Case N-660b
Risk-Informed Safety Classification for Use in Risk-Informed Repair/Replacement Activities
Section XI, Division 1

Inquiry: What additional classification criteria may be used as a supplement to the group classification criteria of IWA-1320 to determine Risk-Informed Safety Classification for use in risk-informed repair/replacement activities?

Reply: It is the opinion of the Committee that as a supplement to the group classification criteria of IWA-1320, the following requirements may be used to determine the Risk-Informed Safety Classification for risk-informed repair/replacement activities.

[Applicability: 1980 Edition with Winter 1981 Addenda through 2004 Edition]

-1000 SCOPE AND RESPONSIBILITY

-1100 Scope

This Case provides a process for determining the Risk-Informed Safety Classification (RISC) for use in risk-informed repair/replacement activities. The RISC process of this Case may be applied to any of Class 1, 2, 3, or non-class[1] pressure-retaining items or their associated supports, except core supports, in accordance with the risk-informed safety classification criteria established by the regulatory authority having jurisdiction at the plant site.

-1200 Classifications

(a) The RISC process is described in Appendix I of this Case. Pressure retaining and component support items shall be classified High Safety Significant (HSS) or Low Safety Significant (LSS). Because this classification is to be used only for repair/replacement activities, failure potential is conservatively assumed to be 1.0 in performing the consequence evaluation per I-3.0 in Appendix I. These classifications might not be directly related to other risk-informed applications.

(b) Class 1 items connected to the reactor coolant pressure boundary, as defined in paragraphs 10 CFR 50.55a (c)(2)(i) and (c)(2)(ii), are within the scope of the RISC evaluation process. All other Class 1 items and items that are within the break exclusion region [>NPS 4 (DN 100)] for high-energy piping systems and their associated supports (NB, NC and NF) shall be classified as HSS and shall meet the full requirements of NCA, NB, NC and NF and are not part of this case. Break exclusion region shall be defined as applicable high-energy piping crediting alternatives to single failure criteria as approved by the regulatory agency having jurisdiction at the plant site.

[1] Non-class items are items not classified in accordance with IWA-1320.

-1300 OWNER'S RESPONSIBILITY

-1310 Determination of Classification

The responsibilities of the Owner shall include determination of the appropriate classification for the items identified for each risk-informed repair/replacement activity, in accordance with Appendix I of this Case. The Owner shall ensure that core damage frequency (CDF) and large early release frequency (LERF) are included as risk metrics in the RISC process.

-1320 Required Disciplines

Personnel with expertise in the following disciplines shall be included in the classification process.

(a) probabilistic risk assessment (PRA)
(b) plant operations
(c) system design
(d) safety or accident analysis

Personnel may be experts in more than one discipline, but are not required to be experts in all disciplines.

-1330 PRA Scope and Technical Adequacy

The PRA must at a minimum model severe accident scenarios resulting from internal initiating events occurring at full power operation. PRA or qualitative approaches that evaluate the plant for external events, low power, and shutdown must also be considered. The PRA must be of sufficient quality and level of detail to support the categorization process, and must be subjected to a peer review process assessed against a standard[2] or set of acceptance criteria that is endorsed by the regulatory agency having jurisdiction over the plant site.

-9000 GLOSSARY

basic safety function – one of the key safety functions of the plant; reactivity control, core cooling, heat sink, and RCS inventory

completion time (CT) – the amount of time allowed for completing a required action. In the context of this Case, the required action is to restore operability (as defined in the technical specifications) to the affected system or equipment train

conditional consequence – an estimate of an undesired consequence, such as core damage or a breach of containment, assuming failure of an item, e.g., conditional core damage probability (CCDP)

conditional core damage probability (CCDP) – an estimate of an undesired consequence of core damage given a specific failure (e.g., piping segment failure)

conditional large early release probability (CLERP) – an estimate of an undesired consequence of large early release (i.e., breach of containment) given a specific failure (e.g., piping segment failure)

[2] A standard that can serve as an example for this application is ASME RA-S-2002, *Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications*. This standard sets forth requirements for PRAs used to support risk-informed decisions for commercial nuclear power plants and prescribes a method for applying these requirements for specific applications. Addenda to this standard and other complementary standards are emerging for consideration to support the requirements of -1330.

