September 27, 2004

MEMORANDUM TO: Thomas Boyce, Section Chief
Technical Specifications Section
Division of Inspection Program Management
Office of Nuclear Reactor Regulation

FROM: Mark Caruso, Acting Section Chief /***RA/***
Probabilistic Safety Assessment Branch
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

SUBJECT: SAFETY EVALUATION OF TSTF-372, "ADDITION OF LCO 3.0.8, INOPERABILITY OF SNUBBERS" (TAC # MB2388)

The Probabilistic Safety Assessment Branch (SPSB) completed the safety evaluation (SE) of industry's request (TSTF-372) to add LCO 3.0.8 to the Technical Specifications (TS). LCO 3.0.8 allows licensees to delay declaring an LCO for equipment, supported by snubbers unable to perform their associated support functions, when risk is assessed and managed.

SPSB concludes that the information included in TSTF-372, Revision 4, and in subsequent responses to the staff requests for additional information (RAI), supports the proposed change. The SPSB safety evaluation (SE) is attached. Should you have any questions, please contact Nick Saltos at 415-1072.

Attachment: As stated

CC: Bob Tjader

CONTACT: Nicholas Saltos, NRR\DSSA\SPSB
415-1072

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DISTRIBUTION: SPSB:r/f, M. Tschiltz, M. Johnson, T. Tjader

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OFFICE	SPSB	SPSB:SC(acting)
NAME	NSaltos:nxh2	MCaruso
DATE	09/ 27 /04	09/ 27 /04

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SAFETY EVALUATION OF TSTF- 372, "ADDITION OF LCO 3.0.8, INOPERABILITY OF SNUBBERS (TAC # MB2388)

1.0 INTRODUCTION AND BACKGROUND

Snubbers are chosen in lieu of rigid supports in areas where restricting thermal growth during normal operation would induce excessive stresses in the piping nozzles or other equipment. Although they are classified as component standard supports, they are not designed to provide any transmission of force during normal plant operations. However, in the presence of dynamic transient loadings, which are induced by seismic events as well as by plant accidents and transients, a snubber functions as a rigid support. The location and size of the snubbers are determined by stress analysis based on different combinations of load conditions, depending on the design classification of the particular piping.

Prior to the conversion to the Improved Standard Technical Specifications (ISTS), technical specifications (TS) requirements applied directly to snubbers. These requirements included:

- a requirement that snubbers be functional and in service when the supported equipment are required to be operable
- a requirement that snubber removal for testing be done only during plant shutdown
- a requirement that snubber removal for testing be done on an one-at-a-time basis when supported equipment are required to be operable during shutdown
- a requirement to repair or replace within 72 hours any snubbers, found to be inoperable during operation in Modes 1 to 4, to avoid declaring any supported equipment inoperable
- a requirement that each snubber be demonstrated operable by periodic visual inspections
- a requirement to perform functional tests on a representative sample of at least 10% of plant snubbers, at least once every 18 months during shutdown.

In the late 1980s, a joint initiative of the NRC and industry was undertaken to improve the standard technical specifications. This effort identified the snubbers as candidates for relocation to a licensee controlled document based on the fact that the TS requirements for snubbers did not meet any of the four criteria in 10 CFR 50.36(c)(2)(ii) for inclusion in the ISTS. The NRC approved the relocation without placing any restriction on the use of the relocated requirements. However, this relocation resulted in different interpretations between the NRC and the industry regarding its implementation. The NRC has stated that since snubbers are supporting safety equipment that are in the TS, the definition of OPERABILITY must be used to declare inoperable any equipment supported by a removed snubber, immediately. This interpretation has in practice eliminated the 72-hour delay to enter the actions for the supported

equipment that existed prior to the conversion to the ISTS (the only exception is if the supported system has been analyzed and determined to be OPERABLE without the snubber). The industry has argued that since the NRC approved the relocation without placing any restriction on the use of the relocated requirements, the licensee controlled document requirements for snubbers should be invoked before the supported system's TS requirements become applicable. The industry's interpretation would, in effect, restore the 72-hour delay to enter the actions for the supported equipment that existed prior to the conversion to the ISTS. However, prior to the conversion to the ISTS, the delay was applicable only to snubbers found to be inoperable (i.e., to emergent conditions only). The industry's interpretation would allow a time delay for all conditions, including snubber removal for testing at power that was not allowed prior to the conversion to the ISTS.

