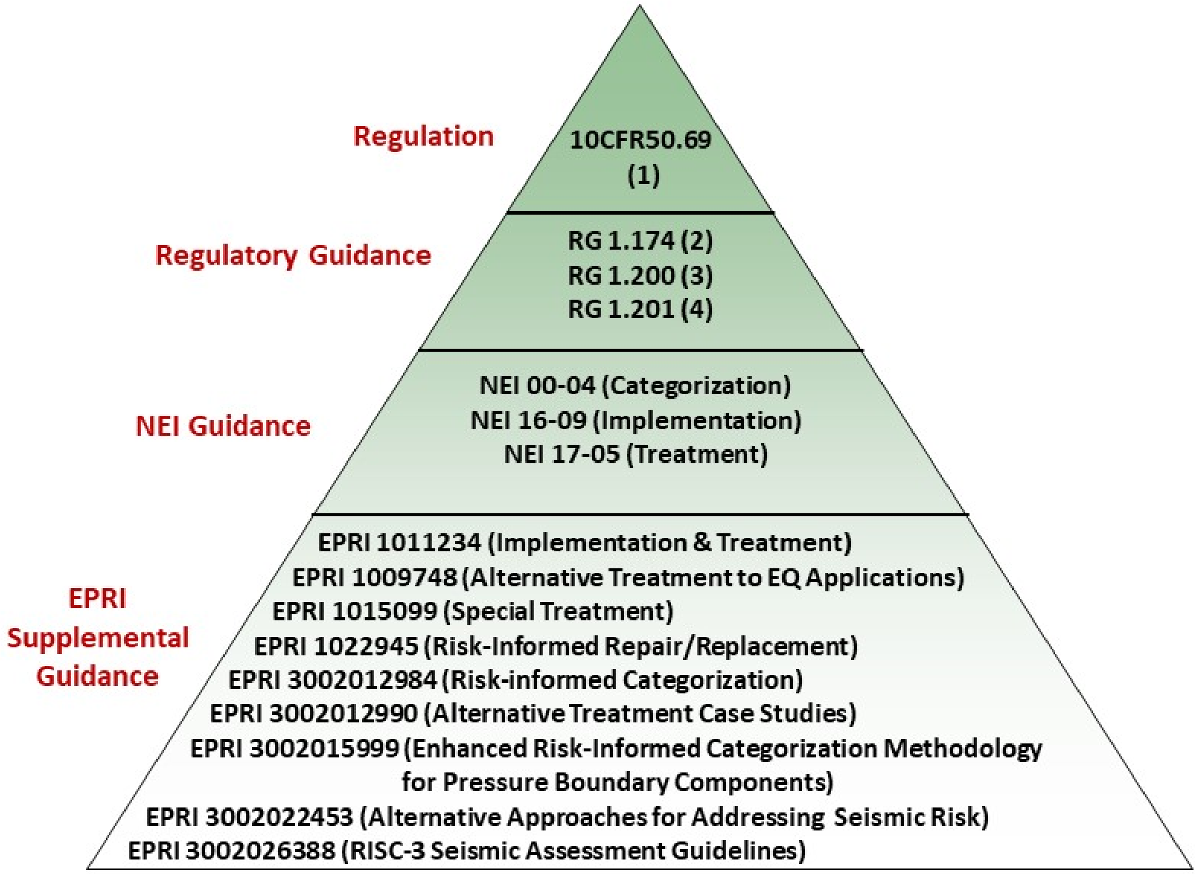
The IDP can direct and approve detailed categorization of components in accordance with NEI 00-04, Section 10.2. The IDP can always elect to change a preliminary LSS component or function to HSS; however, the ability to change component categorization from preliminary HSS to LSS is limited. This ability is available to the IDP only for select process steps as described in NEI 00-04 [2] and endorsed by RG 1.201 [3]. Table 1 summarizes these IDP restrictions in NEI 00-04. The steps of the process are performed at the level of the function, component, or both. This is also summarized in Table 1. A component is assigned its final RISC category on approval by the IDP.

As a final note relative to the purpose of this report, the NEI 00-04 section on integrated risk assessment includes the following:

> Each risk contributor is initially evaluated separately in order to avoid reliance on a combined result that may mask the results of individual risk contributors. The potential masking is due to the significant differences in the methods, assumptions, conservatisms and uncertainties associated with the risk evaluation of each. In general, the quantification of risks due to external events and non-power operations tend to contain more conservatisms than internal events, at-power risks. As a result, performing the categorization simply on the basis of a mathematically combined total CDF/large early release frequency (LERF) would lead to inappropriate conclusions. However, it is desirable in a risk-informed process to understand safety significance from an overall perspective, especially for SSCs that were found to be safety-significant due to one or more of these risk contributors.

2.2 Relationship to the Rule and Other Guidance Documents

Figure 2 illustrates how this report relates to the 10 CFR 50.69 rule [1] and other guidance documents. Requirements for implementing risk-informed categorization and treatment of SSCs are described in 10 CFR 50.69 [1], the adoption of which is voluntary. The rule provides requirements for both phases of implementation—categorization and the resulting treatment allowances.



Notes:

(1) "50.69 Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors"
(2) "An approach for using probabilistic risk assessment in risk-informed decisions on plant-specific changes to the licensing basis"
(3) "An approach for determining the technical adequacy of probabilistic risk assessment results for risk-informed activities"
(4) "Guidance for categorizing structures, systems and components in nuclear power plants according to their safety significance"

Figure 2
Relationship with the 10 CFR 50.69 rule and other guidance documents

3 OPTIONS EVALUATED AND KEY INSIGHTS AND CONSIDERATIONS

As previously explained, some plants have chosen to voluntarily adopt 10 CFR 50.69 categorization efforts as part of an effort to increase operational and licensing efficiencies. As more plants have gained experience with the categorization process under 10 CFR 50.69, questions have arisen as to whether the existing methodology for categorizing pressure boundary components is too conservative and/or too resource-intensive given the level of insights developed. In response to this question, EPRI initiated an effort to assess the existing methodology to determine if it was indeed producing overly conservative results or requiring excessive resources. Based on the results of the investigations, an enhanced and streamlined approach for categorizing pressure boundary components was proposed.

This section briefly lists the options considered in addressing this industry need and provides insights into the decision to develop a new enhanced categorization process for pressure boundary components. In Table 2, each option is identified with a number, title, and description. The strength and challenge/limitation for each option is then summarized. Finally, a conclusion/recommendation is provided.

Table 2
Summary of options considered

	Title	Description	Strengths	Limitations/Challenges	Initial Assessment
1	Streamline existing process				
1A	Treatment of standby systems	Streamline the existing process by providing additional direction/criteria for assessing the impact of failure of standby systems.	• Collapses medium, low, and no consequence ranks into one bin. • Addresses skill set issue by removing some confusion. • Does not require NRC interaction.	• Still needs to assess spatial effects. • Still needs a standalone assessment of standby system (that is, not extracted from existing PRA model/ documentation). • Does not address primary concerns (for example, resource requirements, conservatisms).	Minor cost savings and complexity reduction. Recommendation would be to enhance guidance.
1B	Clarify additional considerations	Add guidance and clarifications, with examples.	• Minimizes confusion. • Does not require NRC interactions.	• Still needs to address questions that do not typically provide much value (for example, LSS to HSS). • Does not address primary concerns (for example, resource requirements, conservatisms).	Minor cost saving and complexity reduction.
1C	Modify additional considerations	Modify and possibly delete some questions.	• Minimizes confusion. • Focuses remaining questions on areas that will move LSS to HSS.	• Does require NRC interactions. • Does not address primary concerns (for example, resource requirements, conservatisms).	Minor cost saving and complexity reduction.

Table 2 (continued)
Summary of options considered

	Title	Description	Strengths	Limitations/Challenges	Initial Assessment
1D	Clarify guidance for addressing shutdown	Additional guidance/ examples that highlight when shutdown aspects would drive LSS to HSS (not expected to be often).	• Minor resource and confusion savings. • Does not require NRC interactions.	Does not address primary concerns (for example, resource requirements, conservatisms).	Minor cost saving and complexity reduction.
2	Develop basis for eliminating the evaluation of shutdown	Develop a basis for showing that other plant activities are in place that control shutdown risk irrespective of an SSC's categorization (for example, RISC-1 versus RISC-3).	Minor resource and confusion savings for pressure boundary but potential large overall savings.	Does require NRC interactions.	Some cost saving and confusion reduction.
3	Adapt to more fully align with other risk-informed processes (for example, risk-informed in-service inspection [RI-ISI] process in TR-112657 Rev B-A) [11].	Incorporate failure probability/degradation mechanism process using existing/modified risk matrix. Might require risk categories RC1–RC5 to be HSS.	More realistic than existing RI-RRA process, which is strictly consequence-based.	• Still need to assess spatial effects. • Still need a standalone assessment of standby system. • Need to develop process and basis (for example, degradation mechanisms for non-piping components). • Might need to perform delta risk calculation or sensitivity (NEI 00-04). • NRC interactions required. • Does not address resource requirements concern (could increase resource requirements).	Limited cost savings; will require further efforts.

Table 2 (continued)
Summary of options considered

	Title	Description	Strengths	Limitations/Challenges	Initial Assessment
4	Use of IF PRA				
4A	Use existing IF PRA with no modifications	Use RG 1.200-compliant internal flooding PRA (already a 10 CFR 50.69 LAR requirement) with no modification to NEI 00-04 supplied metrics/ criteria.	• Cheaper and faster. • Few segments show up as high CDF/ LERF contributors.	• Does not address standby system pressure boundary failures (no current technical basis for exclusion). • Existing NEI 00-04 risk metrics will make pressure boundary SSCs HSS (for example, risk achievement worth [RAW]>2.0). • NRC interaction required.	• Requires additional work (for example, metric to use, conducting delta risk analysis). • Would need to assess how this would impact alternative treatment. Currently, assuming a failure probability of 1.0, prospective alternative treatments cannot increase this failure probability. Therefore, there is no need for sensitivity studies with the existing process. • Although few segments typically show up as high CDF/LERF contributors, current metrics/criteria (for example, RAW>2.0) would make many segments HSS (see Westinghouse Commercial Atomic Power-14572). • Could be resource-intensive.

Table 2 (continued)
Summary of options considered

	Title	Description	Strengths	Limitations/Challenges	Initial Assessment
4B	Upgrade IF PRA study to include standby configurations	Upgrade existing IF PRA to address failures of standby system using existing pressure boundary metrics (for example, CCDP/ conditional large early release probability [CLERP]).	• Complete risk-informed evaluation using upgraded PRA model. • Does not require NRC interactions.	• Treatment of standby failures (for example, failure probability versus frequency, exposure time) (see TR-112657). • Large resources and new ground.	Could be resource-intensive.
4C	Upgrade IF PRA study to explicitly address standby configurations and existing NEI 00-04 metrics	Upgrade existing IF PRA to address failures of standby system using NEI 00-04 risk metrics and values (for example, RAW of 2.0).	Complete risk-informed evaluation using upgraded PRA model.	• Treatment of standby failures (for example, failure probability versus frequency, exposure time) (see TR-112657). • Large resources and new ground; requires NRC interaction. • Requires risk sensitivity analysis.	Could be resource-intensive.
4D	Upgrade IF PRA to explicitly address standby configurations and alternative metrics	Upgrade existing IF PRA to address failures of standby system using alternative risk metrics and values (for example, Birnbaum).	Complete risk-informed evaluation using upgraded PRA model.	• Treatment of standby failures (for example, failure probability versus frequency, exposure time) (see TR-112657). • Large resources and new ground; requires NRC interaction. • Requires risk sensitivity analysis. • Requires developing a basis for threshold value.	Resource-intensive.

Table 2 (continued)
Summary of options considered

	Title	Description	Strengths	Limitations/Challenges	Initial Assessment
4E	Upgrade IF PRA to explicitly address standby configurations and absolute risk metric	Upgrade existing IF to address failures of standby system using absolute risk metric (CDF and LERF < X = LSS).	Complete risk-informed evaluation using upgraded PRA model.	• Treatment of standby failures (for example, failure probability versus frequency, exposure time) (see TR-112657). • Large resources and new ground; requires NRC interaction. • Requires risk sensitivity analysis.	Resource-intensive.
4F	Upgrade IF PRA to explicitly address standby configurations and absolute risk metric	Upgrade existing IF to address failures of standby system using absolute risk metric (CDF and LERF < X = LSS) and DID (for example, CCDP/CLERP).	• Complete risk-informed evaluation using upgraded PRA model. • Quantitatively addresses DID.	• Treatment of standby failures (for example, failure probability versus frequency, exposure time) (see TR-112657). • Large resources and new ground; requires NRC interactions. • Requires risk sensitivity analysis.	Resource-intensive.
5	Develop basis and revise break size assumptions	Apply double-ended guillotine break assumption only to applicable systems/ segments (for example, flow-accelerated corrosion [FAC], high-energy line break [HELB] locations). Use something less (for example, half pipe diameter by half pipe wall thickness) for low-energy systems.	• Reduces conservatism in assessing impacts (flooding, timing).	• Does not address primary concerns (for example, resource requirements, existing skill set).	Substantial industry experience with this approach not succeeding.

Table 2 (continued)
Summary of options considered

	Title	Description	Strengths	Limitations/Challenges	Initial Assessment
6	Develop basis and revise break size assumptions and CCDP metric	Apply double-ended guillotine break and CCDP to only applicable systems/segments (for example, FAC, HELB). Use half pipe diameter by half pipe thickness and separate CCDP for low-energy systems.	Reduces conservatism in assessing impacts (flooding, timing).	• Still need to assess spatial effects. • Still needs a standalone assessment of standby system (that is, not extracted from existing PRA model/ documentation). • Requires NRC interaction. • Does not address primary concerns (for example, resource requirements, skill set).	Substantial industry experience with this approach not succeeding.
7	Develop a holistic approach				
7A	Use streamlined RI-ISI approach (ASME Code Case N-716-1 [12])	Use existing N-716-1 scope and process.	• Stable and predictable. • Easily implemented, cost-effective.	• Current basis for N-716 does not address scope of 50.69. • No basis for applicability to some Class 2 systems and all Class 3 systems. • Change in risk currently addresses only the impact on in-service inspection (for example, missing quality assurance, repair/ replacement activities, seismic).	See option 7E.

Table 2 (continued)
Summary of options considered

	Title	Description	Strengths	Limitations/Challenges	Initial Assessment
7A				• Process requires multiple owner-defined programs (for example, FAC, intergranular stress corrosion cracking-BWRs, localized corrosion). • Requires NRC interaction. • Requires additional work.	
7B	Modify scope of ASME Code Case N-716-1 to address scope of 50.69	Use N-716-1 as starting point and develop generic set of missing Class 2 and all Class 3 systems. Keep existing plant-specific screening (CDF/LERF) threshold.	• Stable and predictable. • Easily implemented, cost-effective. • More than half of U.S. fleet using this method.	• No clear adequate experience/data to draw from. • Need to consider supplementing missing data with plant-specific screening threshold. • Need to address Class 2 and Class 3 standby systems. • Need to consider whether CDF of 1E-06/year and LERF of 1E-07/year are the right thresholds for this option. • Method needs to be developed and tested. • Need NRC interaction.	See option 7E below.

Table 2 (continued)
Summary of options considered

	Title	Description	Strengths	Limitations/Challenges	Initial Assessment
7C	Modify scope of N-716 to address scope of 50.69 and add CCDP/CLERP thresholds.	Use N-716-1 as a starting point and develop generic set of missing Class 2 and all Class 3 systems. Add CCDP/CLERP (that is, to addresses DID) to existing plant-specific screening (CDF/LERF) threshold.	• Stable and predictable. • Easily implemented, cost-effective. • More than half of U.S. fleet using this method.	• There might not be adequate experience/data. • Supplement data with plant-specific screening threshold. • How to address Class 2 and Class 3 standby systems • Are 1E-06/1E-07 the right thresholds for 50.69? • Method needs to be developed and tested. • Need NRC interaction.	See option 7E.
7D	Use streamlined RI-ISI approach (ASME Code Case N-716-1) coupled with identification of what impacts the missing scope (for example, some Class 2 and all Class 3 systems)	Use existing N-716-1 scope and process, coupled with programs that drive pressure boundary reliability.	• Stable and predictable. • Easily implemented, cost-effective. • More than half of U.S. fleet using this method.	Requires NRC interaction. Method needs to be developed and tested.	See option 7E.
7E	Use streamlined RI-ISI approach (ASME Code Case N-716-1), modified to address 50.69 scope (see 7C) coupled with identification of what impacts missing scope (for example, some Class 2 and all Class 3 systems).	Use existing N-716-1 scope and process, add more 50.69 scope, coupled with programs/processes that drive pressure boundary reliability.	• Stable and predictable. • Easily implemented, cost-effective. • More than half of U.S. fleet using this method.	Requires NRC interaction. Method needs to be developed and tested.	Selected. See Sections 4–6 of this report.

As presented in Table 2, numerous options and variations thereof were considered in addressing whether the existing methodology for categorizing pressure boundary components is too conservative and/or too resource-intensive. Some of these options identified that additional guidance would be useful to the industry. Some of this guidance has already been provided to the industry, and future EPRI-sponsored workshops will provide additional technology transfer opportunities.

Based on the work summarized here in Section 3, we conclude that there is the possibility to develop an enhanced categorization methodology for pressure boundary components. This new methodology is provided in Section 4.

4 ENHANCED CATEGORIZATION PROCESS FOR PRESSURE BOUNDARY COMPONENTS

This section describes an alternative (enhanced) methodology for categorizing pressure boundary components in 10 CFR 50.69 applications.

This enhanced passive methodology contains a set of prerequisites and a predetermined set of HSS systems/subsystems coupled with a plant-specific search for pressure boundary components that need to be added to the predetermined HSS scope. This alternative approach offers multiple advantages over the existing approach for categorizing pressure boundary components. These advantages include the following:

- **Full-scope approach**. 10 CFR 50.69 allows for the categorization to be done for a single system or set of systems. This new approach requires a full plant evaluation—that is, all safety-related and non-safety-related systems will be determined to be HSS or LSS from a pressure boundary function perspective. This greatly enhances RISC-3 alternative treatment planning while, as covered in the following paragraph, also providing safety improvement opportunities (for example, RISC-2 components).[1]
- **Identification of RISC-2 components**. Again, this new approach requires a full plant evaluation. Thus, from a pressure boundary function perspective, this will identify all RISC-2 components—which is not currently required by the system-by-system categorization approach allowed by 10 CFR 50.69. The full plant evaluation would provide a safety benefit immediately on implementation by reducing the need to assess each component on a system-by-system basis. That is, consistent with 10 CFR 50.69(d) and (e), licensees will need to ensure that RISC-2 components (for example, piping segments) can perform their function (that is, pressure-retaining) consistent with the categorization process assumptions by evaluating the treatment being applied to these SSCs to ensure that it supports the key assumptions in the categorization process that relate to their assumed performance. And, going forward, licensees will need to make adjustments as necessary to their categorization or treatment processes so that the categorization process and results are maintained valid.
- **Robust and stable**. By defining a set of prerequisites and a set of predetermined HSS systems/subsystems, minor changes to other inputs (for example, PRA updates, 50.69(e) feedback and process adjustment) will have minimal to no impact on the categorization results during the initial application or during subsequent periodic updates.

[1] For definitions of *RISC-1*, *RISC-2*, *RISC-3*, and *RISC-4*, see “Acronyms and Abbreviations” in this report.

- **Cost-effective**. On a plant-specific basis, the new categorization methodology is applied once, no matter how many systems are selected for full 10 CFR 50.69 categorization and alternative treatment. Additionally, if a licensee were to categorize five systems in Year X and another five systems in Year X+1, the list of HSS systems/subsystems from a pressure boundary perspective would not change. Obviously, this would have a positive impact on the cost of pressure boundary categorization. Also, as previously covered, this would provide stability to the overall categorization scheme.

The process consists of five phases as shown in Figure 3 (Phases 1-3) and Figure 4 (Phases 4-5).

- Phase 1: Prerequisites
- Phase 2: Predetermined HSS Passive SSCs
- Phase 3: Design & plant specific search for HSS passive SSCs
- Phase 4: Sensitivity study & IDP review and concurrence
- Phase 5: Performance monitoring

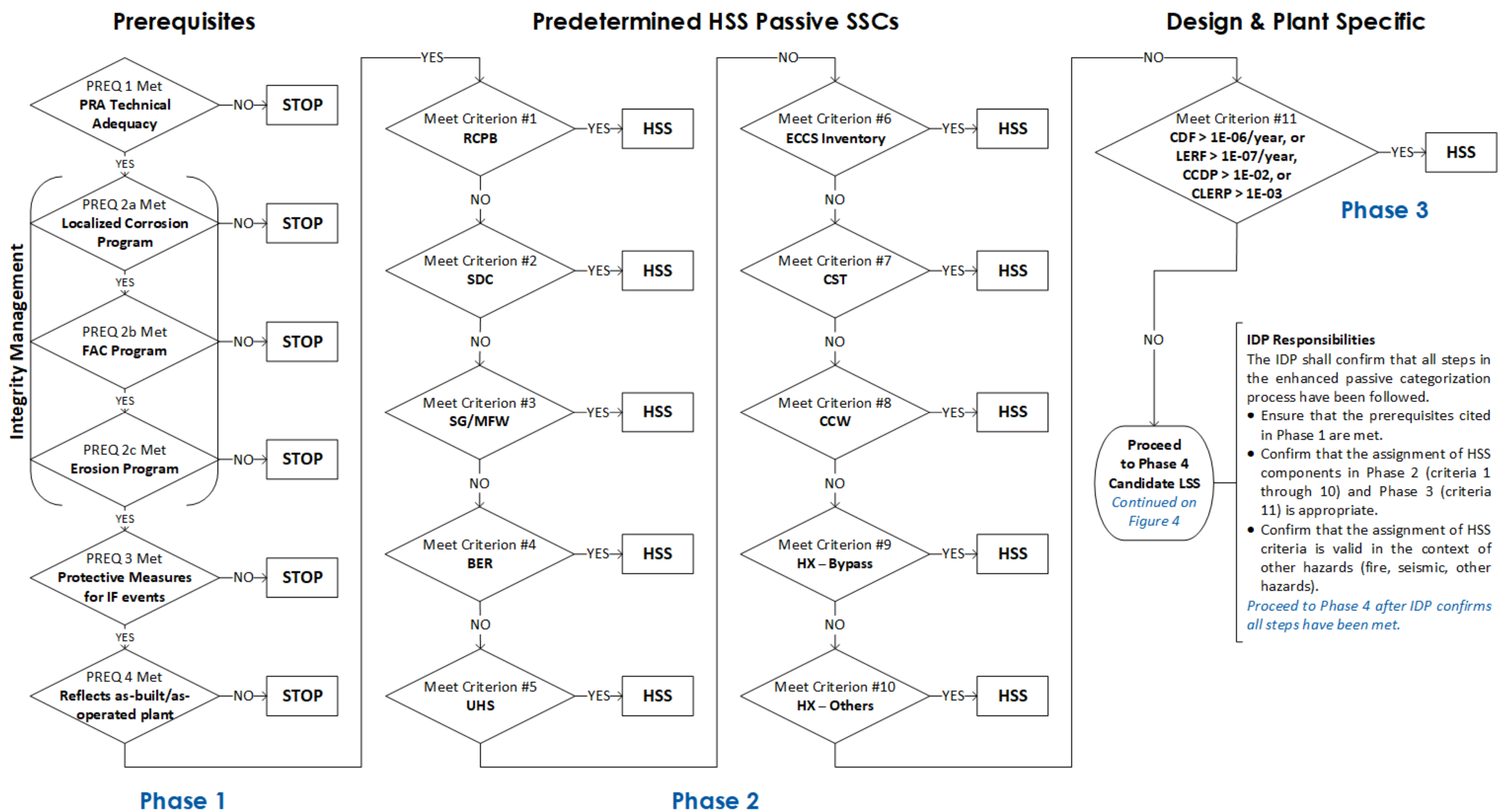


Figure 3
Flowchart of Phases 1-3 of the enhanced passive methodology

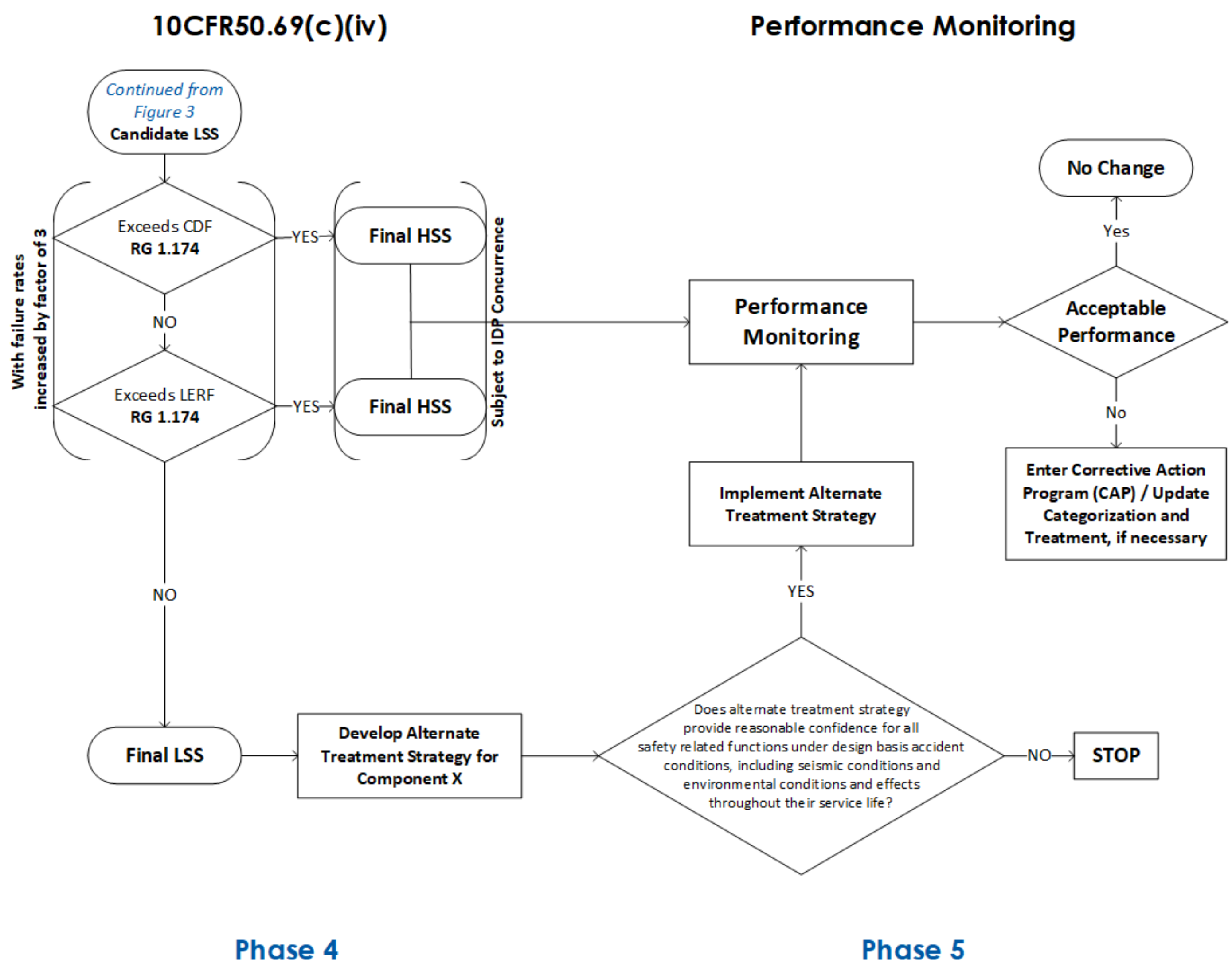


Figure 4
Phase 4 and Phase 5 of the enhanced passive methodology

4.1 Prerequisites

Before implementing the categorization process described in Section 4.2, a licensee will need to ensure that the following prerequisites have been met:

- Prerequisite 1: PRA technical adequacy
  - A robust internal events PRA model, including IF
- Prerequisite 2: integrity management
  - A robust program that addresses localized corrosion
  - A robust program that addresses FAC
  - A robust program that addresses erosion
- Prerequisite 3: protective measures for IF events
- Prerequisite 4: reflect the as-built /as-operated plant

Each prerequisite is explained in further detail in Sections 4.1.1 through 4.1.4.