containment barrier – a component(s) that provides a containment boundary/isolation function such as normally closed valves or valves that are designed to go closed upon actuation

core damage – uncovery and heatup of the reactor core to the point at which prolonged oxidation and severe fuel damage is anticipated and involving enough of the core to cause a significant release

failure – an event involving leakage, rupture, or a condition that would disable the ability of an item to perform its intended safety function

failure mode – a specific functional manifestation of a failure (i.e., the means by which an observer can determine that a failure has occurred) by precluding the successful operation of a piece of equipment, a component, or a system (e.g., fails to start, fails to run, leaks)

failure modes and effects analysis (FMEA) – a process for identifying failure modes of specific items and evaluating their effects on other components, subsystems, and systems

failure potential – likelihood of ruptures or leakage that result in a reduction or loss of the pressure-retaining capability of the component

high-energy systems – those systems that for the major operational period are either in operation or maintained pressurized under conditions where either or both of the following are met:

a. maximum operating temperature exceeds 200 °F, and
b. maximum operating pressure exceeds 275 psi

high-safety-significant (HSS) function – a function that has been determined to be safety significant from the plant probabilistic risk assessment or from other relevant information (e.g., defense in depth considerations)

initiating event (IE) – any event either internal or external to the plant that perturbs the steady state operation of the plant, if operating, thereby initiating an abnormal event, such as a transient or LOCA within the plant. Initiating events trigger sequences of events that challenge plant control and safety systems whose failure could potentially lead to core damage or large early release

large early release – the rapid, unmitigated release of airborne fission products from the containment to the environment occurring before the effective implementation of off-site emergency response and protective actions

low-safety-significant (LSS) function – a function not determined to be high-safety significant from the plant probabilistic risk assessment or from other relevant information (e.g., defense in depth considerations)

moderate-energy systems – those systems that are not high-energy systems and systems that meet the temperature/pressure thresholds of high-energy systems but only for short operational periods. Short operational periods are defined as about 2 percent of the time that the system operates as a moderate-energy system (e.g., reactor decay heat removal); however, systems such as auxiliary feedwater systems operated during PWR reactor startup, hot standby, or shutdown qualify as high-energy systems.

piping segment – a portion of piping, components, or a combination thereof, and their supports, in which a failure at any location results in the same consequence, e.g., loss of a system, loss of a pump train

plant mitigative features – systems, structures, and components that can be relied on to prevent an accident or that can be used to mitigate the consequences of an accident

probabilistic risk assessment (PRA) – a qualitative and quantitative assessment of the risk associated with plant operation and maintenance that is measured in terms of frequency of occurrence of risk metrics, such as core damage or a radioactive material release and its effects on the health of the public (also referred to as a probabilistic safety assessment, PSA)

operator action – a human action performed to regain equipment or system operability from a specific failure or human error in order to mitigate or reduce the consequences of the failure

risk metrics – a determination of what activity or conditions produce the risk, and what individual, group, or property is affected by the risk

spatial effect – a failure consequence affecting other systems or components, such as failures due to pipe whip, jet impingement, jet spray, harsh environment or flooding

success criteria – criteria for establishing the minimum number or combination of systems or components required to operate, or minimum levels of performance per component during a specific period of time, to ensure that the safety functions are satisfied

train – As defined in this appendix, "a train" consists of a set of equipment (e.g., pump, piping, associated valves, motor, and control power) that individually fulfills a safety function (e.g., high pressure safety injection) with an unavailability of 1E-02 as credited in Tables I-2 and I-3

unaffected backup trains – a train(s) that is not adversely impacted (i.e., failed or degraded) by the postulated piping failure in the FMEA evaluation. Impacts can be caused by direct or indirect effects of the postulated piping failure.

APPENDIX I RISK-INFORMED SAFETY CLASSIFICATION (RISC) PROCESS

I-1.0 INTRODUCTION

This Appendix describes the risk-informed process used to determine Risk-Informed Safety Classification (RISC) for use in risk-informed repair/replacement activities. This RISC process is based on conditional consequence of failure. This process divides each selected system into piping segments that are determined to have similar consequence of failure. These piping segments are categorized based on the conditional consequence. Once categorized, the safety significance of each piping segment is identified. Figure I-1 illustrates the RISC methodology presented in the following sections.