The option to relocate the snubbers to a licensee controlled document, as part of the conversion to ISTS, has resulted in non-uniform and inconsistent treatment of snubbers. On the one hand, plants that have relocated are allowed to change the TS requirements for snubbers under the auspices of 10 CFR 50.59 but they are not allowed a 72-hour delay before they enter the actions for the supported equipment. On the other hand, plants that have not converted to ISTS have retained the 72-hour delay if snubbers are found to be inoperable but they are not allowed to use 10 CFR 50.59 to change TS requirements for snubbers. It should also be noted that a few plants that converted to ISTS chose not to relocate the snubbers to a licensee controlled document so they can retain the 72-hour delay. In addition, it is important to notice that unlike plants that have not relocated, plants that have relocated can perform functional tests on the snubbers at power (as long as they enter the actions for the supported equipment) and at the same time can reduce the testing frequency (as compared to plants that have not relocated) if it is justified by 10 CFR 50.59 assessments. Some potential undesirable consequences of this inconsistent treatment of snubbers are:

- Performance of testing during crowded windows when the supported system is inoperable with the potential to reduce the snubber testing to a minimum since the relocated snubber requirements are controlled by the licensee

- Performance of testing during crowded windows when the supported system is inoperable with the potential to increase the unavailability of safety systems

- Performance of testing and maintenance on snubbers affecting multiple trains of same supported system during the 7 hours allotted before entering MODE 3 under limiting condition of operation (LCO) 3.0.3.

To remove the inconsistency in the treatment of snubbers among plants, licensees are proposing a risk-informed TS change which introduces a delay time before entering the actions for the supported equipment when one or more snubbers are found inoperable or removed for testing. Such a delay time will provide needed flexibility in the performance of maintenance and testing during power operation and at the same time will enhance overall plant safety by:

- avoiding unnecessary unscheduled plant shutdowns and, thus, minimizing plant transition and realignment risks,

- avoiding reduced snubber testing, and thus increasing the availability of snubbers to perform their supporting function,

- performing most of the required testing and maintenance during the delay time when the supported system is available to mitigate most challenges and, thus, avoiding increases in safety system unavailability, and

- providing explicit risk-informed guidance in areas that currently does not exist, such as the treatment of snubbers impacting more than one redundant train of a supported system.

The proposed TS change is described in Section 2 and the approach used to assess its risk impact is discussed in Section 3. The results and insights of the risk assessment are presented and discussed in Section 4. Finally, Section 5 summarizes the staff's conclusions from the review of the proposed TS change.

2.0 PROPOSED CHANGE

The proposed change adds a new limiting condition of operation (LCO), LCO 3.0.8, to the TS. LCO 3.0.8 allows licensees to delay declaring an LCO for equipment, supported by snubbers unable to perform their associated support functions, when risk is assessed and managed. This new LCO states:

> *"When one or more required snubbers are unable to perform their associated support function(s), any affected supported LCO(s) are not required to be declared not met solely for this reason if risk is assessed and managed, and:*
>
> – *the snubbers not able to perform their associated support function(s) are associated with only one train or subsystem of a multiple train or subsystem supported system or are associated with a single train or subsystem supported system and are able to perform their associated support function within 72 hours; or*
>
> – *the snubbers not able to perform their associated support function(s) are associated with more than one train or subsystem of a multiple train or subsystem supported system and are able to perform their associated support function within 12 hours.*
>
> *At the end of the specified period the required snubbers must be able to perform their associated support function(s), or the affected supported system LCO(s) shall be declared not met."*

3.0 RISK ASSESSMENT APPROACH

The industry submitted TSTF-372, Revision 4, "Addition of LCO 3.0.8, Inoperability of Snubbers" in support of the proposed TS change. This submittal (Ref. 1) documents a risk-informed analysis of the proposed TS change. Probabilistic Risk Assessment (PRA) results and insights are used, in combination with deterministic and defense-in-depth arguments, to identify and justify delay times for entering the actions for the supported equipment associated

with inoperable snubbers at nuclear power plants. This is in accordance with guidance provided in Regulatory Guides (RGs) 1.174 and 1.177 (Refs 2 and 3, respectively).

