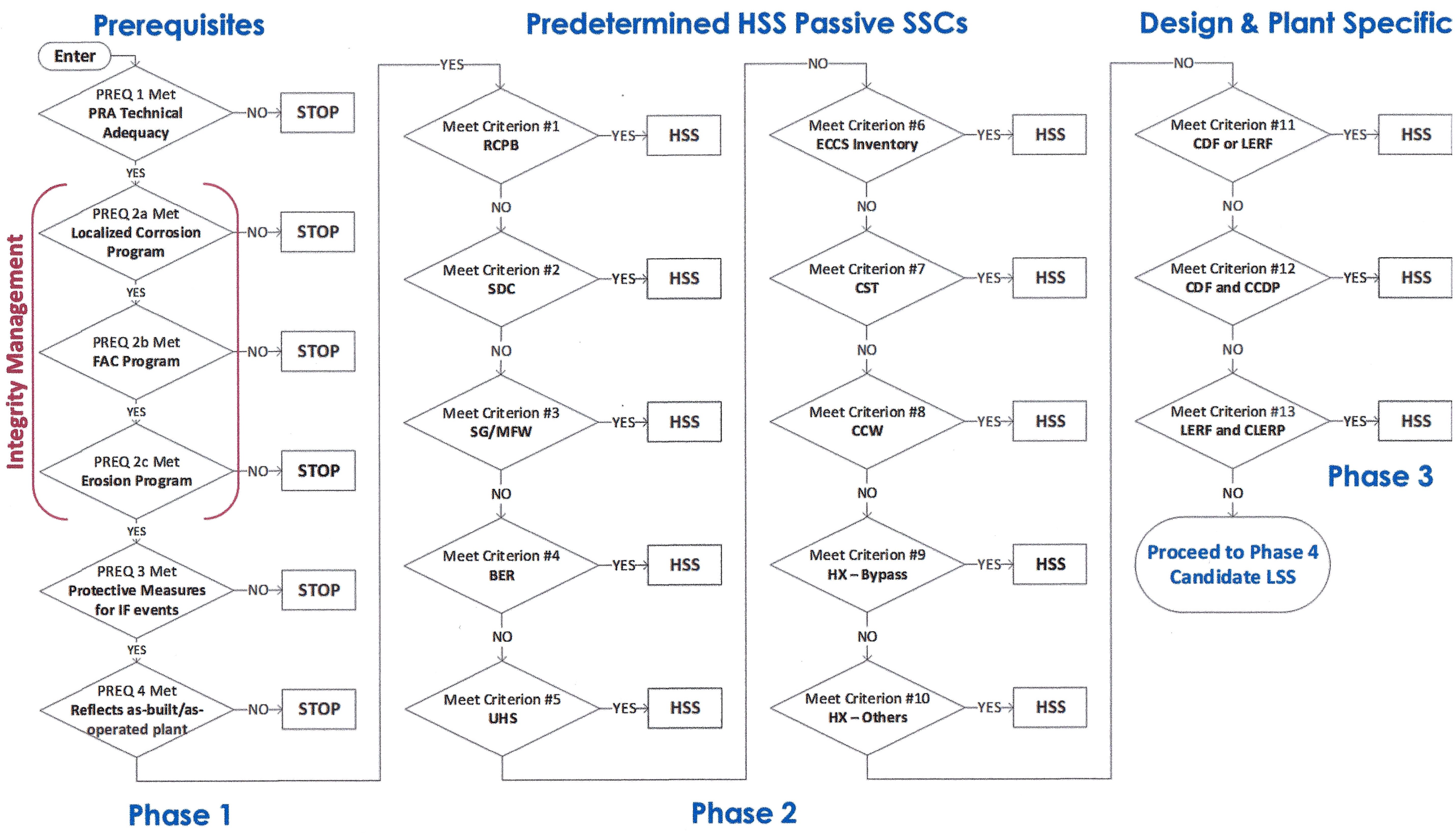
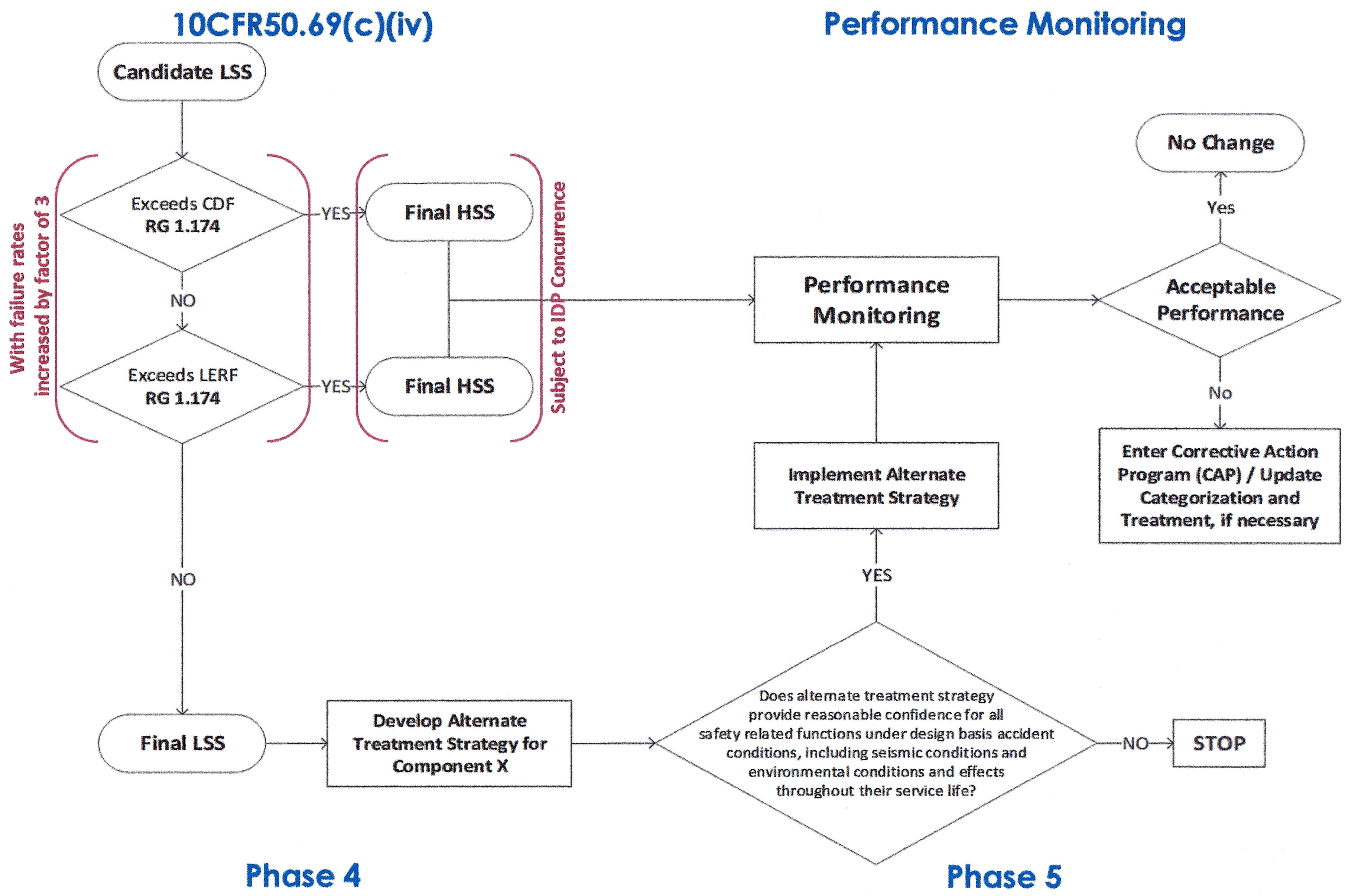
ATTACHMENT 1 –

ENHANCED PASSIVE CATEGORIZATION METHOD FLOWCHART

Attachment 1: Enhanced Categorization Method Flowchart



Attachment 1: Enhanced Categorization Method Flowchart



ATTACHMENT 2 –

METHOD COMPARISON TABLE

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced Methodology
Inquiry & Reply	In addition to defining classification criteria also defines treatment requirements for LSS components. Treatment described in this methodology is identical to the 10 CFR 50.69 rule.	The methodology provides an alternative approach to the classification criteria for LSS and HSS components. The proposed methodology imposes no change in treatment requirements. Licensees who choose to adopt this methodology will comply with treatment requirements of the rule and their 10 CFR 50.69 license condition.
1100 Scope	The proposed methodology will be used to determine the risk-informed safety classification (RISC) for repair/replacement activities applied to Class 2 and 3 pressure retaining items or their associated supports (exclusive of Class CC, concrete containment, and Class MC, metal containment, nuclear power plant components).	3002025288 applies to all Class 2, 3, and non-safety pressure boundary systems. While EPRI 3002025288 does not apply to Class CC and MC items, Criterion 1 (Class 1 items penetrating containment), Criterion 2 (shutdown cooling flow path), Criterion 3 (main feedwater), Criterion 4 (high energy piping penetrating containment), Criterion 6 (sumps and suppression pools) and Criterion 9 (heat exchanger bypass) assure that these components cannot be made LSS. Additionally, Criterion 11 and Criterion 13 will capture any plant-specific outliers. Options for addressing the remainder of CC and MC items include (1) remain uncategorized, (2) follow the existing methodology (RI-RRA) or (3) use of the Integrated Decision-Making Panel (IDP) through NEI 00-04, Section 6.2, “Containment Defense-in-Depth”.

Attachment 2: Method Comparison Table

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced Methodology
1200 Classification (a)	Similar introductory material is provided in [1]. There are no technical requirements in this section of N660. Assuming a failure probability of 1.0 is part of the consequence assessment process.	Similar introductory material although the Enhanced Methodology does not use a 1.0 failure potential. Rather, the methodology relies on a combination of pre-determined HSS criteria and a set of risk criteria based on industry consensus and plant-specific failure data. The pre-determined set of HSS components draws from the experience in applying a failure probability of 1.0 to a broad spectrum of BWR and PWR systems. Criterion 11-13 of the proposed methodology are based on realistic failure probabilities derived from detailed reviews of empirical data. Industry consensus has been reached on the approach to developing pipe rupture frequencies. Each station's modeled pipe rupture frequencies have been peer reviewed per the NRC-endorsed ASME/ANS Level 1/Large Early Release Frequency (LERF) PRA standard addressing at-power conditions and all hazards for operating light water reactors (LWRs).
1200 Classification (b)	This is not applicable to the RI-RRA relief request as the relief request only applies to Class 2 and 3 systems. Note: Licensees with currently approved 10 CFR 50.69 submittals that reference the ANO2 RI-RRA method for passive component categorization also document in the site-specific License Amendment Request that Class 1 components are HSS regardless of the outcome in the categorization process.	Criterion 1 requires all Class 1 portions of the Reactor Coolant Pressure Boundary are HSS.
1310 Determination of Classification	The licensee is responsible for implementing the proposed methodology. Core damage frequency (CDF) and large early release frequency (LERF) are included as risk metrics in the RISC process.	The licensee is responsible for implementing the proposed methodology. Core damage frequency (CDF) and large early release frequency (LERF) are included as risk metrics in the RISC process.

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced Methodology
1320 Required Disciplines	While the ANO2 RI-RRA methodology does not explicitly call out these disciplines, they are necessary to implement the consequence assessment which is the foundation of the methodology. As such, they have been and will continue to be fundamental to the relief request and its supporting analyses.	While the Enhanced Methodology does not explicitly call out these disciplines, knowledge of each of these disciplines is required to implement the assessment. Further, these disciplines are required as part of the IDP that reviews and approves all system categorization activities per NEI 00-04 and each licensee's 10 CFR 50.69 Safety Evaluation. As such, they have been and will continue to be fundamental to the categorization process.
1330	Section I-3.0.2 "PRA Scope and Technical Adequacy" of the proposed methodology provides the following: "The technical adequacy of the PRA used to support the evaluations required by this attachment shall be assessed. The PRA technical adequacy basis for the ANO-2 RI-ISI program application shall be reviewed to confirm it is applicable to the safety significant categorization of this application, including verifying assumptions on equipment reliability for equipment not within the scope of this request.	Prerequisite #1 of the Enhanced Methodology defines the PRA requirements. This includes having a PRA model of sufficient quality and level of detail to support the categorization process, the PRA must be subjected to a peer review process against a standard or set of acceptance criteria endorsed by the NRC. The 10 CFR 50.69 rule requires specific information be submitted regarding the PRA quality and its reviews. Any licensee who adopts the Enhanced Methodology must pursue an acceptable regulatory avenue for adoption of the method (e.g., License Amendment Request per 10 CFR 50.90).
-9000 Glossary		Definitions are provided in the text or a reference to a definition is included.
I-1.0 Introduction	No technical change from N660. Reference [1] provides additional clarity and states that the methodology is founded upon EPRI TR-112657. A figure has been added (Figure I-1) illustrating the modified RISC methodology process, including scope identification, consequence evaluation, consequence categorization, classification considerations, and final classification definitions.	EPRI Response to Action Item 6 of the November 2023 Supplement provides an overview of the entire 10 CFR 50.69 process and shows how EPRI 3002025288 fits into the current guidance (highlighting what changes and what does not change). This includes a flowchart illustrating in detail different portions of the process.