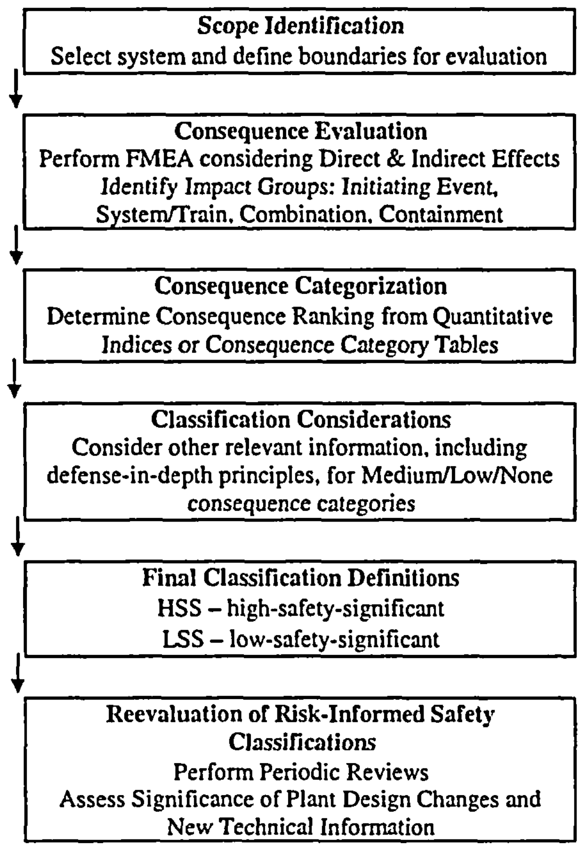

Figure I-1
Risk-Informed Safety Classification Process

I-2.0 SCOPE IDENTIFICATION

The Owner shall define the boundaries included in the scope of the RISC evaluation process.

I-3.0 CONSEQUENCE EVALUATION

All pressure retaining items and their supports shall be evaluated by defining piping segments that are grouped based on common conditional consequence (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 Consequence Evaluation as defined in I-3.1.1 and I-3.1.2. The failure consequence can be quantified using the available PRA(s). Throughout the evaluation of I-3.0, 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. To take credit for operator actions, the following features shall be provided:

- an alarm or other system to provide 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 to define operator actions, and
- operator training in the procedures.

To determine that the consequence evaluation and considerations are sufficient for the RISC process, the requirements of the following subparagraphs shall be met.

I-3.1 Analysis and Assessments

I-3.1.1 Failure Modes and Effects Analysis (FMEA). Potential failure modes for each system or piping segment shall be identified, and their effects shall be evaluated. This evaluation shall consider the following:

(a) Pressure Boundary Failure Size. The consequence analysis shall be performed assuming a large pressure boundary leak for piping segments. Alternatively, the consequence analysis can be performed assuming a smaller leak, when
  (1) a smaller leak is more conservative; or
  (2) a small leak can be justified through a leak-before-break analysis in accordance with the criteria specified in appropriate documentation acceptable to the regulatory agency having jurisdiction over the plant site; or
  (3) it can be documented that a physical configuration precludes the possibility of a large pressure boundary leak (e.g., orifice); or
  (4) applied to Class 2 and 3 moderate-energy systems that meet the requirements of Appendix II; or
  (5) the probability of a large leak at end of normal operation (e.g., 40 years), as calculated per Method A in the Non-mandatory Appendix R for Risk-Informed Inservice Inspection for Piping is less than or equal to 10^{-4}.

(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 or by operator action.

(c) Indirect Effects. These include spatial effects and loss-of-inventory effects (e.g., draining of a tank).

(d) Initiating Events. For systems or piping segments that are modeled either explicitly or implicitly in any existing plant-specific PRA, any applicable initiating event is identified using a list of initiating events from that PRA and the plant design basis.

(e) System Impact or Recovery. The means of detecting a failure, and the Technical Specifications associated with the system and other affected systems. Possible automatic and operator actions to prevent a loss of system function shall be evaluated. Automatic actions need not be safety related nor subject to single failure.

(f) System Redundancy. The existence of redundancy for accident mitigation purposes shall be considered.