The risk impact associated with the proposed delay times for entering the TS actions for the supported equipment can be assessed using the same approach as for allowed Completion Time (CT) extensions. Therefore, the risk assessment was performed following the three-tiered approach recommended in RG 1.177 for evaluating proposed extensions in currently allowed CTs:

- The first tier involves the assessment of the change in plant risk due to the proposed TS change. Such risk change is expressed (1) by the change in the average yearly core damage frequency (ΔCDF) and the average yearly large early release frequency (ΔLERF) and (2) by the incremental conditional core damage probability (ICCDP) and the incremental conditional large early release probability (ICLERP). The assessed ΔCDF and ΔLERF values are compared to acceptance guidelines, consistent with the Commission's Safety Goal Policy Statement as documented in RG 1.174, so that the plant's average baseline risk is maintained within a minimal range. The assessed ICCDP and ICLERP values are compared to acceptance guidelines provided in RG 1.177 which aim at ensuring that the plant risk does not increase unacceptably during the period the equipment is taken out of service.

- The second tier involves the identification of potentially high-risk configurations that could exist if equipment in addition to that associated with the change were to be taken out of service simultaneously, or other risk-significant operational factors such as concurrent equipment testing were also involved. The objective is to ensure that appropriate restrictions are in place to avoid any potential high-risk configurations.

- The third tier involves the establishment of an overall configuration risk management program (CRMP) to ensure that potentially risk-significant configurations resulting from maintenance and other operational activities are identified. The objective of the CRMP is to manage configuration-specific risk by appropriate scheduling of plant activities and/or appropriate compensatory measures.

A simplified bounding risk assessment was performed to justify the proposed addition of LCO 3.0.8 to the TS. This approach was necessitated by (1) the general nature of the proposed TS changes (e.g., they apply to all plants and are associated with an undetermined number of snubbers that are not able to perform their function), (2) the lack of detailed engineering analyses that establish the relationship between earthquake level and supported system pipe failure probability when one or more snubbers are inoperable, and (3) the lack of seismic risk assessment models for most plants. The simplified risk assessment is based on the following major assumptions, which the staff finds acceptable, as discussed below:

- The accident sequences, contributing to the risk increase associated with the proposed TS changes, are assumed to be initiated by a seismically-induced loss of offsite power (LOOP) event with concurrent loss of all safety system trains supported by the out of service snubbers. In the case of snubbers associated with more than one train (or subsystem) of same system, it is assumed that all affected trains (or subsystems) of the supported system are failed. This assumption was introduced to allow the performance

of a simple bounding risk assessment approach with application to all plants. This approach was selected due to the lack of detailed plant-specific seismic risk assessments for most plants and the lack of fragility data for piping when one or more supporting snubbers are inoperable.

- The LOOP event is assumed to occur due to the seismically-induced failure of the ceramic insulators used in the power distribution systems. These ceramic insulators have a high confidence (95%) of low probability (5%) of failure (HCLPF) of about 0.1g, expressed in terms of peak ground acceleration. Thus, a magnitude 0.1g earthquake is conservatively assumed to have 5% probability of causing a LOOP initiating event. The fact that no LOOP events caused by higher magnitude earthquakes were considered is justified because (1) the frequency of earthquakes decreases with increasing magnitude and (2) historical data (References 4 and 5) indicate that the mean seismic capacity of ceramic insulators (used in seismic PRAs), in terms of peak ground acceleration, is about 0.3g which is significantly higher than the 0.1g HCLPF value. Therefore, the simplified analysis, even though it does not consider LOOP events caused by earthquakes of magnitude higher than 0.1g, bounds a detailed analysis which would use mean seismic failure probabilities (fragilities) for the ceramic insulators.

- The assumption that a magnitude 0.1g earthquake would cause the failure of all safety system trains supported by the out of service snubbers is very conservative because safety piping systems are designed to withstand much higher seismic stresses even when one or more supporting snubbers are out of service. The actual piping failure probability is a function of the stress allowable and the number of snubbers removed for maintenance or testing. Analytical and experimental results obtained in the mid-eighties as part of the industry's "snubber reduction program" (References 4 and 6) indicated that piping systems have large margins against seismic stress, so that the removal of some snubbers would not significantly reduce the margin of safety. Since the licensee controlled testing is done on only a small (about 10%) representative sample of the total snubber population, it is not expected to have more than a few snubbers supporting a given safety system out for testing at a time. Furthermore, since the testing of snubbers is a planned activity, licensees have flexibility in selecting a sample set of snubbers for testing from a much larger population by conducting configuration-specific engineering and/or risk assessments. Such a selection of snubbers for testing provides confidence that the supported systems would perform their functions in the presence of a design-basis earthquake and other dynamic loads and, in any case, the risk impact of the activity will remain within the limits of acceptability defined in risk-informed RGs 1.174 and 1.177.