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced Methodology
I-2.0 Scope Identification	No change.	The proposed methodology evaluates the entire plant in one evolution. This is more conservative and complete than the existing process. For example, all RISC-2 components will be identified, and appropriate treatment applied (not currently required by the existing process).
I-3.0 Consequence Assessment	Pressure-retaining items shall be evaluated by defining piping segments that are grouped based on similar conditional consequences (i.e., given failure of the piping segment). To accomplish this grouping, direct and indirect effects shall be assessed for each piping segment. A consequence category for each piping segment is determined from the failure modes and effects analysis (FMEA) and impact group assessment as defined in Sections I-3.1.1 and I-3.1.2, respectively. The failure consequence can be quantified using the available probabilistic risk assessment(s) (PRA) to support the impact group assessment of Section I-3.1.2. Throughout the evaluations specified in Sections I-3.0, I-3.1, and I-3.2, credit may be taken for plant features and operator actions to the extent these would not be affected by failure of the segment under consideration. When crediting operator action, the likelihood for success and failure will be determined consistent with ANO-2's NRC-approved RI-ISI application. The scenario that results in the highest consequence ranking shall be used. As an example, to take credit for operator actions, the following features shall be provided: • An alarm or other system feature provides clear indication of failure; • Equipment activated to recover from the condition must not be affected by the failure; • Time duration and resources are sufficient to perform operator action; • Plant procedures define operator actions; • Operators are trained on the procedures.	The internal flood PRA model evaluates plant piping whose failure could cause an accident or system failure. Fluid sources within the plant that could flood plant areas or create adverse conditions (e.g., spray, elevated temperature, humidity, pressure, pipe whip, jet impingement) that could damage mitigative plant equipment are identified (i.e., indirect effects). Direct effects of the fluid source failure are also considered in the PRA (e.g. a service water break may eliminate the availability of one or both trains of service water to perform its function). Those scenarios that contribute to the core damage frequency and large early release frequency are identified and quantified. To accomplish this, an FMEA is performed. The FMEA is performed by evaluation of the flooding mechanisms (failure modes) of components. For each mechanism, the characteristic of the release and capacity of the source is determined (e.g., type of breach, flow rate, pressure and temperature of the source). Using the information on flood sources, flood affects are determined by developing scenarios for each source by identifying the propagation paths and SSCs affected by the failure event (e.g., flood, spray). Flood scenario development includes identifying plant design features that have the ability to terminate or contain the flood propagation (e.g., flood alarms, drains, sump pumps). Further, automatic or operator responses that have the ability to terminate or contain the flood are identified,

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced Methodology
		which includes, for example, consideration of indication, accessible pathways, and availability of time and resources to take action before the flood affect is realized. These requirements are from the ASME/ANS Level 1/Large Early Release Frequency (LERF) PRA standard addressing at-power conditions and all hazards for operating light water reactors (LWRs) and are a prerequisite of the proposed method.
I-3.1.1(a) Pressure Boundary Failure Size	Postulated break sizes are consistent with N660.	Consistent with previous approaches, the internal flood PRA models include a range of break sizes. For each flood source, applicable flooding mechanisms are evaluated that range from small failures causing a spray event to failures of large expansion joints.
I-3.1.1(b) Isolability of the break	A break can be automatically isolated by a check valve, a closed isolation valve, or an isolation valve that closes on a given signal. In lieu of automatic isolation, operator action may be credited consistent with Section I-3.0.1.	PRA modeled flood scenario development includes identifying plant design features that have the ability to terminate or contain the flood propagation (e.g., flood alarms, drains, sump pumps). Further, automatic or operator responses that have the ability to terminate or contain the flood are identified, which includes, for example, consideration of indication, accessible pathways, and availability of time and resources to take action before the flood affect is realized.
I-3.1.1(c) Indirect Effects	Methodology states that indirect effects need to be evaluated.	The proposed methodology evaluates indirect effects as the PRA model is required to evaluate indirect effects.
I-3.1.1(d) Initiating Events	Methodology states that initiating events need to be evaluated.	The proposed methodology evaluates initiating events as the PRA model is required, per the NRC-endorsed ASME/ANS Level 1/LERF PRA standard, to evaluate pressure boundary failures that are initiating events.
I-3.1.1(e) System Impact or Recovery	Methodology states that system impacts and recovery need to be evaluated.	The proposed methodology evaluates system impacts and recovery as the PRA model is required, per the NRC-endorsed ASME/ANS Level 1/LERF PRA standard, to evaluate system impacts and recovery.

ANO2 RI-RRA Section	**ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009**	**Proposed Enhanced Methodology**
I-3.1.1(f) System Redundancy	Methodology states that system redundancy for accident mitigation purposes needs to be evaluated.	The proposed methodology evaluates system redundancy as the PRA model is required, per the NRC-endorsed ASME/ANS Level 1/LERF PRA standard, to evaluate redundancy (e.g., PRA success criteria).
I-3.1.1(g) System Configuration	The consequence evaluation and ranking is organized into four basic consequence impact groups as discussed in Section I-3.1.2. The three corresponding system configurations for these impact groups are defined in Table I-6.	The consequence impact groups are individually discussed below. This section of the ANO2 RI-RRA methodology is an introduction to the remainder of the section.
I-3.1.2 Impact Group Assessment	The results of the FMEA for each system, or portion thereof, are classified into one of the following three core damage impact groups: (1) Initiating Event, (2) System, or (3) Combination. In addition, failures shall also be evaluated for their importance relative to containment performance. Each system, or portion thereof, shall be partitioned into postulated piping failures that cause an initiating event, disable a system/train/loop without causing an initiating event, or cause an initiating event and disable a system/train/loop. The consequence category assignment (HIGH, MEDIUM, LOW, or NONE) for each piping segment within each impact group shall be selected in accordance with subsequent sections.	The PRA modeling requires, per the NRC-endorsed ASME/ANS Level 1/LERF PRA standard, evaluation of potential flood sources to identify both direct and indirect effects (FMEA). These effects are added to the PRA model depending on the impacts, including those which disable specific equipment in the same system (direct impact) and failures that disable specific equipment in other systems (indirect impact).
I-3.1.2(a)	Initialing events are compared to Table I-1. In Table I-1, initiating events which could result in a high consequence rank include Loss of Off Site Power, Small LOCA, Steam Line Break, Feedwater Line Break, Large LOCA, etc. The initiating event CCDP is also evaluated per Table I-5. Differences between Table I-1 and I-5 need to be reconciled.	All pressure boundary failures that are plant initiating events are modeled in the PRA, as required per the NRC-endorsed ASME/ANS Level 1/LERF PRA standard. Analogous to Table I-5, these initiating events are evaluated quantitatively per criteria 11-13 of the enhanced methodology. The qualitative evaluation using Table I-1 is a relative interpretation to the severity of analyzed accidents. By definition, all pressure boundary failures that result in a Loss of Coolant Accident (LOCA) are from Class 1 SSC. Per the proposed methodology all Class 1 SSCs are HSS. Other pressure boundary component failures that could result in an infrequent initiating event that leads to a more significant accident with limited redundancy are modeled in the PRA with a quantitative risk impact being calculated.

ANO2 RI-RRA Section	**ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009**	**Proposed Enhanced Methodology**
		As discussed in Chapter 5 of the proposed methodology, many limiting faults (e.g., steam line breaks) do not actually result in significant CDF or LERF results. Any pressure boundary failure that could fail a safety function is considered 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 11-13 address loss of safety functions.
I-3.1.2(b) System Impact Group Assessment	The consequence category of a failure that does not cause an initiating event but degrades or fails a system/train/loop essential for preventing core damage, shall be based on the frequency of challenge, number of backup systems, and exposure time as evaluated per Table I-2. Differences in the consequence rank between the use of Table I-2 and I-5 need to be reconciled. Additionally, for defense in depth purposes added "postulated failures that lead to "zero defense" (i.e., no backup trains) shall be assigned a high consequence.	The PRA model requires, per the NRC-endorsed ASME/ANS Level 1/LERF PRA standard, evaluation of potential flood sources to identify both direct and indirect effects (via FMEA). These effects are added to the PRA model depending on the impacts and include failures which disable specific equipment in the same system (direct impact) and failures that disable specific equipment in other systems (indirect impact). These impacts are modeled in the PRA to evaluate the quantitative risk impact of reduced backup systems to provide key functions. Hence, this section of the existing methodology is a key reason why the pre-determined set of HSS items were developed in the proposed methodology in EPRI 3002025288. As an example, lessons learned from application of the existing methodology indicates that, for infrequent events such as LOCAs, if there is at least one unaffected backup train then a consequence rank of Medium (or perhaps Low) is readily obtainable (based on a low conditional core damage probability (CCDP) value). For example, for a postulated LOCA with a CCDP, of approximately 0.001 or 1E-3 with at least one unaffected

ANO2 RI-RRA Section	**ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009**	**Proposed Enhanced Methodology**
		backup train (probability of failure of 1E-2), a CCDP of less than 0.0001 or 1E-4 is readily obtainable or 1E-3). However, as part of the lessons learned from implementation and in line with current guidance, if there is little to no defense in depth then these components should be ranked as High consequence. Hence the development of many of the pre-determined HSS criteria are based on technical and carefully evaluated insights from current implementation. Additionally, the system review in Chapter 5, summarizes past experience categorizing PWR and BWR systems which further support the use of these pre-determined set of HSS components.
I-3.1.2(c) Combination Impact Group Assessment	The consequence category for a piping segment whose failure results in both an initiating event and the degradation of loss of a system shall be determined using Table I-3. The consequence category is a function of two factors: 1) Use of the system to mitigate the induced initiating event 2) Number of unaffected backup systems or trains available to perform the same function Differences in the consequence rank between the use of Table I-3 and I-5 need to be reconciled.	The PRA model evaluates the role of the failed system in mitigating the induced initiating event providing a quantitative risk result of the significance of the event. Further, any pressure boundary failure that could fail a safety function is considered 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) address loss of safety functions.

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced Methodology
I-3.1.2(d) Containment Performance Impact Group Assessment	Failures shall be evaluated for their importance relative to containment performance. 1) For failures that do not result in a LOCA that bypasses containment, the quantitative indices of Table I-5 for CLERP are used. 2) Table I-4 is used to assign consequence categories whose piping failure can lead to a LOCA that bypasses containment. Differences in the consequence rank between the use of Table I-4 and I-5 need to be reconciled.	Please see earlier discussion with regards to Class CC and MC items. The proposed methodology additionally addresses containment bypass as follows: 1) Results from the plant-specific LERF model will reflect those systems and component importance to containment integrity. 2) Predetermined HSS Criterion 9 requires heat exchangers whose failure could allow reactor coolant to bypass primary containment are HSS. 3) Criterion 6 (loss of sump or suppression pool is also a potential containment bypass).
I-3.1.2(e) Shutdown Operation Evaluation	The previously established consequence rank shall be reviewed and adjusted to reflect the pressure boundary failure's impact on plant operation during shutdown.	For all stations with approved 10 CFR 50.69 submittals, shutdown risk is evaluated consistent with NUMARC 91-06 (ML14365A203) with a focus on protecting decay heat removal defense in depth. In the proposed methodology, 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). These systems are relied upon during shutdown conditions and also for decay heat removal. No additional specific review is required for additional pressure boundary failures during shutdown conditions.
I-3.1.2(e) External Events Evaluation	The previously established consequence rank shall be reviewed and adjusted to reflect the pressure boundary failure's impact on the mitigation of external events from two perspectives: 1) External events that can cause a pressure-boundary failure (e.g., seismic events) 2) External events that do not affect likelihood of pressure-boundary failure, but create demands that might cause pressure-boundary failure and events (e.g., internal fires)	With respect to increased loading demands from seismic events, EPRI 1021467 (ML12171A450), "Nondestructive Evaluation: Probabilistic Risk Assessment Technical Adequacy Guidance for Risk-informed Inservice Inspection Program", states in Page 8: "The staff concludes that additional analyses of extreme loading events are not needed because the relevant information (pipe rupture safety-significant and plant-specific service experience) is addressed and additional evaluation will not change the conclusions derived from the RI-ISI program." Therefore, no adjustments are made to the

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced Methodology
		risk consequence values in the PRA model based on the consideration of seismic events. Internal fire events may challenge piping integrity by causing transients requiring the activation of plant mitigative systems. However, challenges from internal fires are predominately driven by the active functions (e.g., fire induced spurious signals) given the lower damage threshold of plant cables over metal piping. Therefore, fire damage to passive components are expected to be less frequent and not significantly different from the challenges caused by the random occurrence of internal initiating events. Hence, the insights from the full power internal events PRA model for this system are assumed to be bounding.
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 new proposed methodology defines components RISC categorization 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 11-13 address loss of safety functions. This consideration is still evaluated through the proposed methodology, with a more transparent and clear set of criteria as described above.