I-3.1.2 Impact Group Assessment. The results of the FMEA evaluation for each piping system, or portion thereof, shall be classified into one of three impact groups: initiating event, system, or combination. Each piping system, or portion thereof, shall be partitioned into postulated piping failures that cause an initiating event, disable a system without causing an initiating event, or cause an initiating event and disable a system. The consequence category assignment (high, medium, low, or none) for each piping segment within each impact group shall be selected in accordance with (a) through (d) below. Available risk information related to the mitigation of fire, seismic, shutdown, and other external events shall be considered.

(a) Initiating Event (IE) Impact Group Assessment. When the postulated failure results in only an initiating event (e.g., loss of feedwater, reactor trip), the consequence shall be classified into one of four categories: high, medium, low, or none. The initiating event category shall be assigned according to the following:
  (1) The initiating event shall be placed in one of the Design Basis Event Categories in Table I-1. All applicable design basis events previously analyzed in the Owner's updated final safety analysis report or PRA shall be included.
  (2) Breaks that cause an initiating event classified as Category I (routine operation) need not be considered in this analysis.
  (3) For piping segment breaks that result in Category II (Anticipated Event), Category III (Infrequent Event), or Category IV (Limiting Fault or Accident), the consequence category shall be assigned to the initiating event according to the conditional core damage probability (CCDP) criteria specified in Table I-5. The quantitative index for the initiating event impact group is the ratio of the core damage frequency due to the initiating event to the initiating event frequency.

(b) System Impact Group Assessment. The consequence category of a failure that does not cause an initiating event, but degrades or fails a system essential to prevention of core damage, shall be based on the following:
  (1) Frequency of challenge that determines how often the affected function of the system is called upon. This corresponds to the frequency of events that require the system operation.
  (2) Number of backup systems (portions of systems, trains, or portions of trains) available, which determines how many unaffected systems (portions of systems, trains, or portions of trains) are available to perform the same mitigating function as the degraded or failed systems.
  (3) Exposure time, which determines the time the system would be unavailable before the plant is changed to a different mode in which the failed system's function is no longer required, the failure is recovered, or other compensatory action is taken. Exposure time is a function of the detection time and completion time, as defined in the plant Technical Specification.

  Consequence categories shall be assigned in accordance with Table I-2 as High, Medium, or Low. Frequency of challenge is grouped into design basis event categories II, III, and IV. The Owner or his designee shall ensure that the quantitative basis of Table I-2 (e.g., one full train unavailability approximately 10^{-2}) is consistent with the failure scenario being evaluated. Quantitative indices may be used to assign consequence categories in accordance with Table I-5 in lieu of Table I-2. The quantitative index for the system impact group is the product of the change in conditional core damage frequency (CCDF) and the exposure time.

(c) Combination Impact Group Assessment. The consequence category for a piping segment whose failure results in both an initiating event and the degradation or loss of a system shall be determined using Table I-3. The Owner or his designee shall ensure that the quantitative basis of Table I-3 (e.g., one full train unavailability approximately 10^{-2}) is consistent with the pipe failure scenario being evaluated. 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.

Quantitative indices may be used to assign consequence categories in accordance with Table I-5 in lieu of Table I-3.

(d) Containment Performance Impact Group Assessment. The above evaluations determine failure importance relative to core damage. Failures shall also be evaluated for their importance relative to containment performance. This shall be evaluated as follows.

(1) For postulated failures which do not result in a LOCA which bypasses containment, the quantitative indices of Table I-5 for CLERP shall be used.

(2) Table I-4 shall be used to assign consequence categories for those piping failures that can lead to a LOCA, which bypasses containment.

I-3.2 ClassificationI-3.2.1 Final Risk-Informed Safety Classification. Piping segments may be grouped together within a system, if the consequence evaluation (I-3.1) determines the effect of the postulated failures to be the same. The Risk-Informed Safety Classification shall be as follows:

<u>Classification Definitions</u>

HSS – Piping segment considered high-safety-significant
LSS – Piping segment considered low-safety-significant

I-3.2.2 Classification Considerations.

(a) Piping segments determined to be a High consequence category in any table by the consequence evaluation in I-3.1 shall be considered HSS.