- The analysis assumes that one train (or subsystem) of <u>all</u> safety systems is unavailable during snubber testing or maintenance (an entire system is assumed unavailable if a removed snubber is associated with both trains of a two-train system). This is a very conservative assumption for the case of corrective maintenance since it is unlikely that a visual inspection will reveal that one or more snubbers across all supported systems are inoperable. This assumption is also conservative for the case of the licensee controlled testing of snubbers since such testing is performed only on a small representative sample.

- In general, no credit is taken for recovery actions and alternative means of performing a function, such as the function performed by a system assumed failed (e.g., when LCO 3.0.8b applies). However, most plants have reliable alternative means of performing certain critical functions. For example, feed and bleed (F&B) can be used to remove heat in most pressurized water reactors (PWRs) when auxiliary feedwater (AFW), the most important system in mitigating LOOP accidents, is unavailable. Similarly, if high pressure makeup (e.g., reactor core isolation cooling) and heat removal capability (e.g., suppression pool cooling) are unavailable in boiling water reactors (BWRs), reactor depressurization in conjunction with low pressure makeup (e.g., low pressure coolant injection) and heat removal capability (e.g., shutdown cooling) can be used to cool the core. A 10% failure probability for recovery actions to provide core cooling using alternative means is assumed for Diablo Canyon, the only West Coast PWR plant with F&B capability, when a snubber impacting more than one trains of the AFW system (i.e., when LCO 3.0.8b is applicable) is out of service. This failure probability value is significantly higher than the value of 2.2E-2 used in Diablo Canyon's PRA. Furthermore, Diablo Canyon has analyzed the impact of a single limiting snubber failure, impacting two trains of same system, and concluded that piping failure would not occur. No credit for recovery actions to provide core cooling using alternative means is necessary for West Coast PWR plants with no F&B capability because it has been determined that there is no single snubber whose non-functionality would disable two trains of AFW in a seismic event of magnitude up to the plant's safe shutdown earthquake (SSE). It should be noted that a similar credit could have been applied to most Central and Eastern US plants but this was not necessary to demonstrate the low risk impact of the proposed TS change due to the lower earthquake frequencies at Central and Eastern US plants as compared to West Coast plants.

- The earthquake frequency at the 0.1g level was assumed to be 1E-3/year for Central and Eastern US plants and 1E-1/year for West Coast plants. Each of these two values envelope the range of earthquake frequency values at the 0.1g level, for Eastern US and West Cost sites, respectively (References 5 and 7).

- The risk impact associated with non-LOOP accident sequences (e.g., seismically-initiated loss of coolant accident (LOCA) or anticipated transient without scram (ATWS) accident sequences) was not assessed. However, this risk impact is small compared to the risk impact associated with the LOOP accident sequences modeled in the simplified bounding risk assessment. Non-LOOP accident sequences, due to the ruggedness of nuclear power plant designs, require seismically-induced failures that occur at earthquake levels above 0.3g. Thus, the frequency of earthquakes initiating non-LOOP accident sequences is much smaller than the frequency of seismically-initiated LOOP events. Furthermore, because of the conservative assumption made for LOOP sequences that a 0.1g level earthquake would fail all piping associated with inoperable snubbers, non-LOOP sequences would not include any additional failures associated with inoperable snubbers than LOOP sequences. Therefore, the risk impact of inoperable snubbers associated with non-LOOP accident sequences is small compared to the risk impact associated with the LOOP accident sequences modeled in the simplified bounding risk assessment.

- The risk impact of dynamic loadings other than seismic loads is not assessed. These shock-type loads include thrust loads, blowdown loads, waterhammer loads,

steamhammer loads, LOCA loads and pipe rupture loads. However, there are some important distinctions between non-seismic (shock-type) loads and seismic loads which indicate that, in general, the risk impact of the out of service snubbers is smaller for non-seismic loads than for seismic loads. First, while a seismic load affects the entire plant, the impact of a non-seismic load is localized to a certain system or area of the plant. Second, shock loads may be higher in total force but are of much shorter duration than seismic loads. Third, the impact of non-seismic loads is more plant specific, and thus harder to analyze generically, than for seismic loads. For these reasons, licensees will be required to perform an engineering assessment every time LCO 3.0.8 is used and show that at least one train of each system that is supported by the inoperable snubber(s) would remain capable of performing their required safety or support functions for postulated design loads other than seismic loads.

4.0 RISK ASSESSMENT RESULTS AND INSIGHTS

The results and insights from the implementation of the three-tiered approach of RG 1.177 to support the proposed addition of LCO 3.0.8 to the TS are summarized and evaluated in the following Sections 4.1 to 4.3.