ANO2 RI-RRA Section	**ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009**	**Proposed Enhanced Methodology**
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 11-13 address loss of safety functions (including loss of power due to a pressure boundary failure). This consideration is still evaluated through the proposed methodology, with a more transparent and clear set of criteria as described above.

ANO2 RI-RRA Section	**ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009**	**Proposed 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 Boiling Water Reactor Owners Group (BWROG) and the Pressurized Water Reactor Owners Group (PWROG) have evaluated the standard plant Emergency Operating Procedures. Based on industry experience and lessons learned, no instances where any single component was found to be the sole means for successful performance of actions required to mitigate an accident or transient were identified. 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 (per criterion 12 and -13). This consideration is still evaluated through the proposed methodology, with a more transparent and clear set of criteria as described above.

ANO2 RI-RRA Section	**ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009**	**Proposed Enhanced Methodology**
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 Criteria 11 and 13 address loss of safety functions for maintaining containment integrity. This consideration is still evaluated through the proposed methodology, just in a different approach.
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 Criteria 11 and 13 evaluations. This consideration is still evaluated through the proposed methodology, with a more transparent and clear set of criteria as described above.

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced Methodology
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 model consequence assessment of the methodology requires an evaluation and ranking of postulated failures on core damage and containment performance (e.g., containment bypass, LERF). Finally, with implementation of the 10 CFR 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.
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 requirements in the NRC-endorsed ASME/ANS Level 1/LERF PRA standard. The inherent process maintains this defense-in-depth attribute. No further evaluation is required when implementing the proposed methodology.

ANO2 RI-RRA Section	ANO2 RI-RRA from letter 2CAN010901 (ML090120620) January 12, 2009	Proposed Enhanced 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 plant's 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 failure modeling is a fundamental aspect of the PRA consequence evaluation methodology and therefore is taken into account, per requirements in the NRC-endorsed ASME/ANS Level 1/LERF 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) (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.

ATTACHMENT 3 –

UPDATED TABLE 1

Attachment 3: Updated Table 1

An updated Table 1 is shown including additional basis and the various resources used in developing this enhanced approach to categorizing the pressure boundary. The enhanced methodology builds on existing, applicable categorization resources with a solid technical basis to justify its use in the context of passive SSCs. Each of these resources were assessed as to their credibility as an input to this process as follows:

- 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, ML0134770102) 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 1). 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) in the enhanced methodology.
- 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 (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 criteria 11, 12 and 13 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, 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 is only used to add HSS segments and not, for example, to remove system parts generically assigned to the HSS in criterion 1 through 10.

- To further reinforce ensuring adequate defense-in-depth in addition to the approach currently acceptable, criteria 12 and 13 were developed and added to the enhanced methodology to conservatively increase the confidence that potentially important pressure boundary components would not be missed on a plant-specific basis. By incorporating CCDP/CLERP (conditional core damage probability/conditional large early release probability) metrics, these measures also provide additional balance between prevention and mitigative. That is, components cannot be assigned to the LSS population based solely on low failure likelihood, unless that likelihood is significantly low (with a lower value than the established 1E-6/year and 1E-7/year risk criteria). That is, less than 1E-08/year CDF and less than 1E-09/year LERF. Similar to criterion 11, criterions 12 and 13 were added to provide additional means of ensuring that any plant-specific locations that are important to safety are identified. Criterion 12 and 13, are used to add HSS segments and not, for example, to remove system parts generically assigned to the HSS in criterion 1 through 10. Finally, 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.
- Criterion 11, 12 and 13 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. Satisfying the guidelines in criterion 11, 12 and 13 requires confidence that the relevant results and risk insights from the PRA models relied upon (i.e., internal event PRA model, and internal flooding PRA model) are capable of identifying the significant contributors to risk that are not included in the generic results. The NRC's Regulatory Guide 1.200 (RG 1.200), "Acceptability Of Probabilistic Risk Assessment Results For Risk-Informed Activities" (ML20238B871) forms the basis for meeting the attributes of an NRC-endorsed PRA standard to demonstrate that a PRA is adequate to support a risk-informed application. Furthermore, RG 1.200 provides an acceptable approach that can be used to ensure technical adequacy is ensured via the implementation of an industry peer review process for PRA models.
- Insights from plant design and practices also contribute to the determination of SSC safety significance and subsequently the development of the enhanced methodology:
    - Plant features that are credited in the internal flooding PRA model as providing a substantial safety benefit (e.g., submarine doors) are key in maintaining a valid categorization (Prerequisite 3).
    - The system review described in Section 5 of EPRI 3002025288 identified that flood mitigation components should not be allowed to be classified LSS without first evaluating their safety significance (see footnotes 7 and 11 in Table 4 of EPRI 3002025288).
- Where PRA outputs are used:
    - A robust plant-specific PRA that reflects the as-built, as-operated plant throughout the plant's lifetime (Prerequisite 1).
    - An appropriate plant-specific search for outliers based upon risk criteria (using quantitative risk results for CDF/LERF) (Criteria 11-13) and defense in depth (CCDP/CLERP) considerations (e.g., Criteria 5, 6).
    - A demonstration that any potential increases in risk resulting from changes in treatment on LSS components are small and consistent with NRC acceptance criteria.

- This integrated approach, while requiring a robust plant-specific PRA is not solely focused on PRA quantitative results, as it requires explicit consideration of the as-built/as-operated plant specific design and operating practices via:
  - Implementation of measures that have a proven track record in providing a reliable pressure boundary,
  - A pre-determined set of HSS systems and sub-systems that provide for a balanced approach as to prevention and mitigation

Table 1 provides additional supplemental information that identify the basis and provide a technical justification for the inclusion of the 14 criteria and their relationship to the methodology in EPRI 3002025288. Section 4.2 provides guidance on how to implement each Criterion. Chapter 5 explains the basis for using the past 30 years of experience in risk-informed categorization for pressure boundary components relied upon to develop the criteria proposed in EPRI 3002025288.

Table 1

<table>
<tr><th>No.</th><th>HSS Criteria</th><th>Basis</th></tr>
<tr><td>1</td><td>RCPB (Class 1)</td><td>
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 below.
<table>
<tr><th>IE Event</th><th>LOCA CCDP</th><th>Isolation</th><th>Valve Failure Rate (per hour)</th><th>Yearly Likelihood</th><th>Final CCDP</th><th>Final Rank</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>LOCA-X</td><td>1.86E-3</td><td>MOV</td><td>1E-7</td><td>8.76E-4</td><td>1.63E-6</td><td>Med</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>LOCA-Y</td><td>3.19E-3</td><td>CV</td><td>3.50E-7</td><td>3.1E-3</td><td>9.78E-6</td><td>Med</td></tr>
</table>
</td></tr>
</table>

Table 1

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, criteria 11, 12 and 13 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 criteria 11, 12 and 13 below. Additionally, for portions of the shutdown cooling function categorized as LSS per this methodology. Section 4.3 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.

Attachment 3: Updated Table 1

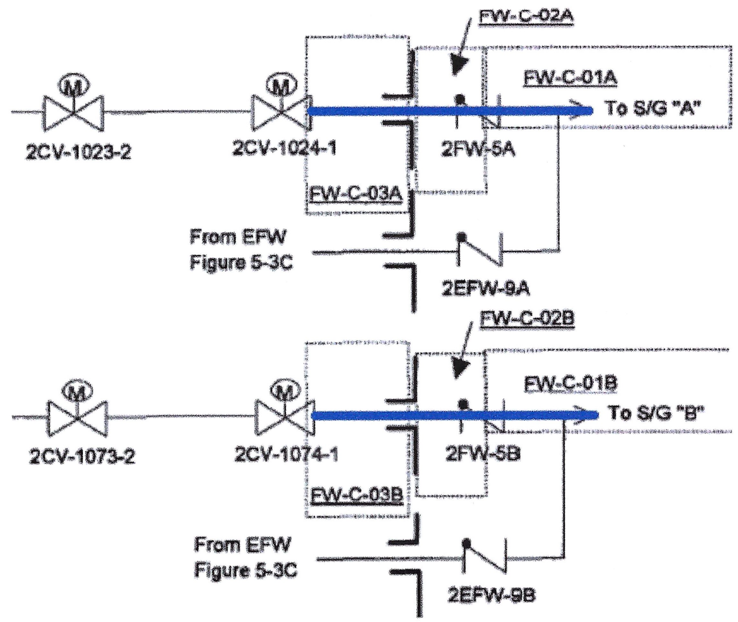
3	Class 2 portions of steam generators and Class 2 feedwater system components greater than NPS 4 (DN 100) of PWRs from the steam generator to the outer containment isolation valve	In a PWR, heat removal through the steam generator is the desired heat removal path for both normal operation and post-accident 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. 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. 

Table 1

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. These additional considerations and how they are adequately addressed via the enhanced methodology are further discussed in Attachment 2 to the June supplement. Further, criteria 11, 12 and 13 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 criteria 11, 12 and 13 below. Additionally, for portions of the feedwater system categorized as LSS per this methodology, Section 4.3 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). 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 criteria 11, 12, and 13 of this 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.

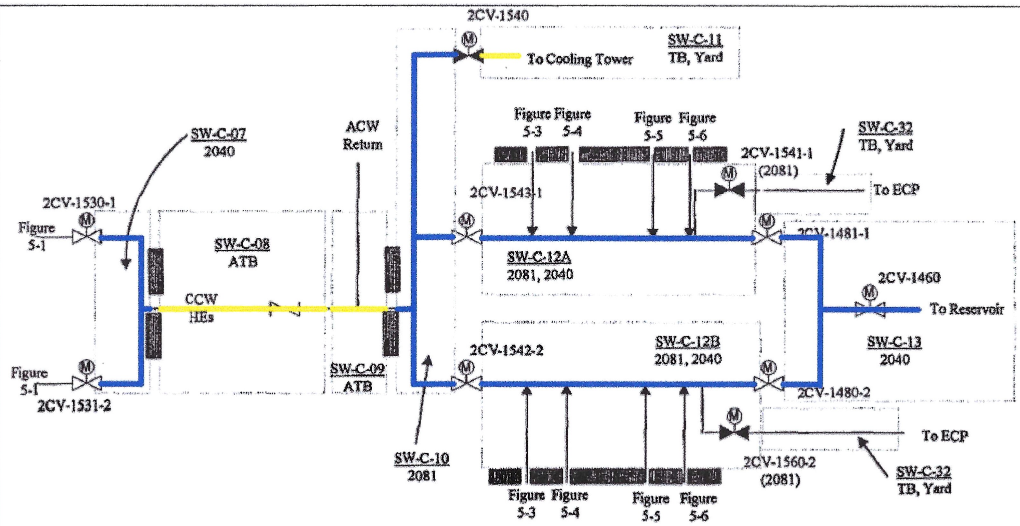
4	Components larger than NPS 4 (DN 100) within the BER for high-energy piping systems as defined by the owner	The Break Exclusion Region (BER) for high-energy piping systems encompasses a special set of piping where design basis double ended guillotine breaks are not postulated in certain locations between 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. 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. These additional considerations and how they are adequately addressed via the enhanced methodology are further discussed in Attachment 2 to the June supplement Further, criteria 11, 12 and 13 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. Please see additional, updated discussion on criteria 11, 12 and 13 below.

