

Industry Guidance on Revised 54.4(a)(2) Scoping Criterion (Non-Safety Affecting Safety)

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1.0 Purpose

The purpose of this document is to provide license renewal applicants with a consistent approach for addressing the 'non-safety affecting safety' scoping criterion (10CFR54.4(a)(2)). Interpretations of this criterion have evolved since publication of the License Renewal Rule (10CFR54). The NRC has issued a generic RAI on this topic, and followed it up with a letter stating the staff position. The industry discussion and guidance is based on positions taken by previous and near-term applicants, to resolve this issue.

2.0 NRC Staff Position on 54.4(a)(2) Scoping Criterion

The following is taken directly from the NRC letter (Ref. 7.1), in its entirety.

1. BACKGROUND

Section 54.29 of 10 CFR Part 54 (the Rule) states that a renewed license may be issued by the Commission if the Commission finds that actions have been or will be taken with respect to the matters identified in 54.29(a)(1) and (a)(2) such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB, and that any changes made to the CLB in order to comply with this paragraph are in accord with the Atomic Energy Act and the Commission's regulations. These matters include managing the effects of aging during the period of extended operation to assure the functionality of structures and components that have been identified to require review under Section 54.21(a)(1).

The Statements of Consideration (SOC) for the Rule state that the objective of a license renewal review is to determine whether the detrimental effects of aging, which could adversely affect the functionality of systems, structures, and components (SSCs) that the Commission determines require review for the period of extended operation, are adequately managed.

Section 54.4(a)(2) of the Rule states that all non-safety related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in Section 54.4(a)(1) should be included within the scope of the Rule. The SOC provides additional guidance related to this scoping criterion. Specifically, the SOC states that "To limit this possibility for the scoping category relating to non safety-related systems, structures, and components... An applicant for license renewal should rely on the plant's CLB, actual plant-specific experience, industry-wide operating experience, as appropriate, and existing engineering evaluations to determine those non safety-related systems, structures, and components that are the initial focus of the license renewal review. Consideration of hypothetical failures that could result from system interdependencies that are not part of the CLB and that have not been previously experienced is not required." (Federal Register, Volume 60, No. 88, 22467).

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2. DISCUSSION

The SOC articulates the underlying philosophy of the Rule; that during the period of extended operation, safety-related functions should be maintained in the same manner and to the same extent as during the current license term.

The staff must have reasonable assurance that the applicant has identified all non safety-related SSCs that meet the 54.4(a)(2) scoping criterion. To accomplish this, the applicant should clearly describe the methodology used to determine those non safety-related SSCs that meet this criterion. This description should include how plant-specific failures of non safety-related SSCs and industry failures of such SSCs were considered in this determination, and should identify whether consideration was given to non safety-related SSCs which may not have failed during the current term, but may have a reasonable expectation of failure during the extended term. Such consideration should be based on sound engineering judgement that assures the failure of those non safety-related SSCs would not occur during the extended period of operation. Information which formed the basis for the applicant's conclusions need not be included in the application, but should be documented, auditable, and retrievable, in accordance with 10 CFR 54.37.

When demonstrating that failures of non safety-related SSCs would not adversely impact on the ability to maintain intended functions, a distinction must be made between non safety-related SSCs that are connected to safety-related SSCs and those that are not connected to safety-related SSCs. For a non safety-related SSC that is connected to a safety-related SSC, the non safety-related SSC should be included within the scope of license renewal up to the first seismic anchor past the safety/non-safety interface. Further, if the in-scope non safety-related structure or component is of the same commodity group (i.e., the same material/environment combination) as the safety-related structure or component to which it's connected, the same aging management programs should be applied to both the safety-related and non safety-related structures and components. If the in-scope non safety-related structure or component is not of the same commodity group, then aging management programs appropriate for the commodity should be applied.