4.1.1 Prerequisite 1: PRA Technical Adequacy (Pressure Boundary Failures)

As stated previously, the plant must have a robust internal events PRA, including internal flooding (IF), that addresses failure of all pressure boundary components (such as main steam line breaks, main feedwater line breaks, IF events, and interfacing system loss-of-coolant accidents [LOCAs]). Because this methodology is being used in support of 10 CFR 50.69 applications, the plant-specific PRA must be sufficient to support the LAR approval process, including consideration of PRA assumptions and sources of uncertainty.

Paragraph 50.69(c)(1)(i) of 10 CFR requires, in part, that the PRA be of sufficient quality and level of detail to support the categorization process, and it must be subjected to a peer review process assessed against a standard or set of acceptance criteria endorsed by the NRC. Paragraph 50.69(b)(2)(iii) of 10 CFR requires that the results of the PRA review process conducted to meet 10 CFR 50.59(c)(1)(i) be submitted as part of the application. This can include full-scope peer review of the internal events and internal flooding PRA against RG 1.200, Revision 2, as well as a gap assessment of earlier peer reviews of the internal events and internal flooding PRA against RG 1.200, Revision 2. An example of the review of a plant-specific PRA that meets these requirements can be found in [13].

Prior to using the enhanced categorization methodology, non-conservatisms or the use of methods not commonly accepted must be reviewed to determine their impact, if any, on the risk-informed categorization of the pressure boundary. The analyst should also review key assumptions and sources of model uncertainty in the context of this application.

4.1.2 Prerequisite 2: Integrity Management

In the context of developing an enhanced methodology for categorizing pressure boundary components for 10 CFR 50.69 purposes, it is important to note that approval to implement 10 CFR 50.69 does not absolve a licensee from meeting other commitments related to pressure boundary integrity—for example, NEI 03-08 (*Guidelines for the Management of Materials Issues*), the Materials Reliability Program, the Boiling Water Reactor Vessel and Internals Project, and license renewal and subsequent license renewal.

Further, during the development of the RI-ISI methodologies, reviews were conducted that looked at various degradation mechanisms potentially operative in safety-related and non-safety-related systems. As a result of these efforts [11, 12, 14–18], it was determined that for systems typically outside the scope of an ISI program, the requirements identified in the following were the appropriate means of ensuring pressure boundary integrity.

Systems/subsystems typically included in an RI-ISI program (such as NRC-approved Code Case N-716-1) that are also within the scope of the predetermined set of HSS systems/subsystems with the enhanced methodology would continue to be treated within the confines of the RI-ISI program.

Additionally, (d)(2) of the 10 CFR 50.69 rule requires that the licensee conduct periodic inspection and testing activities to determine that RISC-3 SSCs will remain capable of performing their safety-related functions under design basis conditions. For significant conditions adverse to quality, measures must be taken to provide reasonable confidence that the cause of the condition is determined and corrective action is taken to preclude repetition.

As such, application of the following prerequisites in the context of 10 CFR 50.69 will provide a robust mechanism for ensuring pressure boundary integrity[2]:

- **A robust program that addresses localized corrosion**. The plant should have a robust program that addresses localized corrosion. For example, pitting and microbiologically influenced corrosion that follows the guidance contained in EPRI reports:
    - TR-103403, *Service Water System Corrosion and Deposition Sourcebook* [19]
    - 3002003190, *Engineering and Design Considerations for Service Water Chemical Addition Systems* [20]
    - TR-102063, *Guide for the Examination of Service Water System Piping* [21]
    - 1010059, *Service Water Piping Guideline* [22], and

[2] For each of these programs, CDF/LERF risk insights alone should not be used to relax testing/inspection/monitoring of highly susceptible locations.

  - 3002018352, *Recommendations for an Effective Program to Control the Degradation of Buried and Underground Piping and Tanks (1016456, Revision 2)* [23]

  Program health can be determined through self-assessments, benchmarking, or peer review.

- **A robust program that addresses FAC**. The plant should have a robust program to address FAC that follows the recommendations contained in EPRI 3002000563, *Recommendations for an Effective Flow-Accelerated Corrosion Program* [24]. This could include the use of standardized health reports, such as those developed out of NEI Efficiency Bulletin 16-34, *Streamline Program Health Reporting* [25].
- **A robust program that addresses erosion**. The plant should have a robust program to address erosion that follows the guidance of EPRI 3002023786, *Recommendations for an Effective Program Against Erosive Attack: Revision 1* [26]. For some licensees, this can be addressed as part of a license renewal commitment. Also, some licensees include erosion in their FAC program; other licensees choose to address it as a separate program.

Consistent with 10CFR50.69(e) Feedback and Process Adjustment, the licensee is required to review changes to the plant, operational practices, applicable plant and industry operational experience, and, as appropriate, update the PRA and SSC categorization and treatment processes. This requirement equally applies to implementing and maintaining integrity management programs.

4.1.3 Prerequisite 3: Protective Measures for IF Events

Protective measures for IF events (that is, floor drains, flood alarm equipment, and barriers) should not be categorized as LSS unless additional evaluations have been conducted to show that loss of these measures or a subset of them will not invalidate the HSS determination provided in Section 4.2. For example, if a submarine door has been credited in preventing a flood from exiting one flood zone and entering another, that submarine door will be considered HSS unless an evaluation has shown that loss of the door will not significantly increase plant risk (that is, exceed criterion 11).

Implementation Guidance: Evaluate whether the internal flooding analysis explicitly models the reliability of flood barriers (e.g., the probability that a flood door is open may be neglected; the door is assumed to prevent propagation). If not explicitly modeled, their level of importance may not be obvious. If the reliability of protective measures is modeled (e.g., probability flood door is open), their importance can be determined from the PRA by assuming the protective measure failed and assessing CDF/LERF impact (if any of the metrics in criteria 11 are exceeded, the protective measure is HSS). However, if protective measures are credited and their reliability is not modeled, additional evaluations are required to justify a LSS categorization (or protective measures must remain uncategorized).

Example: a door designed as a flood barrier is normally closed and its failure (e.g., inadvertently left open) is not treated probabilistically in the PRA (e.g., assumed to be very reliable and remain closed). This is an important assumption that needs to be confirmed via the internal flooding analysis to ensure failure does not significantly increase plant risk (i.e., Criterion 11). An option is to assume and justify a failure probability for the door either failing or being open to confirm the risk results from the PRA model are not significantly changed (see above). Another option is to not categorize such protective measures as LSS (e.g., leave uncategorized or do not categorize as LSS). Note that structural barriers are not considered to be pressure boundary components and must remain uncategorized (or HSS). Also, note that protective barriers can have multiple functions (e.g., floods, fires, HELB, radiation, security) that need to be evaluated as part of any evaluation to categorize them as LSS.

4.1.4 Prerequisite 4: Reflect the As-Built/As-Operated Plant

To reflect the as-built as-operated plant, the PRA must have a configuration control program, update process and periodically update the PRA as described below:

- A PRA Configuration Control Program shall be in place in accordance with the ASME/ANS PRA Standard that maintains the PRA, and any supplementary analysis, to reflect the as-built/as-operated plant.
- A feedback and adjustment process shall be in place to review changes to the plant, operational practices, applicable plant and industry operational experience, and as appropriate, update the PRA model and if necessary, the categorization and treatment processes.
- This review shall meet the required update periodicity requirements for input information, such as the PRA update requirements for the underlying information used as input in the methodology implementation.

4.2 Determination of HSS Passive SSCs

This section describes the scope of systems, subsystems, and piping segments that shall be determined to be HSS. Table 3 also identifies the scope of predetermined HSS components together with the additional clarifications and considerations used in defining the final candidate HSS/LSS scope. For additional technical basis on the HSS passive SSC criteria, please see Appendix A.

HSS components will include the following:

1. Class 1 portions of the RCPB. Depending on the plant-specific licensing basis, piping as described in a and b below might have been optionally classified as Class 1 or Class 1–exempt. Reclassifying this piping as other than Class 1 to gain the full benefit of a 10 CFR 50.69 application should be considered. This change would obviously need to follow the applicable commitment change control process (such as 10 CFR 50.59). LSS shall not be

assigned to the piping described in a and b below until this piping has been classified as non-Class 1.

a. In the event of postulated failure of the component during normal reactor operation, the reactor can be shut down and cooled down in an orderly manner, assuming that makeup is provided by the reactor coolant makeup system.

b. The component is or can be isolated from the reactor coolant system (RCS) by two valves in series (both closed, both open, or one closed and the other open). Each open valve must be capable of automatic actuation and, assuming that the other valve is open, its closure time must be such that, in the event of postulated failure of the component during normal reactor operation, each valve remains operable and the reactor can be shut down and cooled down in an orderly manner, assuming that makeup is provided by the reactor coolant makeup system only.

Implementation Guidance: Evaluate in a straightforward manner as follows:

(a) Class 1 components must be HSS (these components can be in several interface systems besides the reactor coolant system such as CVCS, SI, RHR, and several other BWR systems).

(b) Class 2 components, if designated as such because of line size per the regulations, must still be confirmed as LSS using Criteria 11. From experience, very small LOCA is not a high consequence (similarly, the same applies to lines beyond the Class 1 boundary inside containment).

2. Applicable portions of the shutdown cooling pressure boundary function. That is, Class 1 and 2 components of systems or portions of systems needed to use the normal shutdown cooling flow path in either of the following ways:

   a. As part of the RCPB from the reactor pressure vessel (RPV) to the second isolation valve (that is, farthest from the RPV) capable of remote closure, or to the containment penetration, whichever encompasses more welds

   b. As part of other systems or portions of systems from the RPV to the second isolation valve (that is, farthest from the RPV) capable of remote closure or to the containment penetration, whichever encompasses more welds

3. Class 2 portions of steam generators and Class 2 feedwater system components greater than nominal pipe size (NPS) 4 (DN 100) of pressurized water reactors (PWRs) from the steam generator to the outer containment isolation valve.

4. Components larger than NPS 4 (DN 100) within the break exclusion region for high-energy piping systems, as applicable.

5. Portions of the ultimate heat sink (UHS) flow path (for example, service water) whose failures will fail both trains (that is, unisolable failure of the UHS function, or loss of both trains due to spatial impacts (e.g., flood, spray)). (**Note**: even if piping is isolated/independent, structures such as the service water pumphouse [for example, reservoir, bay] would be expected to be HSS.)

Implementation Guidance: The concern here is with emergency service water systems where the redundant trains are not physically separated and cannot be reliably separated given a pressure boundary failure. Total loss of service water is usually a high consequence at most plants. Criterion 11 should be essentially redundant to this criterion, but it was observed that some PRA models assume that pressure boundary failures in the intake structures can be screened because the internal events PRA accounts for total loss of service water. Thus, the response to this requirement requires a description of the emergency service water system with regard to the physical independence of redundant trains and the PRA model results for service water pressure boundary failure using Criterion 11. The plant must confirm that there are no pressure boundary failures that can result in loss of both safety trains or, where applicable, the components are HSS irrespective of Criterion 11. If the emergency service water trains have a crosstie that is normally open and credit is taken for isolating the trains, the evaluation of isolation credit must be described and consider the following: (a) Flow diversion from both trains must be assumed until isolated if applicable (if not applicable, loss of both safety trains may not be applicable) and spatial impacts must also be considered (spray, flood). (b) Demonstration that TR-112657 requirements for crediting operator actions (e.g., detection, time, procedures) are met for any credited operator action.

6. Tanks/vessels and connected piping and components up to the first isolation valve that support/provide inventory to multiple systems/functions (for example, the refueling water storage tank [RWST] and containment sump for PWRs, suppression pool for boiling water reactors [BWRs]).

Implementation Guidance: The concern here is that pressure boundary failures that drain the RWST can result in loss of a safety function and defense-in-depth, even if the PRA modeling of these failures as internal flood initiating events has been found to result in a LSS determination (e.g., RWST is in the yard and has no other impacts other than a controlled shutdown). Thus, the RWST and the main suction lines to ECCS are HSS regardless of Criterion 11 results.

The Containment Sump in PWRs and Suppression Pool in BWRs is also included in the HSS scope regardless of Criterion 11 results.

Note that the containment sump piping outside containment between the containment penetration and the outside isolation MOV at some plants have this scope encapsulated (piping and MOV are encapsulated) such that pressure boundary failure will not drain the containment sumps. This design is LSS.

7. Condensate storage tank (CST) for auxiliary feedwater (AFW)/emergency feedwater (EFW) in a PWR unless there is a redundant independent reliable source (for example, auto switchover to service water supply to each train of AFW/EFW suction). This includes connected piping greater than 4 in. (101.6 mm) up to the first isolation valve in the AFW/EFW protected volume of the CST.

Implementation Guidance: This requirement comes from an observation that some plants do not model loss of CST as an initiating event (e.g., out in the yard where there is no other impact) and thus it would not be considered through Criterion 11. It was observed at a PWR plant that a reliable backup to the CST was not modeled and feed & bleed (or bleed & feed) cooling capability did not exist. Note that the CST is not pre-determined as HSS at BWRs because RCIC and HPCI auto transfer to the suppression pool and low-pressure sources (LPCI and core spray) are normally aligned to the suppression pool.

Thus, the response to this requirement for PWRs must include both a qualitative and quantitative basis for the CST being LSS. Otherwise, it is HSS. Qualitatively, a description of backup water sources to the CST, including their inventories to justify them as meeting PRA success criteria must be provided. Other capabilities such as feed & bleed cooling must also be described. If “feed and bleed” is not available, a reliable backup to the CST must be demonstrated and modeled in the PRA. Note that the CST as a flood source inside buildings where safety-related equipment are located is expected to be included in a technically adequate PRA model (a requirement for the use of the proposed methodology), such that the importance of the CST in this specific situation is covered by Criterion 11 at both PWRs and BWRs (i.e., such a potentially significant situation would not be missed in implementation, regardless of plant design).

8. For PWR plants, low-volume, intermediate-safety systems that typically consist of two physically independent trains (for example, component cooling water [CCW]) that are, on a plant-specific basis, physically connected. For example, loss of pressure boundary integrity of train A will drain train B as well or loss of both trains due to spatial impacts (e.g., flood, spray). Section 5.3 (Pressure Boundary Interfaces), the final bullet on CCW provides additional guidance on considerations for HSS/LSS assignment.

Implementation Guidance: Because of multiple dependencies on the CCW system (e.g., RCP seal cooling, ECCS pump cooling, SDC/RHR cooling) complete loss of CCW is known to be important for PWRs. Note: these types of CCW dependencies are unique to the PWR design, with a variety of different arrangements. The following examples provide a basis to assume specific considerations that can impact the categorization of CCW in a robust manner:

Example 1
At some plants, both trains of this system operate together and upon failure of one train, separation of the two safety trains requires operator action and there would not be enough time for this limited volume system to be isolated and maintain the availability of the other safety train for the main piping. This postulated failure would lead to total loss of the CCW system and an HSS assignment is required. On a plant-specific basis, an individual plant may demonstrate that, as part of its design basis, there is sufficient time to isolate and protect one train for leakage rates equivalent to 1-inch and less. Thus, an LSS categorization can be justified.

Example 2
At the other extreme, some plants have physically separated trains with each train having its own surge tank. In this case, pressure boundary failures can only fail one train, thus redundancy is preserved, and this is not a high consequence (LSS is assigned).

Example 3
Two physically independent trains with one surge tank, but the surge tank has a baffle that effectively results in two independent tanks in one (LSS is assigned). Caution: the baffle where it is welded at the bottom of the tank if it ruptured could drain both sides and this would be HSS. The remainder of the systems is LSS.

Example 4
The two trains are normally cross tied together, but automatically isolate on low surge tank level making the two trains physically independent. Other than the shared surge tank baffle (see Example 3) the remainder of the system is LSS.

9. Heat exchangers whose failure (for example, tube or tubesheet failures) could allow reactor coolant to bypass primary containment while the plant is at-power or during shutdown. The methodology and criteria [5,6] shall be used to determine HSS versus LSS assignment. For additional guidance on implementation of criterion 9, see Section 5.2 on system interfaces.

Implementation Guidance: Considerations for this requirement are based on:
(1) heat exchangers interfacing with two systems via tubes/tubesheet; thus, failure at the interface can impact both systems, and
(2) the fact that these interfaces do not require evaluation in RI-ISI applications (such that there is limited experience in 10 CFR 50.69 categorization).

This criterion applies to those heat exchangers that interface with the reactor coolant system. All such heat exchangers must be identified and evaluated with regard to functional impacts (e.g., RCS flow into another system) and LOCA outside containment. In general, these heat exchangers should have been considered in the PRA model as introducing a potential LOCA outside containment (but there should be confirmation of its modeling as well as the function impact on the interfacing system for categorization). The following examples provide a basis to assume specific considerations that can impact the categorization of such conditions in heat exchangers in a robust manner:

<u>Example 1</u>
Non-safety related Chemical and Volume Control System (CVCS) letdown heat exchanger interfaces with component cooling water (CCW) <u>and</u> RCS flow into CCW via this heat exchanger is assumed to fail CCW <u>and</u> CCW is HSS due to Criterion 8 because the safety trains are not separated or separable. Thus, this heat exchanger is categorized HSS and LOCA outside containment does not necessarily have to be considered.

<u>Example 2</u>
Non-safety related CVCS letdown heat exchanger interfaces with CCW and RCS flow into CCW via this heat exchanger <u>and</u> is assumed to fail one train of CCW <u>and</u> CCW is LSS due to Criterion 8 because the safety trains are separated. Thus, this heat exchanger is categorized LSS except it is necessary to evaluate LOCA outside containment as well. This heat exchanger is outside containment downstream of the regenerative heat exchanger. There are several auto isolation valves and low flow rate (e.g., ~120 gpm). If the LOCA outside containment via the heat exchanger is modeled in the PRA, whether it is HSS or LSS can be determined using Criterion 11. If it is not modeled in the PRA, it will have to be quantitatively evaluated and documented, i.e., HSS or LSS categorization can be determined using Criterion 11.

10. Other heat exchangers—if not explicitly addressed in Criterion 11, other heat exchangers should be evaluated to determine if component failure (for example, of the tube or tubesheet) could impact multiple systems. If yes, the methodology and criteria of [5, 6] shall be used to determine HSS versus LSS assignment. For additional guidance on implementation of criterion 10, see Section 5.2 on system interfaces.

Implementation Guidance: All heat exchangers not covered by Criterion 9 must be listed and propagation from one system to another via the interface (i.e., tubes) must be postulated and evaluated by referring to Criterion 11 or demonstrating that the CCDP is not high per the traditional methodology. Also, the importance of an interfacing system can impact the importance of the heat exchanger, as demonstrated in the example below, must also be documented:

Example

EDG coolers were initially LSS because loss of a single diesel from pressure boundary failure is LSS, however, the service water connection to the coolers was HSS due to service water flooding impact in the diesel room (i.e., there are additional propagation impacts). Thus, these coolers and associated piping with the EDG system are HSS.

A secondary consideration in this case is whether flow occurs from service water into the EDG cooling system (closed cooling with limited volume), or from the cooling system to service water (depending on system pressures). In either case, loss of the EDG is LSS which bounds the impacts.

11. Any piping or component, including piping segments or components grouped or subsumed within existing plant initiating event groups (main feedwater breaks inside containment; main steam line breaks outside containment; service water flooding events; interfacing system LOCAs; failures of non-Class 1 RCPB connections, such as instrumentation lines; and so on) whose contributions to:

    - CDF is greater than 1E-06/year, or
    - LERF is greater than 1E-07/year,

    or scenarios where the:

    - CCDP is greater than 1E-02, or
    - CLERP is greater than 1E-03

    Note: The 1E-02 (CCDP) / 1E-03 (CLERP) values are similar to EPRI TR-112657, Rev B-A and deterministic single failure criteria, seismic margin analysis, fire protection (Appendix R) in that having a success path results in adequate protection for low frequency events.

This criterion is applied to a plant-specific PRA model that includes pressure boundary failures (for example, pipe whip, jet impingement, spray, and inventory losses). For criterion 11, care should be taken in reviewing the PRA results so that total contributions to CDF and LERF are compared to the risk metrics. For example, separate scenarios of spray, moderate flood, and large flood based on different plant impacts should be combined so that the cumulative impact of the SSC is compared to each risk metric (e.g., CDF, LERF, CCDP, and CLERP).

For purposes of applying criterion 11, the definition of a pipe segment is not a function of whether it was categorized as HSS or LSS according to criteria 1–10. That is, even if a piping segment or a portion of a pipe segment is HSS according to one of the first 10 of the preceding criteria, the impact on risk due to its postulated failure is determined using the plant-specific PRA (see Prerequisite 4.1.1).

Also, even if a piping segment or a portion of a pipe segment is LSS according to the first 10 criteria, the impact on risk due to its postulated failure is determined using the plant-specific PRA (see Prerequisite 4.1.1).Although ASME Code Case N-660 is referenced in NEI 00-04 [2], note that all 10 CFR 50.69 submittals approved to date reference the ANO2-R&R-004 methodology (RI-RRA) [5, 6] for categorizing pressure boundary components. The technical basis for the ANO RI-RRA methodology is EPRI TR-112657, Rev B-A [11], which is also codified in ASME Code Case N-578 and Appendix R, Supplement 2. A streamlined version is contained in NRC-endorsed ASME Code Case N-716 [12].

Each of these approaches, although slightly different in wording as to *piping segments*, has the same purpose—to group pressure-retaining items (welds, valve bodies, pipe runs, and so on) by common consequence.

In its simplest application, if postulated failure of the entire system (direct and indirect effects) had the same consequence (for example, causes an initiating event X), only a single segment would need to be defined. However, from a practical perspective, this is typically not the case; the system would be divided into segments as the postulated consequence of failure changes. This “segmentation” can be caused by a multitude of impacts, such as different trains in the system (for example, train A versus train B); piping located in different parts of the plant (such as flood area C versus flood area D); or piping in the same train and same plant area where a portion is upstream of an isolation valve and the other portion is downstream.

12. Piping/component support boundaries. Any of the following options can be used:

- Supports (for example, component support, hanger, or snubber) may remain uncategorized until a need has been identified (for example, a significant repair/ replacement or modification is required).
- A component support, hanger, or snubber shall have the same categorization as the highest-ranked piping segment within the piping analytical model in which the support is included.
- A combination of restraints or supports such that the LSS piping and associated SSCs attached to the HSS piping are included in scope up to a boundary point that encompasses at least two supports in each of three orthogonal directions [27, 28].

Systems, subsystems, and segments that meet any of the preceding criteria are to be categorized HSS. All other safety-related and non-safety-related SSCs not classified as HSS in accordance with the preceding list shall be categorized LSS.

With respect to categorizing supports (for example, component support, hanger, or snubber), there has been considerable discussion as to whether supports should be included within a system boundary. The 10 CFR 50.69 rule allows licensees to define the system boundaries, and then all components in that system boundary would need to be included in that system's categorization. Currently approved 10 CFR 50.69 LARs are using the "ANO2-R&R-004" methodology [5, 6], which can be applied to "Class 2 and 3 pressure retaining items or their associated supports." As such, component supports, hangers, or snubbers need not be included in a system categorization. Also, the example system categorization provided by ANO2 to the NRC during Requests for Additional Information for the relief request included pressure boundary components only. That is, component supports, hangers, and snubbers were not included within the system boundary categorization.

