Code Case OMN-10
Requirements for Safety Significance Categorization of Snubbers Using Risk Insights and Testing Strategies for Inservice Testing of LWR Power Plants

Inquiry: Is it acceptable to categorize those snubbers under the scope of the ASME OM Code into two categories based on their significance for the purpose of applying different examination and testing strategies to those described in sections ISTD 6 and ISTD 7?

Reply: Yes, provided the following requirements are met.

Applicability: See Applicability Index

1 APPLICABILITY

This Code Case establishes the safety categorization methodology and process for dividing the population of snubbers, as identified in the Owner’s Snubber Program Plan, into high safety significant component (HSSC) and low safety significant component (LSSC) categories, and provides acceptable testing strategies for each category.

2 SUPPLEMENTAL DEFINITIONS

2.1 PRA Definitions

common cause failure (CCF): a single event that adversely affects two or more components at the same time.

core damage frequency (CDF): the calculated frequency (per year) that core damage will occur due to failure of a critical safety function (i.e., reactivity control, core cooling, or containment heat removal).

Fussell-Vesely (F-V) importance: the fractional decrease in total risk level (usually CDF) when the plant feature is assumed to be perfectly reliable (failure rate = 0.0).

importance measure: a mathematical expression that defines a quantity of interest. The most common importance measures are F-V and RAW.

large early release frequency (LERF): the calculated frequency (per year) that radioactivity release from containment is both large and early. “Large” means involving the rapid, unscrubbed release of airborne fission products to the environment. “Early” means occurring before the effective implementation of off-site emergency and protective actions.

Level 1 PRA: a PRA that identifies accident sequences that can lead to core damage, calculates the frequency of each sequence, and sums up those frequencies to obtain CDF.

Level 2 PRA: a PRA that identifies accident sequences that can lead to radioactivity release, calculates the frequency of each sequence, and sums up those frequencies to obtain LERF.

living PRA: a plant-specific PRA that is maintained up to date, such that plant modifications, plant operation changes (including procedure changes), component performance, and other technical information significantly affecting the model are reflected in the model.

probabilistic risk assessment (PRA): a quantitative assessment of the risk associated with plant operation and maintenance. Risk is measured in terms of the frequency of occurrence of different events, including core damage. In general, the scope of a PRA is divided into three categories: Level 1, Level 2, and Level 3. A Level 1 maps from initiating events to plant damage states, including their aggregate, core damage. Level 2 includes Level 1 mapping from initiating events to release categories (source term). Level 3 includes Level 2 and uses the source term of Level 2 to quantify consequences, the most common of which are health effects and property damage in terms of cost.

risk achievement worth (RAW): the increase in risk of a modeled plant feature (usually a component, train, or system) when the feature is assumed to be out of service (failed). RAW is expressed in terms of the ratio of the risk with the event failed to the baseline risk level.

2.2 Safety Definitions

decision criteria: the quantitative and qualitative factors that affect a decision. These include both quantitative screening criteria (for PRA model) and the evaluation of other qualitative (or deterministic) factors that influence the results of an application.

Expert Panel: a multidisciplined group of experienced plant experts who evaluate specific information, discuss this information among themselves (and others as appropriate), and make HSSC and LSSC determinations.

high safety significant components (HSSCs): components that have been designated as more important to plant safety by a blended process of PRA risk ranking and Expert Panel evaluation.

low safety significant components (LSSCs): components that have been designated as less important to plant safety by a blended process of PRA risk ranking and Expert Panel evaluation.

technical specification: the plant technical specifications that are a condition of the plant operating license granted to the Owner by the regulator.
2.3 IST Definitions

*active valve:* valve that is required to change obturator position to accomplish the required design functions.

*inservice test (IST):* a test to determine the operational readiness of a component/system (snubber).

*operational readiness:* ability of a component (snubber) to perform its intended system function when required.

*testing strategy:* the IST strategy to measure component (snubber) degradation or to monitor a component (snubber) for operational readiness at some interval by operating, examining, or testing the component (snubber).

2.4 Snubber Definitions

*component's snubber:* snubbers required to protect a component (e.g., pump, valve) during a dynamic event.

*equipment dynamic restraint (snubber):* a device that provides restraint to a component or system during the sudden application of forces, but allows essentially free motion during thermal movement.

*hydraulic snubbers:* devices in which the load is transmitted through a hydraulic fluid.

*mechanical snubbers:* devices in which the load is transmitted entirely through mechanical components.

*replacement snubber:* any snubber other than the snubber immediately previously installed at a given location.

*service conditions:* the operating environment for the snubber (e.g., temperature, vibration, weather) at its installed plant location, categorized as harsh or benign.