For non safety-related SSCs which are not connected to safety-related piping or components or are beyond the first seismic anchor past the safety/non-safety interface, but have a spatial relationship such that their failure could adversely impact on the performance of a safety-related SSC's intended function, the applicant has two options when performing its scoping evaluation; a mitigative option or a preventive option. With the mitigative option, the applicant should demonstrate that plant mitigative features (e.g., pipe whip restraints, jet impingement shields, spray and drip shields, seismic supports, flood barriers) are provided which protect safety-related SSCs from failures of non safety-related SSCs. This demonstration should show that the mitigating devices are adequate to protect safety-related SSCs from failures of non safety-related SSCs regardless of failure location (consideration can be given to the likelihood of failure at a particular location based on sound engineering judgement). If this level of protection can

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be demonstrated, then only the mitigative features need to be included within the scope of license renewal. However, if an applicant cannot demonstrate that the mitigative features are adequate to protect safety-related SSCs from the consequences of failures of non safety-related SSC's, then the applicant should utilize the preventive option, which requires that the entire non safety-related SSC be brought into the scope of license renewal. An applicant may determine that, in order to ensure adequate protection of the safety-related SSC, a combination of mitigative features and non safety-related SSCs must be brought within scope. Again, it is incumbent upon the applicant to provide adequate justification for the approach taken with respect to scoping of non safety-related SSCs in accordance with the Rule.

To ensure that all relevant non safety-related SSCs are captured within the scope of the Rule, an applicant should consider not only its CLB, but also plant and industry operating experience. Operating experience includes all documented plant-specific and industry-wide experience which can be used to determine the plausibility of a failure. Documentation would include NRC generic communications and event reports, plant-specific condition reports, industry reports such as SOERs, and engineering evaluations.

3. CONCLUSION

On the basis of the guidance provided in the SOC, the staff expects applicants for license renewal to identify non safety-related SSCs whose failure could adversely impact intended functions. Such SSCs are to be included within the scope of license renewal. The evaluation to determine which non safety-related SSCs are within scope should not consider hypothetical failures, but should, based on engineering judgement and operating experience, consider the likelihood of system failure during the extended period of operation. The information used to support the scoping determination should be documented and available for staff review.

Based on the original Rule and the above guidance, components meeting the scoping criterion of 54.4(a)(2) will generally fall into three categories. 1) A plant's Current Licensing Basis (CLB). The CLB will generally include a number of specific issues that meet the criterion of 54.4(a)(2). 2) Non-safety-related (NSR) SSCs directly connected to a safety-related (SR) SSCs (typically piping systems). 3) NSR SSCs that are not directly connected to SR SSCs. In this case, two options are provided, a mitigative option or a preventive option.

The following discussion is intended to provide the rationale in these three categories, for determining which NSR SSCs would be considered within the scope of license renewal per 54.4(a)(2).

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3.0 Non-Safety SSCs Typically Identified in the Current Licensing Basis

3.1 Missiles

Missiles can be generated from internal or external events such as failure of rotating equipment. Inherent NSR features that protect safety-related equipment from missiles are within the scope of license renewal per 54.4(a)(2).

These protection features (missile barriers) are typically included as part of the building structure, and evaluated in the civil/structural area review.

3.2 Cranes

Most plants utilize a number of cranes in support of unit operations and maintenance activities which might be used to move heavy loads over safety-related equipment, spent fuel, or fuel in the core. Damaged spent fuel could release radioactive material potentially resulting in offsite doses that exceed 10CFR100 limits. If the dropped heavy load damaged equipment associated with safe shutdown, the ability to achieve and maintain safe shutdown might be compromised. NUREG-0612 was issued by the NRC to provide guidelines to prevent heavy load drops which might affect safety-related equipment or cause fuel damage that would result in significant offsite releases.

The overhead-handling systems from which a load drop could result in damage to any system that could prevent the accomplishment of a SR function, are considered to meet the criteria of 54.4(a)(2) and are within the scope of license renewal.