4.1 Risk Impact

The bounding risk assessment approach, discussed in Section 3.1, was implemented generically for all U.S. operating nuclear power plants. Risk assessments were performed for two categories of plants, Central and East Coast plants and West Coast plants, based on historical seismic hazard curves (earthquake frequencies and associated magnitudes). The first category, Central and East Coast plants, includes the vast majority of the U.S. nuclear power plant population (Reference 7). For each category of plants, two risk assessments were performed :

- The first risk assessment applies to cases where all inoperable snubbers are associated with only one train (or subsystem) of the impacted safety systems. It was conservatively assumed that a single train (or subsystem) of each safety system is unavailable. It was also assumed that the probability of non-mitigation using the unaffected redundant trains (or subsystems) is 2%, which is a conservative value given that for core damage to occur under those conditions two or more failures are required.

- The second risk assessment applies to the case where one or more of the inoperable snubbers are associated with multiple trains (or subsystems) of same safety systems. It was assumed in this bounding analysis that all safety systems are unavailable to mitigate the accident, except for West Coast PWR plants. Credit for using F&B to provide core cooling is taken for plants having F&B capability (e.g., Diablo Canyon) when a snubber impacting more than one trains of the AFW system is inoperable. Credit for one AFW train to provide core cooling is taken for West Coast PWR plants with no F&B capability (e.g., San Onofre) because it has been determined that there is no single snubber whose non-functionality would disable two trains of AFW in a seismic event of magnitude up to the plant's safe shutdown earthquake (SSE).

The results of the performed risk assessments, in terms of core damage and large early release risk impacts, are summarized in Table 1. The first row lists the conditional risk increase, in terms of CDF, ΔR_{CDF}, caused by the out of service snubbers (as assumed in the bounding analysis). The second and third rows list the ICCDP and the ICLERP values, respectively. The ICCDP for the case where all inoperable snubbers are associated with only one train (or subsystem) of the supported safety systems, was obtained by multiplying the corresponding ΔR_{CDF} value by the proposed 72-hour delay to enter the actions for the supported equipment. The ICCDP for the case where one or more of the inoperable snubbers are associated with multiple trains (or subsystems) of same safety system, was obtained by multiplying the corresponding ΔR_{CDF} value by the proposed 12-hour delay to enter the actions for the supported equipment. The ICLERP values were obtained by multiplying the corresponding ICCDP values by 0.1 (i.e., by assuming that the ICLERP value is an order of magnitude less than the ICCDP). This assumption is conservative since containment bypass scenarios, such as steam generator tube rupture accidents and interfacing system loss of coolant accidents, would not be uniquely affected by the out of service snubbers. Finally, the fourth and fifth rows list the assessed ΔCDF and ΔLERF values, respectively. These values were obtain by dividing the corresponding ICCDP and ICLERP values by 1.5 (i.e., by assuming that the snubbers are tested every 18 months, as was the case before the snubbers were relocated to a licensee controlled document). This assumption is reasonable because (1) it is not expected that licensees would test the snubbers more often than what used to be required by the TS, and (2) testing of snubbers is associated with higher risk impact than the average corrective maintenance of snubbers found inoperable by visual inspection (testing is expected to involve significantly more snubbers out of service than corrective maintenance). The assessed ΔCDF and ΔLERF values are compared to acceptance guidelines, consistent with the Commission's Safety Goal Policy Statement as documented in RG 1.174, so that the plant's average baseline risk is maintained within a minimal range. This comparison indicates that the addition of LCO 3.0.8 to the existing TS would have an insignificant risk impact.

Table 1 Bounding Risk Assessment Results for Snubbers Impacting a Single Train and Multiple Trains of a Supported System.

	Central and East Coast Plants		West Coast Plants	
	Single Train	Multiple Train	Single Train	Multiple Train
ΔR_{CDF}/yr	1E-6	5E-6	1E-4	5E-4
ICCDP	8E-9	7E-9	8E-7	7E-7
ICLERP	8E-10	7E-10	8E-8	7E-8
ΔCDF/yr	5E-9	5E-9	5E-7	5E-7

ΔLERF/yr	5E-10	5E-10	5E-8	5E-8

The assessed ΔCDF and ΔLERF values meet the acceptance criteria of 1E-6/year and 1E-7/year, respectively, based on guidance provided in RG 1.174. This conclusion is true without taking any credit for the removal of potential undesirable consequences associated with the current inconsistent treatment of snubbers (e.g., reduced snubber testing frequency, increased safety system unavailability and treatment of snubbers impacting multiple trains) discussed in Section 1 above, and given the bounding nature of the risk assessment.