(b) Piping segments determined to be a Medium, Low, or None (no change to base case) consequence category in any table by the consequence evaluation in I-3.1 and segments in moderate-energy systems shall be determined HSS or LSS by considering the other relevant information for determining classification. Under the same conditions of I-3.1.1(a), a large pressure boundary leak does not need to be assumed. Also, 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. The following conditions shall be evaluated and answered TRUE or FALSE.

(1) Failure of the pressure boundary function will not directly or indirectly (e.g., through spatial effects) fail a basic function.

(2) Failure of the pressure boundary function will not prevent the plant from reaching or maintaining safe shutdown conditions; and the pressure boundary function is not significant to safety during mode changes or shutdown. Assume that the plant would be unable to reach or maintain safe shutdown conditions if a pressure boundary failure results in the need for actions outside of plant procedures or available backup plant mitigative features.

(3) The pressure boundary function 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.

(4) The pressure boundary function 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.

(5) Failure of the pressure boundary function will not result in unintentional release of radioactive material in excess of plant offsite dose limits specified in 10 CFR Part 100.

The RISC process shall demonstrate that the defense-in-depth philosophy is maintained. Defense-in-depth may be demonstrated by following acceptable guidelines of the regulatory agency having jurisdiction. Defense-in-depth is maintained if:

(6) Reasonable balance is preserved among prevention of core damage, prevention of containment failure or bypass, and mitigation of an offsite release.

(7) There is no over-reliance on programmatic activities and operator actions to compensate for weaknesses in the plant design.

(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.

(9) Potential for common cause failures is taken into account in the risk analysis categorization.

(10) Independence of fission-product barriers is not degraded.

If any of the above ten (10) conditions are answered FALSE, then HSS shall be assigned. Otherwise, LSS may be assigned.

(c) If LSS has been assigned from I-3.2.2(b), then the RISC process shall verify that there are sufficient safety margins to account for uncertainty in the engineering analysis and in the supporting data. Safety margin shall be incorporated when determining performance characteristics and parameters, e.g., piping segment, system, and plant capability or success criteria. The amount of margin should depend on the uncertainty associated with the performance parameters in question, the availability of alternatives to compensate for adverse performance, and the consequences of failure to meet the performance goals. Sufficient safety margins are maintained by ensuring that safety analysis acceptance criteria in the plant licensing basis are met, or proposed revisions account for analysis and data uncertainty.

If sufficient safety margins are maintained then LSS should be assigned; if not, then HSS shall be assigned.

(d) A component support, hanger, or snubber shall have the same classification as the highest-ranked piping segment within the piping analytical model in which the support is included.

I-4.0 Reevaluation of Risk-Informed Safety Classifications

The assessment of potential equipment performance changes and new technical information shall be performed during the normally scheduled periodic review cycle. Plant design changes shall be screened prior to implementation to determine if they would result in a significant change to the plant risk profile. If significant changes to the plant risk profile are identified, or if it is identified that a low-safety-significant SSC can (or actually did) prevent a safety significant function from being satisfied, an immediate evaluation and review shall be performed prior to the normally scheduled periodic review.

Risk-Informed Safety Classification made in accordance with the risk-informed process, described in I-3.0, shall be reevaluated on the basis of inspection periods and inspection intervals that coincide with the inspection program requirements for Inspection Program A or B of IWA-2431 or IWA-2432, as applicable. The performance of each inspection period or inspection interval reevaluation may be accelerated or delayed by as much as one year. The reevaluation shall determine if any changes to the risk-informed safety classifications need to be made, by evaluation of the following:

a) Plant design changes (e.g., physical; new piping or equipment installation; programmatic: power uprating / 18 to 24 month fuel cycle; procedural: pump test frequency changes, operating procedure changes)
b) Changes in postulated conditions or assumptions (e.g., check valve seat leakage greater than previously assumed, decrease in reliability of plant mitigative features)
c) PRA updates (e.g., new initiating events, new system functions, more detailed model used, initiating event and failure data changes)