3.3 Flooding

Flooding from various sources is generally considered during design of the plant. Typically, only equipment in the lowest levels of the plant is susceptible to flooding. (This assumes open stairwells and floor grating to allow flood water to cascade to lower levels. If a room does not allow for cascading, it would need to be dispositioned on a plant-specific basis.) If level instrumentation and alarms are utilized to warn the operators of flood conditions, and operator action is necessary to mitigate the flood, then these instruments and alarms are within the scope of license renewal per 54.4(a)(2). If NSR sump pumps, piping and valves, are necessary to mitigate the effects of a flood which threatens SR SSCs intended functions, then these components are also within the scope of license renewal per 54.4(a)(2).

Walls, curbs, dikes, doors, etc., that provide flood barriers to SR SSCs, are within the scope of license renewal per 54.4(a)(2), and are typically included as part of the building structure, and evaluated in the civil/structural area review.

3.4 HELB

A high energy system is defined in each plant's CLB, either as a system that operates >200°F and >275 psig, or that operates >200°F or >275 psig. Typically, a plant will have

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evaluated all high energy systems outside of containment in their High Energy Line Break (HELB) analysis. NSR whip restraints, jet impingement shields, blow-out panels, etc., that are designed and installed to protect SR equipment from the effects of a HELB, are within the scope of license renewal per 54.4(a)(2). These protective features are typically associated with the structure, and would be addressed in the Civil/Structural area review.

If the HELB analysis assumes that a NSR high energy piping system does not fail or assumes failure only at specific locations, then that piping system must be within the scope of license renewal per 54.4(a)(2), and subject to aging management review in order to ensure those assumptions remain valid.

4.0 Non-Safety SSCs Directly Connected to Safety-Related SSCs

For non-safety SSCs directly connected to safety-related SSCs (typically piping systems), the non-safety piping and supports, up to and including the first equivalent anchor beyond the safety/non-safety interface, are within the scope of license renewal per 54.4(a)(2).

5.0 Non-Safety SSCs Not Directly Connected to Safety-Related SSCs

For non-safety SSCs that are not directly connected to safety-related SSCs, or are connected downstream of the first equivalent anchor, the NSR SSCs may be in scope if their failure could prevent the performance of the system safety function for which the SR SSC is required. To determine which NSR SSCs may be in scope for 54.4(a)(2), two options exist: either a mitigative option or a preventive option.

5.1 Mitigative Option

An NRC reviewer described the mitigative option in a recent RAI (Ref. 7.4):

With respect to the mitigative approach, the applicant must demonstrate that plant mitigative features (e.g., pipe whip restraints, jet impingement shields, spray and drip shields, seismic supports, flood barriers, etc.) are provided which protect SR SSCs from a failure of NSR piping segments. When evaluating the failure modes of NSR piping segments and the associated consequences, age-related degradation must be considered. The staff notes that pipe failure evaluations typically do not consider age-related degradation when determining pipe failure locations. Rather, pipe failure locations are normally postulated based on high stress. Industry operating experience has shown that age-related pipe failures can, and do, occur at locations other than the high-stress locations postulated in most pipe failure analyses. Therefore, to utilize the mitigative option, an applicant should demonstrate that the mitigating devices are adequate to protect SR SSCs from failures of NSR piping segments at any location where age-related degradation is plausible. If this level of protection can be demonstrated, then only the mitigative features need to be included within the scope of license renewal, and the piping segments need not be included within the scope.

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If an applicant [cannot demonstrate protection of the] SR SSCs from the consequences of NSR pipe failures, then the applicant should utilize the preventive option, which requires that the entire NSR piping system be brought into the scope of license renewal and an AMR be performed on the components within the piping system.