Consistent with this approach, the enhanced methodology does not require that component supports, hangers, or snubbers be categorized as part of categorizing the pressure boundary function. The exception to this is when the enhanced methodology identifies non-safety-related pressure boundary components as HSS. In this case, once the categorization is approved by the IDP panel, 50.69(d) requires that the licensee ensure that RISC-2 SSCs perform their functions consistent with the categorization process assumptions by evaluating treatment being applied to these SSCs to ensure that it supports the key assumptions in the categorization process that relate to their assumed performance. Thus, this review should include an assessment of the supports once RISC-2 SSCs are identified.

Table 3
HSS criteria: considerations

No.	HSS Criteria	Premise	Additional Considerations
1	RCPB (Class 1)	Consistent with LARs approved to date.	This is a conservative portrayal of the safety significance of some of the Class 1 components as experience using the existing methodology has shown that the Class 1 piping between the first and second isolation valve is typically a low consequence rank (e.g., CCDP less than 1E-06). In this enhanced methodology, all Class 1 components are categorized as HSS regardless of risk information.
2	Applicable portions of the shutdown cooling pressure boundary function. Class 1 and 2 components of systems or portions of systems needed to use the normal shutdown cooling flow path either: (a) as part of the RCPB from the RPV to the second isolation valve (that is, farthest from the RPV) capable of remote closure, or to the containment penetration, whichever encompasses more welds, or (b) other systems or portions of systems from the RPV to the second isolation valve (that is, farthest from the RPV) capable of remote closure or to the containment penetration, whichever encompasses more components	Consistent with some of the insights from previous pressure boundary categorization efforts (for example, 10 CFR 50.69, RI-ISI, RI-RRA).	Some Class 2 components in PWRs will be HSS that might otherwise be LSS if other parts of NEI 00-04 do not make them HSS. This is likely driven HSS by consideration of shutdown events.
3	Class 2 portions of steam generators and Class 2 feedwater system components greater than NPS 4 (DN 100) of PWRs from the steam generator to the outer containment isolation valve	Consistent with some of the insights from previous pressure boundary categorization efforts (for example, risk-informed break exclusion region, RI-RRA). High-energy system.	Some components will be HSS per this enhanced methodology that might otherwise be LSS based on PRA and plant design.

Table 3 (continued)
HSS criteria: considerations

No.	HSS Criteria	Premise	Additional Considerations
4	Components larger than NPS 4 (DN 100) within the BER for high-energy piping systems as defined by the owner	Consistent with some of the insights from previous pressure boundary categorization efforts (for example, 10 CFR 50.69, RI-BER). High-energy system. Typically, cannot meet single failure criteria and/or equipment qualification issue.	Some components will be HSS that might otherwise be LSS based on PRA and plant design.
5	Portions of the UHS flow path (for example, service water) whose failures will fail both trains (that is, fail the UHS function). (Note: even if piping is isolated/independent, the service water pumphouse [for example, reservoir, bay] would be expected to be HSS.)	Consistent with present passive categorization method where loss of safety function is loss of DID.	Redundant to row 11 of this table.
6	Tanks/vessels and connected piping and components up to the first isolation valve that support/provide inventory to multiple systems/functions (for example, RWST for PWRs, containment sumps, SP for BWR).	Consistent with present passive categorization method where loss of safety function is loss of DID.	None.
7	Condensate storage tank for AFW/EFW in a PWR unless there is a redundant, independent, reliable source (for example, auto switchover to service water supply to each train of AFW/EFW suction).	Consistent with present passive categorization method where loss of safety function is loss of DID.	None.
8	For PWR plants, low-volume, intermediate-safety systems that typically consist of two physically independent (for example, CCW) trains that are, on a plant-specific basis, physically connected. For example, loss of pressure boundary integrity on train A will drain train B as well.	Relies on risk insights indicating that plant designs with physically independent CCW trains (for example, two surge tanks) are LSS, whereas plants without separation are not.	Might be overly conservative, but PRA results presently indicate that total loss of CCW is a high consequence at most PWR plants.

Table 3 (continued)
HSS criteria: considerations

No.	HSS Criteria	Premise	Additional Considerations
9	Heat exchangers whose failure (for example, tube or tubesheet failures) could allow reactor coolant outside primary containment.	Addresses important containment issues that might not be typically covered by PRA importance measures. Confirmation of risk insight/safety insights.	May be covered by row 11 of this table (LE-D4 of [31]) except maybe during shutdown, which is typically not included in full-power operation IF.
10	Other heat exchangers, if not explicitly addressed in row 11 of this table, should be evaluated to determine if component failure (for example, that of tube or tubesheet) could impact multiple systems. If yes, the methodology and criteria of [5, 6] shall be used to determine HSS versus LSS assignment.	Experience to date: applicable only to service water floods.	Experience to date: applicable only to service water floods. Add guidance from row 11 of this table.
11	Any piping or component (including piping segments or components grouped or subsumed within existing plant initiating event groups) whose contribution to CDF is greater than 1E-06/year, whose contribution to LERF is greater than 1E-07/year, CCDP is greater than 1E-02, or CLERP is greater than 1E-03 based on a plant-specific PRA of pressure boundary failures (for example, pipe whip, jet impingement, spray, and inventory losses). This might include Classes 1 and 2 and Class 3 or non-class components.	Agreement from NRC based on N-716 scope. Consistent with risk-informed decision-making philosophy. Safety improvement.	Need to reexamine applicable supporting requirements and capability categories.

Table 3 (continued)
HSS criteria: considerations

No.	HSS Criteria	Premise	Additional Considerations
12	Piping/component support boundaries. Any of the following options can be used: (a) Supports (component support, hanger, or snubber) may remained uncategorized until a need has been identified (for example, a significant repair/replacement or modification is required). (b) A component support, hanger, or snubber shall have the same categorization as the highest-ranked piping segment within the piping analytical model in which the support is included. (c) A combination of restraints or supports such that the LSS piping and associated SSCs attached to the HSS piping are included in scope up to a boundary point that encompasses at least two supports in each of three orthogonal directions.	Additional flexibility included in option c. Consistent with previously NRC-approved positions (for example, license renewal, subsequent license renewal).	Options consistent with previous NRC-approved positions.

4.3 External Events Evaluation

The preliminary HSS / LSS assignments shall be reviewed and adjusted to reflect the pressure boundary failure's impact on the mitigation of external events. The effect of external events on core damage and containment performance shall be evaluated from two perspectives, as follows:

- External events that can cause a pressure-boundary failure (e.g., seismic events); and
- External events that do not affect likelihood of pressure-boundary failure, but create demands that might cause pressure-boundary failure and events (e.g., fires).

The purpose of this review is to confirm (and adjust as necessary) that the assignment of HSS/LSS criteria is valid in the context of other hazards (fire, seismic, other hazards).

4.4 Acceptably Small Increases to CDF and LERF

NEI 00-04 and 10 CFR 50.69 require evaluations that provide reasonable confidence that for SSCs categorized as RISC-3, any potential increases in CDF and LERF resulting from changes in treatment are small. In addition to the existing requirement by NEI 00-04, to provide a complete risk-informed pressure boundary categorization methodology, this section of the report describes the evaluations necessary for the pressure boundary function when implementing the enhanced categorization methodology.

As covered in Section 8.1 of NEI 00-04, one of the guiding principles of this process is that changes in treatment should not significantly degrade performance for RISC-3 SSCs and should maintain or improve the performance of RISC-2 SSCs. When that principle is coupled with Prerequisite 1 in Section 4.1 of this report, there is high confidence that there would be little, if any, net increase in risk as a result of implementing the enhanced methodology.

For this effort, passive RISC-3 SSCs (i.e., those pressure boundary components modeled in the internal events or internal flooding PRA) shall have their failure rates (such as pipe break frequency) increased by a factor of 3 and their CDF and LERF quantified so that the cumulative impact of any potential alternate treatment is assessed. As previously covered, due to the requirements of this enhanced methodology and the requirements that RISC-3 SSCs continue to perform their safety-related functions under design basis conditions, this type of degradation is extremely unlikely for any single component, let alone entire groups of components. Therefore, the factor of 3 is a conservative bound on the potential impact of alternative treatment and is consistent with industry application of NEI 00-04 Section 8.1.

Results of this sensitivity study shall be compared to the quantitative acceptance guidelines of RG 1.174. Any pressure boundary component as modeled in the IE PRA or IF PRA that exceeds the acceptance guidelines of RG 1.174 shall be candidate high-safety-significant, subject to IDP concurrence. All pressure boundary components that were determined to be LSS according to

Section 4.2 of this report and remain below RG 1.174 acceptance guidelines shall be categorized as LSS.

Notwithstanding the above, Licensees per 10CFR50.69(d)(2) must ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety-related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life (e.g. see Appendix B, EPRI response to RAI 1a).

4.5 Integrated Decision Making Panel Guidance

After the performance of the evaluations required by sections 4.1 (prerequisites), 4.2 (predetermined HSS passive SSCs), 4.3 (external events evaluation), and 4.4 (acceptably small increases to CDF and LERF) a preliminary (candidate) HSS / LSS assignment of all safety related and non-safety related pressure retaining components has been completed.

As required by Section 9.2 of NEI 00-04, the IDP is responsible for reviewing candidate HSS and LSS assignments and determining the final HSS and LSS assignment. Consistent with past practice any candidate HSS assignment (i.e., components meeting any one of the 11 criteria or determined to be HSS by a non-PRA external hazard evaluation) cannot be assigned LSS by the IDP. Per NEI 00-04, the IDP may determine a function/SSC has not been appropriately characterized and may be re-evaluated based on insights from the IDP. Also, NEI 00-04 allows for more detailed characterization of the SSC associated with a safety-significant function. This can be performed after the initial IDP, but the basis for that re-categorization must be considered and discussed in a follow up IDP session.

For application of the enhanced categorization methodology for pressure boundary components the IDP shall also confirm that all steps in the process have been followed.

- The IDP shall ensure that the prerequisites cited in Section 4.1 are met.
- The IDP shall confirm the assignment of HSS components (from the results of using criteria 1 through 11) is appropriate.
- The IDP shall confirm that the assignment of HSS criteria is valid in the context of other hazards (fire, seismic, other hazards).

4.6 Alternative Treatment Requirements Under 10 CFR 50.69(d)(2)

This enhanced methodology for passive categorization requires an evaluation of the pressure retention function of all systems. In this enhanced approach the pressure boundary function is treated as a system for 10 CFR 50.69 categorization and alternative treatment purposes, whereas the traditional passive methodology is applied on a system-by-system basis. Treating the pressure boundary function as a system is consistent with 10 CFR 50.69 rule language and several citations in the final rule's Statement of Considerations (the boundaries for the pressure boundary system are limited to pressure retention) in that there will be no other important functions that would escape categorization and appropriate assignment of safety significance. When categorizing a system that contains active and passive (pressure boundary) components, active components (e.g., non-pressure retaining functions) must follow the existing process for categorization in NEI 00-04 which ensures that all safety functions are properly identified and categorized regarding their safety significance.

Categorizing the pressure retention function as one system is consistent with 10 CFR 50.69 and NRC's approval of the ANO RI-RRA applications [29, 30]. That is, RI-RRA categorization and treatment are limited to the pressure retaining function. For example, a motor-operated valve body can be RI-categorized as LSS without RI-categorizing its active functions (for example, valve fails to open or valve fails to close). This is further documented in the NRC's letter to Vogtle Units 1 and 2 - Issuance of Amendments RE: Use of 10 CFR 50.69 (ML14237A034) as summarized below:

> In the response, the licensee confirmed that the failure of a passive component (e.g., motor operated valve body) that supports an HSS active function may be assigned LSS by the passive categorization methodology if confirmed LSS by the IDP. This can occur because, for example, there are no common cause failures (CCF) among passive components (i.e., multiple and simultaneous pipe ruptures are not expected), so an active function may be HSS due to CCF considerations but the individual pressure retaining components whose individual failures do not fail the function can be LSS. The NRC staff finds that risk assessments generally do not consider the very unlikely simultaneous multiple failures of passive components (except for external hazard events impacts that should be included in the external hazard evaluation) and therefore the proposed method is acceptable.

Similarly, alternative repair/replacement activities can be applied to the LSS pressure-retaining function of the valve body, and the active function will continue to be maintained through existing practices.

5 REVIEW OF SYSTEMS AGAINST PROPOSED METHODOLOGY

The risk informed pressure boundary categorization methodology contained in Chapter 4 is based on 30 years of categorization experience using the NRC-approved "Consequence of Failure" (CoF) evaluation methodology in EPRI TR-112657, Rev B-A which was developed during the 1990s. The methodology in TR-112657 is identical to the methodology used in ASME Code Case N-752 which has been endorsed for use at 5 licensees at 21 plants. It is also the same methodology in use at plants implementing 10 CFR 50.69 (approximately 70 units). Figure 5 & Figure 6 provides a chronological view of the evolution and adaptation of risk technology to the pressure boundary function. In taking this next step in the evolution of 10 CFR 50.69 pressure boundary categorization, it was necessary to evaluate insights from past experience as well as assess what a holistic pressure boundary categorization needed to include (e.g., what is needed to supplement Criterion 1 and Criterion 11). How the enhanced methodology contained in Chapter 4 incorporated these previous experiences, closed identified gaps as well as captures design and plant-specific insights are summarized in the following sections.

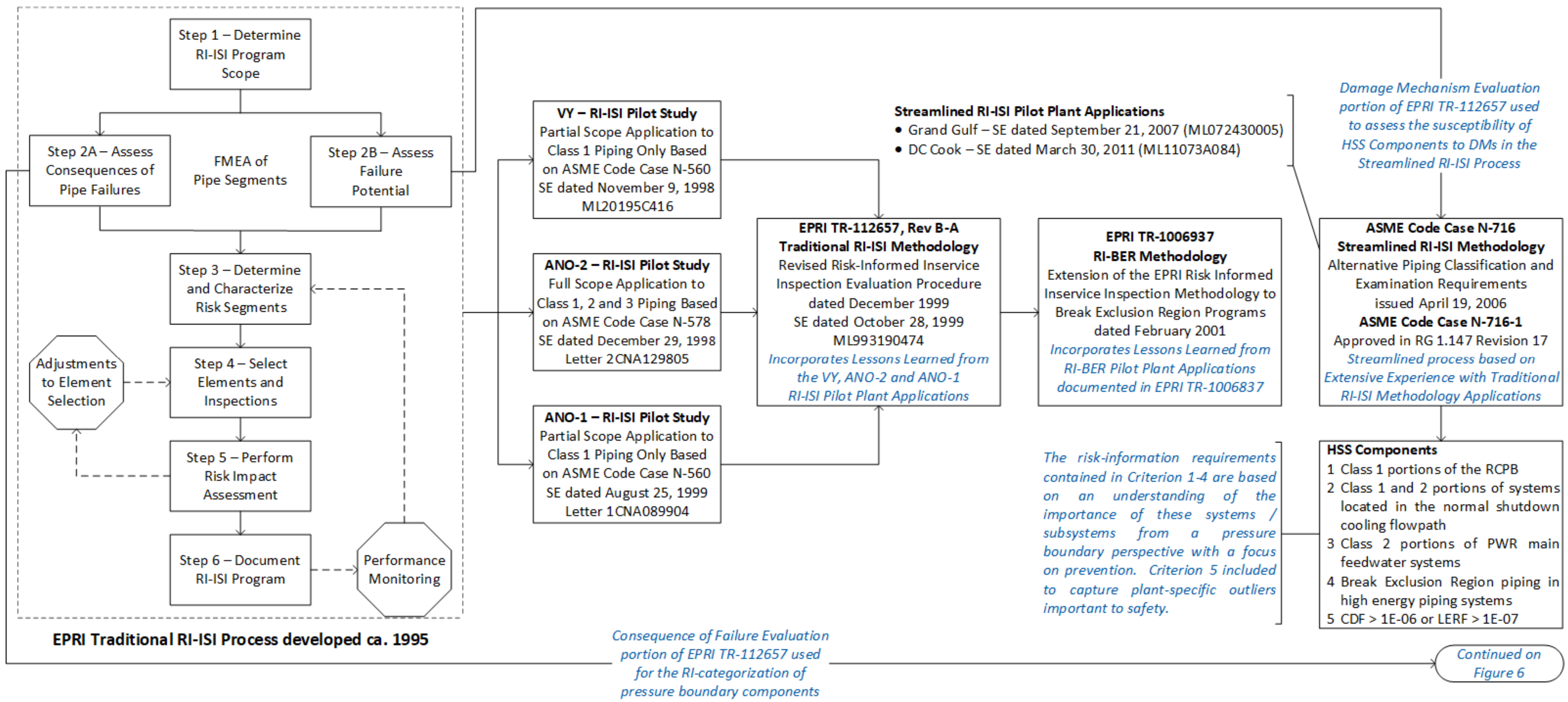


Figure 5
Evolution of EPRI RI-technology to pressure boundary components (1 of 2)

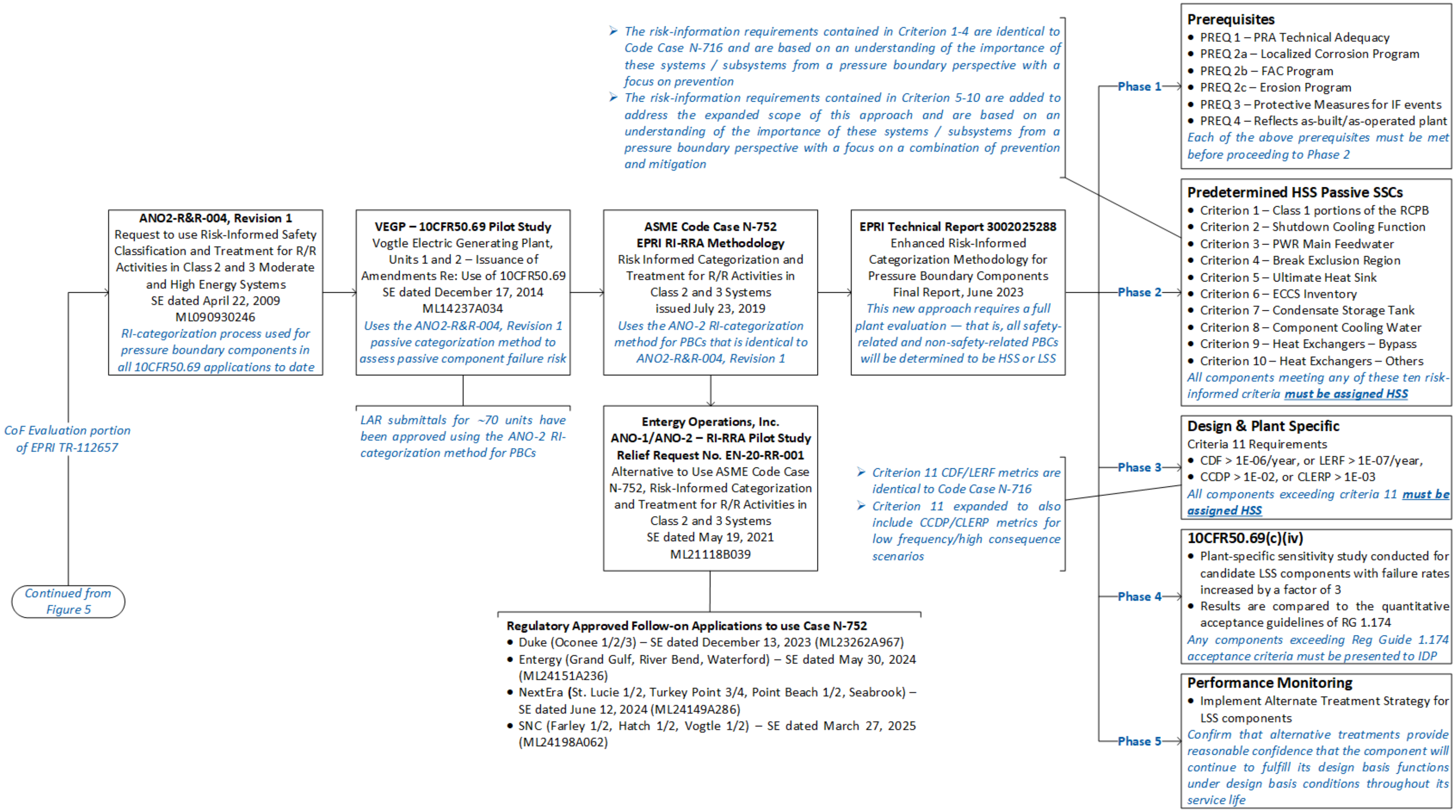


Figure 6

Evolution of EPRI RI-technology to pressure boundary components (2 of 2)

With the intent to appropriately use a risk-informed methodology, Criterion 11 was ultimately developed to provide the quantitative risk thresholds for making a component HSS. Additionally, prerequisite 1 ensures the PRA model used in the evaluation meets the technical adequacy requirements from the American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) Level 1/Large Early Release Frequency (LERF) PRA standard addressing at-power conditions and all hazards for operating light water reactors (LWRs) for a technically adequate PRA model. Further, prerequisite 4 was also added to specifically state that the PRA model used in the evaluation represents the as-built, as-operated plant and that the PRA information and the passive categorization are appropriately maintained to be up to date; reflect the as-built, as-operated plant.

Given current industry usage of risk-informed categorization techniques, the reactor coolant pressure boundary (Class 1 SSCs) should continue to be HSS in this methodology as it is a fission product barrier. This is reflected in Criteria 1.

The remaining predetermined HSS criteria and prerequisites were developed by including previous consequence evaluation experience in the following tasks:

- Reviewing the potential set of systems that could be categorized in a 10 CFR 50.69 application to determine generic insights into what systems or portion of systems were determined to be HSS and the reasons why they were determined to be HSS,
- Reviewing the potential set of systems that could be categorized in a 10 CFR 50.69 application to determine generic insights into what systems or portion of systems were determined to be LSS and the reasons why they were determined to be LSS,
- Reviewing the systems not typically included in a 10 CFR 50.69 application (e.g., non-safety related systems) from a functional perspective to determine if there were safety improvement opportunities available,
- Examining how pressure boundary components that interface with multiple systems could be treated,
- Examining how Regulatory Guide 1.200 compliant PRAs modeled pressure boundary components and how that differs from the existing NRC-approved methodology for RI-categorizing pressure boundary components,
- Examining the inputs and assumptions in the existing NRC-approved methodology for RI-categorizing pressure boundary components that contribute HSS versus LSS assignment (e.g., safety function redundancy), and
- Examining the inputs and assumptions in Regulatory Guide 1.200 compliant PRAs that contribute to low values of CDF and LERF (e.g., prerequisites 1, 2, 3 and 4)

Throughout each task the considerations for unique plant design attributes were considered.

5.1 System Scope Reviews

While the breadth of applying risk-technology to the pressure boundary is widespread, RI-ISI experience is somewhat limiting in that with the exception of a few plants (ANO-2, JAF, MP3, Surry 1 and 2, Ringhals 2, 3 and 4 and more recently Canada), it is typically only applied to Class 1 and 2 systems. As a result, a list of BWR and PWR systems were reviewed in Tables 4 and 5 to document important insights and to supplement the existing database of experience. For example, it is noted that 10 CFR 50.69 is not being implemented on non-safety systems because there is no benefit in doing, thus, the new methodology (Criterion 11) is aimed at identifying risk significant pressure boundary failures on a design specific and plant specific basis, regardless of safety class. Table 7 provides a listing of design specific and plant-specific voluntary safety improvements based on implementation of Criterion 11 to a subset of plants. These safety improvements include hardware changes and new or revised operating procedure to reduce the risk associated with postulated pressure boundary failures.

The following summarizes the system review contained in Table 4 (BWRs) and Table 5 (PWRs) and the columns in these tables are explained below:

- A number of instrumentation and control (I&C) and electrical systems do not have pressure boundary components. If there are no pressure boundary components, no further evaluation is required as the enhanced methodology contained in Chapter 4 is limited to the pressure boundary function. However, the methodology does require that pressure boundary failures that could adversely impact I&C and electrical equipment (e.g., due to indirect effects) be assessed on a plant-specific basis (Criterion 11 accounts for this).
- A key factor that determines the risk significance of a component or system is its functional importance. This consideration determines whether the system is modeled in the internal events PRA and if so, whether the component/system is important. Many systems are not safety-related and are also not functionally important to PRA risk (e.g., not explicitly modeled in the PRA with a directly quantifiable CDF/LERF result). Some safety-related systems support PRA critical safety functions (see Table 6) and thus total failure of the system could be important. However, because of system redundancy and layers of defense in depth which are not affected by 10 CFR 50.69 implementation, a single pressure boundary failure does not typically fail a safety function or even a single system in most cases. Any pressure boundary failure that could fail a safety function is considered a high consequence (HSS). Criterion 5 (loss of ultimate heat sink), Criterion 6 (loss of ECCS), Criterion 7 (loss of secondary cooling in a PWR), Criterion 8 (loss of CCW in a PWR) and Criterion 11 address loss of safety functions.
- Pressure boundary failure experience is considered which addresses whether system pressure boundary failures are modeled in PRA (spatial impacts from HELB, internal flooding etc.) and consequence evaluation experience. For pressure boundary failures associated with fluid systems (not air or ventilation), the PRA must consider these as part of the internal flooding analysis and Criterion 11 will address safety significance.