TABLE I-1
CONSEQUENCE CATEGORIES FOR INITIATING EVENT IMPACT GROUP

Design Basis Event Category	Initiating Event Type	Representative Initiating Event Frequency Range (1/yr)	Example Initiating Events	Consequence Category (Note 1)
I	Routine Operation	>1		None
II	Anticipated Event	$\geq 10^{-1}$	Reactor Trip, Turbine Trip, Partial Loss of Feedwater	Low/ Medium
III	Infrequent Event	10^{-1} to 10^{-2}	Excessive Feedwater or Steam Removal	Low/Medium
			Loss of Off Site Power	Medium/High
IV	Limiting Fault or Accident	$<10^{-2}$	Small LOCA, Steam Line Break, Feedwater Line Break, Large LOCA	Medium/ High

Note 1: Refer to I-3.1.2(a)(3)

TABLE I-2
GUIDELINES FOR ASSIGNING CONSEQUENCE CATEGORIES TO FAILURES RESULTING IN SYSTEM OR TRAIN LOSS

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 Cat 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 Cat. 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 Cat. 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

Note: If there is no containment barrier and the consequence category is marked by an *, the consequence category should be increased (medium to high or low to medium).

TABLE I-3
CONSEQUENCE CATEGORIES FOR COMBINATION IMPACT GROUP

Event	Consequence Category
Initiating Event and 1 Unaffected Train of Mitigating System Available	High
Initiating Event and 2 Unaffected Trains of Mitigating Systems Available	Medium[1] (or IE Consequence Category from Table I-1)
Initiating Event and More Than 2 Unaffected Trains of Mitigating Systems Available	Low[1] (or IE Consequence Category from Table I-1)
Initiating Event and No Mitigating System Affected	N/A

Note 1: The higher classification of this table or Table I-1 shall be used.

TABLE I-4
CONSEQUENCE CATEGORIES FOR FAILURES RESULTING IN INCREASED POTENTIAL FOR AN UNISOLATED LOCA OUTSIDE OF CONTAINMENT

Protection Against LOCA Outside Containment	Consequence Category
One Active[1]	HIGH
One Passive[2]	HIGH
Two Active	MEDIUM
One Active, One Passive	MEDIUM
Two Passive	LOW
More than Two	NONE

Note 1: An example of Active Protection is a valve that needs to close on demand.
Note 2: An example of Passive Protection is a valve that needs to remain closed.

TABLE I-5
QUANTITATIVE INDICES FOR CONSEQUENCE CATEGORIES

CCDP or Quantitative Index, no units	CLERP or Quantitative Index, no units	Consequence Category
$>10^{-4}$	$>10^{-5}$	High
$10^{-6} <$ value $\leq 10^{-4}$	$10^{-7} <$ value $\leq 10^{-5}$	Medium
$\leq 10^{-6}$	$\leq 10^{-7}$	Low
No change to base case	No change to base case	None

APPENDIX II

REQUIREMENTS FOR CLASS 2 AND 3 MODERATE ENERGY SYSTEMS

II-1.0 INTRODUCTION

The Owner shall have the following additional administrative requirements in place as accepted by the regulatory authority having jurisdiction at the plant site. These requirements are based upon risk insights, operating experience and performance data associated with the pressure boundary integrity of moderate energy water systems.

This Appendix provides one method of determining credible lead size for a considered piping segment. The Owner shall document any modifications to the method presented in this Appendix.

II-2.0 SCOPE IDENTIFICATION

The Owner shall define the boundaries included within the scope of this action.

II-3.0 GENERAL REQUIREMENTS

(a) An evaluation, in accordance with the criteria provided in Table II-1 and II-2, shall be conducted to confirm that the potential for a large break is negligible. This may include a confirmation (e.g. evaluation) that the considered activity does not increase the unit's susceptibility to the identified degradation mechanism, implementation of a new or existing condition monitoring program or a combination of both.

(b) The owner shall have in place owner controlled augmented programs that meet the intent of Generic Letter 89-08 (Erosion/Corrosion Induced Pipe Wall Thinning) and Generic Letter 89-13 (Service Water System Problems Affecting Safety-Related Equipment).

(c) The owner shall have:

  (i) Procedures for Feedback of Operating Experience to Plant Staff[3] that includes;

    (a) Identification of organization responsibilities for review of plant-specific and industry operating experience and feedback to pertinent plant staff,

    (b) Identification of administrative and technical review steps necessary in translating recommendations into plant actions,

[3] NUREG-0737 (Clarification of TMI Action Plan Requirements) provides an acceptable method for developing an operating experience review program.