*service life:* period of time an item is expected to meet the operational readiness requirements without maintenance.

3 GENERAL REQUIREMENTS

3.1 Implementation

The requirements of this Code Case shall be implemented for all snubbers identified in the Snubber Program Plan, after the Owner has transferred the plant snubber examination and testing requirements from the plant technical specification to an Owner-controlled document and adopted the OM Code.

3.2 Plant-Specific PRA

The plant-specific PRA (Level 1 with internal initiating events, as a minimum) shall be available and used to perform system risk ranking.

3.3 Living PRA

The PRA shall be maintained up to date [reference (b) in section 9 below provides guidance].

3.4 Expert Panel

An Expert Panel shall be designated to perform the blended safety evaluation of probabilistic and deterministic engineering information for snubbers.

3.5 Determination of HSSC and LSSC

The Expert Panel shall evaluate each snubber and categorize it as HSSC or LSSC.

3.6 Inservice Testing Strategies for HSSCs and LSSCs

Testing strategies shall be implemented for HSSC snubbers and for LSSC snubbers.

3.7 Other Requirements

Subsection ISTD of reference (a) in section 9 below provides examination and testing requirements for snubbers. Any requirements not specifically addressed by alternative requirements in this Code Case shall stand.

4 SPECIFIC REQUIREMENTS FOR SAFETY CATEGORIZATION

In addition to section 3 above, the following requirements apply to snubber classification into HSSC and LSSC categories.

4.1 System Risk Categorization

This paragraph establishes requirements for separating systems with snubbers into high and low risk categories.

4.1.1 Importance Measures

(a) As a minimum, two importance measures, F-V and RAW, shall be calculated for those systems modeled in the PRA.

(b) The impact upon CDF, and upon LERF if available, shall be determined.

4.1.2 Screening Criteria.

For those systems modeled in the PRA, a threshold value of $F-V > 0.05$ (system level) or $F-V > 0.005$ (component or train level) based on CDF (and LERF if available) or $RAW > 2$ (component or train level) shall be initially considered as high risk components, trains, or systems.

4.1.3 Sensitivity Studies

(a) The following sensitivity studies shall be performed for each system containing snubbers:

(1) For Level 1 PRA (CDF end state), determine system and component importance rankings (F-V and RAW) from internal and external initiating events. If external/seismic initiating event PRA is not available, then use alternative deterministic evaluation (i.e., seismic margins).

(2) If available for Level 2 PRA (LERF end state), determine system and component importance rankings as appropriate from internal and external initiating events. If Level 2 PRA is not available, then use...
alternative deterministic evaluation (i.e., containment bypass).

(3) Identify the major components and their contribution to system risk (F-V and RAW), using internal (and external if available) initiating events.

(4) If available for shutdown PRA (CDF end state), determine system and component importance rankings as appropriate from internal and external initiating events. If shutdown PRA is not available, then use alternative deterministic evaluation (i.e., shutdown cooling paths).

(b) The results of these sensitivity studies, and any others that are performed, shall be documented.

(c) The results and insights of these sensitivity studies shall be provided to the Expert Panel for their consideration in the final categorization of the snubbers.

4.1.4 Qualitative Assessments. Qualitative assessments shall be performed for all active IST components (e.g., pumps and valves) protected by snubbers, unless those snubbers are categorized as HSSC.

(a) The following qualitative assessments shall be performed:

(1) impact of initiating events (i.e., the impact of failure or degradation as it might result in an initiator)

(2) potential consequences of shutdown (outage) conditions

(3) response to external initiating events (e.g., seismic, fire, high winds/tornadoes, flooding, etc.)

(b) Qualitative assessments shall be performed for plant-specific design basis conditions and events not modeled in a PRA.

(c) Qualitative assessments shall consider the impacts upon the plant to

(1) prevent or mitigate accident conditions

(2) reach and/or maintain safe shutdown conditions

(3) preserve the reactor primary coolant pressure boundary integrity

(4) maintain containment integrity

(d) Qualitative assessments shall also consider

(1) safety function being satisfied by the component's operation

(2) level of redundancy existing at the plant to fulfill the component's function

(3) ability to recover from a failure of the component

(4) performance history of the component

(5) plant technical specifications requirements applicable to the component

(6) emergency operating procedure instructions that use the component(s)

(7) design and licensing basis information relevant to IST component function

(e) The cumulative impacts of combinations of component unavailability, which could impact an entire system (e.g., multitrain impacts) or critical safety function (e.g., multisystem impacts), shall also be considered.

(f) These qualitative assessments and the Expert Panel’s disposition of them shall be documented so independent parties can review and cognizant analysts who did not take part in the original assessment can confirm the result.

(g) These qualitative assessments shall be available to the Expert Panel for their decision of component safety categorization.