Table 1

No.	HSS Criteria	Basis
		Additionally, for portions of the BER region categorized as LSS per this methodology, Section 4.3 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 criteria 11, 12, and 13 of this 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 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. Figure 3 uses a graphic from the existing process that demonstrates mitigating systems with two redundant trains results in an acceptably low CCDP/CLERP. 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).

Attachment 3: Updated Table 1

<table>
<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.

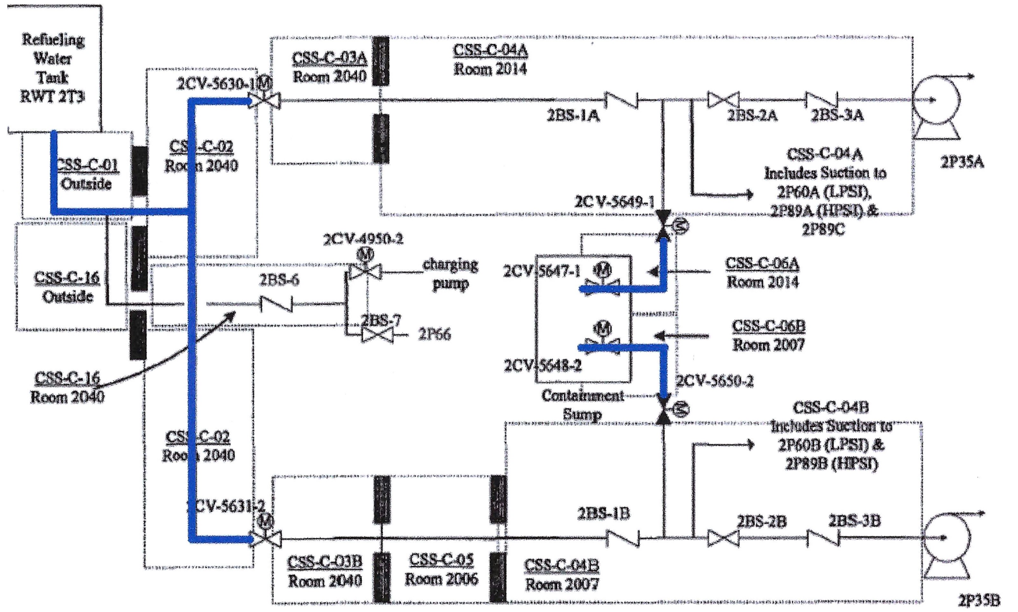
Figure 2 shows the initial consequence rank and how the final HSS/LSS determination is accomplished. High consequence rank components are categorized as HSS with no further input. Medium and Low consequence rank components are subjected to additional considerations in the proposed methodology. For the 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. These additional considerations and how they are adequately addressed via the enhanced methodology are further discussed in Attachment 2 to the June supplement.

Further, criteria 11, 12 and 13 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 criteria 11, 12 and 13 below.

Additionally, for individual portions of the UHS function categorized as LSS per this methodology, Section 4.3 of EPRI 3002025288 requires that the licensees must demonstrate that any potential increases in risk resulting from changes in treatment are
</td></tr>
</table>

Table 1

No.	HSS Criteria	Basis
		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.

<table>
<tr>
<td>6</td>
<td>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).</td>
<td>
Emergency core cooling systems (ECCS) typically contained a single source of inventory (see Figures 4A and 4B). 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.


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.
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
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Table 1

No.	HSS Criteria	Basis
		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. These additional considerations and how they are adequately addressed via the enhanced methodology are further discussed in Attachment 2 to the June supplement. That is, while use of Criteria 11-13 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 criteria 11-13 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 risk as a result of its application.

<table>
<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 (see Figure 4C). 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).

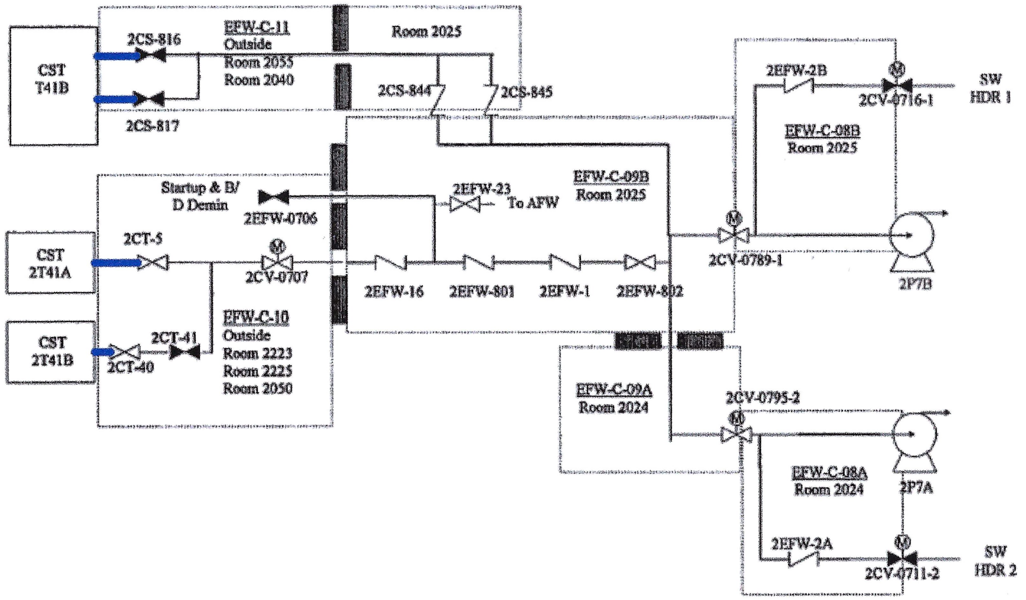


Figure 2 shows the initial consequence rank and how the final HSS/LSS determination is accomplished. High consequence rank components are categorized as HSS with no further input. Medium and low consequence rank components are subjected to the "additional considerations." For the reasons discussed in 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. These
</td>
</tr>
</table>

Table 1

No.	HSS Criteria	Basis
		additional considerations and how they are adequately addressed via the enhanced methodology are further discussed in Attachment 2 to the June supplement. 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 Criteria 11-13 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 criteria 11-13 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 risk as a result of its application.
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 11-13 of this enhanced methodology must be evaluated and it must be confirmed that LSS is the correct assignment. Please see additional, updated discussion on criteria 11, 12 and 13 below. Additionally, for portions of the CCW systems categorized as LSS per this methodology, Section 4.3 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.

Table 1

No.	HSS Criteria	Basis
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). 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.

Table 1

No.	HSS Criteria	Basis
10	Other heat exchangers—if not explicitly addressed in rows 11- 14 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 4.3 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.

Table 1

No.	HSS Criteria	Basis
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 whose contribution to LERF is greater than 1E-07/year, based upon a plant-specific PRA of pressure boundary failures (for example, pipe whip, jet impingement, spray, and inventory losses). This may include Class 1 and 2 and Class 3, or non-class components.	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 HSS. Application of this criterion have already resulted in a number of voluntary safety improvements implemented by the industry, as identified in Table 7 of EPRI 3002025288. 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-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. 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 4.3 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). 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.

Table 1

No.	HSS Criteria	Basis
12	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-08/year and the product of its CDF contribution times its associated CCDP is greater than 1E-08/year, based upon a plant-specific PRA of pressure boundary failures (for example, pipe whip, jet impingement, spray, and inventory losses)	This Criterion assures that, on design specific or a plant-specific basis, the previous criteria (i.e., 1 through 11) have not missed anything that is important and that should be categorized HSS including adding a metric to address defense in depth (i.e., CCDP). Based on lessons learned with Criterion 11, this more conservative assessment will result in additional voluntary safety improvements that have already been implemented by industry as shown in Table 7 of EPRI 3002025288. The value of 1E-08/year is similar yet more conservative to that used in RG 1.200-compliant PRA models for reactor vessel rupture (RVR) initiating events. RVR, also known as Excessive LOCA, Very Large LOCA, exceeds the capacity of emergency core cooling systems and leads to core damage (i.e., CCDP = 1.0). Additionally, for all components categorized as LSS per this methodology, Section 4.3 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 (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.

Table 1

No.	HSS Criteria	Basis
13	Any piping or component (including piping segments or components grouped or subsumed within existing plant initiating event groups) whose contribution to LERF is greater than 1E-09/year and the product of its LERF contribution times its associated CLERP is greater than 1E-09/year, based upon a plant-specific PRA of pressure boundary failures (for example, pipe whip, jet impingement, spray, and inventory losses).	This Criterion assures that, on a design specific and a plant-specific basis, the previous criteria (i.e., 1 through 12) have not missed anything that is important and that should be categorized HSS including adding a metric to address defense in depth (i.e., CLERP). Based on lessons learned with Criterion 11, this more conservative assessment will result in additional voluntary safety improvements that have already been implemented by industry as shown in Table 7 of 3002025288. The value of 1E-09/year is one order of magnitude more conservative than that used for criterion 12. This order of magnitude reduction has been approved by NRC in numerous risk-informed applications, such as RI-ISI and RI-RRA (N660, N752), for assuring that containment performance is adequately addressed. Additionally, for all components categorized as LSS per this methodology, Section 4.3 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). 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.

Table 1

No.	HSS Criteria	Basis
14	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. © 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). Criteri©(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).

Attachment 3: Updated Table 1

Consequence Evaluation

Failure Potential Assessment ***(Degradation Mechanism)***

		CONSEQUENCE CATEGORY CCDP and CLERP Potential			
		NONE	LOW	MEDIUM	HIGH
DEGRADATION CATEGORY Pipe Rupture Potential	HIGH	LOW (Cat. 7)	MEDIUM (Cat. 5)	HIGH (Cat. 3)	HIGH (Cat. 1)
	MEDIUM	LOW (Cat. 7)	LOW (Cat. 6)	MEDIUM (Cat. 5)	HIGH (Cat. 2)
	LOW	LOW (Cat. 7)	LOW (Cat. 7)	LOW (Cat. 6)	MEDIUM (Cat. 4)

Figure 1

Attachment 3: Updated Table 1

<table>
<tr><th rowspan="6">Conditional Core Damage Probability</th><th rowspan="6">Conditional Large Early Release Probability</th><th rowspan="6">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="4">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></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>$\leq 10^{-6}$</td><td>$\leq 10^{-7}$</td><td>Low(2)</td><td>HSS</td><td>LSS</td><td>HSS</td></tr>
<tr><td colspan="6">(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.</td></tr>
</table>

Figure 2

Attachment 3: Updated Table 1

2 trains equal
Medium / Low
consequence rank

Affected Systems		Number of Unaffected Backup Trains							
Frequency of Challenge	Exposure Time to Challenge	0.0	0.5	1.0	1.5	2.0	2.5	3.0	≥3.5
Anticipated (DB Category II)	All year	High	High	High	High	Medium	Medium	Low*	Low
	Between tests (1-3 months)	High	High	High	Medium*	Medium	Low*	Low	Low
	Long CT (≤1 week)	High	High	Medium*	Medium	Low*	Low	Low	Low
	Short CT (≤1 day)	High	Medium*	Medium	Low*	Low	Low	Low	Low
Infrequent (DB Category III)	All year	High	High	High	Medium	Medium	Low*	Low	Low
	Between tests (1-3 months)	High	High	Medium*	Medium	Low*	Low	Low	Low
	Long CT (≤1 week)	High	Medium*	Medium	Low*	Low	Low	Low	Low
	Short CT (≤1 day)	High	Medium	Low*	Low	Low	Low	Low	Low
Unexpected (DB Category IV)	All year	High	High	Medium	Medium	Low*	Low	Low	Low
	Between tests (1-3 months)	High	Medium	Medium	Low*	Low	Low	Low	Low
	Long CT (≤1 week)	High	Medium	Low*	Low	Low	Low	Low	Low
	Short CT (≤1 day)	High	Low*	Low	Low	Low	Low	Low	Low