Tables 4 and 5 provide a comprehensive list of BWR and PWR systems. A premise of this review is that the PRA, including the internal flooding analysis (Criteria 11 of Section 4), will capture the most significant pressure boundary failures. This evaluation was conducted to identify where pressure boundary failures may be important and require further consideration, either because the system is not a flood source (e.g., air or ventilation) or where consequence evaluation experience has indicated HSS assignment may be appropriate. The following summarizes the columns in Tables 4 and 5:

- The "*PB*" column asks whether the system contains any pressure boundary components. If the answer is *No*, passive SSC categorization does not apply. However, all other aspects of 10 CFR 50.69 categorization apply if the system is selected for 10 CFR 50.69 categorization. If the system is not selected all SSCs of the system remain uncategorized and retain their special treatments.
- The "*112657 Existing Methodology Experience*" column provides insights into whether the system is typically modeled in the plant PRA (for example, as part of the initiating events and/or plant response models in the internal events PRA model, including internal floods). It also summarizes experience from ~30 years of experience in applying the EPRI 112657 consequence methodology (RI-ISI, 10 CFR 50.69, N-752). In many cases, the system is not modeled in the PRA (suggests low importance), is non-safety related (NSR) and as a result of being NSR there is no experience with regard to consequence evaluations. However, if the system is functionally not important to core damage or large early release, the only way for the system to contain HSS components is via the indirect effects from the failure as modeled in the PRA analysis of pressure boundary failures (HELB, internal floods, etc.). Indirect effects of a pressure boundary failure that affect equipment important to risk (regardless of the source system) is a requirement of a PRA that meets the PRA Standard and risk significance is captured by Criterion 11.

  It is important to note that the passive categorization process is a single pressure boundary failure at a time. Determining whether a single pressure boundary failure is important to risk is different from an active component's PRA importance. When determining active component risk, common cause failures across multiple trains that can fail a complete system are considered. A single pressure boundary failure (required by passive methodology) rarely fails all pumps or discharge paths and flow rates are much lower than a pressure boundary failure on the suction side (e.g., CST, RWST, Suppression Pool, Containment Sump). Pressure boundary failures on the discharge are also detectable and there is time for isolation further ensuring that system and spatial impacts are minimized. Also, the existing methodology accounts for frequency of challenge and exposure time when applicable. For example, using Table 3-5 of TR-112657, the frequency of challenging ECCS (LOCA conditions) is ~1E-3 or less and therefore per Table 3-5 only one unaffected backup train is needed to obtain a medium consequence rank (i.e., CCDP < 1E-04).

- The "*3002025288 Coverage"* column identifies the applicable criteria that covers the potential high-risk criterion based on the pervious column.

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Main Steam (MS)	Yes	– Steam line breaks inside and outside Drywell are modeled in the PRA – Heat removal via main condenser is modeled, but not HSS because of the backup heat removal capabilities (suppression pool cooling and containment venting) – Inside Drywell LOCA has CCDP>1E-4 and this scope is Class 1 HSS to the outside isolation valve – Beyond Class 1 boundary outside Drywell is usually NSR and not evaluated for 10 CFR 50.69 unless part of main steam system scope	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis whether SR or NSR
Service Water (SW) (Ultimate Heat Sink)	Yes	– Function is modeled in PRA – Total loss of essential safety related SW Is usually HSS (emergency SW) – Loss of 1 of 2 safety trains is LSS – Other NSR service water systems are not evaluated for 10 CFR 50.69 and functionally LSS – SW is evaluated as internal flooding source; significance is plant specific	– Criterion 5: plant must confirm that any PB failure that results in total loss of emergency service water is HSS – Criterion 11 determines risk significance (e.g., HSS) whether SR or NSR for all SW systems
Circulating Water	Yes	– Function is modeled in PRA (loss of condenser) – Loss of condenser function is LSS because of the backup heat removal capabilities (suppression pool cooling and containment venting) – System is NSR and not evaluated for 10 CFR 50.69 – Circulating water is evaluated as internal flooding source	– Criterion 11 determines risk significance (e.g., HSS) even though the system is NSR
Meteorological Monitoring	No	– No pressure boundary components	– No pressure boundary components

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Standby Diesels	Yes	– Function is modeled in PRA – Loss of one diesel due to PB failure is LSS because frequency of challenge and backup capabilities ensure CCDP <1E-4 – Diesel support systems (fuel, cooling loop, etc.) are low volume and do not propagate to redundant diesels – Regardless, these fluid systems are in the internal flooding analysis scope and must be addressed – Exception is service water interface with diesel coolers (at some plants SW floods in diesel rooms are HSS)	– Criterion 10: ensure that all heat exchangers in the plant are evaluated to ensure this interface is not missed – Criterion 11 determines risk significance on a plant specific basis for the diesel support systems if they are not screened from the PRA scope per the PRA standard
Acid treatment/hypochlorite	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69. Must be considered as internal flooding sources but usually screens from the PRA scope per the PRA standard.	– Criterion 11 determines risk significance on a plant specific basis
Hydrogen water chemistry	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69. Must be considered as internal flooding sources but usually screens from the PRA scope per the PRA standard.	– Criterion 11 determines risk significance on a plant specific basis
Alternate decay heat removal	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69. Must be considered as internal flooding sources but usually screens from the PRA scope per the PRA standard.	– Criterion 11 determines risk significance on a plant specific basis
Service water chemical treatment	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69. Must be considered as internal flooding sources but usually screens from the PRA scope per the PRA standard.	– Criterion 11 determines risk significance on a plant specific basis
Traveling water screens and wash disposal	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69. Must be considered as internal flooding sources but usually screens from the PRA scope per the PRA standard.	– Criterion 11 determines risk significance on a plant specific basis
Reactor building closed loop cooling	Yes	– Function is modeled in PRA – Loss of function is LSS because no impact on safe shutdown equipment – NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding sources but usually screens from PRA scope due to low volume per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Turbine closed loop cooling	Yes	– Function is modeled in PRA – Loss of function is LSS because no impact on safe shutdown equipment – NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding sources but usually screens from PRA due to low volume per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis
Makeup water treatment	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding sources but usually screens from the PRA scope per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis
Makeup water storage and transfer	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding sources	– Criterion 11 determines risk significance on a plant specific basis
Process sampling	Yes	– Function not modeled in PRA – Small lines do not impact interface systems (e.g., flow diversion) – Must be considered as internal flooding sources	– Criterion 11 determines risk significance on a plant specific basis
Instrument and service air	Yes	– Function is modeled including initiating event – Safety related interfaces have accumulators – LSS due to limited impact on safety systems – Not a flood source	– LSS
Moisture separator reheater	Yes	– See "Main Steam"	– Criterion 11 determines risk significance on a plant specific basis
Breathing air	Yes	– Function is not modeled in PRA, is NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS
Main turbine	No	– No pressure boundary components	– No pressure boundary components
Turbine generator lube oil	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA due to limited volume and location per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis Note that other parts of the categorization process address importance of systems to fire risk

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Generator hydrogen seal oil	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from PRA due to limited volume and location per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis Note that other parts of the categorization process address importance of systems to fire risk
Main turbine electrohydraulic control	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA due to limited volume and location per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis
Generator isolated phase duct cooling	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA due to limited volume and location per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis
Auxiliary steam, condensate, and gland seal	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA due to limited volume and location per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis
Generator stator and exciter rectifier cooling	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA due to limited volume and location per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis
Generator H_2 and CO_2	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Not a flood source	– LSS - Note that other parts of the categorization process address importance of systems to fire risk

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Reactor recirculation	Yes	– LOCA initiating event, Class 1 is HSS – Beyond Class 1 boundary is LSS but needs to be confirmed by PRA. Shutdown can occur without recirc seal cooling and forced circulation.	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis whether SR or NSR
Condensate and feedwater	Yes	– Function is modeled in PRA, but not HSS because of the numerous backup sources – Breaks inside & outside Drywell are modeled – Inside Drywell LOCA has CCDP>1E-4 and this scope is Class 1 HSS to the outside isolation valve – Beyond Class 1 boundary outside Drywell is usually NSR and not evaluated for 10 CFR 50.69 unless part of the feedwater system scope	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis whether SR or NSR
Control rod drive	Yes	– Function is modeled in the PRA but not HSS because of the numerous makeup sources and scram function is fail-safe and highly reliable – CRD interface with CST must be considered as an internal flooding source – Class 1 components must be HSS regardless of CCDP – Scram discharge volume break evaluated (e.g., NUREG-0803) and shown not to be a high consequence	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) beyond Class1 boundary on a plant specific basis whether SR or NSR

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Residual heat removal	Yes	– Function is modeled in PRA (both LPCI and heat removal functions) – With exception of suppression pool drain down, there are two trains and numerous other makeup sources (LSS) – Complete loss of heat removal requires loss of main condensers, both suppression pool cooling trains and containment venting (LSS) – Heat exchanger interface with RCS during shutdown requires evaluation (not considered in RI-ISI experience) – At some older BWRs suppression pool cooling is accomplished via containment spray heat exchangers and there is a separate shutdown cooling system (both of these have redundant trains) – Suppression pool is a flood source that must be considered in the PRA	– Criterion 1: Class 1 is HSS – Criterion 6: suppression pool connections are HSS – Criterion 9: heat exchanger interface with RCS during shutdown must be evaluated – Criterion 10: heat exchanger interface with service water must be evaluated – Criterion 11 determines risk significance (e.g., HSS) on a plant specific basis
Low-pressure core spray	Yes	– Function is modeled in PRA – With exception of suppression pool drain down, there are two trains and numerous other makeup sources (LSS) – Suppression pool is a flood source that must be considered in the PRA	– Criterion 1: Class 1 is HSS – Criterion 6: suppression pool connections are HSS – Criterion 11 determines risk significance (e.g., HSS) on a plant specific basis
HPCS or HPCI	Yes	– Function is modeled in PRA – Normally aligned to CST but auto switches to suppression pool – With exception of suppression pool drain down, there are numerous other makeup sources (LSS) – Suppression pool is a flood source that must be considered in the PRA	– Criterion 1: Class 1 is HSS – Criterion 6: suppression pool connections are HSS – Criterion 11 determines risk significance (e.g., HSS) on a plant specific basis
Nuclear boiler ADS and SRVs	Yes	– Function is modeled in PRA – Class 1 scope is HSS – Downstream of Class 1 - redundancy and pressure boundary failure supports the pressure control function (LSS) – Instrument lines may be part of this system scope and may or may not be Class 1. Regardless, if not Class 1, failure of a single instrument line is not HSS in the PRA because in some cases failure creates a signal success and other cases there is redundancy.	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) on a plant specific basis

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Reactor core isolation cooling	Yes	– Function is modeled in PRA – Normally aligned to CST but auto switches to suppression pool – With exception of suppression pool drain down, there are numerous other makeup sources (LSS) – Suppression pool is a flood source that must be considered in the PRA	– Criterion 1: Class 1 is HSS – Criterion 6: suppression pool connections are HSS – Criterion 11 determines risk significance (e.g., HSS) on a plant specific basis
Emergency Condenser (Isolation Condenser)	Yes	– Function is modeled in PRA – Backups to loss of this function include numerous inventory makeup sources (LSS) – Regarding heat removal: there are two trains of suppression pool cooling and containment venting (LSS) – Breaks inside & outside Drywell are modeled in the PRA – Inside Drywell LOCA has CCDP>1E-4 and this scope is Class 1 HSS to the outside isolation valve – Beyond Class 1 boundary outside Drywell is included in the PRA as potential LOCA outside containment and/or flood source	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis
Standby liquid control	Yes	– Function is modeled in PRA – The frequency of challenge and probability of ATWS ensure this function is LSS – Class 1 components are HSS – Breaks outside containment beyond Class 1 scope are considered in the PRA	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis
Redundant reactivity control	No	– No pressure boundary components	– No pressure boundary components
Reactor water cleanup	Yes	– Function not modeled in PRA except for auto isolation during ATWS – Breaks inside & outside Drywell are modeled – Inside Drywell LOCA has CCDP>1E-4 and this scope is Class 1 HSS to the outside isolation valve – Beyond Class 1 boundary outside Drywell is usually NSR but is evaluated in the PRA as a potential LOCA outside containment – Interface with RCS via heat exchangers need to be evaluated	– Criterion 1: Class 1 is HSS – Criterion 9: heat exchanger interface with RCS must be evaluated – Criterion 10: heat exchanger interface with service water or RBCCW must be evaluated – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Spent fuel pool cooling and cleanup	Yes	– Function not modeled in PRA – Must be considered as flood source although design precludes draining more than a few inches from the pool	– Criterion 11 determines risk significance on a plant specific basis
Fuel handling and reactor service equipment	No	– No pressure boundary components	– No pressure boundary components
Condensate storage and transfer	Yes	– Function is modeled in PRA, but is not HSS because RCIC & HPCI auto transfer to suppression pool and LPCI/LPCS are normally aligned to suppression pool – Must be considered a flood source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Off-gas	Yes	– Functional impact is loss of main condenser but this is LSS due to backup heat removal systems – NSR, not evaluated for 10 CFR 50.69 and not a flood source	– LSS
Fire protection – water	Yes	– Function not modeled in PRA except as another external makeup source to RPV which is LSS dues to numerous makeup sources – NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source and can be important on plant specific basis	– Criterion 11 determines risk significance on a plant specific basis Note that other parts of the categorization process address importance of systems to fire risk
Fire protection – foam	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS - Note that other parts of the categorization process address importance of systems to fire risk
Fire protection – carbon dioxide	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS - Note that other parts of the categorization process address importance of systems to fire risk
Fire protection – halon	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS - Note that other parts of the categorization process address importance of systems to fire risk
Fire detection	No	– No pressure boundary components	– No pressure boundary components
Auxiliary boiler	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Hot water and glycol heating	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69	– Criterion 11 determines risk significance on a plant specific basis

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
		– Must be considered as internal flooding source in PRA	
Condensate demineralizer	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Domestic water	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Sanitary plumbing	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Reactor building ventilation	Yes	– -Function not usually modeled in PRA (large building, redundancy, time, and multiple unit coolers) – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Control building ventilation	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – With regard to protecting operators from hazards, frequency of these accident is low and there is either pressure boundary redundancy or other backup actions such as using portable self-contained breathing apparatus to protect operations personnel – If applicable, service water interface with unit coolers need to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Standby switchgear/battery room ventilation	Yes	– Function may not be modeled in PRA but there is redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Normal switchgear building ventilation	Yes	– Function may not be modeled in PRA but this is NSR and not evaluated for 10 CFR 50.69 – Loss of offsite power is equivalent and LSS – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Ventilation – chilled water	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – Limited flood source volume that must be considered in PRA	– Criterion 11 determines risk significance on a plant specific basis
Turbine building ventilation	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Radwaste building ventilation	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Diesel generator building ventilation	Yes	– Function is modeled in PRA – Impact is loss of one diesel (see "Standby Diesels" above) LSS – If applicable, service water interface with unit coolers need to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Screenwell and fire pump room ventilation	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Electrical tunnels ventilation	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Auxiliary building ventilation	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Miscellaneous ventilation	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Drywell cooling	Yes	– Function not usually modeled because capacity insufficient for accident conditions; however, loss of system may be modeled as an initiating event because of forced shutdown and potential impacts due to Drywell heat up (LSS) – Equipment is inside the Drywell where cooler interfaces (e.g., service water) is screened from internal flooding	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Primary containment ventilation, purge, and nitrogen	Yes	– Both containment venting and containment isolation are modeled in the PRA – Frequency of challenge is low (post core damage releases for containment isolation and loss of suppression pool cooling and main condenser for containment venting) – Not a flood source	– LSS
Standby gas treatment	Yes	– Function not modeled in PRA – Frequency of challenge is low, releases (LSS) – Not a flood source	– LSS

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
DBA hydrogen recombiner	Yes	– Function not modeled in PRA – Frequency of challenge is low, core damage (LSS) – Not a flood source	– LSS
Reactor building drains	Yes	– Function not explicitly modeled, but may be credited in the internal flood analysis. Pressure boundary failure along the drain path could propagate the flood to an unplanned location.	– Prerequisite 3: requires evaluation to make LSS or must leave drains uncategorized
Turbine building drains	Yes	– Function not explicitly modeled, but may be credited in the internal flood analysis. Pressure boundary failure along the drain path could propagate the flood to an unplanned location.	– Prerequisite 3: requires evaluation to make LSS or must leave drains uncategorized
Radwaste building drains	Yes	– Function not explicitly modeled, but may be credited in the internal flood analysis. Pressure boundary failure along the drain path could propagate the flood to an unplanned location.	– Prerequisite 3: requires evaluation to make LSS or must leave drains uncategorized
Miscellaneous drains	Yes	– Function not explicitly modeled, but may be credited in the internal flood analysis. Pressure boundary failure along the drain path could propagate the flood to an unplanned location.	– Prerequisite 3: requires evaluation to make LSS or must leave drains uncategorized
Drywell equipment and floor drains	Yes	– Function not explicitly modeled, but may be credited in the internal flood analysis. Pressure boundary failure along the drain path could propagate the flood to an unplanned location.	– Prerequisite 3: requires evaluation to make LSS or must leave drains uncategorized
Main generator exciter, transformer, switchyard, and protection	No	– No pressure boundary components	– No pressure boundary components
Station electric feed and switchyard	No	– No pressure boundary components	– No pressure boundary components
13.8KV AC power distribution	No	– No pressure boundary components	– No pressure boundary components
4.16KV AC power distribution	No	– No pressure boundary components	– No pressure boundary components
600V AC power distribution	No	– No pressure boundary components	– No pressure boundary components
Uninterruptible power supplies	No	– No pressure boundary components	– No pressure boundary components
Standby and emergency AC distribution	No	– No pressure boundary components	– No pressure boundary components

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Normal DC distribution	No	– No pressure boundary components	– No pressure boundary components
24/48 volt DC distribution	No	– No pressure boundary components	– No pressure boundary components
Emergency DC distribution	No	– No pressure boundary components	– No pressure boundary components
HPCS 125VDC	No	– No pressure boundary components	– No pressure boundary components
Station lighting	No	– No pressure boundary components	– No pressure boundary components
Plant communications	No	– No pressure boundary components	– No pressure boundary components
Remote shutdown	No	– No pressure boundary components	– No pressure boundary components
Radiation monitoring	Yes	– Area radiation monitoring does not have pressure boundary components – Process radiation monitoring does have pressure boundary components, but function is not modeled in the PRA – Small lines do not impact interface systems (e.g., flow diversion) or flooding	– Criterion 11 determines risk significance on a plant specific basis
Feedwater heaters and extraction steam	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Impact is subsumed by main feedwater and main steam above (LSS) – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Containment leakage monitoring	Yes	– Function not modeled in PRA – There is physical redundancy and small lines – Not a flood source	– LSS
Containment atmosphere monitoring	Yes	– Function not modeled in PRA – There is physical redundancy and small lines – Not a flood source	– LSS
Primary containment isolation	Yes	– Function is modeled in the PRA but not HSS due to several reasons (frequency of core damage challenge, backup on both sides of penetration or small lines screen from LERF)	– LSS
Reactor building crane	No	– No pressure boundary components	– No pressure boundary components
Loose parts monitoring	No	– No pressure boundary components	– No pressure boundary components
Condenser air removal	Yes	– Functional impact is loss of main condenser but this is LSS due to backup heat removal systems – NSR, not evaluated for 10 CFR 50.69 and not a flood source	– LSS
Seismic monitoring	No	– No pressure boundary components	– No pressure boundary components

Table 4
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Process computer	No	– No pressure boundary components	– No pressure boundary components
Safety parameter display	No	– No pressure boundary components	– No pressure boundary components
Neutron monitoring	No	– No pressure boundary components	– No pressure boundary components
Traversing in-core probe	No	– No pressure boundary components	– No pressure boundary components
Rod worth minimizer	No	– No pressure boundary components	– No pressure boundary components
Rod sequence control	No	– No pressure boundary components	– No pressure boundary components
Reactor manual control and rod position indication	No	– No pressure boundary components	– No pressure boundary components
Reactor protection system	No	– No pressure boundary components	– No pressure boundary components
Buildings and structures	N/A	– Not modeled and not flood source, but also not in the scope of pressure boundary categorization	– Building and structures are not part of pressure boundary categorization scope and cannot be categorized LSS
Doors (if not part of buildings and structures above)	Yes	– Function may not be explicitly modeled, but may be credited in the internal flood and HELB analysis	– Prerequisite 3: requires evaluation to make LSS or must leave doors uncategorized. Note that doors may have several functions that need evaluation to make LSS (Flood, HELB, Radiation, Security etc.)

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Auxiliary boiler/auxiliary steam	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Auxiliary feedwater	Yes	– Function is modeled in PRA – With exception of the common CST the pumps and discharge side have redundancy and are LSS (lower flow rates, isolability, feed & bleed) – A reliable backup to the CST is required to ensure LSS for the CST – Must be considered a flood source in PRA	– Criterion 7: requires a reliable backup to the CST, otherwise CST & suction paths are HSS – Criterion 11 determines risk significance on a plant specific basis
Condenser	Yes	– Function is modeled in PRA (loss of condenser) – Loss of condenser function is LSS because of the backup heat removal capabilities (steam generators, auxiliary feedwater, feed & bleed cooling) – Condenser is NSR and not evaluated for 10 CFR 50.69 – Condenser is evaluated as internal flooding source	– Criterion 11 determines risk significance on a plant specific basis
HP heater drains and vent	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Impact is subsumed by main feedwater and main steam (LSS) – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
LP heater and vent	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Impact is subsumed by main feedwater and main steam (LSS) – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Feedwater	Yes	– Function is modeled in the PRA, but LSS because of backup capabilities (auxiliary feedwater, feed & bleed cooling) – Feedwater line breaks are modeled in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Gland seal water supply	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from PRA scope due to limited volume and location per the PRA Standard	– Criterion 11 determines risk significance on a plant specific basis

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Feedwater pump injection and miscellaneous	Yes	– Function if conservatively assumed to impact Feedwater is LSS (see "Feedwater" above) – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Condensate	Yes	– Function is modeled in the PRA, but LSS because of backup capabilities (auxiliary feedwater, feed & bleed cooling) – Feedwater/condensate line breaks are modeled in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Condensate demineralizer	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Condensate storage and transfer	Yes	– Function is modeled in PRA and can be HSS if no reliable backup to the CST (see also "Auxiliary Feedwater" above) – Must be considered a flood source in PRA	– Criterion 7: requires a reliable backup to the CST, otherwise CST & suction paths are HSS – Criterion 11 determines risk significance on a plant specific basis
Condensate and feedwater treatment system/secondary chemistry control	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69. Must be considered as internal flooding sources but usually screens from the PRA scope per the PRA Standard.	– Criterion 11 determines risk significance on a plant specific basis
Condenser vacuum (off-gas)	Yes	– Functional impact is loss of main condenser but this is LSS due to backup heat removal systems (see "Condenser") – NSR, not evaluated for 10 CFR 50.69 and not a flood source	– LSS
13800V normal AC auxiliary power distribution	No	– No pressure boundary components	– No pressure boundary components
6900V normal AC auxiliary power distribution	No	– No pressure boundary components	– No pressure boundary components
480V normal AC auxiliary power distribution	No	– No pressure boundary components	– No pressure boundary components
6900V Class 1E AC auxiliary power distribution	No	– No pressure boundary components	– No pressure boundary components

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
480V Class 1E AC auxiliary power distribution	No	– No pressure boundary components	– No pressure boundary components
120V Class 1E AC vital power distribution	No	– No pressure boundary components	– No pressure boundary components
Class 1E AC auxiliary power distribution	No	– No pressure boundary components	– No pressure boundary components
480Y/277V normal AC lighting	No	– No pressure boundary components	– No pressure boundary components
208Y/120V normal AC lighting	No	– No pressure boundary components	– No pressure boundary components
208Y/120V standby AC lighting	No	– No pressure boundary components	– No pressure boundary components
125V normal DC power distribution	No	– No pressure boundary components	– No pressure boundary components
250V normal DC power distribution	No	– No pressure boundary components	– No pressure boundary components
125V normal DC power distribution	No	– No pressure boundary components	– No pressure boundary components
26V turbine DC power distribution	No	– No pressure boundary components	– No pressure boundary components
24V DC power distribution	No	– No pressure boundary components	– No pressure boundary components
125V Class 1E vital power distribution	No	– No pressure boundary components	– No pressure boundary components
120V normal AC power distribution	No	– No pressure boundary components	– No pressure boundary components
48V telephone AC power distribution	No	– No pressure boundary components	– No pressure boundary components
120V computer AC power distribution	No	– No pressure boundary components	– No pressure boundary components

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
120V instrument AC power distribution	No	– No pressure boundary components	– No pressure boundary components
Fuel oil dispenser	Yes	– May be modeled with diesels (importance is same as diesel because each diesel has an independent oil supply). See "Emergency diesel generator" – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Breathing air	Yes	– Function is not modeled in PRA, is NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS
CO_2 storage, fire protection, and purging	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS - Note that other parts of the categorization process address importance of systems to fire risk
Nitrogen	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS
Hydrogen storage and transfer	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS - Note that other parts of the categorization process address importance of systems to fire risk
Nitrogen storage and transfer	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS
Annunciators	No	– No pressure boundary components	– No pressure boundary components
Integrated control	No	– No pressure boundary components	– No pressure boundary components
Engineered safety features actuation system (ESFAS)	No	– No pressure boundary components	– No pressure boundary components
Backup scram	No	– No pressure boundary components	– No pressure boundary components
Integrated control	No	– No pressure boundary components	– No pressure boundary components
ECCS and reactor coolant leak detection	Yes	– Function not modeled in PRA – There is physical redundancy and small lines (LSS) – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Temperature monitoring	No	– No pressure boundary components	– No pressure boundary components