The assessed ICCDP and ICLERP values are compared to acceptance guidelines provided in RG 1.177 which aim at ensuring that the plant risk does not increase unacceptably during the period the equipment is taken out of service. This comparison indicates that the addition of LCO 3.0.8 to the existing TS meets the RG 1.177 numerical guidelines of 5E-7 for ICCDP and 5E-8 for ICLERP. The small deviations shown for West Coast plants are acceptable because of the bounding nature of the risk assessments, as discussed in Section 2.

The risk assessment results of Table 1 are also compared to guidance provided in NUMARC 93-01, endorsed by RG 1.182 (Reference 8), for implementing the Maintenance Rule 10 CFR 50.65(a)(4) requirements. Such guidance is summarized in Table 2. Guidance regarding the acceptability of conditional risk increase in terms of CDF (i.e., ΔR_{CDF}) for a planned configuration, is provided. This guidance states that a specific configuration that is associated with a CDF higher than 1E-3/year should not be entered voluntarily. Since the assessed conditional risk increase, ΔR_{CDF}, is significantly less than 1E-3/year, plant configurations including out of service snubbers and other equipment may be entered voluntarily if supported by the results of the risk assessment required by 10 CFR 50.65(a)(4).

Table 2Guidance for Implementing 10 CFR 50.65(a)(4).

ΔR_{CDF}	Guidance
Greater than 1E-3/year	Configuration should not normally be entered voluntarily

ICCDP	Guidance	ICLERP
Greater than 1E-5	Configuration should not normally be entered voluntarily	Greater than 1E-6
1E-6 to 1E-5	Assess non-quantifiable factors Establish risk management actions	1E-7 to 1E-6
Less than 1E-6	Normal work controls	Less than1E-7

Guidance regarding the acceptability of ICCDP and ICLERP values for a specific planned configuration and the establishment of risk management actions, is also provided in NUMARC 93-01. This guidance states that a specific plant configuration that is associated with ICCDP and ICLERP values below 1E-6 and 1E-7, respectively, is considered to require "normal work controls." Table 1 shows that for the majority of plants (i.e., for all plants in the Central and East Coast category) the conservatively assessed ICCDP and ICLERP values are over an order of magnitude less than what is recommended as the threshold for the "normal work controls" region. For East Coast plants, the conservatively assessed ICCDP and ICLERP values are still within the "normal work controls" region. Thus, the risk contribution from out of service snubbers is within the normal range of maintenance activities carried out at a plant. Therefore, plant configurations involving out of service snubbers and other equipment may be entered voluntarily if supported by the results of the risk assessment required by 10 CFR 50.65(a)(4). However, this simplified bounding analysis indicates that for West Coast plants the provisions of LCO 3.0.8 must be used cautiously and in conjunction with appropriate management actions, especially when equipment other than snubbers are also inoperable, based on the results of configuration-specific risk assessments required by 10 CFR 50.65(a)(4).

The staff finds that the risk assessment results support the proposed addition of LCO 3.0.8 to the TS. The risk increases associated with this TS change will be insignificant based on guidance provided in RGs 1.174 and 1.177 and within the range of risks associated with normal maintenance activities. In addition, LCO 3.0.8 will remove potential undesirable consequences stemming from the current inconsistent treatment of snubbers in the TS, such as reduced frequency of snubber testing, increased safety system unavailability and the treatment of snubbers impacting multiple trains.

4.2 Identification of High Risk Configurations

The second tier of the three-tiered approach recommended in RG 1.177 involves the identification of potentially high-risk configurations that could exist if equipment, in addition to those associated with the TS change, were to be taken out of service simultaneously. Insights from the risk assessments, in conjunction with important assumptions made in the analysis and defense-in-depth considerations, were used to identify such configurations. To avoid these potentially high-risk configurations, specific restrictions to the implementation of the proposed TS changes were identified.