(c) Identification of the recipients of various categories of information from operating experience (e.g. ISI personnel),

(d) Periodic audits to assure that the feedback program functions effectively.

(ii) Incorporated any insights from these programs that would impact the inservice inspection requirements of Section II-4.0 below and repair/replacement requirements.

II-4.0 INSERVICE INSPECTION REQUIRMENTS

The program developed in response to II-3.0(a) shall be evaluated against the criteria in Table II-3 to assure a robust program for localized corrosion exists at the plant site. Any program modifications necessary to meet the requirements of Table II-3 shall be documented. Similar confirmations shall be conducted for any other type of degradation identified in II-3.0(a).

Examinations shall be conducted as determined by the owner.

TABLE II-1
DEGRADATION MECHANISM EVALUATION

Mechanisms [1]		Attributes	Susceptible Regions
TF	*TASCS*	– piping > NPS 1 (DN 25); and – pipe segment has a slope < 45° from horizontal (includes elbow or tee into a vertical pipe), and – potential exists for low flow in a pipe section connected to a component allowing mixing of hot and cold fluids, or potential exists for leakage flow past a valve (i.e., in-leakage, out-leakage, cross-leakage) allowing mixing of hot and cold fluids, or potential exists for convection heating in dead-ended pipe sections connected to a source of hot fluid, or potential exists for two phase (steam / water) flow, or potential exists for turbulent penetration in branch pipe connected to header piping containing hot fluid with high turbulent flow, and – calculated or measured $\Delta T > 50°F$ (10°C), and – Richardson number > 4.0	nozzles, branch pipe connections, safe ends, welds, heat affected zones (HAZ), base metal, and regions of stress concentration
	TT	– operating temperature > 270°F (130°C) for stainless steel, or operating temperature > 220°F (105°C) for carbon steel, and – potential for relatively rapid temperature changes including cold fluid injection into hot pipe segment, or hot fluid injection into cold pipe segment, and – $\lvert\Delta T\rvert > 200°F$ (93°C) for stainless steel, or $\lvert\Delta T\rvert > 150°F$ (65°C) for carbon steel, or $\lvert\Delta T\rvert > \Delta T$ allowable (applicable to both stainless and carbon)	
SCC	*IGSCC (BWR)*	– evaluated in accordance with existing plant IGSCC program per NRC Generic Letter 88-01, or alternative (e.g. BWRVIP-075)	austenitic stainless steel welds and HAZ
	IGSCC (PWR)	– operating temperature > 200°F (93°C), and – susceptible material (carbon content ≥ 0.035%), and – tensile stress (including residual stress) is present, and – oxygen or oxidizing species are present —— OR —— – operating temperature < 200°F (93°C) , the attributes above apply, and – initiating contaminants (e.g., thiosulfate, fluoride, chloride) are also required to be present	
	TGSCC	– operating temperature > 150°F (65°C), and – tensile stress (including residual stress) is present, and – halides (e.g., fluoride, chloride) are present, or caustic (NaOH) is present, and – oxygen or oxidizing species are present (only required to be present in conjunction w/halides, not required w/caustic)	austenitic stainless steel base metal, welds, and HAZ

TABLE II-1 (Cont'd)
DEGRADATION MECHANISM EVALUATION

Mechanisms		Attributes	*Susceptible Regions*
SCC	*ECSCC*	– operating temperature > 150°F (65°C), and – an outside piping surface is within five diameters of a probable leak path (e.g., valve stems) and is covered with non-metallic insulation that is not in compliance with Reg. Guide 1.36, or an outside piping surface is exposed to wetting from concentrated chloride-bearing environments (e.g., seawater, brackish water, brine)	austenitic stainless steel base metal, welds, and HAZ
	PWSCC	– piping or weld material is Alloy 600,182,82, and – exposed to primary water at T > 570°F (300°C), and – the material is mill-annealed and cold worked, or cold worked and welded without stress relief	nozzles, welds, and HAZ without stress relief
LC	*MIC*	– operating temperature < 150°F (65°C), and – low or intermittent flow, and – pH < 10, and – presence/intrusion of organic material (e.g., raw water system), or water source is not treated w/biocides (e.g., refueling water tank)	fittings, welds, HAZ, base metal, dissimilar metal joints (e.g., welds, flanges), and regions containing crevices
	PIT	– potential exists for low flow, and – oxygen or oxidizing species are present, and – initiating contaminants (e.g., fluoride, chloride) are present	
	CC	– crevice condition exists (i.e. thermal sleeves), and – operating temperature > 150°F (65°C), and – oxygen or oxidizing species are present	
FS	*E-C*	– existence of cavitation source (i.e., throttling or pressure reducing valves or orifices) – operating temperature < 250°F (120°C), and – flow present > 100 hrs/yr, and – velocity > 30 ft/s (9.1 m/s), and – $(P_d - P_v) / \Delta P < 5$	fittings, welds, HAZ, and base metal
	FAC	– evaluated in accordance with existing plant FAC program	per plant FAC program
Other		– items identified as susceptible to degradation by a plant-specific service history review.	As identified