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Solid state control	No	– No pressure boundary components	– No pressure boundary components
In-core monitoring	No	– No pressure boundary components – Class 1 interface with RCS, if applicable is HSS	– No pressure boundary components – Criterion 1: Class 1 if applicable is HSS
Nuclear instrumentation / reactor protection system and protection system auxiliary cabinets	No	– No pressure boundary components	– No pressure boundary components
Radiation monitoring	Yes	– Area radiation monitoring does not have pressure boundary components – Process radiation monitoring does have pressure boundary components, but function is not modeled in the PRA – Small lines do not impact interface systems (e.g., flow diversion) or flooding but must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Nonnuclear instrumentation / essential controls and instrumentation	No	– No pressure boundary components	– No pressure boundary components
Environmental monitoring	No	– No pressure boundary components	– No pressure boundary components
Core loose parts monitoring	No	– No pressure boundary components	– No pressure boundary components
Seismic instrumentation	No	– No pressure boundary components	– No pressure boundary components
Component cooling	Yes	– Function is modeled in the PRA and can be HSS if two physically independent trains cannot be demonstrated – Heat exchanger interface with service water must be evaluated – Must be considered as internal flooding source in PRA	– Criterion 8: requires system to be HSS if pressure boundary failure can drain both safety trains of CCW – Criterion 10: heat exchanger interface with service water must be evaluated – Criterion 11 determines risk significance on a plant specific basis

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Control rod drive cooling water	Yes	– Function is not modeled in the PRA – Must be considered as internal flooding source in PRA	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS)
Essential raw cooling water	Yes	– Function is modeled in PRA – Total loss of essential safety related service water is usually HSS (emergency SW) – Loss of 1 of 2 safety trains is LSS – SW is evaluated as internal flooding source; importance is plant specific	– Criterion 5: plant must confirm that any PB failure that results in total loss of emergency service water is HSS – Criterion 10: other system heat exchanger interfaces with service water must be evaluated – Criterion 11 determines risk significance (e.g., HSS) whether SR or NSR for all SW systems
Circulating Water	Yes	– Function is modeled in PRA (loss of condenser) – Loss of condenser function is LSS because of the backup heat removal capabilities (see "Condenser") – System is NSR and not evaluated for 10 CFR 50.69 – Circulating water is evaluated as internal flooding source	– Criterion 11 determines risk significance on a plant specific basis
Raw cooling water	Yes	– Function is modeled in PRA – Total loss of essential safety related service water is usually HSS (emergency SW) – Loss of 1 of 2 safety trains is LSS – Other NSR service water systems are not evaluated for 10 CFR 50.69 and functionally LSS – Raw cooling water (e.g., SW) is evaluated as internal flooding source; importance is plant specific	– Criterion 5: plant must confirm that any PB failure that results in total loss of emergency service water is HSS – Criterion 10: other system heat exchanger interfaces with service water must be evaluated – Criterion 11 determines risk significance (e.g., HSS) whether SR or NSR for all SW systems

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Lube oil	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA scope due to limited volume and location per the PRA Standard	– Criterion 11 determines risk significance on a plant specific basis – Note that other parts of the categorization process address importance of systems to fire risk
Access system	No	– No pressure boundary components	– No pressure boundary components
Heat trace system	No	– No pressure boundary components	– No pressure boundary components
Elevators, reactor building, turbine building, auxiliary building, and service and office building	NA	– Not modeled and not flood source, but also not in the scope of pressure boundary categorization	– Buildings and structures are not part of pressure boundary categorization scope and cannot be categorized LSS
Doors (if not part of Buildings and Structures above)	Yes	– Function may not be explicitly modeled, but may be credited in the internal flood and HELB analysis	– Prerequisite 3: requires evaluation to make LSS or must leave doors uncategorized. Note that doors may have several functions that need evaluation to make LSS (Flood, HELB, Radiation, Security etc.)
Clothing decontamination	No	– No pressure boundary components	– No pressure boundary components
Lab gas	Yes	– Function not modeled in the PRA, is NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS
Material and equipment handling	No	– No pressure boundary components	– No pressure boundary components
Machine shop equipment	No	– No pressure boundary components	– No pressure boundary components

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Chemical & Volume Control	Yes	– Important functions modeled in PRA include high pressure injection and RCP seal cooling; functionally the system is LSS given its failure – High pressure injection: there are several backups which includes high and low pressure safety injection paths (see ECCS) – RCP seal cooling: CCW provides backup seal cooling and even if seal LOCA did occur ECCS can mitigate – Interface with RCS via heat exchangers need to be evaluated – Must be considered as flood source in the PRA	– Criterion 1: Class 1 is HSS – Criterion 6: requires the RWST and its common ECCS suction pipe to be HSS (also, containment sump path if applicable must be considered) – Criterion 9: heat exchanger interface with RCS must be evaluated – Criterion 10: heat exchanger interface with service water or CCW must be evaluated – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis
Reactor coolant	Yes	– LOCA initiating event, Class 1 is HSS – Beyond Class 1 boundary is LSS but needs to be confirmed by PRA	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis whether SR or NSR
Decay heat removal	Yes	– Function is modeled in the PRA, but LSS because there are redundant capabilities for heat removal. Complete loss of heat removal requires loss of main condensers, secondary cooling with steam generators etc. – Interface with RCS is Class 1 HSS – Heat exchanger interface with RCS requires evaluation (not considered in RI-ISI experience)	– Criterion 1: Class 1 is HSS – Criterion 9: heat exchanger interface with RCS during shutdown must be evaluated – Criterion 10: heat exchanger interface with service water or CCW must be evaluated – Criterion 11 determines risk significance (e.g., HSS) on a plant specific basis
Fuel handling/reactor service	No	– No pressure boundary components	– No pressure boundary components
Containment isolation penetration/leak test	Yes	– Function not modeled in the PRA, leak test is NSR and not evaluated for 10 CFR 50.69	– LSS

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
		– Containment penetrations are considered part of the containment structure and are not categorized (remain uncategorized and safety related) – Not a flood source	
Reactor coolant system drains and vents	Yes	– Class 1 scope may be HSS with CCDP>1E-4 – Function not explicitly modeled, but may be credited in the internal flood analysis. Pressure boundary failure along the drain path could propagate the flood to an unplanned location.	– Criterion 1: Class 1 is HSS – Prerequisite 3: requires evaluation to make LSS or must leave drains uncategorized
Core flooding and ECCS	Yes	– Function is modeled in PRA and is LSS because of backup ECCS (high pressure and low-pressure injection trains) and frequency of challenge – The RWST suction source (common to ECCS) is HSS because loss of RWST will fail all ECCS – RWST water source is considered as infernal flooding source in PRA	– Criterion 6: requires the RWST and its common ECCS suction pipe to be HSS (also, containment sump path if applicable must be considered) – Criterion 11 determines risk significance on a plant specific basis
Spent fuel cooling and cleaning	Yes	– Function not modeled in PRA – Must be considered as flood source although design precludes draining more than a few inches from the pool	– Criterion 10: heat exchanger interface with service water or CCW must be evaluated – Criterion 11 determines risk significance on a plant specific basis
Containment combustible gas control	Yes	– Function not modeled in PRA – Frequency of challenge is low, core damage (LSS) – Not a flood source	– LSS
Control rod drive	Yes	– Function is modeled in the PRA but not HSS because scram function is fail-safe and highly reliable – Class 1 components must be HSS whether CCDP is greater than 1E-4 or not	– Criterion 1: Class 1 is HSS – Criterion 11 determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis whether SR or NSR
Reactor building (containment) spray	Yes	– Function is usually modeled in PRA and is LSS because of backup containment heat removal systems – The RWST suction source (common to ECCS as well) is HSS because loss of RWST will fail all ECCS – RWST water source is considered as internal flooding source in PRA	– Criterion 6: requires the RWST and its common ECCS suction pipe to be HSS (also, containment sump path if applicable must be considered)

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
			– Criterion 10: heat exchanger interface with service water or CCW must be evaluated – Criterion 11 determines risk significance on a plant specific basis
Ice Condenser	Yes	– This system (located inside containment) in certain PWRs may or may not be explicitly modeled, but the system is very reliable with multiple backups, including pressure boundary components. Also, the frequency of challenge (e.g., LOCA) is low supporting an LSS categorization.	– LSS
Makeup and purification	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding sources but usually screens from the PRA scope per the PRA Standard	– Criterion 6: if connected to RWST source, this will be evaluated as HSS – Criterion 11 determines risk significance on a plant specific basis
Annunciation and operations supporting	No	– No pressure boundary components	– No pressure boundary components
Sound-powered telephone	No	– No pressure boundary components	– No pressure boundary components
Code call, alarm, and paging	No	– No pressure boundary components	– No pressure boundary components
DACOADA and automatic dispatching control circuit	No	– No pressure boundary components	– No pressure boundary components
Communication equipment alarm	No	– No pressure boundary components	– No pressure boundary components
Miscellaneous intercom	No	– No pressure boundary components	– No pressure boundary components
Microwave radio	No	– No pressure boundary components	– No pressure boundary components
Closed circuit television	No	– No pressure boundary components	– No pressure boundary components
Communication test and fire detection	No	– No pressure boundary components	– No pressure boundary components
VHF radio	No	– No pressure boundary components	– No pressure boundary components

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Security	No	– No pressure boundary components	– No pressure boundary components
Automatic telephone	No	– No pressure boundary components	– No pressure boundary components
Reactor building	NA	– Not in the scope of pressure boundary categorization	– Building and structures are not part of pressure boundary categorization scope and cannot be categorized LSS
Condenser cleaning	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 (worst case is loss of condenser - see "Condenser") – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Demineralized water	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as internal flooding source in PRA	– Criterion 11 determines risk significance on a plant specific basis
Fire protection	Yes	– Function not modeled in PRA except possibly as backup cooling supply (LSS because requires several failures) – NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source and can be important on plant-specific basis	– Criterion 11 determines risk significance on a plant specific basis Note that other parts of the categorization process address importance of systems to fire risk
Diesel generator starting air	Yes	– May be modeled with diesels (importance is same as diesel because each diesel has it independent air supply). See "Emergency diesel generator" – Not a flood source	– LSS
Service air	Yes	– Function is not usually modeled in the PRA (backup via cross tie to instrument air might be modeled, but low importance), is NSR and not evaluated for 10 CFR 50.69 – LSS due to no impact on safety systems – Not a flood source	– LSS
Control air	Yes	– Function is modeled including initiating event – Safety related interfaces have accumulators – LSS due to limited impact on safety systems – Not a flood source	– LSS

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Essential air	Yes	– Function is modeled including initiating event – Safety related interfaces have accumulators – LSS due to limited impact on safety systems – Not a flood source	– LSS
Service water (SW)	Yes	– Function is modeled in PRA – Total loss of essential safety related SW Is usually HSS (emergency SW) – Loss of 1 of 2 safety trains is LSS – Other NSR service water systems are not evaluated for 10 CFR 50.69 and functionally LSS – SW is evaluated as internal flooding source; importance is plant specific	– Criterion 5: plant must confirm that any PB failure that results in total loss of emergency service water is HSS – Criterion 10: other system heat exchanger interfaces with service water must be evaluated – Criterion 11 determines risk significance (e.g., HSS) whether SR or NSR for all SW systems
Emergency diesel generator	Yes	– Function is modeled in PRA – Loss of one diesel due to PB failure is LSS because frequency of challenge and backup capabilities ensure CCDP <1E-4 – Diesel support systems (fuel, cooling loop etc.) are low volume and do not propagate to redundant diesels – Regardless, these fluid systems are in the internal flooding analysis scope and must be addressed – Exception is service water interface with diesel coolers (at some plants SW floods in diesel rooms are HSS)	– Criterion 10: ensure that all heat exchangers in the plant are evaluated to ensure this interface is not missed – Criterion 11 determines risk significance on a plant specific basis for the diesel support systems
Conduit and grounding	No	– No pressure boundary components	– No pressure boundary components
Plant lighting	No	– No pressure boundary components	– No pressure boundary components
Extraction steam	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Impact is subsumed by main feedwater and main steam (LSS) – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Main and reheat steam	Yes	– Main steam breaks are modeled in PRA which are LSS at most plants – Heat removal via main condenser is modeled, but not HSS because of the backup heat removal capabilities (see "Condenser"). Pressure	– Criterion 11 determines risk significance on a plant specific basis

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
		boundary failures also tend to support the secondary cooling function although it can be too much.	
Main steam relief vents	Yes	– Function is modeled in the PRA but LSS based on redundant vent paths that support secondary cooling – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Main turbine instrument and control	No	– No pressure boundary components	– No pressure boundary components
Turbine drains and miscellaneous piping	Yes	– Function not explicitly modeled, but may be credited in the internal flood analysis. Pressure boundary failure along the drain path could propagate the flood to an unplanned location.	– Prerequisite 3: requires evaluation to make LSS or must leave drains uncategorized
Main generator excitation	No	– No pressure boundary components	– No pressure boundary components
Generator hydrogen cooling	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA scope due to limited volume and location per the PRA standard	– Criterion 11 determines risk significance on a plant specific basis
Generator stator cooling	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA scope due to limited volume and location per the PRA Standard	– Criterion 11 determines risk significance on a plant specific basis
Main generator seal oil	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA scope due to limited volume and location per the PRA Standard	– Criterion 11 determines risk significance on a plant specific basis Note that other parts of the categorization process address importance of systems to fire risk

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Turbine steam seal water	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA scope due to limited volume and location per the PRA Standard	– Criterion 11 determines risk significance on a plant specific basis
Miscellaneous turbine vents	Yes	– Functional impact is turbine trip, is NSR and not evaluated for 10 CFR 50.69 – LSS because no impact on safety systems – Potential flood source that must be considered but usually screens from the PRA scope due to limited volume and location per the PRA Standard	– Criterion 11 determines risk significance on a plant specific basis
Auxiliary building trained areas heating and vent	Yes	– Function is not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS
Auxiliary building fuel handling area environmental control	Yes	– Function is not modeled in PRA and is LSS because the frequency of a fuel handling accident is low and there is either pressure boundary redundancy or other backup actions such as using portable self-contained breathing apparatus to protect operations personnel – Not a flood source	– LSS
Auxiliary building common area environmental control	Yes	– Function not usually modeled in PRA because of redundancy, time for backup actions etc. – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Instrument shop HVAC	Yes	– Function not modeled in PRA, is NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
Auxiliary building trained areas air conditioning	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Auxiliary building common area air conditioning	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Diesel generator building HVAC	Yes	– Function is modeled in PRA – Impact is loss of one diesel (see "Emergency Diesel Generator" above) LSS – If applicable, service water interface with unit coolers need to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Reactor building vent and purge	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS
Reactor building heating	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered a flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Reactor building air conditioning	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Control building environmental control	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – With regard to protecting operators from hazards, frequency of these accidents is low and there is either pressure boundary redundancy or other backup actions such as using portable self-contained breathing apparatus to protect operations personnel – If applicable, service water interface with unit coolers need to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Control building non-ESF HVAC	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
		– Not a flood source except for possible service water interface	
CR emergency air	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – With regard to protecting operators from hazards, frequency of these accidents is low and there is either pressure boundary redundancy or other backup actions such as using portable self-contained breathing apparatus to protect operations personnel – Not a flood source	– LSS - Note that other parts of the categorization process address importance of systems to fire risk etc.
Service and office building HVAC	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Intake pumping station HVAC	Yes	– Function not usually modeled in PRA (redundancy, heat up takes time, there are other forms of cooling such as fans, opening doors etc.) – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed
Service building ventilation	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated – Not a flood source except for possible service water interface	– Criterion 11 determines risk significance on a plant specific basis
Service building heating	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Service building air conditioning	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated – Must be considered as flood source in the PRA	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed – Criterion 11 determines risk significance on a plant specific basis
Turbine building air conditioning	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
		– Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Turbine building hot water heating	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Reactor building secondary containment air cleanup	Yes	– Function not modeled in PRA – Frequency of challenge is low, releases (LSS) – Not a flood source	– LSS
Miscellaneous yard building heat and ventilation	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated – Must be considered as flood source in the PRA	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed – Criterion 11 determines risk significance on a plant specific basis
Waste disposal	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Equipment and floor drains	Yes	– Function not explicitly modeled, but may be credited in the internal flood analysis. Pressure boundary failure along the drain path could propagate the flood to an unplanned location.	– Prerequisite 3: requires evaluation to make LSS or must leave drains uncategorized
Gaseous waste disposal	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS
Liquid radwaste disposal	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Heat rejection water treatment	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Health physics lab ventilation	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – If applicable, service water interface with unit coolers needs to be evaluated – Must be considered as flood source in the PRA	– Criterion 10: ensure that all coolers are evaluated to ensure this interface is not missed – Criterion 11 determines risk significance on a plant specific basis
Sanitary waste disposal	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis

Table 5
BWR systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
161-kV switchyard	No	– No pressure boundary components	– No pressure boundary components
500-kV switchyard and AC power distribution	No	– No pressure boundary components	– No pressure boundary components
500-kV/24kV AC main transformers	No	– No pressure boundary components	– No pressure boundary components
Main generator load break switch	No	– No pressure boundary components	– No pressure boundary components
Main generator isolated phase bus	No	– No pressure boundary components	– No pressure boundary components
24kV/13.8kV and 6.9kV unit station service XFRs	No	– No pressure boundary components	– No pressure boundary components
Hypochlorite	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Raw water chlorination	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Cask decontamination	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Potable water system	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Sampling and water quality	Yes	– Function not modeled in PRA – Small lines do not impact interface systems (e.g., flow diversion) or flooding	– Criterion 11 determines risk significance on a plant specific basis
Steam generator secondary side chemical cleaning	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Must be considered as flood source in the PRA	– Criterion 11 determines risk significance on a plant specific basis
Reactor building pressure leakage test	Yes	– Function not modeled in PRA, NSR and not evaluated for 10 CFR 50.69 – Not a flood source	– LSS

Table 6
PWR and BWR Critical Safety Function Review Summary

Function	PWR Key Systems	PWR Insights	BWR Key Systems	BWR Insights
Reactivity Control	Control Rod Drives Boron Injection	• Fail safe design (redundancy and diversity); pressure boundary failures that fail even a single rod insertion has not been identified • Pressure boundary components are inside containment and Class 1 • Boration via CVCS is not HSS because the probability of challenging this function is very low (e.g., ATWS)	CRD Standby Liquid Control	• Fail safe design • Some components inside Drywell are Class 1 & pressure boundary failure only impacts one rod • CRD failures outside Drywell can result in loss of CRD, but procedures instruct operators to Scram and even if this failed each control rod ball check valve will lift and reactor pressure will supply motive force to insert each rod • Scram discharge volume breaks would support the scram function and spatial impacts have been addressed generically at all BWRs to ensure this is not a high consequence (e.g., NUREG-0803, "Generic Safety Evaluation Report Regarding Integrity of BWR Scram System Piping," U.S. Nuclear Regulatory Commission, August 1981.) • Standby Liquid Control is not HSS because the probability of challenging this function is very low (e.g., ATWS)

Table 6
PWR and BWR Critical Safety Function Review Summary

Function	PWR Key Systems	PWR Insights	BWR Key Systems	BWR Insights
Inventory Control	CVCS SI LPI	• Using the existing NRC-approved methodology these systems are LSS due to low frequency of challenge and multiple sets of equipment providing inventory control (e.g., CVCS, SI, LPI) and physical separation of equipment thus providing redundancy such that indirect effects are needed to cause a high consequence • The RWST and containment sump are exceptions (loss of DID) although PRA results may not be a high consequence (Criterion 6) • ISLOCA, internal flooding and other pressure boundary failures modeled in the PRA capture high consequence events that are design/plant-specific issues (see Criterion 11)	Condensate Feedwater RCIC + CST & SP HPCI + CST & SP Core Spray + SP LPCI +SP External sources such as service water and fire protection water	• Using the existing NRC-approved methodology these systems are LSS due to multiple sets of equipment providing inventory control (e.g., RCIC, HPCI, LPI, Core Spray, external sources) and physical separation of equipment thus providing redundancy such that indirect effects are needed to cause a high consequence • The suppression pool is an exception (loss of DID) although PRA results may not be a high consequence (Criterion 6). • As discussed in Section 5.3, Loss of CST is not a high consequence given SP backup as well as others • ISLOCA, internal flooding and other pressure boundary failures modeled in the PRA capture high consequence events that are design/plant-specific issues (see Criterion 11)

Table 6
PWR and BWR Critical Safety Function Review Summary

Function	PWR Key Systems	PWR Insights	BWR Key Systems	BWR Insights
Heat Removal	Main Condenser/MFW EFW/AFW + CST Feed & Bleed (F&B) Containment Heat Removal (RHR, Containment Coolers)	• Using the existing NRC-approved methodology these systems are LSS due to multiple sets of equipment providing for heat removal (e.g., AFW, CST backup and F&B) and physical separation of equipment thus providing redundancy. This ensures no high consequence unless spatial impact • CST failure as discussed in Section 5.3 may be potentially important for plants without backup (e.g., service water and F&B capability) (Criterion 7) • LOCA condition (low frequency of challenge) requires containment heat removal (Criterion 11)	Main Condenser Containment Heat Removal (suppression pool cooling) Containment Venting	• Using the existing NRC-approved methodology these systems are LSS due to multiple sets of equipment providing for heat removal and physical separation of equipment thus providing. Redundancy through suppression pool cooling and containment venting ensuring no high consequence
Pressure Control	PORVs Safety Valve	• Postulated pressure boundary failures would actually support pressure relief. These components are part of the reactor coolant pressure boundary and therefore would be HSS per Criterion 1	SRVs SVs	• Postulated pressure boundary failures would actually support pressure relief, but these components are part of the reactor coolant pressure boundary and therefore would be HSS per Criterion 1

Table 6
PWR and BWR Critical Safety Function Review Summary

Function	PWR Key Systems	PWR Insights	BWR Key Systems	BWR Insights
Key Support Systems	UHS/Service Water EDGs CCW	• UHS/Service water – as discussed in Section 5.3, complete loss of emergency service water at most plants is important and thus Criterion 5 was developed • EDGs are physically independent and low volume systems (not flood concern). Using Table 3-5 of TR-112657, the existing approved methodology, infrequent event, test frequency exposure and more than one backup trains (non-impacted diesel train, OSP recovery, SBO diesel, FLEX) would be a low consequence rank • Because of possible systems interfaces, for some plants there is the possibility that EDG coolers can be a high consequence. Criterion 10 requires that they be assessed using the existing approved methodology and ranked as HSS or LSS accordingly. • CCW – As discussed in Section 5.3, complete loss of CCW can be important and thus Criterion 8 was developed	UHS/Service Water EDGs RBCCW TBCCW	• UHS/Service water – as discussed in Section 5.3, complete loss of emergency service water at most plants is important and thus Criterion 5 was developed • EDGs are physically independent and low volume systems (not flood concern). Using Table 3-5 of TR-112657, the existing approved methodology, infrequent event, test frequency exposure and more than one backup trains (non-impacted diesel train, OSP recovery, SBO diesel, FLEX) would be a low consequence rank. • Because of possible systems interfaces, for some plants there is the possibility that EDG coolers can be high consequence. Criterion 10 requires that they be assessed using the existing approved methodology and ranked as HSS or LSS accordingly. • As discussed Section 5.4.3 (Example 3), using the existing approved methodology, loss of RBCLC and TBCLC would not results in a high consequence rank (no impact on ECCS, no impact on safety related heat removal, etc.)

5.2 System Interfaces

Typically, the RI-ISI evaluation scope includes piping welds and their interface with components (e.g., piping, piping welds, valve bodies, pump bodies, bolting). With the advent of risk informed repair replacement and 10 CFR 50.69 applications, other system interfaces were brought into consideration. This included, for example, heat exchanger tubes, chillers, pump coolers, ventilation coolers. While the consequence of failure from weld failures can be correlated to pump bodies, valve bodies and heat exchanger shell and nozzles, the physical interfaces and functional impacts between two systems (e.g., tubes, tube sheet) requires an independent and different evaluation. Criteria 9 and 10 were added to ensure that all physical interfaces and functional impacts are identified and their safety significance determined on a design specific and plant specific basis. The following provides an example for each Criterion:

- Criterion 9 states "Heat exchangers whose failure could allow reactor coolant to bypass primary containment while the plant is at-power or during shutdown conditions"

  An example of a component that would be HSS from this criterion is a non-safety related CVCS letdown heat exchanger that exchanges heat between the RCS primary coolant and component cooling water (CCW) system. If the heat exchanger fails, RCS could flow into CCW and is assumed to fail CCW. If this resulted in failure of both trains of CCW (Criterion 8 indicates HSS), this heat exchanger would be categorized HSS per criterion 9.

  If this functional impact was LSS (e.g., only one train of CCW impacted), then it is necessary to evaluate LOCA outside containment as well. This heat exchanger is outside containment downstream of the regenerative heat exchanger. There are several isolation valves, flow rate (e.g., ~120 gpm) and pressures are less. This needs to be evaluated and documented to determine LSS or HSS assignment.

- Criterion 10 states "Other heat exchangers—if not explicitly addressed in Criterion 11, other heat exchangers should be evaluated to determine if component failure (for example, of the tube or tubesheet) could impact multiple systems. If yes, the methodology and criteria of [5, 6] shall be used to determine HSS versus LSS assignment.

  An example of a component that could be HSS from this criterion is an EDG cooler. EDG coolers are initially LSS because loss of a single emergency diesel generator from pressure boundary failure is LSS, however, the service water connection to the coolers could be HSS if service water flooding had a significant spatial impact. Thus, these coolers and associated piping with the EDG system become HSS.

5.3 Pressure Boundary Failures

As discussed in Chapter 3 and summarized in Table 2 a number of brainstorming sessions were conducted which identified and stress tested a large number of possible options in developing an alternative approach for RI-categorizing the pressure boundary. These alternatives ranged from simply developing and providing more improved training tools on the current methodology to using the plant-specific PRA directly. Ultimately, the project team decided on a framework that identified a pre-determined set of HSS criteria and exercises the plant-specific PRA to identify risk-significant passive SSCs. Together the pre-determined HSS criteria along with the plant-specific PRA ensure a risk-informed and robust categorization approach. The pre-determined HSS criteria are developed from insights from previous passive categorization experience (namely ensuring key safety functions remain available and defense-in-depth is maintained). The PRA criteria are intended to identify, on a plant-specific basis, risk-significant passive SSCs beyond the pre-determined HSS criteria.