Figure 3

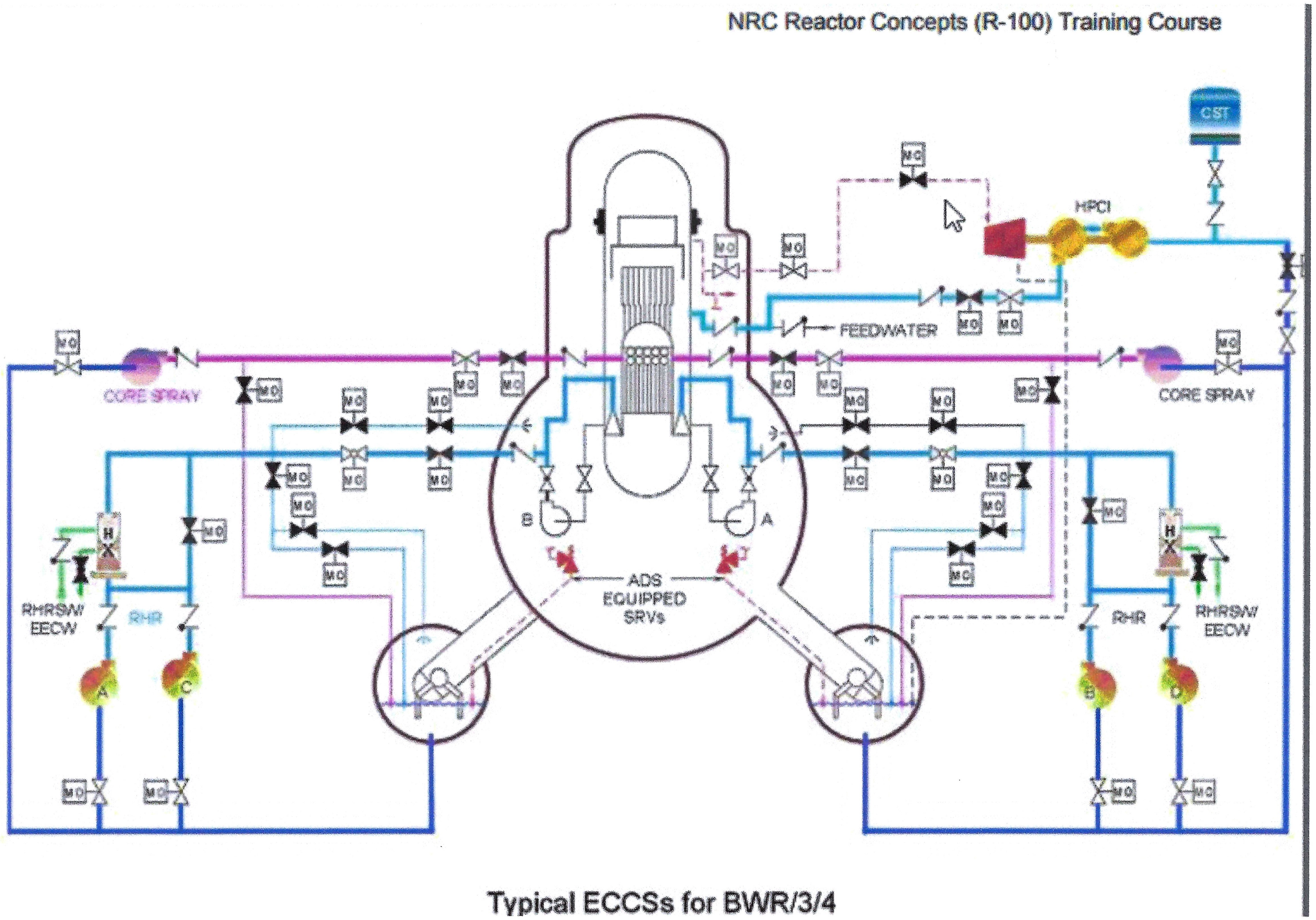
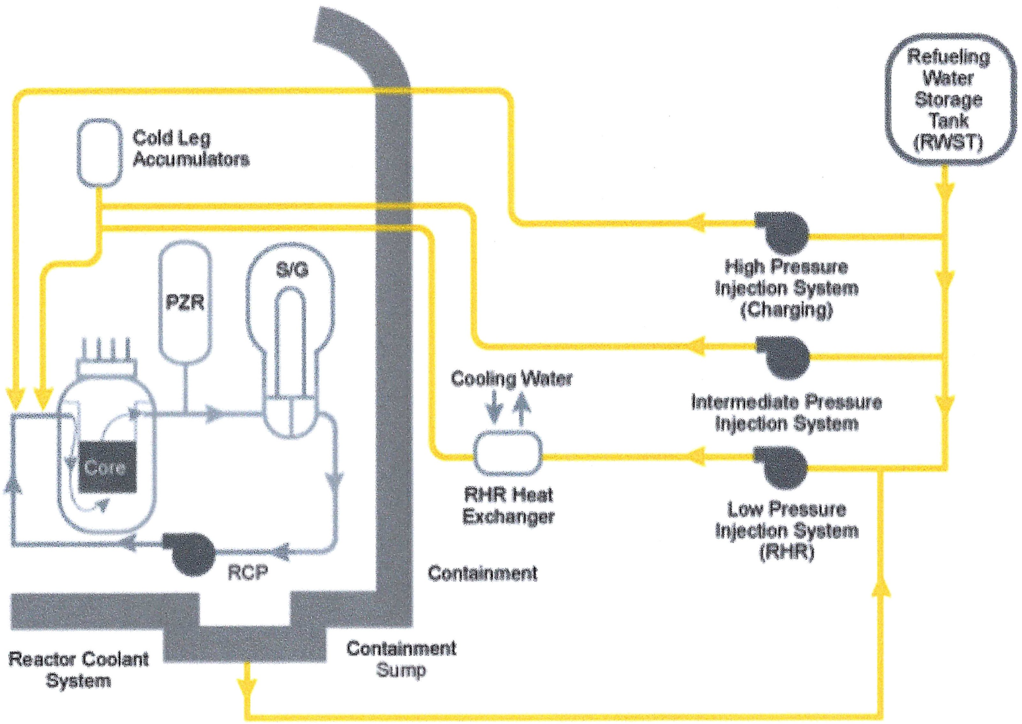


Figure 4A (Source = https://www.nrc.gov/cdn/legacy/reading-rm/training/reactor-concepts-training-course.pd)

Attachment 3: Updated Table 1

NRC Reactor Concepts (R-100) Training Course



Emergency Core Cooling System (ECCS)

Figure 4B (Source = https://www.nrc.gov/cdn/legacy/reading-rm/training/reactor-concepts-training-course.pd)

Attachment 3: Updated Table 1

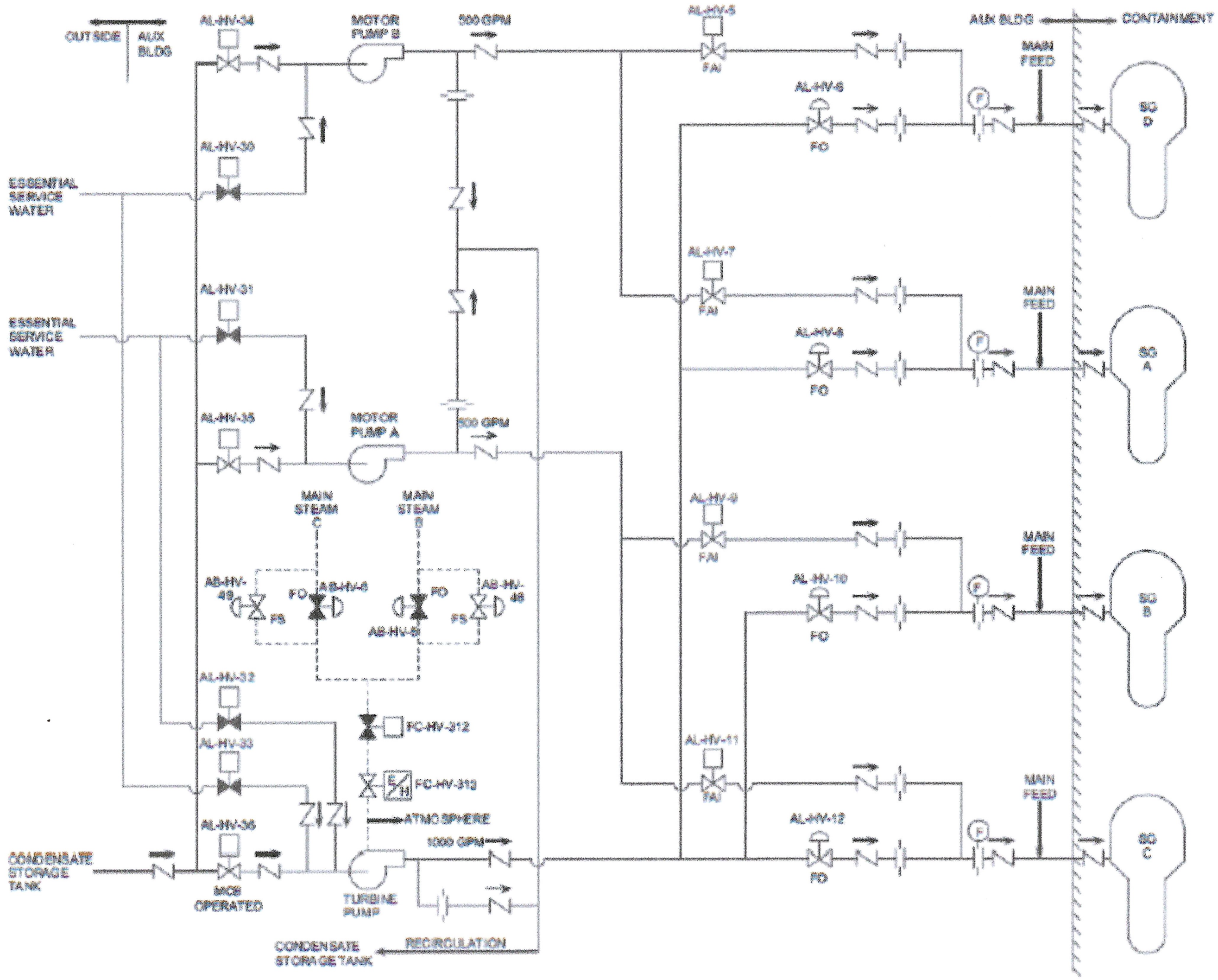


Figure 5.7-1 Auxiliary Feedwater System

Figure 4C (Source = ML11223A229)

ATTACHMENT 4 –

UPDATED CHAPTER 5

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 4 licensees at 15 plants. It is also the same methodology in use at plants implementing 10 CFR 50.69 (approximately 50 units). Figure 1 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 11-13). How the enhanced methodology contained in Chapter 4 incorporated these previous experiences, closed identified gaps as well as captures design and plant-specific insights is summarized in the following sections.

Evolution of EPRI RI-technology to Pressure Boundary Components

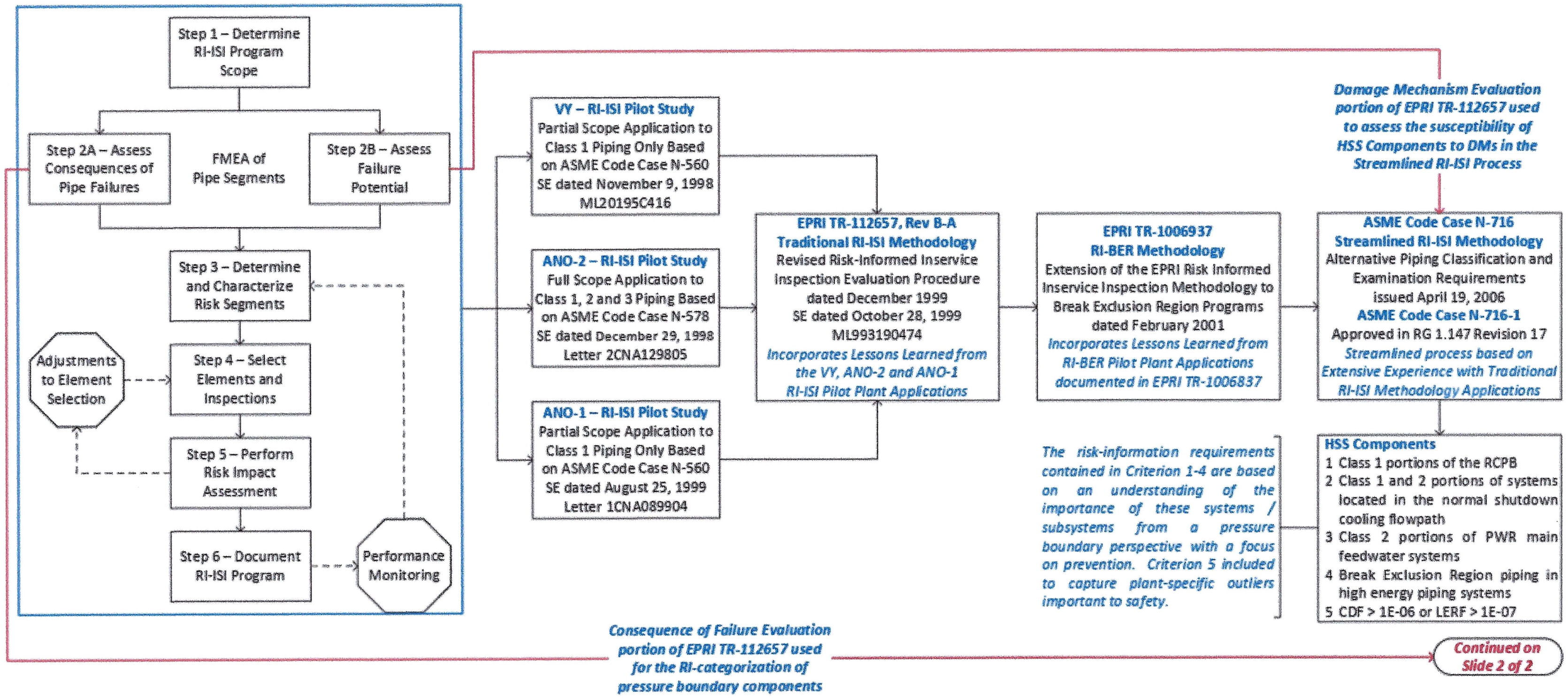


Figure 1
Evolution of EPRI RI-technology to pressure boundary components (1 of 2)