Finally, an applicant may determine that in order to ensure adequate protection of the SR SSC, a combination of mitigative features and NSR SSCs must be brought within scope. Regardless, it is incumbent upon the applicant to provide adequate justification for the approach taken with respect to scoping of NSR SSCs in accordance with the Rule. Therefore the applicant is requested to identify which option is used for NSR piping systems which are not connected to SR piping, but have a spatial relationship such that their failure could adversely impact on the performance of an intended safety function. For each non-safety-related piping system which would normally be included within the scope of license renewal, but is excluded because mitigative features have been credited for protecting SR SSCs from the failure of the NSR piping system, please identify the following:

- a. the mitigative feature(s) that is credited for protection*
- b. the hazard (e.g., failure mechanisms and postulated failure locations) for which the mitigative feature(s) is providing protection*
- c. a summary discussion (including references, such as reports, analyses, calculations, etc.) of the basis for the conclusion that the mitigative feature(s) is adequate to protect SR SSCs."*

In this context, "mitigative" means that the effects of failures of an NSR SSC are mitigated by other SSCs. This mitigation is such that the failure of the NSR SSC will not prevent the performance of a SR SSC's intended function identified in 54.4(a)(1). If the mitigative option is used, then the mitigative features (whip restraints, spray shields, supports, barriers, etc) need to be included within the scope of license renewal per 54.4(a)(2), and the non-safety system can be excluded from the scope of license renewal. These mitigative features are typically associated with the structure, and would be addressed in the Civil/Structural area review.

5.2 Preventive Option

If mitigative features are not installed, or cannot be shown to adequately protect safety related SSCs, then the preventive option needs to be used. The concern is that age-related degradation of non-safety SSCs could lead to interactions with safety-related SSCs that have not been previously considered. These interactions (pipe whip, jet impingement, spray or flooding from the non-safety systems) could create additional failures of the safety-related SSCs. The preventive option is where the most guidance is needed.

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5.2.1 General Considerations

5.2.1.1 Loss of a Safety-Related Component vs. Loss of a Safety-Related Function

Potential loss of SR components due to failure of NSR components shall be identified. Resolution of potential impact may consider failure of SR components acceptable, provided the functions of 10CFR54.4(a)(1)(i), (ii), and (iii) are not compromised. It is generally not considered acceptable to allow a non-safety-related component to fail one safety-related train on the basis another is still available, with exceptions only as supported by the CLB.

5.2.1.2 Equipment Used to Establish Initial Conditions

For many plants, non-safety-related equipment, augmented with a suitable surveillance or monitoring program, is used to maintain safety-related equipment or plant conditions within limits consistent with event assumptions. For instance, plant chemistry is assumed to be within the specifications maintained by the Chemistry Program based upon regular monitoring and analysis. Here, it is the monitoring or surveillance program that is primarily credited with ensuring the appropriate initial conditions exist, rather than the reliability of non-safety-related chemistry monitoring equipment. Therefore, the function of non-safety-related equipment to establish initial conditions for equipment operation or accident assumptions does not constitute the bases for inclusion in license renewal scope under 54.4(a)(2).

5.2.1.3 Malfunctions Resulting in Challenges to Safety-related SSCs

Malfunctions of non-safety-related equipment which result in a challenge to safety-related equipment does not constitute a basis for inclusion under §54.4(a)(2), since these malfunctions do not result in the loss of a safety-related function. For example, loss of a condensate pump might result in a reactor trip and resultant challenge to plant safety systems. However, this would not prevent the accomplishment of a function identified in 54.4(a)(1).

5.2.1.4 Cascading/Hypothetical Failures

The cascading issue applies to 10 CFR 54.4(a)(2) components and involves the consideration of subsequent levels of support systems that are necessary to ensure that a safety-related SSC performs its intended function. For instance, the RHR pump seal coolers are cooled by the Service Water System, which performs as a second level support function in this capacity. The plant electrical system provides a third level support

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function in providing power to the Service Water pumps. The NRC Staff's position on this issue is as follows:

"Therefore, to satisfy the scoping criterion under 10CFR 54.4(a)(2), an applicant needs to identify those non-safety-related SSCs (including certain second-, third- or fourth-level support systems) whose failure can prevent the satisfactory accomplishment of the safety-related function identified under 10CFR54.4(a)(1). In order to identify such systems, an applicant would consider those failures identified in 1) the documentation that makes up its CLB, 2) plant-specific operating experience, and 3) industry-wide operating experience that is specifically applicable to the facility. The applicant need not consider hypothetical failures that are not part of the CLB, and that have not been previously experienced." (Ref. 7.2)

Consistent with the staff's position, cascading must be considered to the same level that it is considered in the plant's CLB. Additionally, consideration will be given to plant specific and applicable industry operating experience to identify non-safety-related features which might be required to support the successful completion of a safety-related function.