Experience indicates that pressure boundary failures modeled in the PRA are most important in identifying high consequence (HSS) failures because both functional and spatial impacts of the failures are evaluated when equipment important to risk is affected. An internal flood PRA includes evaluation of pressure boundary failures consistent with the methodology in EPRI-112657 which requires several inputs to be considered such as direct and indirect effects from the break, walkdowns, isolation success/failure, and spectrum of break sizes, among others. Pressure boundary failures modeled in the PRA include tank failure, high energy line breaks, spray events, and internal flooding events (small, medium, and large). The scope of the internal events PRA includes steam line breaks, feedwater breaks, internal flood sources, interfacing LOCA, breaks outside containment LOCAs etc. However, due to the nature of the PRA models, there are potential areas where additional considerations are warranted. The additional areas regarding potential gaps identified during the development of the Chapter 4 methodology are summarized below:

- Treatment of flood protection features – PRA evaluations of pressure boundary failures (e.g., internal flood, HELB) are most important for the identification of high consequence events; it was observed that barriers (e.g., flood protection door), drains, etc. may be credited in the PRA evaluation but they might not be explicitly modeled in the PRA (e.g., assigned a basic event name/probability) and their failure could be important. Thus Prerequisite 3 ensures that these pressure boundary components are not inadvertently categorized LSS and requires evaluation if they are to be categorized. Note that structural or fire barriers are not considered pressure boundary components and must remain uncategorized and are addressed in the other elements of 10 CFR 50.69 categorization.

- Service Water – in a couple PRA models reviewed when developing this methodology flooding events in the service water intake structure were screened out of the PRA model because loss of service water was already addressed in the internal events PRA model (e.g., pressure boundary failures were subsumed in the modeling of total loss of service water). While this might be quantitatively addressed via modeling perspective, it does not provide a sufficient basis that pressure boundary failures are LSS from a risk-informed categorization methodology perspective. It was also recognized that total loss of service water (loss of the ultimate heat sink) at most plants is a high consequence whereas loss of one train was not. Thus, Criterion 5 was added to ensure that pressure boundary failures leading to a total loss of both emergency service water safety trains is HSS.

- ECCS Inventory Source – it was noted that RWST failure is not modeled as an initiating event in many PRAs because it is located in the yard and its failure does not have any other impacts for normal, full power operation. Failure of the RWST in the yard would result in a plant shutdown without availability of the functions provided by it and, in the absence of a LOCA condition, it can be shown quantitatively that such a scenario would have a low-risk contribution (i.e., low CDF/LERF values). However, this postulated failure of the RWST would result in failure of the ECCS function (i.e., loss of defense in depth) and regardless of the quantitively low risk, this is not considered acceptable from a risk-informed categorization methodology perspective because it could challenge a basic safety function. Thus, Criterion 6 was added to ensure that pressure boundary failures leading to loss of RWST, Suppression Pool or the Containment Sump are HSS.

- Auxiliary / Emergency Feedwater Inventory Source (CST) – it was noted that CST failure is not modeled as an initiating event in many PRAs because it is located in the yard and its failure does not have any other impacts for normal, full power operation. Failure of the CST in the yard would result in a plant shutdown without the CST and as there is usually backup to the CST for auxiliary / emergency feedwater as well as the main condenser. For BWRs there are a larger number of options available for primary system makeup regardless of plant vintage (e.g., RCIC, HPCI, LPCI, core spray, external makeup). The multiple methods for BWR heat removal provide sufficient defense-in-depth. This scenario may be quantitatively low risk from a CDF/LERF perspective for PWRs, however the potential reduction in defense-in-depth was not considered acceptable from a risk-informed categorization methodology perspective because it could challenge a basic safety function. Further, different PWR designs use a variety of defense-in-depth options for redundant and independent sources of inventory for AFW/EFW functions. Because of uncertainty with PRA modeling of backup AFW/EFW inventory sources, Criterion 7 was added to require a reliable backup source; otherwise, the CST would be HSS for PWRs.

- CCW – because of multiple dependencies on the CCW system (e.g., RCP seal cooling, ECCS pump cooling, SDC/RHR cooling) total loss of CCW at most PWRs is important amongst different designs. [Note: these types of CCW dependencies are unique to the PWR designs. At some plants, both trains of this system operate together and upon failure of one train, separation of the two safety trains requires operator action and there would not be enough time for this limited volume system to be isolated and save the other safety train. This postulated failure would lead to total loss of the CCW system and an HSS assignment is appropriate from a risk-informed categorization perspective. At the other extreme, some plants have physically separated trains with each train having its own surge tank; pressure boundary failures can only fail one train and thus redundancy is preserved and this is not a high consequence. Criterion 8 was added requiring those systems where pressure boundary failure can drain both trains to be HSS. From experience, other acceptable designs that are not HSS per Criterion 8 include the following:

- Two physically independent trains with one surge tank, but the surge tank has a baffle that effectively results in two independent tanks in one. Caution: the baffle where it is welded at the bottom of the tank if it ruptured could drain both sides and this would be HSS.

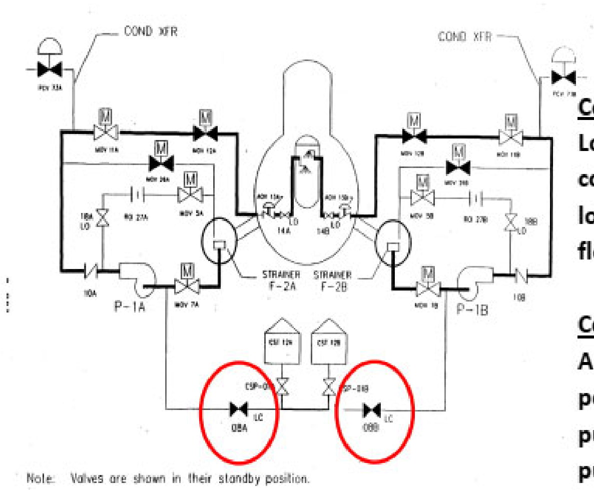
- The two trains are normally cross tied together, but automatically isolate on low surge tank level making the two trains physically independent. No manual operator action is required.

5.4 Examples

Three examples (Figures 7 through 9) were discussed during a public meeting (ML24117A256) to provide further insights on how these would be categorized by the existing passive methodology (i.e., EPRI-112657, REV B-A, ASME Code Case N-752, 10 CFR 50.69) versus the enhanced methodology in Chapter 4. The following summarizes an evaluation of this information regarding the importance of pressure boundary failures.

5.4.1 *Example 1:* ***CST in BWR***

This example evaluates the piping from the CST to the low-pressure core spray pump as shown in Figure 7. This example is from a BWR and is intended to highlight the differences between the importance of the CST in BWRs versus PWRs (as Criterion 7 is only applicable to PWRs). This example is also intended to highlight more generally the potential importance of spatial impacts (e.g., flooding impacting one train of low-pressure injection and either RCIC or HPCI).



Configuration:

Low Pressure Core Spray system in a BWR/4 (Mark I containment). Piping to pump suction from each CST to locked-closed valves 08A and 08B located in the grade level floor of a Reactor Building Crescent area.

Concern:

A single rupture of either line in each Crescent Area has the potential to result in flood and spray damage to a core spray pump, LPCI/RHR pump on one loop, and either HPCI or RCIC pump controls. The scenario may be high safety significant because it could erode several functional areas for core cooling.

EPRI TR 3002025288:

This could be categorized as LSS since it falls outside the scope of Criterion 7 which only addresses failures associated with the CST for PWRs as HSS.

Figure 7
Example 1 – BWR CST

Functionally, based on experience with application of the existing NRC-approved methodology, the CST is much less risk significant in BWRs because, upon its loss, RCIC and HPCI auto transfer to the suppression pool and other ECCS options (e.g., low-pressure injection and core spray) which are already normally aligned to the suppression pool. There are also additional external makeup sources available, if required. Thus, this level of redundancy, results in such scenarios having a low consequence rank per the existing method, see Table 3-5 of TR-112657 Rev B-A (infrequent event, all year exposure time, two or more backup trains). As discussed in Section 5.3, the CST is identified as potentially important to some PWR designs if there is no backup (e.g., service water) and no “feed and bleed” (F&B) capability, thus Criterion 7 was defined for PWRs to capture this uncertainty on a design and plant-specific basis.

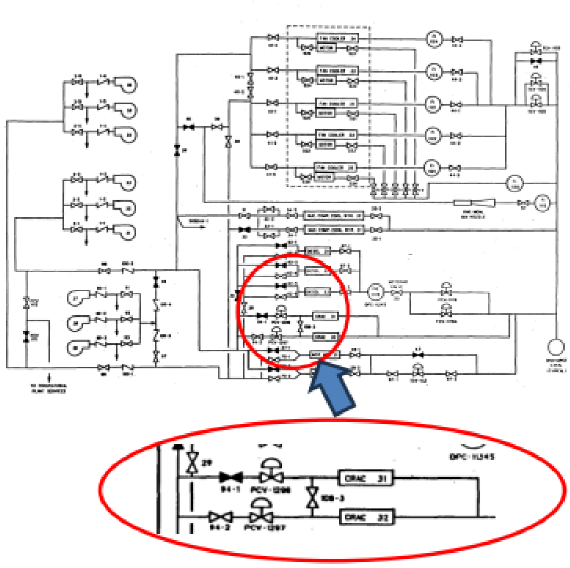
Flooding indirect impacts from the CST source must be evaluated on a plant specific basis in the internal flooding PRA and Criterion 11 are the metrics for risk significance and HSS determination for both PWRs and BWRs. Example 1 indicates either the East or West Crescent area could be flooded, failing one train of RHR and Core Spray as well as either RCIC or HPCI depending on which area is flooded. Still, in such a scenario, there is a redundant unaffected train of RHR and core spray as well as either RCIC or HPCI (now taking suction from the suppression pool). Also, BWRs have the capability to provide makeup from external sources (e.g., directly from the river, lake, etc.). As such, this would not be a high consequence rank using the existing NRC-approved methodology, since the CCDP for this scenario will be less than 1E-4 (i.e., with two or more available backup trains), yielding a low to medium consequence rank. Also, given the available redundancy, it is expected that Criterion 11 will also confirm that this example has low risk significance, and would be evaluated for each plant. Based on the BWR designs in the current US fleet, different configurations are possible (e.g., corner rooms instead of an East & West Crescent), but separation between trains is still maintained and the above conclusion (i.e., LSS) remains valid for those designs as well. Additionally, evaluation of these components against Criterion 11 is still required and would identify any high-risk outliers on a design and plant-specific basis.

The conclusion for this example is that using the existing NRC-approved passive categorization methodology yields a LSS categorization (low consequence rank due to additional makeup sources being available).

In the enhanced methodology, using criteria 1-10, the section of piping from the CST is LSS. On a plant-specific basis, this may be HSS if any of the metrics in Criterion 11 are exceeded.

5.4.2 Example 2: Control Room Ventilation

In this example, the common service water piping from the essential header to both control room air conditioning (CRAC) unit condensers CRAC-31 and CRAC-31 is evaluated as an illustration for the type of additional information that may need to be considered in addition to the PRA model outputs. If the piping ruptures (see circled piping in Figure 8), a loss of control room air conditioning can occur since both CRAC-31 and CRAC-32 lose service water cooling and could possibly result in a control room habitability issue.



Configuration:
Common service water line in a 4-loop Westinghouse (pre-GDC) PWR from the Essential Header to both Control Room Air Conditioning (CRAC) unit condensers CRAC-31 and CRAC-32.

Concern:
A single rupture could lead to loss of control room air conditioning since both CRAC units are impacted, and therefore pose a control room habitability issue in an accident scenario requiring isolation of the control room.

EPRI TR 3002025288:
The staff is concerned that this would be categorized as LSS, per the EPRI proposed methodology, because the conditions of Criteria 1-10 may not be met. And, since control room HVAC is not modeled in most licensee model-of-records, there is no entry into Criteria 11-13 as a safety-net to determine as HSS.

Figure 8
Example 2 Control Room Ventilation

This example postulates a service water pressure boundary failure which is included in the PRA model internal flooding analysis (there is an entry into Criterion 11 for service water breaks with the potential for flooding impacts as well as functional impacts). Also, Criterion 5 would apply if this pressure boundary failure could result in loss of both service water safety trains (this does not appear to be the case based on the drawing snapshot). If the pressure boundary failure could result in loss of both service water safety trains, this would be HSS. However, as indicated, functional impact on CRAC may not be modeled in the PRA.

All components/systems must pass all 11 criteria to be assigned LSS. The concern is that there is no 'entry' into Criterion 11 for this system as it may not be modeled.

Control room HVAC is typically not modeled in the PRA because the heat up of the control room typically evolves with sufficient time to be easily detectable by operators, and there are other forms of cooling that introduce air movement (e.g., fans, opening doors). The probability that this event leads to a core damage event is very unlikely and this is why it is not typically modeled (i.e., it is not a deficiency in the PRA modeling approach, simply a recognition of its low contribution and properly dispositioned – a standard state-of-practice in PRA modeling and risk-informed applications).

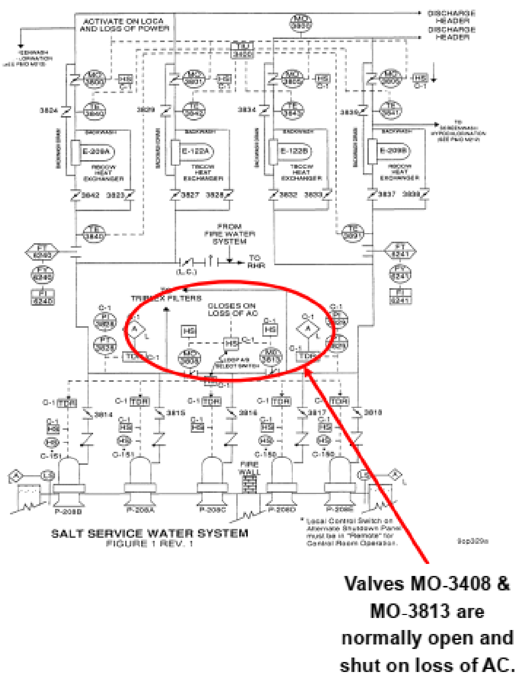
Also, the control room envelope (including maintaining positive pressure) is a design basis requirement to protect the operators from certain hazards not modeled in most PRAs because the frequency of these accidents is low and their consequence is much less significant than large early release scenarios (which typically have a much lower frequency than most scenarios modeled in PRAs), for example. Other factors such as pressure boundary redundancy or backup actions such as using portable self-contained breathing apparatus or remote shutdown capabilities are available to protect operations personnel and ensure that loss of ventilation to the control room does not result in loss of the sole means for operator actions needed to safely shutdown the plant.

The conclusion using the existing NRC-approved passive categorization methodology is an LSS categorization.

Through criteria 1-10, control room HVAC is not HSS. On a plant-specific basis, a service water failure may be HSS if any of the metrics in Criterion 11 are exceeded. Thus, the enhanced methodology provides equivalent or more conservative results as compared to the existing NRC-approved methodology, ensuring the appropriateness of the proposed methodology with prior risk-informed applications and within the specific context of its application to pressure boundary components. In this example, it ensures appropriate implementation by considering both quantitative risk and qualitative information that intends to cover the variety of other situations where additional information must be considered.

5.4.3Example 3: Loss of All Service Water

This example considers a salt service water system in a BWR, see Figure 9. This system is assumed to isolate into two trains on a LOOP or accident signal. As an example, consider if the pressure boundary failures could result in a loss of all service water before isolation.



Configuration:

Salt Service Water system in a BWR/3 (Mark I containment). A single train system which will isolate to two trains on a LOOP or accident signal.

Concern:

A single rupture while both trains operating together could result in a catastrophic loss of cooling before isolation.

EPRI TR 3002025288:

Criterion 8 addresses this condition only for PWR plants.

Figure 9
Example 3 – Loss of Salt Service Water

Criterion 8, specific to PWRs, was developed to address pressure boundary components that are physically connected (loss of pressure on train A will drain train B). As shown in this example, salt service water (which is distinct from emergency service water and the ultimate heat sink) in a BWR supplies reactor building and turbine building component cooling (RBCCW and TBCCW, respectively). As discussed in Section 5.3, failure of these systems does not result in a high consequence. TBCCW failure would impact the turbine plant (loss of main condenser and feedwater). RBCCW failure would impact cooling to certain loads (e.g., recirculation pumps, CRD, sample coolers etc.) which would lead to plant trip and shutdown, but there is no impact on PRA critical safety functions such as inventory makeup and heat removal. The service water in this example does not supply emergency diesels, RHR and other critical safety loads (it is not the ultimate heat sink), thus Criterion 5 does not apply. Furthermore, this pressure boundary failure could be isolated before any additional impact occurred to the plant.

The item of interest is that pressure boundary failure could result in loss of all service water before isolation and that because Criterion 8 only applies to PWRs it would not capture this example, if this example was HSS per the existing NRC-approved methodology.

As these pressure boundary components are not on the pre-determined HSS list, entry to any of the metrics in Criterion 11 are evaluated. In this example, the salt service water pressure boundary failure is included in the PRA internal flooding analysis (this considers functional and flooding impacts).

The conclusion using the existing NRC-approved passive categorization method is that an LSS categorization is appropriate.

Through criteria 1-10, the piping in the salt service water system is not HSS. On a plant-specific basis, this piping may be HSS if any of the metrics in Criterion 11 are exceeded. Thus, the enhanced methodology provides equivalent or more conservative results as compared to the existing NRC-approved methodology, ensuring the appropriateness of the proposed methodology with prior risk-informed applications and within the specific context of its application to pressure boundary components. In this example, it ensures pressure boundary failures are considered with respect to the potential for causing a loss of all service water, using actual plant-specific information and criteria focused at identifying potential HSS considerations for categorization.

5.5 Criteria 11

Application of criterion 11 identifies plant-specific pressure boundary components that are not assigned to the generic HSS category but that could be risk-significant at a particular plant. Criterion 11 of the enhanced methodology requires that any piping or component whose contribution to CDF exceeds 1E-06/year, LERF exceeds 1E-07/year, CCDP exceeds 1E-02, or CLERP exceeds 1E-03 be assigned to the HSS category. As discussed in the Grand Gulf and DC Cook Safety Evaluation Reports for their ASME Code Case N-716 relief requests [32, 33], these guideline values (1E-6/year/1E-7/year) are suitably small and consistent with the decision guidelines for acceptable changes in CDF and LERF found in NRC-endorsed EPRI TR-112657, Rev B-A. Criterion 11 was added as a DID measure to provide a method of ensuring that any plant-specific locations important to safety are identified. Criterion 11 is used only to add HSS segments and not, for example, to remove system parts generically assigned to the HSS in criteria 1–10.

By incorporating CCDP/CLERP metrics in Criterion 11, these measures also provide additional balance between prevention and mitigation. That is, components cannot be assigned to the LSS population based solely on low failure likelihood. Finally, 10CFR50.69(d)(2) requires that licensees ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety-related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life.

The metrics in Criterion 11 provide confidence that the goal of identifying the more risk-significant locations is met while permitting the use of generic HSS system parts identification to simplify and standardize the evaluation. The metrics in Criterion 11 provide additional confidence that the PRA (internal event PRA, internal flooding PRA) can identify the plant-specific significant contributors to risk that are not included in the generic results. RG 1.200 states that meeting the attributes of an NRC-endorsed industry PRA standard can be used to demonstrate that a PRA is adequate to support a risk-informed application. As described in Prerequisite #1, a robust plant-specific PRA is required to implement this enhanced methodology.

Table 7 provides examples of industry experience of pressure boundary components that exceeded the 1E-6/year (CDF) /1E-7/year (LERF) metrics. Table 7 provides examples of safety improvements that have been brought about by voluntary implementation of criterion 11 on other risk-informed applications.

Table 7
Examples of implementation of Criterion 11

Plant No.	Issue	Action
1	Interfacing system LOCA exceeded metrics	More refined/realistic analyses
2	Interfacing system LOCA exceeded metrics	More refined/realistic analyses
3	Failure of a fire protection line in the auxiliary building that was postulated to flood the electrical switchgear cable enclosure, battery room, and battery charger	Plant hardware modification (piping removed from area)
	Failures of the circulating water system in the condenser pit (CDF contribution of 3.75E-06)	Operating procedure update to better define human error probabilities
4	Failure of a fire protection line in the auxiliary building that was postulated to flood the electrical switchgear cable enclosure, battery room, and battery charger	Plant hardware modification (piping removed from area)
	Failures of the circulating water system in the condenser pit (CDF contribution of 3.75E-06)	Operating procedure update to better define human error probabilities
5	Fire protection piping in auxiliary building	Supplementary visual inspection of the associated fire protection piping required every quarter and six ultrasonic (thickness) exams per interval
6	Fire protection piping in auxiliary building	Supplementary visual inspection of the associated fire protection piping required every quarter and six ultrasonic (thickness) exams per interval
7	Plant service water exceeded LERF criterion	More refined/realistic analyses
8	Service water piping in the 480-V switchgear room	Five new inspections added to look for wall loss
9	Class 3 nuclear service water in AFW pump room impacting mechanical/ electrical equipment	New nondestructive evaluation (NDE) selected
10	Class 3 nuclear service water in AFW pump room impacting mechanical/ electrical equipment	New NDE selected

Table 7 (continued)
Examples of implementation of Criterion 11

Plant No.	Issue	Action
11	Flooding caused by fire protection piping in the East dc switchgear room	Three of 10 mechanical connections selected for inspection
12	Service water in cable spreading room—loss of electrical equipment	New NDE selected
13	Service water in cable spreading room—loss of electrical equipment	New NDE selected
14	Service water in auxiliary building exceeded metrics	Updated analysis to allow credit for operator action in response to the postulated flood scenario
15	Failure of fire protection in the control building (three separate locations) can cause loss of emergency switchgear rooms and cable spreading rooms	Hardware (that is, flow-limiting orifice) and procedure modification
16	Flood originating in the turbine building zone designated *TGB*; area located at elevation of 46 ft (14 m), essentially plant-grade	More refined/realistic analyses
17	High-pressure firewater in auxiliary building exceeded metrics	New NDE and/or removal of piping
17	Raw cooling water in auxiliary building exceeded metrics	New NDE and/or removal of piping
18	Failure of expansion bellows can cause loss of ESWG rooms	Hardware and NDE being investigated

6 RISK-INFORMED DECISION-MAKING FOR CATEGORIZING PRESSURE BOUNDARY COMPONENTS

In risk-informed decision-making, licensing basis changes are expected to meet a set of key principles (see Figure 10).

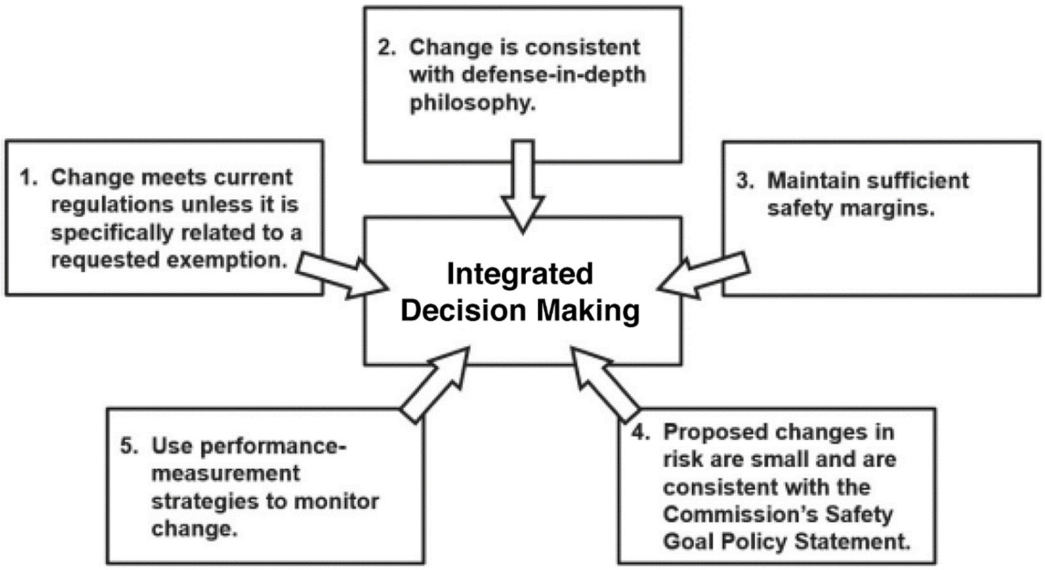


Figure 10
Principles guiding decision making (source: Figure 2, RG 1.174, Rev. 3)

The principles shown in Figure 10 and how they are met by this enhanced categorization process are as follows:

Principle 1: The proposed licensing basis change meets the current regulations unless it is explicitly related to a requested exemption (that is, a specific exemption under 10 CFR 50.12).

Although 10 CFR 50.69 is an NRC-approved rule, the implementation vehicle is through a plant-specific LAR. 10 CFR 50.69(b)(2) identifies the type of information that must be contained in the LAR, including a description of the process for categorization of RISC-1, RISC-2, RISC-3, and RISC-4 SSCs.

Principle 2: The proposed licensing basis change is consistent with the DID philosophy.

- Piping systems in a nuclear power plant contribute to DID in two important ways. First, the piping of the RCPB provides one of the sets of barriers in the barrier DID arrangement. This barrier protects the release pathway from the reactor core to containment release pathways, and part of it is responsible for protecting against potential containment bypass pathways. This enhanced methodology requires that the RCPB be categorized as HSS.

- Second, piping contributes to DID in its role in the protection of the core through providing critical safety functions that require piping system integrity. As can be seen in the preceding sections, the enhanced methodology requires that pressure boundary failures that would fail a critical safety function be categorized as HSS. These include those failures that would impact key inventory sources, plant-specific outliers that contribute to core damage or containment performance, and failure of the UHS and component that can have intersystem impact (for example, heat exchangers).