Evolution of EPRI RI-technology to Pressure Boundary Components

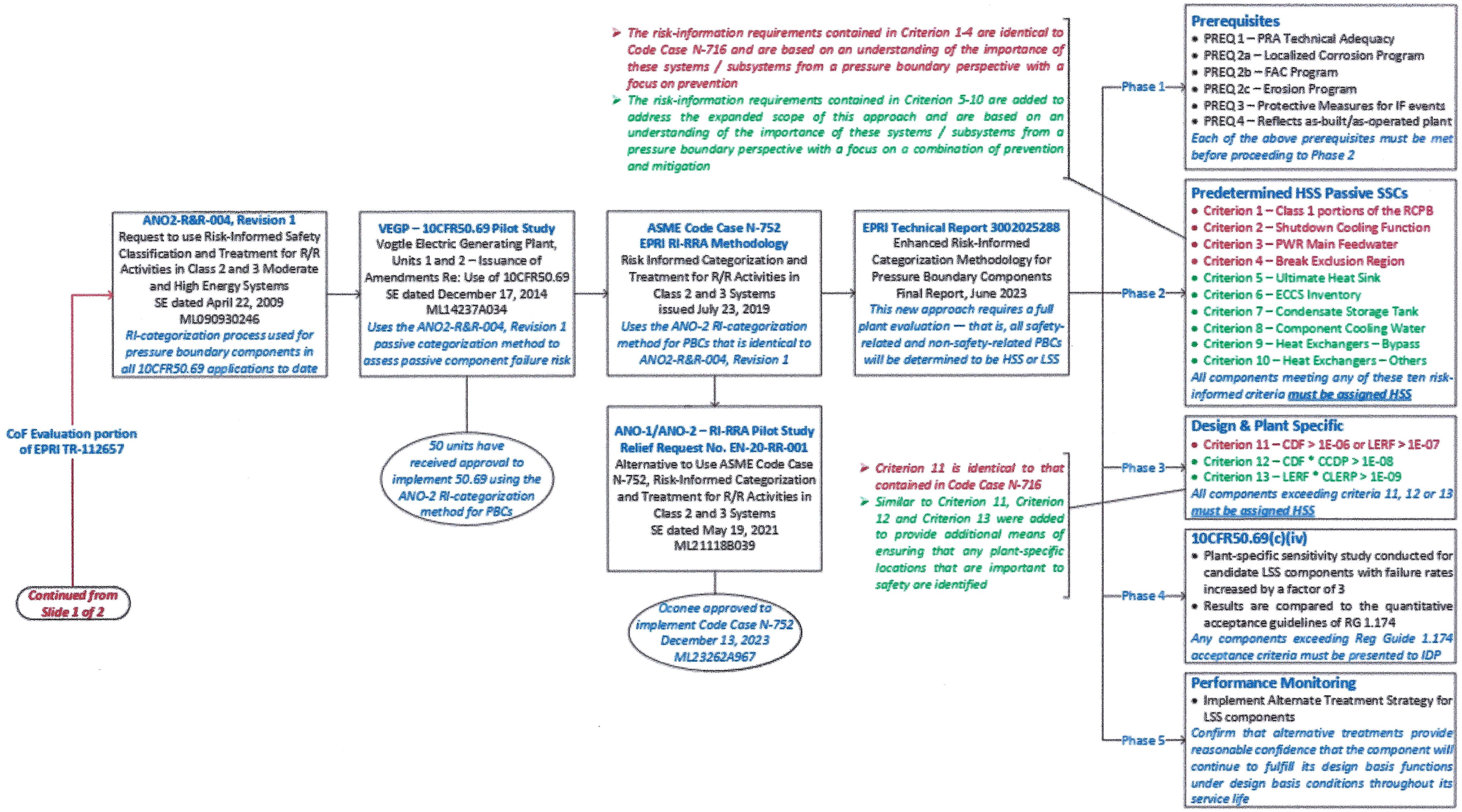


Figure 2

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

With the intent to appropriately use a risk-informed methodology, Criteria 11-13 ultimately were 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 and 3)

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 11-13) 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. It is anticipated that application of Criteria 12 and 13 will increase the number of voluntary design specific and plant-specific safety improvements.

The following summarizes the system review contained in Table 4 and 5 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 11-13 account 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 11-13 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, thus Criterion 11-13 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 11−13 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 the tables:

- 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 11-13.

  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 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 11-13: determines risk significance (e.g., HSS) beyond Class1 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 11-13: 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 11-13: 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 11-13: 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 11-13: 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 11-13: 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 11-13: 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 11-13: determines risk significance on a plant specific basis

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: determines risk significance on a plant specific basis
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 11-13: 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 11-13: 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 11-13: 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 11-13: determines risk significance on a plant specific basis

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: determines risk significance on a plant specific basis – Note that other parts of the categorization process address importance of systems to fire risk
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 11-13: 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 11-13: determines risk significance on a plant specific basis

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: 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
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 11-13: determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis whether SR or NSR

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: 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 11-13: determines risk significance (e.g., HSS) on a plant specific basis

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: determines risk significance (e.g., HSS) on a plant specific basis
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 11-13: determines risk significance (e.g., HSS) on a plant specific basis

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: 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 11-13: 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 11-13: 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 11-13: 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

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 – Must be considered as internal flooding source in PRA	– Criterion 11-13: 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 11-13: 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 11-13: 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 11-13: 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

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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
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

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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
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

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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
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

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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
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

Table 4
BWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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
PWR 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 11-13: 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 11-13: 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 11-13: 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 11-13: 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 11-13: determines risk significance on a plant specific basis

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: determines risk significance on a plant specific basis
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 11-13: 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 11-13: 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 11-13: 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 11-13: determines risk significance on a plant specific basis

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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
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

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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
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 11-13: 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

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: determines risk significance on a plant specific basis
Temperature monitoring	No	– No pressure boundary components	– No pressure boundary components
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

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: determines risk significance on a plant specific basis
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 11-13: determines risk significance (e.g., HSS)

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: determines risk significance (e.g., HSS) whether SR or NSR for all SW systems
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 11-13: 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
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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
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 11-13: determines risk significance (e.g., HSS) beyond Class 1 boundary on a plant specific basis

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 – Containment penetrations are considered part of the containment structure and are not categorized (remain uncategorized and safety related) – Not a flood source	– LSS
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

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: 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) – Criterion 10: heat exchanger interface with service water or CCW must be evaluated – Criterion 11-13: determines risk significance on a plant specific basis

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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
Security	No	– No pressure boundary components	– No pressure boundary components
Automatic telephone	No	– No pressure boundary components	– No pressure boundary components

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: 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

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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
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 11-13: 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 11-13: 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

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 boundary failures also tend to support the secondary cooling function although it can be too much.	– Criterion 11-13: determines risk significance on a plant specific basis
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 11-13: 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

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: determines risk significance on a plant specific basis – Note that other parts of the categorization process address importance of systems to fire risk
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 11-13: determines risk significance on a plant specific basis

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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
PWR 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 11-13: 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 11-13: 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 11-13: 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

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 – 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
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.

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: determines risk significance on a plant specific basis

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 – 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 11-13: 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 11-13: 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 11-13: 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 11-13: 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 11-13: determines risk significance on a plant specific basis

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: determines risk significance on a plant specific basis
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 11-13: 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 11-13: determines risk significance on a plant specific basis

Table 5
PWR Systems

System	PB	112657 Existing Methodology Experience	3002025288 Coverage
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 11-13: 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 11-13: 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 11-13: 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 11-13: 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 Sandby 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 11-13)	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 11-13)

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 11-13)	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 in Section 5.4 and 5.5 (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. Criterion 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 whether LSS or HSS.

- Criterion 10 sates “Other heat exchangers—if not explicitly addressed in 11–13, 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 are summarized below 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. This approach to modeling is acceptable per the NRC-endorsed ASME/ANS Level 1/Large Early Release Frequency (LERF) PRA standard. 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 as 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. For BWR designs refer to Section 5.4 and 5.5]. 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 Evaluation of Ranking from NRC Database

Figure 3 was provided by NRC during the April 30th, 2024 public meeting (ML24117A256) showing the importance of key systems modeled in PRA models developed by the NRC (referred to as Standardized Plant Analysis Risk, SPAR, models; and usually based on more detailed individual industry plant PRA information, complemented by standardized modeling and quantification performed by the Idaho National Laboratory for use by the NRC, see ML102930134). As discussed in Section 5.3, a number of brainstorming sessions were conducted which identified and stress-tested a large number of possible options in developing an alternative approach for risk-informed categorization of the pressure boundary. While Figure 3 was initially not available during the development of the Chapter 4 methodology, system importances are a typical output of plant PRA and these types of insights were available and have been discussed throughout the methodology development.

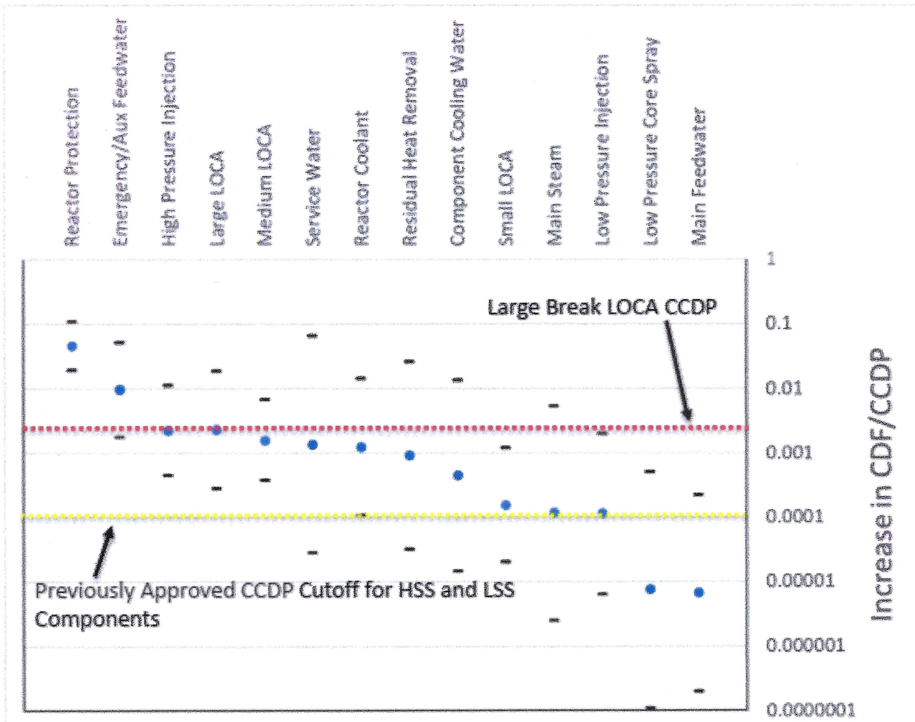


Figure 3
System Rankings from NRC SPAR models

The chart presented by NRC staff during this public meeting provides valuable insights into system importance from a risk-informed point of view. As presented by NRC, the ranking provided in the chart are based upon total failure of the system's active functions. For example, complete loss of motive power to all pumps within the system thereby causing a total loss of flow from the system.