Notes:

(1) Thermal Fatigue (TF)
- Thermal Stratification, Cycling, and Striping (TASCS)
- Thermal Transients (TT)

Stress Corrosion Cracking (SCC)
- Intergranular Stress Corrosion Cracking (IGSCC)
- Transgranular Stress Corrosion Cracking (TGSCC)
- External Chloride Stress Corrosion Cracking (ECSCC)
- Primary Water Stress Corrosion Cracking (PWSCC)

Localized Corrosion (LC)
- Microbiologically Influenced Corrosion (MIC)
- Pitting (PIT)
- Crevice Corrosion (CC)

Flow Sensitive (FS)
- Erosion-Cavitation (E-C)
- Flow Accelerated Corrosion (FAC)

TABLE II-2
FAILURE POTENTIAL

Failure Potential	Conditions	Degradation Category	Degradation Mechanism
High [1]	Degradation mechanism likely to cause a large break	Large Break	Flow-Accelerated Corrosion
Medium	Degradation mechanism likely to cause a small leak	Small Leak	Thermal Fatigue, Erosion-Cavitation, Corrosion, Stress Corrosion Cracking
Low	None	None	None

Notes:
(1) Segments having degradation mechanisms listed in the small leak category shall be upgraded to the high failure potential/large break category, if the pipe segments also have the potential for water hammer loads.

TABLE II-3

Criteria for Assessing Programs That Are Used to Determine the Susceptibility of Raw Water Systems to Localized Corrosion

1. Evaluation was performed for the entire system, considering design and operating characteristics as listed in Item A, Design and Operating Characteristics (below)
2. Degradation assessment concluded that:
   a) Localized corrosion mechanisms are the only operative mechanisms identified (1), except as noted in Table II-2
   b) Degradation typically does not occur in discrete areas (e.g. only at welds)
   c) Leakage only; structural integrity is not jeopardized
3. Documentation
   a) Influences of design and operation parameters on operative degradation mechanisms are documented
   b) All inputs and assumptions for input values used in the evaluation are documented
   c) Evaluation results are documented
4. Element selection
   a) Selected elements include the most susceptible locations determined from evaluation and service history
   b) Program includes typical locations or locations selected randomly if typical locations were not identified by the assessment
   c) Internal validation performed and predictions compare favorably to failure, repair, examination history
5. Appropriate examination methods are used to detect and characterize localized corrosion (e.g. thickness measurements versus angle beam exams)
6. Acceptance criteria are defined such that the presence and extent of localized corrosion are reliably detected (2).
7. Sample expansion criteria are defined to require additional examination based on inspection results (3).

A. Design and Operating Characteristics

- System layout (P&IDs, isometrics)
- Materials of construction
- Weld joint details
- Operation History
- Consideration of Normal Operation and Operability Demonstrations
- Temperature
- Flow
- Flow changes due to changes in section
- Water Chemistry
- Water Treatment
- Condition Assessment History:
  - Failures
  - Repairs
  - Examination results

Notes to Table II-3:
(1) – EPRI TR-112657, Rev B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," section 3.4 provides an acceptable method for conducting a degradation assessment.
(2) – EPRI TR-112657, Rev B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," section 3.6.7.2 provides an acceptable method for determining acceptance criterion.
(3) – Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," provides an acceptable method for determining sample expansion requirements.