Principle 3. The proposed licensing basis change maintains sufficient safety margins.

Existing safety analyses are not impacted by implementation of a 10 CFR 50.69 program, nor are the design basis conditions and requirements for any safety-related SSCs changing. Further, the prerequisites associated with this enhanced methodology require that operating practices and conditions that can challenge pressure boundary integrity be adequately controlled, thereby again ensuring a reliable pressure boundary, regardless of a component’s category assignment.

Principle 4: When proposed licensing basis changes result in an increase in risk, the increases should be small and consistent with the intent of the NRC’s policy statement on safety goals for the operations of nuclear power plants.

The enhanced methodology proposed for categorizing pressure boundary components will have at most a negligible increase in risk and, more than likely, will positively impact plant safety. This is because the enhanced methodology requires a full plant evaluation. That is, all safety-related and non-safety-related systems will be determined to be HSS or LSS from a pressure boundary function perspective before any alternative treatment being applied.

Given that all RISC-2 components will have been identified, it is anticipated that an immediate safety benefit will occur on implementation. That is, consistent with 10 CFR 50.69(d) and (e), licensees will need to ensure that RISC-2 components (for example, piping segments) can perform their function (that is, pressure-retaining) consistent with the categorization process assumptions. Licensees should evaluate the treatment being applied to these SSCs to ensure that it supports the key assumptions in the categorization process that relate to their assumed performance. And, going forward, licensees will need to make adjustments as necessary to the categorization or treatment processes so that the categorization process and results are maintained valid.

Additionally, 10 CFR 50.69 requires that all RISC-3 SSCs continue to meet their design basis function under design basis conditions so that little to no change in reliability is anticipated for RISC-3 SSCs. Finally, the prerequisites associated with this enhanced methodology require that those operating practices and conditions that can challenge pressure boundary integrity be adequately controlled, thereby again ensuring a reliable pressure boundary, regardless of a component’s categorization assignment.

Finally, in line with NEI 00-04 and related guidance, PRA insights and risk results (where available) are used, coupled with sufficient margin to confirm an LSS categorization. In line with the principles on DID and safety margin covered previously, the PRA results and risk insights are considered along with engineering insights to ensure the robustness of the proposed enhanced categorization approach.

Principle 5: The impact of the proposed licensing basis change should be monitored using performance measurement strategies.

10 CFR 50.69(d)(2) requires that periodic inspection and testing activities be conducted to determine that RISC-3 SSCs will remain capable of performing their safety-related functions under design basis conditions. Additionally, conditions that would prevent a RISC-3 SSC from performing its safety-related functions under design basis conditions must be corrected in a timely manner. For significant conditions adverse to quality, measures must be taken to provide reasonable confidence that the cause of the condition is determined, and corrective action taken to preclude repetition.

Further, the prerequisites associated with this enhanced methodology require that those operating practices and conditions that can challenge pressure boundary integrity are adequately controlled (monitored), thereby again assuring a reliable pressure boundary, regardless of a component's categorization assignment.

Finally, Table 8 summarizes how, for the pressure boundary function, this enhanced methodology fulfills the requirements of 10 CFR 50.59, particularly 10 CFR 50.69(c)(1).

Table 8
Comparison to 10 CFR 50.69(c)(1)

50.69(c)(1) SSCs must be categorized as RISC-1, RISC-2, RISC-3, or RISC-4 SSCs using a categorization process that determines if an SSC performs one or more safety-significant functions and identifies those functions. The process must:	
(i) Consider results and insights from the plant-specific PRA. At a minimum, this PRA must model severe accident scenarios resulting from internal initiating events occurring at full power operation. The PRA must be of sufficient quality and level of detail to support the categorization process, and it must be subjected to a peer review process assessed against a standard or set of acceptance criteria that is endorsed by the NRC.	As stated previously, the plant needs to have a robust internal events PRA, including IF, that addresses failure of all pressure boundary components (main steam line breaks, main feedwater line breaks, internal flooding events, interfacing system LOCA, and so on). Because this methodology is being used in support of 10 CFR 50.69 applications, the plant-specific PRA needs to be sufficient to support the LAR approval process, including consideration of PRA assumptions and sources of uncertainty. Paragraph 50.69(c)(1)(i) of 10 CFR requires, in part, that the PRA be of sufficient quality and level of detail to support the categorization process, and it must be subjected to a peer review process assessed against a standard or set of acceptance criteria that is endorsed by the NRC. Paragraph 50.69(b)(2)(iii) of 10 CFR requires that the results of the PRA review process conducted to meet 10 CFR 50.59(c)(1)(i) be submitted as part of the application. This can include full-scope peer review of the internal events and internal flooding PRA against RG 1.200, Revision 2, as well as a gap assessment of earlier peer reviews of the internal events and internal flooding PRA against RG 1.200, Revision 2. An example of the review of a plant-specific PRA that meets these requirements can be found in [13].
(ii) Determine SSC functional importance using an integrated, systematic process for addressing initiating events (internal and external), SSCs, and plant operating modes, including those not modeled in the plant-specific PRA. The functions to be identified and considered include design bases functions and functions credited for mitigation and prevention of severe accidents. All aspects of the integrated, systematic process used to characterize SSC importance must reasonably reflect the current plant configuration and operating practices, and applicable plant and industry operational experience.	The enhanced methodology is limited to categorizing the pressure boundary function. All other functions, including design bases functions and functions credited for mitigation and prevention of severe accidents, continue to be addressed as part of NEI 00-04. The enhanced methodology was built to reflect and confirm for the pressure boundary function that the supporting analysis (such as internal events and IF PRA) reflect the current plant configuration and operating practices, and applicable plant and industry operational experience (such as prerequisite 2 [integrity management]).

Table 8 (continued)
Comparison to 10 CFR 50.69(c)(1)

50.69(c)(1) SSCs must be categorized as RISC-1, RISC-2, RISC-3, or RISC-4 SSCs using a categorization process that determines if an SSC performs one or more safety-significant functions and identifies those functions. The process must:	
(iii) Maintain DID.	Piping systems in a nuclear power plant contribute to DID in two important ways. The first is that the RCPB provides one of the sets of barriers in the barrier DID arrangement. This barrier protects the release pathway from the reactor core to containment release pathways, and part of it is responsible for protecting against potential containment bypass pathways. This enhanced methodology requires that the applicable Class 1 portion of the RCPB be categorized as HSS. Under this enhanced methodology, there are no pressure boundary components categorized as LSS that could be considered part of the RCPB (criterion 1). The second way pressure boundary components can contribute to DID is in its role in the protection of the core through providing critical safety functions that require piping system integrity. This was considered in developing the enhanced methodology. The enhanced methodology requires that pressure boundary failures that would fail a critical safety function be categorized as HSS. These include failures that would impact key inventory sources (criteria 6 and 7); generic lessons learned and plant-specific insights into contributors to core damage or containment performance, including consideration of common cause and the balance between prevention and mitigation (criteria 3, 4, 6, 9, 11); failure of the UHS (criterion 5) and components that can have intersystem impact (for example, heat exchangers [criteria 9 and 10]); and failures of the suppression pool and containment sump connections to containment (criterion 6). As such, there are no pressure boundary components categorized as LSS that would challenge these critical safety functions (see criteria 1–11). Essentially, pressure boundary failures that fail a basic safety function could not meet criteria 11 for LSS, which includes consideration of common cause. In addition, consistent with the 10CFR50.69 rule, the enhanced methodology does not alter the design basis of the plant. As such, the level of redundancy, independence, and diversity of key safety features, including fission product barriers, remains unchanged. Further, 10 CFR 50.69(d)(2) requires that licensees ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety-related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life, ensuring that DID is not compromised.

Table 8 (continued)
Comparison to 10 CFR 50.69(c)(1)

50.69(c)(1) SSCs must be categorized as RISC-1, RISC-2, RISC-3, or RISC-4 SSCs using a categorization process that determines if an SSC performs one or more safety-significant functions and identifies those functions. The process must:	
(iv) Include evaluations that provide reasonable confidence that for systems, structures, or components categorized as RISC-3, sufficient safety margins are maintained and that any potential increases in CDF and LERF resulting from changes in treatment permitted by implementation of Paragraphs 50.69(b)(1) and (d)(2) are small.	For the pressure boundary function of RISC-3 SSCs, the plant design basis is not changed and sufficient safety margins are maintained as the existing safety analysis and acceptance criteria in the plant licensing basis are not changed and the evaluation required by Section 8.1 of NEI 00-04 ensures that any potential increases in CDF and LERF resulting from changes in treatment permitted on the pressure boundary function by implementation of Paragraphs 50.69(b)(1) and (d)(2) will be small.
(v) Be performed for entire systems and structures, not for selected components within a system or structure.	The enhanced methodology requires categorization of all systems providing a pressure boundary function.

7 SUMMARY

The NRC amended its regulations to provide an alternative approach for establishing the requirements for treatment of SSCs for nuclear power reactors using a risk-informed method of categorizing SSCs according to their safety significance. This rule is 10 CFR 50.69, Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors. The risk-informed categorization process helps focus attention on SSCs that are the most important to plant safety while allowing increased operational flexibility for SSCs that are less important to plant safety.

As the industry has gained experience with this categorization methodology, questions have arisen as to whether the existing methodology is too conservative and/or too resource-intensive for the level of insights developed. In response to this question, EPRI initiated an effort to assess the existing methodology to determine if it was indeed producing overly conservative results or requiring excessive resources. To that end, an enhanced approach for categorizing pressure boundary components for use in 10 CFR 50.69 applications has been developed, which includes the following:

- A proposed methodology derived from insights gained from application of the existing methodology to the industry 10 CFR 50.69 pilot efforts as well as applications for subsequent plants (that is, follow-on plants)
- Review and assessment of a listing of all SSCs that must be categorized for passive SSCs for both PWRs and BWRs
- Insights highlighting that a set of predetermined HSS SSCs can be identified that can be supplemented with a plant-specific search for HSS outliers so that plant safety can be maintained and, in many cases, improved more cost-effectively than the existing process.

To that end, this report provides an enhanced approach for categorizing pressure boundary components for use in 10 CFR 50.69 applications. This methodology is based on decades of experience with risk-informing the pressure boundary, currently focused on plants licensed under 10 CFR 50 and plants with renewed licenses under 10 CFR 54. The methodology in this report is not currently applicable beyond the scope of plants for which the existing experience was used as part of the basis for methodology development.

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A HIGH SAFETY SIGNIFICANT PASSIVE COMPONENTS

The passive HSS components are developed of existing categorization resources including:

- Use of the existing NRC-approved process for 10 CFR 50.69 categorization using risk-informed repair/replacement methodology (ANO-2 RI-RRA, ML090930246) is directly relatable as it provides reliable risk outcomes for pressure boundary components.
- Use of the EPRI traditional RI-ISI methodology (TR-112657 Rev B-A, ML013470102) was used in the context of a 10 CFR 50.69 application, as follows:
    - The consequence of failure portion of EPRI TR-112657 is identical to that contained in the NRC-approved RI-RRA (ANO-2 RI-RRA, ML090930246) process currently being used by licensees with approved 10 CFR 50.69 submittals.
    - Use of insights from applying the traditional RI-ISI methodology from a “consequence of failure” perspective is directly applicable as a resource for developing this approach to pressure boundary categorization.
    - EPRI TR-112657 insights contributed to the Predetermined HSS Passive SSCs criteria 2 (shutdown cooling function), criteria 3 (steam generators and high energy feedwater) and criteria 4 (break exclusion regions).

  In contrast, the traditional RI-ISI methodology includes a consideration of failure potential in determining the safety significance of SSCs. That is, low failure potential can be used to reduce the safety significance of an SSC (see the Risk Matrix in Figure 3-2 of TR-112657 Rev B-A, ML013470102). Thus, the failure potential aspect of TR-112657 is not used by RI-RRA and current 10 CFR 50.69 methodologies (i.e., the probability of pressure boundary failure is conservatively set to 1.0). As 10 CFR 50.69 allows for alternate treatment of low safety significant SSCs, there is the potential for a change (increase) in failure potential, resulting in the addition of Prerequisite 2 (Integrity Management).
- The EPRI streamlined RI-ISI methodology (ASME Code Case N-716 as endorsed in Regulatory Guide 1.147) provides valuable insights for justifying the assignment of HSS for specific Class 2, Class 3 and non-safety related systems/subsystems (e.g., criteria 2, 3, 4, 11). In contrast, ASME Code Case N-716 criteria alone as the sole justification for the assignment of LSS to other Class 2, Class 3 and non-safety related systems was not sufficient for the 10 CFR 50.69 application (e.g., criterion 7, 9, 10).
- Criterion 11 is similar to one of the criteria contained in N-716. Application of criterion 11 identifies plant-specific pressure boundary components that are not assigned to the generic HSS category but that may be risk-significant at a particular plant. Criterion 11 of the enhanced methodology requires that any piping or component whose contribution to CDF or LERF is greater than 1E-6/year or 1E-7/year, CCDP is greater than 1E-02, CLERP is greater than 1E-03, respectively, be assigned to the HSS category. As discussed in the Grand Gulf and DC Cook Safety Evaluation Reports for their ASME Code

Case N-716 relief requests (ML072430005 and ML072620553, respectively), these guideline CDF/LERF risk criteria (1E-6/year and 1E-7/year, respectively) are suitably small and consistent with the decision guidelines for acceptable changes in CDF and LERF found in NRC endorsed EPRI TR-112657, Rev B-A. Criterion 11 was added as a defense-in-depth measure to provide a method of ensuring that any plant-specific locations that are important to safety are identified. Criterion 11 provides confidence that the goal of identifying the more risk-significant locations is met while permitting the use of generic HSS system parts to simplify and standardize the evaluation.

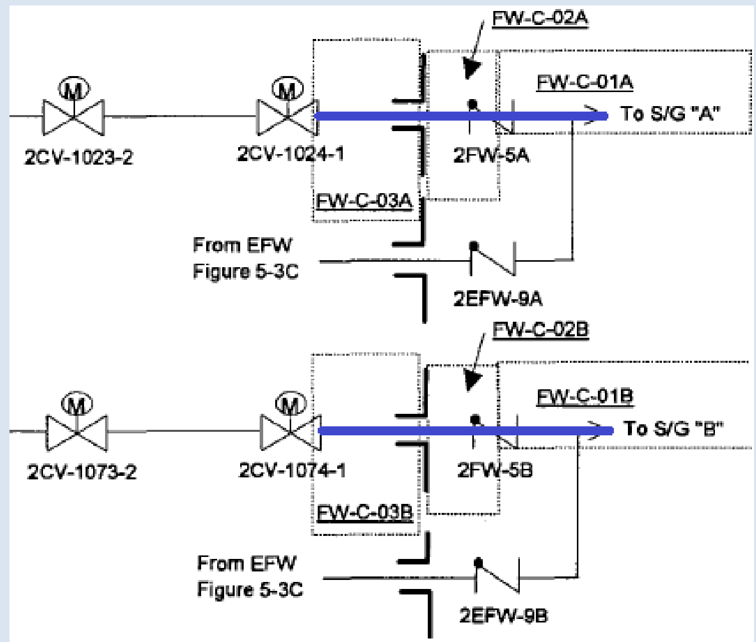
Table 9 provides additional supplemental information that identify the basis and provide a technical justification for the inclusion of the 12 criteria and their relationship to the methodology in EPRI 3002025288.

Table 9
Technical Basis for HSS criteria

No.	HSS Criteria	Basis
1	RCPB (Class 1)	As many Class 1 components constitute a principal fission product barrier given that they belong to the reactor coolant system or connected systems, this criterion maintains this primary fission product barrier as HSS. This is consistent with 10 CFR 50.55a (c)(2)(i) and all 10 CFR 50.69 LARs approved to date including Vogtle Units 1 and 2 dated December 14, 2014 (ML14237A034) and Columbia dated December 15, 2022 (ML22308A096). This is conservative as Class 1 piping beyond the 1st RCPB isolation valve is a medium or low consequence rank using the existing NRC-approved methodology (ANO-2 RI-RRA, ML090930246). An example is provided in the table below.

IE Event	LOCA CCDP	Isolation	Valve Failure Rate (per hour)	Yearly Likelihood	Final CCDP	Final Rank
LOCA-X	1.86E-3	MOV	1E-7	8.76E-4	1.63E-6	Med
LOCA-Y	3.19E-3	CV	3.50E-7	3.1E-3	9.78E-6	Med

No.	HSS Criteria	Basis
2	Applicable portions of the shutdown cooling pressure boundary function. Class 1 and 2 components of systems or portions of systems needed to use the normal shutdown cooling flow path either: (a) as part of the RCPB from the RPV to the second isolation valve (that is, farthest from the RPV) capable of remote closure, or to the containment penetration, whichever encompasses the larger number of welds, or (b) other systems or portions of systems from the RPV to the second isolation valve (that is, farthest from the RPV) capable of remote closure or to the containment penetration, whichever encompasses the larger number of components	Shutdown cooling (SDC) systems play a key role in removing decay heat and keeping the core cooled after the reactor has shutdown either from an event or normal operations. Maintaining core cooling is vital to protecting fuel integrity. As discussed in ASME Whitepaper 2002-02A-01, many of these SSCs were generally medium or low risk with no identified degradation mechanism. However, there are some locations identified as potentially susceptible to thermal fatigue during initiation and operation of shutdown cooling. As such, because of the potential for thermal fatigue and the multiple functions of this system, a significant portion of this system is classified as HSS per this methodology. The enhanced methodology is a conservative application of these insights in that much of the subject scope is typically LSS for pressure boundary using the existing NRC-approved methodology (ANO-2 RI-RRA, ML090930246). Further, criterion 11 assures that other portions of the shutdown cooling pressure boundary function that perform a risk significant function, on a plant-specific basis, are identified as HSS. Please see additional, updated discussion on criterion 11 below. Additionally, for portions of the shutdown cooling function categorized as LSS per this methodology. Section 4.4 of 3002025288 requires that the users must demonstrate that any potential increases in risk resulting from changes in treatment are small and consistent with NRC acceptance criteria in the NRC's Regulatory Guide 1.174, "An Approach For Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes To The Licensing Basis", Revision 3 (ML17317A256). Finally, 10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that the treatment of RISC-3 SSCs be consistent with the categorization process.
3	Class 2 portions of steam generators and Class 2 feedwater system components greater than NPS 4 (DN 100) of PWRs from the steam generator to the outer containment isolation valve	In a PWR, heat removal through the steam generator is the desired heat removal path for both normal operation and post-accident conditions. Thus, this criterion provides both a preventive function (minimize likelihood of a feedwater line break) as well as a mitigative function (reliable secondary heat removal). This is also consistent with NRC past precedent (see the South Texas Project Exemption Request, ML003733405) where portions of some high energy systems were considered for inclusion as HSS.

No.	HSS Criteria	Basis
		The enhanced methodology is a conservative application in that much of the subject scope is typically LSS for pressure boundary using the existing NRC-approved methodology (ANO-2 RI-RRA submittal, ML20217E899, via NRC approval, ML090930246). An example of Consequence of Failure (CoF) evaluation results for Class 2 feedwater system piping from the steam generator to the outer containment isolation valve are provided below from a RI-ISI pilot plant application (ML20217E899). The consequence segments (FW-C-01A, FW-C-02A, FW-C-03A, FW-C-01B, FW-C-02B, FW-C-03B) depicted below in blue are all medium consequence rank and would be LSS per the existing NRC-approved methodology but are HSS per Criteria 3. 

No.	HSS Criteria	Basis
		(see nested table and text below)

Conditional Core Damage Probability	Conditional Large Early Release Probability	Consequence Rank	Final Risk-Informed Safety Classification Additional Considerations (10) and Safety Margins Any Condition False	All Conditions True Safety Margins Maintained Yes	No
$>10^{-4}$	$>10^{-5}$	High(1)	HSS (Additional Considerations/Safety Margins are NA)		
10^{-6} < value ≤ 10^{-4}	10^{-7} < value ≤ 10^{-5}	Medium(2)	HSS	LSS	HSS
$\leq 10^{-6}$	$\leq 10^{-7}$	Low(2)	HSS	LSS	HSS

(1) High consequence rank components considered HSS with no further review.

(2) Medium and Low consequence rank components subject to additional considerations (functional and defense-in-depth plus safety margins) and then categorized as HSS or LSS.

The table above shows the initial consequence rank and how the final HSS/LSS determination is accomplished. High consequence rank components are categorized as HSS with no further input. Medium and Low consequence rank components are subjected to additional considerations in the proposed methodology. For the reasons discussed in ML22182A400, the Limerick RAI response submittal dated June 30, 2022 (see page 53 of 153) this further review does not alter the ranking of any additional components from Medium/Low consequence rank to HSS.

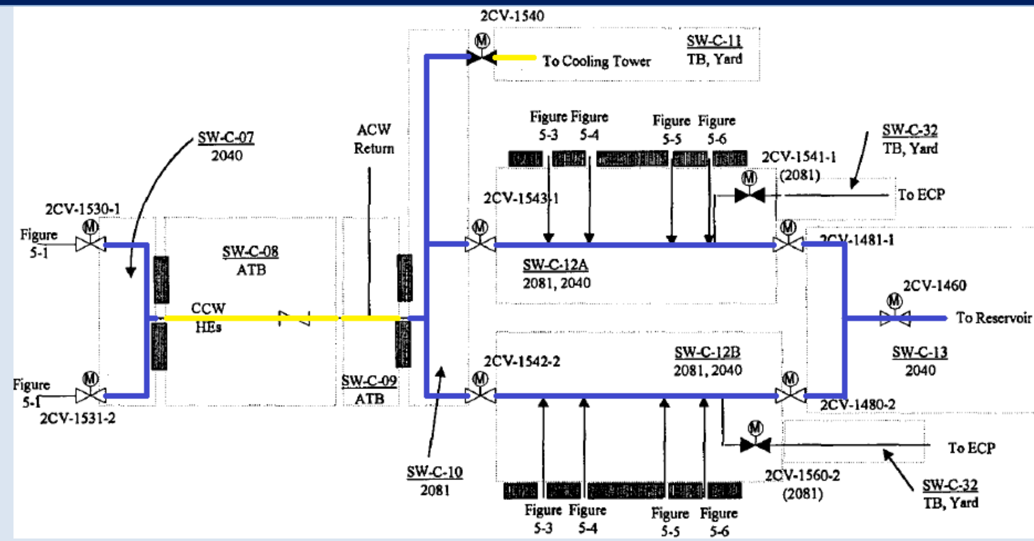
Further, criterion 11 assures that other portions of the feedwater system (e.g., <4 NPS) that perform a risk significant function, on a design specific or plant-specific basis, are identified as HSS. Please see additional, updated discussion on criterion 11 below.

Additionally, for portions of the feedwater system categorized as LSS per this methodology, Section 4.4 of EPRI 3002025288 requires that the users must demonstrate that any potential

No.	HSS Criteria	Basis
		increases in risk resulting from changes in treatment are small and consistent with NRC acceptance criteria (e.g., RG 1.174, Revision 3, ML17317A256). While small piping may have a higher break frequency than larger piping, the impacts are less severe with regards to spatial (e.g., pipe whip, jet impingement, flooding) and system impacts (e.g., flow diversion). All of these impacts are considered via criterion 11 of the enhanced methodology. Finally,10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that the treatment of RISC-3 SSCs be consistent with the categorization process.
4	Components larger than NPS 4 (DN 100) within the BER for high-energy piping systems as defined by the owner	The Break Exclusion Region (BER) for high-energy piping systems encompasses a special set of piping where design basis double ended guillotine breaks are not postulated in certain locations between the containment isolation valves and/or boundary restraints, if certain preventative measures are taken (e.g., maintaining design stresses low, minimizing welded attachments, minimizing the number of branch connections, postulation of pipe breaks upstream and downstream of the "no break zone," increased number of inspections in the “no break zone” region). Due to the unique impacts of breaks in this region, the SSCs within the BER region for high-energy piping are conservatively assigned as HSS in this methodology (i.e., no changes in treatment for this piping would occur). This criterion assures that postulated breaks in a plant area that can possibly challenge design basis single failure criteria and possibly degrade a fission product barrier be categorized as HSS. This is also consistent with NRC past precedent (STP Exemption Request, ML003733405) where portions of some high energy systems were considered for inclusion as HSS. The enhanced methodology is a conservative application in that much of the subject scope is typically LSS for pressure boundary (ML20217E899) using the existing NRC-approved methodology (ANO-2 RI-RRA, ML090930246). For example, dependent upon a plant’s specific licensing commitments, some or all portions of the Class 2 feedwater system piping from the steam generator to the outer containment isolation valve depicted in the sketch above may be in the BER program. In this example, all of the piping is medium consequence rank and would be LSS per the existing NRC-approved methodology but is HSS per Criteria 4.