As discussed during the April 30th, 2024 public meeting, insights from these SPAR model calculations may be conservative with regards to the importance of a pressure boundary failure within the system or they could be unconservative with regards to the importance of pressure boundary failures within the system because for example, the NRC provided data does not address spatial impacts (flooding, spray, loss of inventory) from the postulated system failures.

As noted in Section 5.3, pressure boundary failures rarely render an entire system unavailable. Typically, only one train of the system is affected by the failure. These direct effects are within the scope of the PRA model, provided the system is important to risk.

The following summarizes an evaluation of this NRC's PRA system ranking chart (Figure 3) regarding the importance of pressure boundary failures for these systems and its relevance to the Chapter 4 methodology:

- Reactor Protection (RPS) – this system is an I&C system with no pressure boundary components (there is no piping, valves, pumps etc.), therefore no further evaluation is necessary.

  Note that if the control rod penetrations are considered part of this system, the associated CCDP values for these nozzles would be lower than depicted in Figure 3. Additionally, control rod penetrations and other reactor vessel nozzles are part of the reactor coolant pressure boundary and per Criterion 1 are HSS.

  Additionally, if a pressure boundary failure of another system could indirectly affect the RPS (e.g., spray) then it would be modeled in the plant specific PRA. Indirect effects are unique to each plant design due to where each component is located in the buildings. This methodology captures these effects using Criteria 11-13 where the PRA model provides the quantitative impact of these indirect effects.

- Emergency/Aux Feedwater – the pumps and their discharge to the steam generators have redundancy (a single pressure boundary failure does not fail all pumps) and flow rates are much lower than on the suction side from the CST. Pressure boundary failures on the discharge are also detectable and there is time for isolation. Thus, unless there are indirect effects associated with the postulated failure the pumps and their discharge paths are a medium consequence using the existing NRC-approved consequence evaluation methodology. The CST presents a potential common mode failure for both EFW and AFW if there is no reliable backup source. As shown by the NRC's PRA system ranking chart based on the SPAR model results, this is potentially a high consequence. This is why Criterion 7 requires that the Licensee ensure on plant-specific and design specific basis that there is a reliable backup to the CST function otherwise this portion of the Emergency / Auxiliary Feedwater system is assigned HSS per Criterion 7.

- High Pressure Injection – there is redundancy with pumps and discharge paths to the RPV (a single pressure boundary failure does not fail all injection) and the RPV can be depressurized allowing low pressure injection success. Thus, the pumps and their discharge paths are a medium consequence using the existing NRC-approved process. As discussed above in Section 5.3, the RWST at PWRs (suppression pool for BWRs) presents a common mode failure of the high-pressure injection water source to all high-pressure injection pumps. As shown by the NRC's PRA system ranking chart using SPAR models, this is a high consequence. This is why Criterion 6 requires the RWST and its common ECCS suction pipe to be HSS. Note: Criterion 6 also requires that the BWR Suppression Pool and the PWR Containment Sump be HSS.

- Large LOCA – this is modeled in PRAs and has a high CCDP as indicated by the NRC's PRA system ranking chart using SPAR models. Components whose postulated failure would lead to a Large LOCA are part of the reactor coolant pressure boundary and per Criterion 1 are HSS.

- Medium LOCA – this is modeled in PRAs and has a high CCDP as indicated by the NRC's PRA system ranking chart using SPAR models. Components whose postulated failure would lead to a Medium LOCA are part of the reactor coolant pressure boundary and per Criterion 1 are HSS.

- Service Water – total loss of emergency service water (ultimate heat sink) at most plants is a high consequence (HSS). However, as previously discussed loss of one train of service water is a medium consequence using the existing NRC-approved methodology. As described previously (Section 5.3), some PRA models have screened service water floods in the pump house because failure of service water is already modeled in the internal events PRA. When this occurs, the applicable risk-informed applications (e.g., RI-ISI, RI-RRA, 10 CFR 50.69) had to determine whether a single pressure boundary failure could fail both trains of service water. If the postulated failure could fail both trains of service water, then it was assigned as HSS (reason being limited to no redundancy and CCDP > 1E-04). If the postulated failure did not fail both trains of service water, then it was assigned as LSS (reason being available redundancy and CCDP < 1E-04). This is why Criterion 5 requires the Licensee to ensure on a plant-specific and design specific basis that a single pressure boundary failure in the service water system cannot fail both service water safety trains. If so, these components must be HSS per Criterion 5.

- Reactor Coolant – postulated failures of those portions of the reactor coolant system that lie between the reactor pressure vessel and the first isolation would result in a loss of coolant accident (SLOCA, MLOCA, LLOCA). These would all be HSS per the existing methodology (CCDP > 1E-04) as well as the methodology contained in Chapter 4 (Criterion 1). Postulate failures of those portions of the reactor coolant system that lie between the first isolation valve and the second isolation would not result in a loss of coolant accident and would be LSS per the existing methodology (CCDP < 1E-04) but HSS per this methodology because it is Class 1 (Criterion 1).

- Residual Heat Removal – there are two trains of RHR and there are also other backup capabilities. For example, in a PWR, main feedwater and emergency feedwater provide heat removal unless there is a LOCA (much lower frequency of challenge that only requires one backup train) and then containment coolers or 1 of 2 RHR trains must provide heat removal. Thus, the existing NRC-approved methodology would categorize this piping as LSS due to unexpected frequency of challenge, all year exposure and at least one backup train (see Table 3-5 of TR-112657, Rev B-A). Additionally portions of the system may be HSS via criteria 2, 5, 9 or 10.

BWRs would also require the loss of main condenser (the frequency of challenge is higher than the PWR LOCA demand), however, there are two trains of suppression pool cooling and containment venting is a reliable backup. Thus, the existing NRC-approved methodology would categorize this piping as LSS due to infrequent event, all year exposure and at least two backup trains (see Table 3-5 of TR-112657, Rev B-A). Additionally portions of the system may be HSS via criteria 2, 5, 9 or 10.

Criterion 11-13 also provides an additional safety check on a design and plant-specific specific basis.

- Component Cooling Water – total loss of CCW is usually a high consequence (HSS) in PRAs. This system is an important support system in most PWRs. However, as discussed in Section 5.3 for those plants that have physically separated trains such that a pressure boundary failure only fails one safety train, pressure boundary failure is not a high consequence. This is why Criterion 8 requires that the Licensee ensure on a design and plant-specific basis that a single pressure boundary failure cannot fail both safety trains. If a postulated pressure boundary failure fails both safety trains, these components must be HSS per Criterion 8.

  Note that reactor building and turbine building closed loop cooling (RBCLC and TBCLC) in BWRs are not as important. TBCLC failure would impact the turbine plant (loss of main condenser and feedwater). RBCLC failure would impact cooling to certain loads (e.g., recirculation pumps, CRD pumps, 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. These systems although important to plant operations are non-safety related and are not required to assure safe shutdown. This is also discussed in Section 5.3 and Section 5.5, Example 3.

- Small LOCA – this is modeled in PRAs and has a high CCDP (HSS) as indicated by the NRC's PRA system ranking chart using SPAR models. Components whose postulated failure would lead to a small LOCA are part of the reactor coolant pressure boundary and per Criterion 1 are HSS.

- Main Steam – as demonstrated in numerous NRC-approved RI-ISI relief requests, main steam line breaks in PWRs are not HSS (see Table 3-4 of TR-112657), but if there is information that may indicate the potential for HSS categorization at a particular plant, they would be captured by Criteria 11-13. In BWRs, the Class 1 portion of the main steam system up to the second auto isolation valve is part of the reactor coolant pressure boundary and therefore HSS per Criterion 1. Beyond the Class 1 boundary, postulated breaks are modeled in the plant-specific PRA and will be determined to be HSS based on Criteria 11-13.

- Low Pressure Injection – as discussed in Section 5.3, given the low frequency of challenge (e.g., LOCA) and redundancy, experience indicates that ECCS is LSS. The exception to this as discussed in Section 5.3 is for the common water sources (e.g., RWST, suppression pool) which are HSS per Criterion 6. See Table 3-5 of TR112657 with

Unexpected Frequency of Challenge, All Year Exposure Time and One Unaffected Backup Train.

- Low Pressure Core Spray – as discussed in Section 5.3, given the low frequency of challenge (e.g., LOCA) and redundancy (e.g., LPSI, HPCI, RCIC, external makeup), experience indicates that ECCS is LSS. The exception to this as discussed in Section 5.3 is for the common water sources (e.g., suppression pool) which are HSS per Criterion 6.

- Main Feedwater – as demonstrated in numerous NRC-approved RI-ISI relief requests, main feedwater line breaks in PWRs are not HSS (e.g., PWR – AFW, CST backup, F&B), but if there is information that may indicate the potential for HSS categorization at a particular plant, they would be captured by Criteria 11-13 risk metrics which identify HSS scope. In BWRs, the Class 1 portion of the main feedwater system up to the second auto isolation valve is part of the reactor coolant pressure boundary Class 1 and therefore HSS per Criterion 1. Beyond the Class 1 boundary, postulated breaks are modeled in the plant-specific PRA and will be evaluated based on Criteria 11-13 although there is redundancy (for BWRs, this includes suppression pool cooling and containment venting).

5.5 Examples

Three examples (Figures 4 through 6) were provided by NRC during a public meeting (ML24117A256) to allow discussions on how these would be categorized by the existing NRC-approved methodology (i.e., EPRI-112657, REV B-A, ASME Code Case N752, 10 CFR 50.69) versus the enhanced methodology contained in Chapter 4. The following summarizes an evaluation of this information with regard to the importance of pressure boundary failures.

5.5.1 CST in BWR

This example evaluates the piping from the CST to the low-pressure core spray pump as shown in Figure 4.

EXAMPLE 1

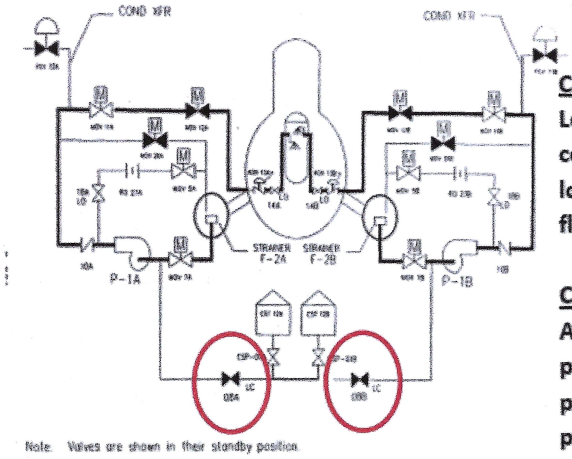


Figure 4
Example 1 – BWR CST

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.

The concern expressed by NRC staff is that a postulated failure of CST in a BWR is not covered by Criterion 7, which applies only to PWRs. Also, this example is 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).

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 NRC-approved 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 11-13 are the metrics for risk significance and HSS determination for both PWRs and BWRs. Example 1 indicates either the East <u>or</u> 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 11-13 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 11-13 is still required and would identify any high-risk outliers on a design and plant-specific basis.

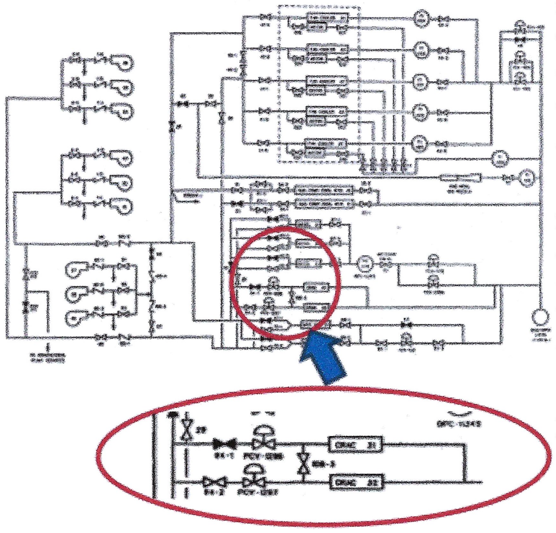
The conclusion for this example (and the concern expressed by the NRC staff) is that using the existing NRC-approved passive categorization methodology yields a LSS categorization (low consequence rank due to additional makeup sources being available).

Using the enhanced methodology results in the conclusion that the categorization is not HSS per pre-determined HSS criteria (1-10). On a plant-specific basis, this may be HSS if criteria, 11, 12 or 13 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.

5.5.2 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 5), 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.