For cases where all inoperable snubbers are associated with only one train (or subsystem) of the impacted systems (i.e., when LCO 3.0.8a applies), it was assumed in the analysis that there be unaffected redundant trains (or subsystems) available to mitigate the seismically initiated LOOP accident sequences. This assumption implies that there will be at least one success path available when LCO 3.0.8a applies. Therefore, potentially high-risk configurations can be avoided by ensuring that such a success path exists when LCO 3.0.8a applies. Based on a review of the accident sequences which contribute to the risk increase associated with LCO 3.0.8a, as modeled by the simplified bounding analysis (i.e., accident sequences initiated by a seismically-induced LOOP event with concurrent loss of all safety system trains supported by the out of service snubbers), the following restrictions were identified to prevent potentially high-risk configurations:

- For PWR plants, at least one AFW train (including a minimum set of supporting equipment required for its successful operation) not associated with the inoperable snubber(s), should be available when LCO 3.0.8a is used

- For BWR plants, one of the following two means of heat removal should be available when LCO 3.0.8a is used:

  – at least one high pressure makeup path (e.g., using high pressure coolant injection (HPCI) or reactor core isolation cooling (RCIC) or equivalent) and heat removal capability (e.g., suppression pool cooling), including a minimum set of supporting equipment required for success, not associated with the inoperable snubber(s), or

  – at least one low pressure makeup path (e.g., low pressure coolant injection (LPCI) or containment spray (CS)) and heat removal capability(e.g., suppression pool cooling or shutdown cooling), including a minimum set of supporting equipment required for success, not associated with the inoperable snubber(s).

For cases where one or more of the inoperable snubbers are associated with multiple trains (or subsystems) of same safety system (i.e., when LCO 3.0.8b applies), it was assumed in the bounding analysis that all safety systems are unavailable to mitigate the accident, except for West Coast plants. Credit for using F&B to provide core cooling is taken for plants having F&B capability (e.g., Diablo Canyon) when a snubber impacting more than one trains of the AFW system is inoperable. Credit for one AFW train to provide core cooling is taken for West Coast PWR plants with no F&B capability (e.g., San Onofre) because it has been determined that there is no single snubber whose non-functionality would disable more than one train of AFW in a seismic event of magnitude up to the plant's safe shutdown earthquake (SSE). Based on a review of the accident sequences which contribute to the risk increase associated with LCO 3.0.8b (as modeled by the simplified bounding analysis) and defense-in-depth considerations, the following restrictions were identified to prevent potentially high-risk configurations:

- LCO 3.0.8b cannot be used at West Coast PWR plants with no F&B capability when a snubber whose non-functionality would disable more than one train of AFW in a seismic event of magnitude up to the plant's safe shutdown earthquake (SSE) is inoperable (it should be noted, however, that based on information provided by the industry, there is no plant that falls in this category)

- When LCO 3.0.8b is used at PWR plants, at least one AFW train (including a minimum set of supporting equipment required for its successful operation) not associated with the inoperable snubber(s), or some alternative means of core cooling (e.g., F&B, fire water system or "aggressive secondary cooldown" using the steam generators) should be available

- When LCO 3.0.8b is used at BWR plants, it should be verified that at least one success path exists, using equipment not associated with the inoperable snubber(s), to provide makeup and core cooling needed to mitigate LOOP accidents sequences.

4.3 Configuration Risk Management

The third tier of the three-tiered approach recommended in RG 1.177 involves the establishment of an overall configuration risk management program (CRMP) to ensure that potentially risk-significant configurations resulting from maintenance and other operational activities are identified. The objective of the CRMP is to manage configuration-specific risk by appropriate scheduling of plant activities and/or appropriate compensatory measures. This objective is met by licensee programs to comply with the Maintenance Rule 10 CFR 50.65 (a)(4) requirement to assess and manage risk resulting from maintenance and other operational activities. These programs can support licensee decision making regarding the appropriate actions to control risk whenever a risk-informed TS is entered. Since the Maintenance Rule 10 CFR 50.65 (a)(4) guidance, NUMARC 93-01, does not currently address seismic risk, implementation guidance should be developed by licensees adopting this change to ensure that the proposed LCO 3.0.8 is considered with respect to other plant maintenance activities and integrated into the existing 10 CFR 50.65 (a)(4) process.

5.0 SUMMARY AND CONCLUSIONS

The option to relocate the snubbers to a licensee controlled document, as part of the conversion to ISTS, has resulted in non-uniform and inconsistent treatment of snubbers. Some potential undesirable consequences of this inconsistent treatment of snubbers are:

- Performance of testing during crowded windows when the supported system is inoperable with the potential to reduce the snubber testing to a minimum since the relocated snubber requirements are controlled by the licensee

- Performance of testing during crowded windows when the supported system is inoperable with the potential to increase the unavailability of safety systems

- Performance of testing and maintenance on snubbers affecting multiple trains of same supported system during the 7 hours allotted before entering MODE 3 under limiting condition of operation (LCO) 3.0.3.