5.2.2 System/Component Applicability

5.2.2.1 Systems and Components Containing Air/Gas

Air and gas systems (non-liquid) are not a hazard to other plant equipment. Operating experience for systems containing air/gas, has shown no failures due to aging that have adversely impacted the accomplishment of a safety function. In addition, there are no credible aging mechanisms for air/gas systems with dry internal environments. A review of site specific operating experience should be performed to verify this assumption. Additionally, components containing air/gas cannot adversely affect safety-related SSCs due to leakage or spray. Therefore, these systems are not considered to be in scope for 54.4(a)(2).

5.2.2.2 Systems Containing Liquids or Steam

5.2.2.2.1 High Energy Systems

A high energy system is defined in each plant's CLB, either as a system that operates $>200^{\circ}\text{F}$ and >275 psig, or that operates $>200^{\circ}\text{F}$ or >275 psig. Physical impacts of pipe whip and jet impingement are credible only with high energy systems. The effects of spray and harsh environment also need to be considered.

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Non-safety high energy piping with a potential for spatial interaction (pipe whip, jet impingement, spray, or harsh environment) with vulnerable safety-related equipment that is not protected from the effects of a failure of the high energy line, must be included within the scope of license renewal per 54.4(a)(2).

See Section 5.2.3 for definitions of vulnerable equipment.

5.2.2.2.2 Moderate/Low Energy Systems

Moderate/low energy systems have potential spatial interactions of spray or leakage. Operating experience has shown that mechanical interactions from moderate/low energy systems do not need to be considered.

Non-safety moderate/low energy piping that has potential spatial interactions (spray or leakage) with vulnerable safety related equipment that is not protected from the effects of spray or leakage, must be included within the scope of license renewal per 54.4(a)(2).

See Section 5.2.3 for definitions of vulnerable equipment.

5.2.2.3 Non-Seismic and Seismic II/I Piping and Supports

This section is intended to describe the potential spatial interaction of non-safety piping systems that may fall on or otherwise physically impact safety related SSCs. Reference 7.3 looked at earthquake experience data, including experience with aged pipe, and the following conclusions can be made:

- NO experience data exists of welded steel pipe segments falling due to a strong motion earthquake
- Falling of piping segment is extremely rare and only occurs when there is a failure or unzipping of the supports
- These observations hold for new and aged pipe

Consistent with leak-before-break philosophy, it can be assumed that piping which has retained its functional integrity will remain supported as long as its supports do not fail.

Therefore, as long as the effects of aging on the supports for these piping systems are managed, falling of piping sections is not considered credible, and the piping section itself would NOT be in scope for 54.4(a)(2) due to the physical impact hazard (although the leakage or spray hazard may still apply).

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All NSR supports for non-seismic or Seismic II/I piping systems with a potential for spatial interaction with safety-related SSCs, will be included within the scope of license renewal per 54.4(a)(2). These supports can typically be addressed in a commodity fashion, within the civil/structural area review.

Other potential physical impacts from swaying or other piping system movements due to seismic events or waterhammer, are not age-related, and therefore do not need to be considered in scope for 54.4(a)(2). Any of these potential physical impacts that are identified should be considered CLB/design issues, and addressed via a plant's existing corrective action process. (Note: A plant-specific SQUG analysis may have addressed some of these issues.)

5.2.3 Vulnerability Clarifications

For a NSR SSC to be within the scope of license renewal per 54.4(a)(2), its failure due to age-related degradation must prevent the accomplishment of a SR SSC's intended function. A SR SSC is considered "vulnerable" if there are NSR SSCs in the vicinity whose failure could prevent accomplishment of the SR SSC's safety function, with the following clarifications.