4.2 Snubber Safety Categorization

This paragraph provides requirements for the Expert Panel’s review and evaluation process for categorizing snubbers relative to their safety significance, using both deterministic and probabilistic insights.

4.2.1 Expert Panel Utilization. The Expert Panel shall blend deterministic and probabilistic information to classify snubbers into HSSC or LSSC categories using both PRA insights and deterministic insights.

(a) PRA Insights. The results of PRA analyses shall be used by the Expert Panel to determine the safety significance of components (e.g., pumps and valves) within HSSC systems. Information contained in PRAs relative to the role of components in mitigating or preventing core damaging events or large early radiological release events shall be considered.

(b) Quality of PRA. The scope of the PRA and depth of probabilistic analyses shall be assessed, evaluated, and documented. As a minimum, the following shall be documented:

(1) the level of plant-specific PRA analysis available for assessing the applicability of PRA information relative to IST programs. For example, written documentation describing the level of plant-specific PRA analysis such as Level 1 PRA (assessment of core damage frequency) and/or Level 2 PRA (assessment of core damage frequency plus containment performance).

(2) scope of initiating events considered (internal events, external events, both).

(3) typical failure modes considered (e.g., hardware failures, testing/maintenance failures, common cause failures, human errors).

(4) PRA scope for plant configurations (e.g., low power risk, shutdown risk, transition mode risk, at-power risk) reviewed relative to the applicability of PRA information and IST component function(s).

(c) Deterministic Insights. The Expert Panel shall also consider deterministic factors when assessing the safety significance of components within the scope of IST programs (see Nonmandatory Appendix A of Division 1 for a sample list of deterministic considerations).

4.2.2 Expert Panel Requirements

(a) Plant Procedure. An approved plant procedure shall describe the process, including

(1) designated members and alternates
(2) designated chair and alternate
(3) quorum
(4) attendance records
(5) agendas
(6) motions for approval
(7) process for decision making
(8) documentation and resolution of differing opinions
(9) minutes
(10) required training

(b) Training. The Expert Panel shall be trained and indoctrinated in the specific requirements to be used for this Code Case. Training and indoctrination shall include the application of risk analysis methods and techniques used for this Code Case. At a minimum, the risk methods and techniques include

(1) PRA fundamentals (e.g., PRA technical approach, PRA assumptions and limitations, failure probability, truncation limits, uncertainty)
(2) use of risk importance measures
(3) assessment of failure modes for snubbers and components being supported by snubbers
(4) reliability versus availability
(5) risk thresholds
(6) expert judgment elicitation

Each of the aforementioned topics shall be covered in the indoctrination to the extent necessary to provide the Expert Panel with a level of knowledge needed to adequately evaluate and approve the scope of the snubber selections, using both probabilistic and deterministic information.

(c) Experience. Requirements shall be established for ensuring adequate experience levels of Expert Panel members. Member experience levels shall be documented and maintained.

(d) Membership

(1) There shall be at least five experts designated as members of the Expert Panel. Members may be experts in more than one field; however, excessive reliance on any one member’s judgment shall be avoided.
(2) The chairperson shall be familiar with this Code Case and shall facilitate Expert Panel activities, to ensure that the requirements of this Code Case are satisfied.
(3) Expertise in the following functions shall be represented on the Expert Panel:

(-a) operation
(-b) safety analysis engineering
(-c) probabilistic risk assessment
(4) Additional members of the Expert Panel should be selected who have the following plant expertise:

(-a) systems performance
(-b) maintenance
(-c) licensing
(-d) component performance
(-e) ASME inservice examination and testing for snubbers
(-f) ASME inservice testing for pumps and valves
(-g) quality assurance
(5) Alternate members to the Expert Panel may be designated on a temporary basis; however, vacancies in the Expert Panel membership should be filled by qualified individuals within a reasonable period of time.
(6) Other plant or nuclear industry experts may be invited to attend some or all of the sessions of the Expert Panel as visitors to provide observations, opinions, or recommendations.

4.2.3 Expert Panel Decision Criteria

(a) Level A Inclusion Criteria. Any of the following contributors to snubber importance above stated threshold will potentially make the snubber HSSC:

(1) Level A-1. All snubbers protecting the following components:

(-a) PWRs: steam generators, reactor coolant pumps
(-b) BWRs: recirculation pumps
(2) Level A-2. All snubbers protecting components in systems with PRA importance ranking F-V > 0.05 or, if evaluated on a component/train level, all snubbers supporting the components in trains with PRA importance ranking F-V > 0.005 or RAW > 2.