To remove the inconsistency in the treatment of snubbers among plants, licensees are proposing a risk-informed TS change which introduces a delay time before entering the actions for the supported equipment when one or more snubbers are found inoperable or removed for testing. Such a delay time will provide needed flexibility in the performance of maintenance and testing during power operation and at the same time will enhance overall plant safety by (1) avoiding unnecessary unscheduled plant shutdowns, thus, minimizing plant transition and realignment risks; (2) avoiding reduced snubber testing, thus, increasing the availability of snubbers to perform their supporting function; (3) performing most of the required testing and maintenance during the delay time when the supported system is available to mitigate most challenges, thus, avoiding increases in safety system unavailability; and (4) providing explicit risk-informed guidance in areas that currently does not exist, such as the treatment of snubbers impacting more than one redundant train of a supported system.

The risk impact of the proposed TS changes was assessed following the three-tiered approach recommended in RG 1.177. A simplified bounding risk assessment was performed to justify the

proposed TS changes. This bounding assessment assumes that the risk increase associated with the proposed addition of LCO 3.0.8 to the TS is associated with accident sequences initiated by a seismically-induced LOOP event with concurrent loss of all safety system trains supported by the out of service snubbers. In the case of snubbers associated with more than one train, it is assumed that all affected trains of the supported system are failed. This assumption was introduced to allow the performance of a simple bounding risk assessment approach with application to all plants and was selected due to the lack of detailed plant-specific seismic risk assessments for most plants and the lack of fragility data for piping when one or more supporting snubbers are inoperable. The impact from the addition of the proposed LCO 3.0.8 to the TS on defense-in-depth was also evaluated in conjunction with the risk assessment results.

Based on this integrated evaluation, the staff concludes that the proposed addition of LCO 3.0.8 to the TS would lead to insignificant risk increases, if any. Indeed, this conclusion is true without taking any credit for the removal of potential undesirable consequences associated with the current inconsistent treatment of snubbers, such as the effects of avoiding a potential reduction in the snubber testing frequency and increased safety system unavailability.

To be consistent with the staff's approval, licensees interested in implementing LCO 3.0.8 should commit to operate in accordance with the following stipulations:

1. Appropriate plant procedures and administrative controls will be used to implement the following Tier 2 Restrictions.

   (a) At least one AFW train (including a minimum set of supporting equipment required for its successful operation) not associated with the inoperable snubber(s), should be available when LCO 3.0.8a is used at PWR plants.

   (b) At least one AFW train (including a minimum set of supporting equipment required for its successful operation) not associated with the inoperable snubber(s), or some alternative means of core cooling (e.g., F&B, fire water system or "aggressive secondary cooldown" using the steam generators) should be available when LCO 3.0.8b is used at PWR plants.

   (c) LCO 3.0.8b cannot be used by West Coast PWR plants with no F&B capability when a snubber, whose non-functionality would disable more than one train of AFW in a seismic event of magnitude up to the plant's safe shutdown earthquake (SSE), is inoperable.

   (d) BWR plants should verify, every time the provisions of LCO3.0.8 are used, that at least one success path, involving equipment not associated with the inoperable snubber(s), exists to provide makeup and core cooling.

   (e) Licensees will be required to perform an assessment, every time the provisions of LCO 3.0.8 are used, and show that at least one train (or subsystem) of systems supported by the inoperable snubbers would remain capable of performing their required safety or support functions for postulated design loads other than seismic loads. This assessment should be documented and available for inspection by the staff.

2. Licensees should implement the provisions of LCO 3.0.8 for snubbers, which include delay times to enter the actions for the supported equipment when one or more snubbers are out of service for maintenance or testing, in accordance with an overall configuration risk management program (CRMP) to ensure that potentially risk-significant configurations resulting from maintenance and other operational activities are identified and avoided. This objective is met by licensee programs to comply with the Maintenance Rule 10 CFR 50.65 (a)(4) requirement to assess and manage risk resulting from maintenance and other operational activities. These programs can support licensee decision making regarding the appropriate actions to control risk whenever a risk-informed TS is entered. Since the Maintenance Rule 10 CFR 50.65 (a)(4) guidance, NUMARC 93-01, does not currently address seismic risk, implementation guidance should be developed by licensees adopting this change to ensure that the proposed LCO 3.0.8 is considered in conjunction with other plant maintenance activities and integrated into the existing 10 CFR 50.65 (a)(4) process.

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