5.2.3.1 Exposure Duration

Long term exposure to conditions resulting from a failed NSR SSC (such as leakage or spray) is not considered credible. The basis for this is that leakage/spray would be quickly identified by personnel walkdowns, sump level trends, or by system parameter monitoring and alarms, and once identified, appropriate corrective actions would be taken. As such, only NSR SSCs whose failure could result in short-term failure of a SR SSC, would need to be considered in scope for 54.4(a)(2).

For example, spray or leakage from NSR SSCs onto a pipe or valve body would not cause a short term failure of the pressure boundary intended function of these components, and therefore the NSR SSC would not be considered in scope for 54.4(a)(2). However, spray or leakage onto a unprotected or unshielded SR motor or switchgear could prevent accomplishment of their intended functions, and therefore the NSR SSCs would be in scope for 54.4(a)(2).

Primarily active components would be affected in this manner, although some passive components may be considered vulnerable.

One possible exception to this would be in inaccessible areas, where routine monitoring may not normally be performed. In these areas, long-term effects may need to be considered.

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5.2.3.2 Fail-Safe Components

Some safety-related components are fail-safe by design. Fail-safe components are components whose failure (through interaction with the failed NSR SSC) cannot prevent the accomplishment of the safety-related intended function. Fail-safe devices are not vulnerable because their function is accomplished as a result of their failure. The NSR SSCs that could only cause a failure of a fail-safe component, would NOT be considered in scope for 54.4(a)(2).

5.2.3.3 Components Qualified/Designed for Environment

If a component is qualified/designed to maintain its function in an environment that could be caused by failure of a nearby non-safety SSC, that non-safety SSC would NOT need to be within the scope of 54.4(a)(2). Assurance must be provided that the equipment's qualification/design is appropriate for all possible environments, before eliminating the non-safety system from scope.

6.0 Industry Guidance – Preventive Option

This section provides generic guidance for scoping under the preventive option. There are many different ways to achieve the desired result. When used, this guidance should be incorporated within plant specific rules and processes, and plant specific documentation should be developed.

- A. Determine plant structures that house 54.4(a)(1) equipment.
- B. Determine non-safety systems or portions of systems that are within the structures identified in A.
- C. Determine vulnerable SR equipment (see Section 5.2.3) in the structures identified in A. If a plant participated in the SQUG effort, some of this information may already be available. However, the SQUG efforts typically only covered safe-shutdown paths and not all safety-related equipment/functions. Therefore, the plant specific SQUG evaluations need to be screened carefully.
- D. Review documentation and/or perform walkdowns to identify non-safety systems or portions of systems that have spatial interaction potential with vulnerable equipment. Assume a failure anywhere along the length of the non-safety system. Use criteria developed in section 5.2.
- E. Add these non-safety systems or portions of systems identified in D.), to the scope of license renewal, and perform screening and aging management review, as appropriate.

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- F. Document plant-specific 54.4.(a)(2) scoping methodology. The results from the application of this methodology will be plant specific (commodity lists, component lists, or boundary drawings, etc.). Document the basis for engineering judgments made during this review.

7.0 References

- 7.1 Letter from Grimes (NRC) to Nelson (NEI) and Lochbaum (UCS), regarding Guidance on the identification of Structures, Systems and Components which meet 10CFR54.4.(a)(2), Dated March 15, 2002. This letter is a supplement to Reference 7.5.
- 7.2 Letter from Chris Grimes (NRC) to Doug Walters (NEI), Subject: "License Renewal Issue No. 98-0082, Scoping Guidance", dated August 5, 1999
- 7.3 NUREG CR-6239 "Survey of Strong Motion Earthquake Effects on Thermal Power Plants in California with Emphasis on Piping Systems"
- 7.4 Letter from Robert Prato to David Christian, Request for Additional Information for the Review of the North Anna Nuclear Station, Units 1 and 2, and Surry Nuclear Station, Units 1 and 2, License Renewal Application, Dated 10/22/01.
- 7.5 Letter from Grimes (NRC) to Nelson (NEI) and Lochbaum (UCS) regarding Scoping of Seismic II/I Piping Systems, dated Dec. 3, 2001.