EXAMPLE 2



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 5
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 11-13 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 which does not look like the case based on the drawing snapshot for the purposes of illustration. 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 13 criteria to be LSS. The concern is that there is no ‘entry’ into criterion 11-13 for this system as it may not be modeled in the plant-specific PRA, even if consistent with the NRC-approved ASME/ANS Level 1/Large Early Release Frequency (LERF) PRA standard.

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 for an LSS categorization.

Using the proposed enhanced methodology results in a not HSS categorization per the pre-determined HSS criteria (1-10). On a plant-specific basis, a service water failure may be HSS if criteria 11, 12 or 13 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.

5.5.3 Loss of All Service Water

This example considers a salt service water system in a BWR, see Figure 6. This single train system is assumed to isolate to two trains on a LOOP or accident signal, as an example to consider if the pressure boundary failures could result in a loss of all service water before isolation.

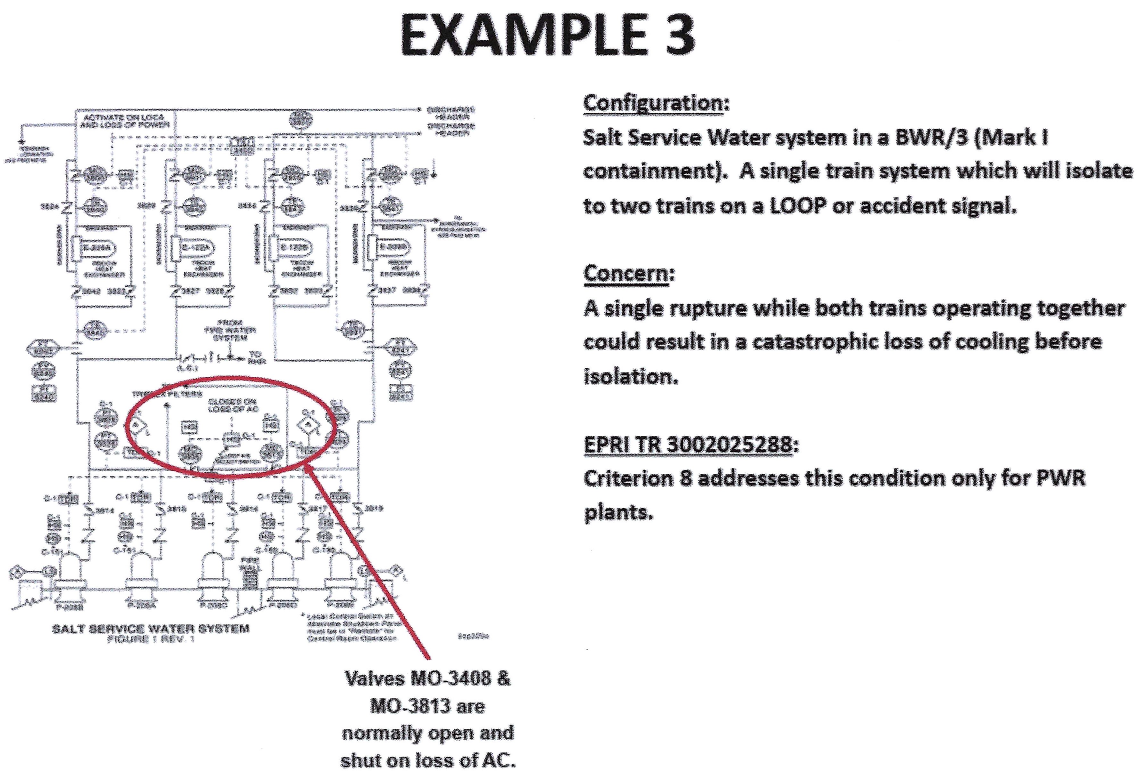


Figure 6
Example 3 – Loss of Salt Service Water

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 Sections 5.3 and 5.4, 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 impacts occurred to the plant.

The concern expressed by the NRC staff 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 Criterion 11-13 is 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.

Using the enhanced methodology results in a not HSS categorization per the pre-determined HSS criteria (1-10). On a plant-specific basis, this may be HSS if criteria 11, 12 or 13 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.

5.6 Criteria 11-13

Application of criteria 11, 12 and 13 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, 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 [32, 33], these risk criteria 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 is only used to add HSS segments and not, for example, to remove system parts generically assigned to the HSS in criterion 1 through 10.

To further the goal of defense-in-depth beyond that previously found acceptable, criteria 12 and 13 were developed and added to the enhanced methodology to conservatively increase the confidence that somewhat important pressure boundary components would not be missed on a plant-specific basis. By incorporating CCDP/CLERP metrics (conditional core damage probability and conditional large early release probability, respectively), 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, unless that likelihood is extremely low. That is, less than 1E-08/year CDF and less than 1E-09/year LERF. Similar to criterion 11, criteria 12 and 13 were added to provide additional means of ensuring that any plant-specific locations that are important to safety are identified. Criteria 12 and 13, are used to add HSS segments and not, for example, to remove system parts generically assigned to the HSS in criteria 1 through 10. Finally, 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.

Criteria 11, 12 and 13 provides 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. Satisfying the guidelines in criteria 11, 12 and 13 requires confidence that the PRA model (including internal events and internal flooding modeling) is capable of identifying the significant contributors to risk that are not included in the generic results. The NRC's RG 1.200 provides an acceptable approach that can be used to ensure technical adequacy via the implementation of an industry peer review process for PRA models. As discussed 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 well-established CDF/LERF risk criteria of 1E-6/year and 1E-7/year, respectively. This table provides examples of safety improvements that have been brought about by voluntary implementation of criterion 11 on other risk-informed applications. It is expected that use of criteria 12 and 13 together with criterion 11 will provide additional safety improvements.

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 which 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 (HEPs)
4	Failure of a fire protection line in the Auxiliary Building which 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 HEPs
5	Fire protection piping in auxiliary building	Supplementary visual inspection of the associated fire protection piping is required every quarter and 6 UT (thickness) exams per interval.
6	Fire protection piping in auxiliary building	Supplementary visual inspection of the associated fire protection piping is required every quarter and 6 UT (thickness) exams per interval.
7	Plant service water exceeded LERF criterion	More refined / realistic analyses
8	Service Water piping in the 480V switchgear room	Five new inspections added looking for wall loss
9	Class 3 nuclear service water in auxiliary feedwater pump room impacting mechanical / electrical equipment	New NDE selected

Plant No.	Issue	Action
10	Class 3 nuclear service water in auxiliary feedwater pump room impacting mechanical / electrical equipment	New NDE selected
11	Flooding caused by fire protection piping in the East DC switchgear room	3 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
	Service Water in Control 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 (3 separate locations) can cause loss of ESWG Rooms and CSR	Hardware (i.e. flow limiting orifice) and procedure modification
16	This remaining scenario involves a flood originating in the turbine building zone designated TGB. The area is located at elevation 46 feet, essentially plant grade.	More refined / realistic analyses
17	High Pressure Firewater in Auxiliary building exceeded metrics	New NDE and/or removal of piping
	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

ATTACHMENT 5 –

IMPLEMENTATION GUIDANCE

This attachment provides expanded implementation guidance to further strengthen the implementation details of the EPRI 3002025288 methodology criteria with a more detailed basis and specific examples for both PWR and BWR systems (proposed as an insert into Chapter 4 to provide more consistent implementation).

Prerequisite 3: Protective measures for internal flood events

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 Criterion 11, 12 or 13 is 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 11-13). 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.

Criterion 1: Class 1 portions of the RCPB

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 Criterion 11-13. From experience, very small LOCA is not a high consequence (similarly, the same applies to lines beyond the Class 1 boundary inside containment).

Criterion 5: Portions of the ultimate heat sink (UHS) flow path (e.g., service water) whose failures will fail both trains (i.e., unisolable failure of the UHS function)

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 11-13 should be 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 11-13. 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 11-13.

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.

Criterion 6: Tanks/vessels and connected piping and components up to the first isolation valve that support/provide inventory to multiple systems/functions (e.g., 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 11-13 results.

The Containment Sump in PWRs and Suppression Pool in BWRs is also included in the HSS scope regardless of Criterion 11-13 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.

Criterion 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)

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 included in Criterion 11-13 evaluations. 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 11-13 at both PWRs and BWRs (i.e., such a potentially significant situation would not be missed in implementation, regardless of plant design).

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

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:

<u>Example 1</u>

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.

Criterion 9: Heat exchangers whose failure (e.g., tube or tubesheet failures) could allow reactor coolant to bypass primary containment while the plant is at-power or during shutdown

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:

Example 1

Non-safety related Chemical and Volume Control System (CVCS) letdown heat exchanger interfaces with component cooling water (CCW) and RCS flow into CCW via this heat exchanger is assumed to fail CCW and 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.

Example 2

Non-safety related CVCS letdown heat exchanger interfaces with CCW and RCS flow into CCW via this heat exchanger and is assumed to fail one train of CCW and 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 11-13. 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 11-13.

Criterion 10: Other heat exchangers—if not explicitly addressed in 11–13, other heat exchangers should be evaluated to determine if component failure (e.g., of the tube or tubesheet) could impact multiple systems

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 11-13 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.

ATTACHMENT 6 –

MATERIAL CHANGE EXAMPLE

To provide additional context for implementation of the proposed methodology in EPRI 3002025288, when considering the replacement of a pressure retaining component, the following example is discussed.

When replacing a RISC-3 component (e.g., a valve bonnet), alternate codes and standards could be used as well as installation of an industrial component. The new component could also be made of a different material than those traditionally used in such components (such that operating experience may not be extensive). The following intends to highlight some of the programs and processes that remain in place, unaffected by the use of 10 CFR 50.69 Alternative Treatments.

While for RISC-3 SSCs, 10 CFR 50.69 scopes out ASME Section XI and Appendix B Quality Assurance Program Requirements, it does not eliminate Design Control process requirements. The Design Control program function requires various levels of engineering evaluation based on the change implemented and whether that change is within the Bounding Technical Requirements, including evaluation of the changes per 10 CFR 50.59. For example, the 10 CFR 50.59 change control process does not allow changes if they:

- (v) Create a possibility for an accident of a different type than any previously evaluated in the final safety analysis report;
- (vi) Create a possibility for a malfunction of an SSC important to safety with a different result than any previously evaluated in the final safety analysis report;

Changes, such as using a different material for the bonnet, would be evaluated in the licensee's Design Control Process. The licensee's procurement process would also require the specification of treatment by the responsible Engineering licensee organization (e.g., design, fabrication, testing, documentation, receipt) of the RISC-3 SSCs to ensure reasonable confidence is maintained.

Further, as 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. These additional controls ensure continued capability and reliability of the design-basis function. In addition, any conditions that may prevent an RISC-3 SSC from performing its safety-related function under design-basis conditions will be identified and addressed in accordance with the licensee's corrective action program. In the example above, the valve bonnet must perform the pressure boundary function and must allow the active items of the valve to perform their function. Controls are established to ensure both of these functions are addressed for changes to the plant (via design control) and identification/resolution of undesirable conditions (via the corrective action program).

For this example, the licensee would continue to implement other special treatments to the pressure boundary components that are not affected by the 10 CFR 50.69 application (e.g., License Renewal Aging Management, Flow Accelerated Corrosion, Erosion, Raw Water Program, Buried Pipe Program). Components such as valves require extensive, explicit testing for degradation and the design calculations would also explicitly evaluate the impact of material property changes.

Application of 10 CFR 50.69 does not change the licensee's Technical Specifications in that all Surveillance Requirements will continue to be performed with the specified frequencies (as specified in SR 3.0.1 of the licensee's Technical Specifications, which governs and provides usage rules for all Surveillance Requirements).

It is important to stress that implementation of the proposed methodology in EPRI 3002025288 requires specific prerequisites regarding material integrity (specifically, a robust program that addresses localized corrosion, flow accelerated corrosion and erosion). These three sources of degradation are the most prevalent failure mechanisms in nuclear plants with respect to pressure boundary components. Implementation of these programs ensures pressure boundary component failure probabilities remain low.

Lastly, performance of components categorized in accordance with 10 CFR 50.69 are monitored through a feedback and adjustment process outlined in NEI 00-04 and licensee submittals. Performance trends are reviewed and adjustments to alternative treatments are implemented as needed. In addition, 10 CFR 50.69 requires use of corrective action to identify and fix issues with RISC-3 components. All of these activities are implemented by any licensee adopting the proposed methodology in EPRI 3002025288.