No.	HSS Criteria	Basis
		Figure 2 shows the initial consequence rank and how the final HSS/LSS determination is accomplished. High consequence rank components are categorized as HSS with no further input. Medium and Low consequence rank components are subjected to additional considerations in the proposed methodology. For the reasons discussed in ML22182A400, the Limerick RAI response submittal dated June 30, 2022 (see page 53 of 153) this further review does not alter the ranking of any additional components from Medium/Low consequence rank to HSS. Further, criterion 11 assures that other portions of the BER region (e.g., <4 NPS) that perform a risk significant function, on a design specific and a plant-specific basis, are identified as HSS. Additionally, for portions of the BER region categorized as LSS per this methodology, Section 4.4 of 3002025288 requires that the users demonstrate that any potential increases in risk resulting from changes in treatment are small and consistent with NRC acceptance criteria (e.g., RG 1.174, Revision 3, ML17317A256). While small piping may have a higher break frequency than larger piping, the impacts are less severe with regards to spatial (e.g., pipe whip, jet impingement, flooding) and system impacts (e.g., flow diversion). All of these impacts are considered via criterion 11 the enhanced methodology. Finally, 10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that the treatment of RISC-3 SSCs be consistent with the categorization process.
5	Portions of the ultimate heat sink flow path (for example, service water) whose failures will fail both trains (that is, fail the UHS function). (Note: even if piping is isolated/independent, the service water pumphouse [for example, reservoir, bay] would be expected to be HSS.)	This criterion requires that a reliable ultimate heat sink function be maintained. As noted in criterion 2 and 3, the heat removal safety function is fundamental to keeping the core cooled and the fuel intact. The ultimate heat sink flow path connects the shutdown cooling system to the ultimate heat sink (e.g., cooling tower, lake, river, ocean) - per General Design Criterion (GDC) 44 in Appendix A to 10 CFR 50: “A system to transfer heat from structures, systems, and components important to safety, to an ultimate heat sink shall be provided. The system safety function shall be to transfer the combined heat load of these structures, systems, and components under normal operating and accident conditions.” Following this HSS criterion would ensure that any single SSC failure that would cause failure of the UHS function would be categorized as HSS. That is, single passive failures that result in loss of redundancy are to be categorized as HSS. Implementing this HSS criterion, failure of only one

<table>
<tr><th>No.</th><th>HSS Criteria</th><th>Basis</th></tr>
<tr><td></td><td></td><td>
train of service water would leave at least one other train of service water available as well as other mitigation capabilities (e.g., steam generators) that ensures a resulting CCDP will be less than 0.0001 or 1E-4. Using Table 3-5 from TR-112657 Rev B-A (copied below) demonstrates mitigating systems with two redundant trains results in a medium/low consequence rank.
<table>
<tr><th colspan="2">Affected Systems</th><th colspan="8">Number of Unaffected Backup Trains</th></tr>
<tr><th>Frequency of Challenge</th><th>Exposure Time to Challenge</th><th>0.0</th><th>0.5</th><th>1.0</th><th>1.5</th><th>2.0</th><th>2.5</th><th>3.0</th><th>>=3.5</th></tr>
<tr><td rowspan="4">Anticipated (DB Cat II)</td><td>All Year</td><td>HIGH</td><td>HIGH</td><td>HIGH</td><td>HIGH</td><td>MEDIUM</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td></tr>
<tr><td>Between tests (1-3 months)</td><td>HIGH</td><td>HIGH</td><td>HIGH</td><td>MEDIUM*</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td></tr>
<tr><td>Long AOT (<=1 week)</td><td>HIGH</td><td>HIGH</td><td>MEDIUM*</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
<tr><td>Short AOT (<=1 day)</td><td>HIGH</td><td>MEDIUM*</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
<tr><td rowspan="4">Infrequent (DB Cat. III)</td><td>All Year</td><td>HIGH</td><td>HIGH</td><td>HIGH</td><td>MEDIUM</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td></tr>
<tr><td>Between tests (1-3 months)</td><td>HIGH</td><td>HIGH</td><td>MEDIUM*</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
<tr><td>Long AOT (<=1 week)</td><td>HIGH</td><td>MEDIUM*</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
<tr><td>Short AOT (<=1 day)</td><td>HIGH</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
<tr><td rowspan="4">Unexpected (DB Cat. IV)</td><td>All Year</td><td>HIGH</td><td>HIGH</td><td>MEDIUM</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
<tr><td>Between tests (1-3 months)</td><td>HIGH</td><td>MEDIUM</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
<tr><td>Long AOT (<=1 week)</td><td>HIGH</td><td>MEDIUM</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
<tr><td>Short AOT (<=1 day)</td><td>HIGH</td><td>LOW*</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td><td>LOW</td></tr>
</table>
This is consistent with the existing NRC-approved passive categorization method (ANO-2 RI-RRA, ML090930246) where loss of all emergency service water due to single passive failure typically results in a HSS assignment. That is, the intent of this HSS Criterion is to ensure that HSS is assigned if system redundancy cannot be demonstrated.
An example of CoF evaluation results for Class 2 service water system piping are provided below from a RI-ISI pilot plant application (ML20217E899). Failure of the SW-C-07, SW-C-10, SW-C-12A, SW-C-12B and SW-C-13 consequence segments depicted below in blue are high consequence rank due to loss of all SW and would be HSS per both the existing NRC-approved methodology and Criteria 5. Note that failure of the SW-C-08, SW-C-09 and SW-C-11 segments depicted below in yellow also results in loss of all SW but are medium consequence rank because there are two backup trains (since breaks are outside RAB there are two opportunities to isolate/recover).
</td></tr>
</table>

<table>
<tr><th>No.</th><th>HSS Criteria</th><th>Basis</th></tr>
<tr><td></td><td></td><td>


Of the 49 total consequence segments in the service water system, seven are high consequence rank and of these five are HSS per Criteria 5. The remaining 42 consequence segments are medium or low consequence rank and would be LSS in either the existing or enhanced methodology.
</td></tr>
</table>

No.	HSS Criteria	Basis

Conditional Core Damage Probability	Conditional Large Early Release Probability	Consequence Rank	Final Risk-Informed Safety Classification — Additional Considerations (10) and Safety Margins		
			Any Condition False	All Conditions True — Safety Margins Maintained	
				Yes	No
$>10^{-4}$	$>10^{-5}$	High[(1)]	HSS (Additional Considerations/Safety Margins are NA)		
10^{-6} < value ≤ 10^{-4}	10^{-7} < value ≤ 10^{-5}	Medium[(2)]	HSS	LSS	HSS
$\leq 10^{-6}$	$\leq 10^{-7}$	Low[(2)]	HSS	LSS	HSS

(3) High consequence rank components considered HSS with no further review.

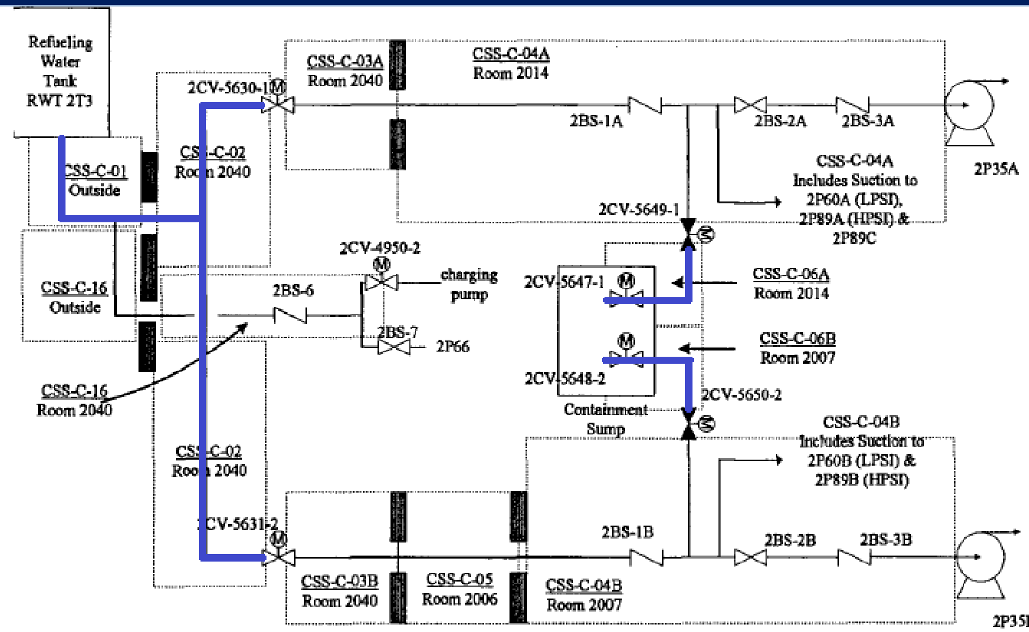
(4) Medium and Low consequence rank components subject to additional considerations (functional and defense-in-depth plus safety margins) and then categorized as HSS or LSS.

The table above shows the initial consequence rank and how the final HSS/LSS determination is accomplished. High consequence rank components are categorized as HSS with no further input. Medium and Low consequence rank components are subjected to additional considerations in the proposed methodology. For the reasons discussed in ML22182A400, the Limerick RAI response submittal dated June 30, 2022 (see page 53 of 153) this further review does not alter the ranking of any additional components from Medium/Low consequence rank to HSS.

Further, criterion 11 of the enhanced methodology assures that if any portion of the system that performs a risk significant function, on a design specific or a plant-specific basis, are identified as HSS. Please see additional, updated discussion on criterion 11, below.

Additionally, for individual portions of the UHS function categorized as LSS per this methodology, Section 4.4 of EPRI 3002025288 requires that the licensees must demonstrate that any potential

No.	HSS Criteria	Basis
		increases in risk resulting from changes in treatment are small and consistent with NRC acceptance criteria (e.g., RG 1.174, Revision 3, ML17317A256). Finally, 10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, that RISC-3 SSCs remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that the treatment of RISC-3 SSCs be consistent with the categorization process.
6	Tanks/vessels and connected piping and components up to the first isolation valve that support/provide emergency core cooling system (ECCS) inventory to multiple systems/functions (for example, RWST for PWRs, containment sumps, SP for BWR).	Emergency core cooling systems (ECCS) typically contained a single source of inventory (see the figures on page 60 of the NRC's Reactor Concepts Training). As such some postulated tank and vessel failures can impact multiple systems (e.g., loss of defense in depth). Thus, this criterion assures that those component failures that can adversely impact the ECCS mitigative function of the plant be maintained as HSS irrespective of quantitative risk results. An example of CoF evaluation results for Class 2 containment spray system piping from the RWST and containment sumps up to the first isolation valve are provided below from a RI-ISI pilot plant application (ML20217E899). The consequence segments (CSS-C-01, CSS-C-02, CSS-C-06A, CSS-C-06B) depicted below in blue are high consequence rank and would be HSS per both the existing NRC-approved methodology and Criteria 6.

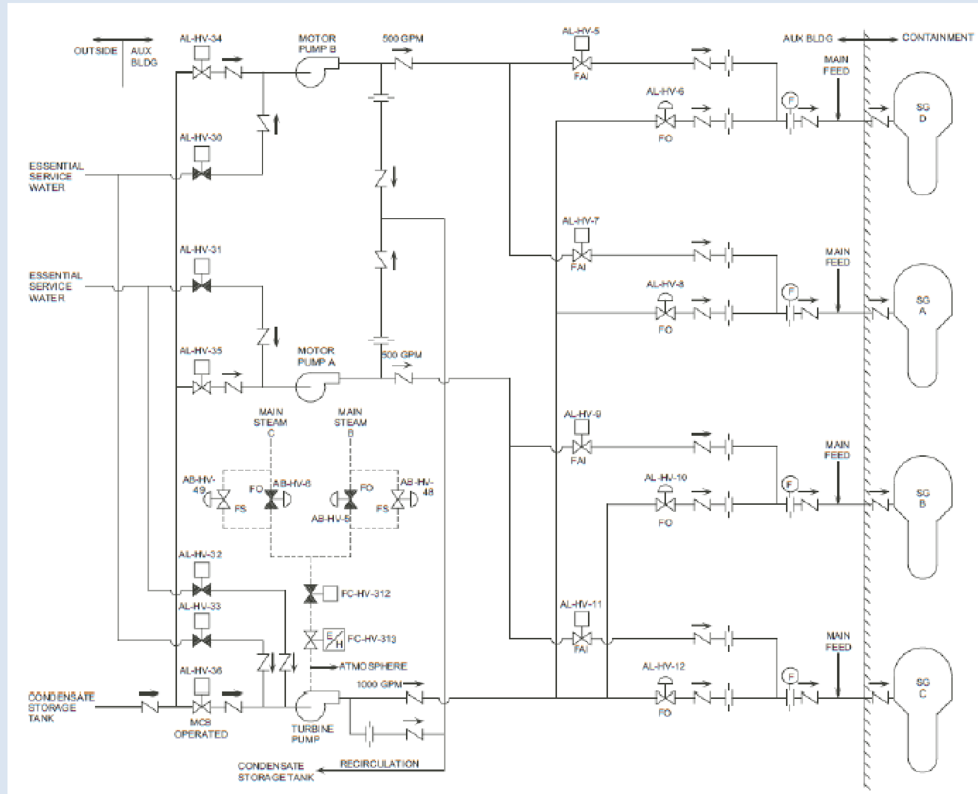
No.	HSS Criteria	Basis
		 Of the 30 total consequence segments in the containment spray system, five are high consequence rank and of these four are HSS per Criteria 6. The remaining 25 consequence segments are medium or low consequence rank and would be LSS in either the existing or enhanced methodology.

<table>
<tr><th>No.</th><th>HSS Criteria</th><th>Basis</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th rowspan="5">Conditional Core Damage Probability</th><th rowspan="5">Conditional Large Early Release Probability</th><th rowspan="5">Consequence Rank</th><th colspan="3">Final Risk-Informed Safety Classification</th></tr>
<tr><th colspan="3">Additional Considerations (10) and Safety Margins</th></tr>
<tr><th rowspan="3">Any Condition False</th><th colspan="2">All Conditions True</th></tr>
<tr><th colspan="2">Safety Margins Maintained</th></tr>
<tr><th>Yes</th><th>No</th></tr>
<tr><td>>10^{-4}</td><td>>10^{-5}</td><td>High[1]</td><td colspan="3">HSS (Additional Considerations/Safety Margins are NA)</td></tr>
<tr><td>10^{-6} < value ≤ 10^{-4}</td><td>10^{-7} < value ≤ 10^{-5}</td><td>Medium[2]</td><td>HSS</td><td>LSS</td><td>HSS</td></tr>
<tr><td>≤10^{-6}</td><td>≤10^{-7}</td><td>Low[2]</td><td>HSS</td><td>LSS</td><td>HSS</td></tr>
<tr><td colspan="6">(5) High consequence rank components considered HSS with no further review.
(6) Medium and Low consequence rank components subject to additional considerations (functional and defense-in-depth plus safety margins) and then categorized as HSS or LSS.</td></tr>
</table>
The table above shows the initial consequence rank and how the final HSS/LSS determination is accomplished. High consequence rank components are categorized as HSS with no further input. Medium and low consequence rank components are subjected to the "additional considerations." For the reasons discussed in ML22182A400, the Limerick RAI response submittal dated June 30, 2022 (see page 53 of 153) this further review does not move any additional components from Medium/Low consequence rank to HSS.

That is, while use of Criterion 11 may show that these components are quantitatively low risk, this conservative step is added, consistent with defense in depth principles, to require that the RWST, Containment Sump, Suppression Pool and their connections be categorized as HSS (i.e., over-riding criterion 11 results). This is introduced as a conservative step, to ensure the methodology is consistently applied.

As these components are HSS, no alternate treatment can be applied so there is no change in potential risk as a result of its application.</td></tr>
</table>

<table>
<tr><th>No.</th><th>HSS Criteria</th><th>Basis</th></tr>
<tr><td>7</td><td>Non power conversion system (PCS) secondary heat removal inventory (e.g. condensate storage tank, CST) for AFW/EFW in a PWR unless there is a redundant independent reliable source (for example, auto switchover to service water supply to each train of AFW/EFW suction).</td><td>The CST provides inventory in support of the secondary heat removal function in a PWR (as shown below from ML11223A229). If there is not a reliable backup to the CST, this criterion assures defense in depth is considered for this function, irrespective of quantitative risk results. That is, lack of defense in depth requires an HSS assignment.



An example of CoF evaluation results for Class 2 emergency feedwater system piping from the CST up to the first isolation valve are provided below from a RI-ISI pilot plant application (ML20217E899). The consequence segments (portions of EFW-C-10 and EFW-C-11) depicted below in blue are low consequence rank and would be LSS per the existing NRC-approved methodology but are HSS per Criteria 7 (unless there is a redundant independent reliable source, such as auto switchover to service water supply to each train of AFW/EFW suction).</td></tr>
</table>

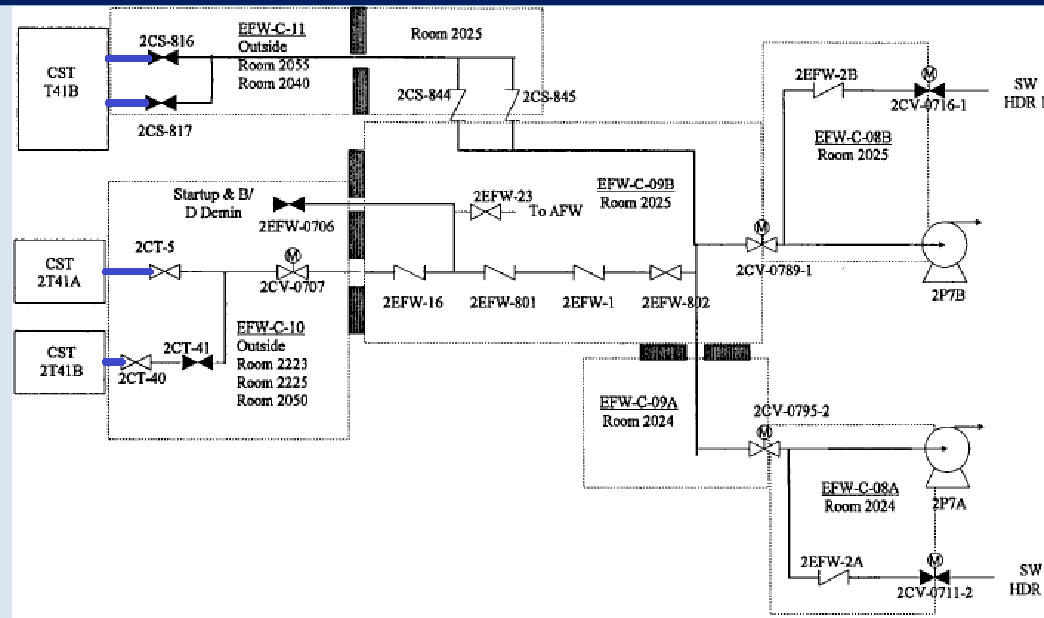
<table>
<tr><th>No.</th><th>HSS Criteria</th><th>Basis</th></tr>
<tr><td></td><td></td><td>


Figure 2 shows the initial consequence rank and how the final HSS/LSS determination is accomplished. High consequence rank components are categorized as HSS with no further input. Medium and low consequence rank components are subjected to the "additional considerations." For the reasons discussed in ML22182A400, the Limerick RAI response submittal dated June 30, 2022 (see page 53 of 153) this further review does not move any additional components from Medium/Low consequence rank to HSS.

All 25 total consequence segments in the emergency feedwater system are medium or low consequence rank and would be LSS per the existing methodology.

That is, while use of Criterion 11 may show that these components are quantitatively low risk, this conservative step is added, consistent with defense in depth principles, to require that CSTs and their connections be categorized as HSS (i.e., over-riding criterion 11 results). This is introduced as a conservative step, to ensure the methodology is consistently applied.

As these components are HSS, no alternate treatment can be applied so there is no change in potential risk as a result of its application.
</td></tr>
</table>

No.	HSS Criteria	Basis
8	For PWR plants, low-volume, intermediate safety systems that typically consist of two physically independent (for example, component cooling water) trains that are, on a plant-specific basis, physically connected. For example, loss of pressure boundary integrity on train A will drain train B as well.	CCW in a PWR can be an important support system (e.g., RCP seal cooling, ECCS pump cooling). Experience with the existing NRC-approved methodology (ANO-2 RI-RRA, ML090930246) has shown that pressure boundary failures that result in loss of both trains of CCW have been found to be HSS. While this will be conservative where CCW dependencies have reliable backups installed, having this requirement in this methodology assures consistent implementation across the fleet. Even if assignment for Criterion 8 is LSS, Criteria 11 of this enhanced methodology must be evaluated and it must be confirmed that LSS is the correct assignment. Please see additional, updated discussion on criterion 11 below. Additionally, for portions of the CCW systems categorized as LSS per this methodology, Section 4.4 of EPRI 3002025288 requires that the users must demonstrate that any potential increases in risk resulting from changes in treatment are small and consistent with NRC acceptance criteria (e.g., RG 1.174, Revision 3, ML17317A256). Finally, 10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, that for portions of the CCW system CCW systems categorized as LSS (RISC-3 SSCs) remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that the treatment of RISC-3 SSCs be consistent with the categorization process.
9	Heat exchangers that if they fail (for example, tube or tubesheet failures) could allow reactor coolant outside primary containment.	This criterion requires that direct containment bypass events (i.e., loss of all fission product barriers) are assigned HSS categorization. This criterion addresses important containment issues that may not be explicitly modeled in the plant PRA model (e.g., SDC heat exchangers and CVCS heat exchangers, such as letdown heat exchangers). The enhanced methodology requires that these interfaces be explicitly evaluated consistent with the existing approved methodology. This is mostly consistent with the existing NRC-approved approach, except that the enhanced methodology contained in EPRI 3002025288 requires that all heat exchangers be evaluated (i.e., the existing NRC-approved approach allows users to decide which heat exchangers are subject to categorization). This provides a more complete risk characterization as compared to the existing NRC-approved approach (ANO-2 RI-RRA, ML090930246).

No.	HSS Criteria	Basis
		Finally, 10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, heat exchangers categorized as LSS (RISC-3 SSCs) remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that the treatment of RISC-3 SSCs be consistent with the categorization process.
10	Other heat exchangers—if not explicitly addressed in row 11 of this table, other heat exchangers should be evaluated to determine if component failure (for example, tube or tubesheet) may impact multiple systems. If yes, the existing methodology and criteria of shall be used to determine HSS versus LSS assignment.	From a pressure boundary perspective, heat exchangers are unique in that they interface with multiple systems and are susceptible to unique failure modes (e.g., tube failures, tubesheet failures, divider plate failures) This criterion addresses system interfaces that may or may not be covered by existing PRA models (requires a review of all heat exchangers to confirm the impact of interface failure as LSS or HSS) using the existing approved methodology. This is mostly consistent with the existing NRC-approved approach, except that the enhanced methodology contained in EPRI 3002025288 requires that all heat exchangers be evaluated (i.e., the existing NRC-approved approach allows users to decide which heat exchangers are subject to categorization). This provides a more complete risk characterization as compared to the existing NRC-approved approach (ANO-2 RI-RRA, ML090930246). Additionally, for all components categorized as LSS per this methodology, Section 4.4 of EPRI 3002025288 requires that the users must demonstrate that any potential increases in risk resulting from changes in treatment are small and consistent with NRC acceptance criteria (e.g., RG 1.174, Revision 3, ML17317A256). Finally, 10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, that heat exchangers categorized as LSS (RISC-3 SSCs) remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that the treatment of RISC-3 SSCs be consistent with the categorization process.
11	Any piping or component (including piping segments or components grouped or subsumed within existing plant initiating event groups) whose contribution to CDF is greater than 1E-06/year, or LERF is greater than 1E-07/year, or CCDP greater than 1E-02, or CLERP greater than 1E-03, based upon a plant-specific PRA of pressure boundary failures (for example, pipe whip, jet impingement, spray, and inventory	This criterion assures that, on a design specific or a plant-specific basis, the previous criteria (i.e., 1 through 10) have not missed piping or components that are important and that should be categorized as HSS. Application of this criterion have already resulted in a number of voluntary safety improvements implemented by the industry, as identified in Table 7. Criterion 11 of the enhanced methodology requires that any piping or component whose contribution to CDF and LERF results in values greater than 1E-6/year and 1E-7/year, respectively be assigned to the HSS category. These guideline CDF/LERF risk criteria (1E-6/year /and 1E-

No.	HSS Criteria	Basis
	losses). This may include Class 1 and 2 and Class 3, or non-class components.	7/year, respectively) are consistent with RG 1.174, Revision 3 (ML17317A256) as suitably small, and in line with the decision guidelines for acceptable changes in CDF and LERF found in NRC-endorsed EPRI TR-112657, Rev B-A. Additionally, any piping or component whose contribution to CCDP is greater than 1E-02 or CLERP greater than 1E-03, be assigned to HSS. Criterion 11 was added as a defense-in-depth measure to provide a method of ensuring that any design specific or plant-specific locations that are important to safety are identified. Criterion 11 is only used to add HSS components and not, for example, to remove system parts generically assigned to the HSS in criterion 1 through 10. Additionally, for all components categorized as LSS per this methodology, Section 4.4 requires that the users must demonstrate that any potential increases in risk resulting from changes in treatment are small and consistent with NRC acceptance criteria (e.g., RG 1.174, Revision 3, ML17317A256). Further, 10 CFR 50.69(d)(2) requires that the licensee ensure, with reasonable confidence, that components categorized as LSS (RISC-3 SSCs) remain capable of performing their safety related functions under design basis conditions, including seismic conditions and environmental conditions and effects throughout their service life and that the treatment of RISC-3 SSCs be consistent with the categorization process.

No.	HSS Criteria	Basis
12	Piping/component support boundaries. Any of the following options may be used: (a) Supports (component support, hanger, or snubber) may remained un-categorized until a need has been identified (for example, a significant repair/replacement or modification is required). (b) A component support, hanger, or snubber shall have the same categorization as the highest ranked piping segment within the piping analytical model in which the support is included. (c) A combination of restraints or supports such that the LSS piping and associated SSCs attached to the HSS piping are included in scope up to a boundary point that encompasses at least two (2) supports in each of three (3) orthogonal directions.	Criteria (a) and (b) are consistent with all NRC 10 CFR 50.69 LARs approved to date, such as the submittals by Vogtle Units 1 and 2, dated December 14, 2014 (ML14237A034), and Columbia, dated December 15, 2022 (ML22308A096). Criteria (c) is consistent with NRC positions for similar applications such as those intended to meet NUREG-1800, Revision 2, Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants, December 2010 (ML103490036) and NUREG-2192, Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants, July 2017 (ML17188A158).