(b) Level B Exclusion Criteria. The following conditions allow a snubber to potentially be classified as LSSC:

(1) Level B-1. All snubbers that support the component with an importance ranking F-V ≤ 0.005 and a RAW ≤ 2.
(2) Level B-2. All snubbers associated with unmodeled components and associated with components that would likely be unmodeled in Levels 1, 2, 3, and shutdown PRAs, including both internal and external events.

4.2.4 Reconciliation. Decisions of the Expert Panel shall be arrived at by consensus. Differing opinions shall be documented and resolved, if possible. If a resolution cannot be achieved concerning the safety significance classification of a snubber, then the snubber shall be classified HSSC.

5 SPECIFIC REQUIREMENTS FOR SNUBBER SERVICE CONDITION DETERMINATION

All snubbers shall be placed in one of two service conditions, harsh or benign.

5.1 Harsh

The harsh service condition shall be considered for those operating environments where the snubber is exposed to higher temperatures, vibration, or other service condition variables (see section ISTD 8, Nonmandatory Appendix F) that would result in a predicted service life of ≤ 10 yr.

5.2 Benign

The benign service condition shall be considered for those operating environments where the snubber is
exposed to lower temperatures, minimal vibration, or other service condition variables (see section ISTD 8, Nonmandatory Appendix F) that would result in a predicted service life of >10 yr.

6 SPECIFIC REQUIREMENTS FOR HSSC TESTING STRATEGIES

NOTE: These are alternate examination and testing strategies in lieu of sections ISTD 6 and ISTD 7 requirements in reference (a) in section 9 below.

6.1 Examination and Testing Strategies for HSSC Snubbers in Harsh Environment

(a) All snubbers (size, manufacturer, type) in this category shall be considered as one population for examination and testing.
(b) Perform visual examination per section ISTD 6.
(c) Test per 37% or 10% plan each refueling cycle or 24 months. If a failure occurs, follow the applicable requirements of the selected plan.
(d) Test and/or replace all snubbers within this DTPG once every 6 yr.
(e) The snubbers may be selected for testing on a rotational basis.

6.2 Examination and Testing Strategies for HSSC Snubbers in Benign Environment

(a) All snubbers (size, manufacturer, type) in this category shall be considered as one population for examination and testing.
(b) Perform visual examination per section ISTD 6.
(c) Test per 37% or 10% plan each refueling cycle or 24 months. If a failure occurs, follow the applicable requirements of the selected plan.
(d) Test and/or replace all snubbers within this DTPG once every 10 yr.
(e) The snubbers may be selected for testing on a rotational basis.

7 SPECIFIC REQUIREMENTS FOR LSSC TESTING STRATEGIES

NOTE: These are alternate examination and testing strategies in lieu of sections ISTD 6 and ISTD 7 requirements in reference (a) in section 9 below.

7.1 Examination and Testing Strategies for LSSC Snubbers in Harsh Environment

(a) All snubbers (size, manufacturer, type) in this category shall be considered as one population for examination and testing.
(b) Perform visual examination per section ISTD 6.
(c) Test per 37% or 10% plan each refueling cycle or 24 months. If a failure occurs, follow the applicable requirements of the selected plan.
(d) Test and/or replace all snubbers within this DTPG once every 10 yr.
(e) Test the snubbers may be selected for testing on a rotational basis.

7.2 Examination and Testing Strategies for LSSC Snubbers in Benign Environment

(a) Determine and monitor service life of each snubber per section ISTD 8.
(b) Perform visual examination of all hydraulic snubbers in this category per section ISTD 6.
(c) Perform visual examination of all mechanical snubbers in this category to satisfy visual examination requirements of para. ISTD 6.3 and verify freedom of motion by manual stroking, measuring incremental thermal movement, or functional testing. Perform visual examination of all mechanical snubbers once every 10 yr, staggered on minimum 10% to 20% every refueling cycle or 24 months. If degradation is found, test the snubber. If the snubber fails, then verify freedom of motion or test all snubbers susceptible to the same failure mode.

8 RECORDS AND REPORTS

In addition to the requirements of reference (a) in section 9 below with respect to records, the following records of the Expert Panel and the component shall be maintained.

8.1 Expert Panel Records

(a) membership and attendance
(b) member expertise representation and training records
(c) member experience (years of experience in each of the expertise categories)
(d) meeting agendas
(e) meeting minutes
(f) plant procedure

8.2 Component Records

(a) risk significance based on PRA importance measures
(b) additional PRA quantitative information
(c) deterministic information
(d) expert Panel categorization decisions of HSSC or LSSC
(e) basis for the HSSC/LSSC decision

9 REFERENCES

(a) ASME OM Code, Subsection ISTD, Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Power Plants, 1995 edition and later addenda
(b) EPRI PSA Applications Guide, TR-105396, August 1995