It appears that our questions were mostly addressed. However, some of the arguments need better documentation and some areas need clarification. I suggest that the provided information be included in the revised TSTF-372 submittal with some additional specific details to address the following points:

1) *For the dominant accident sequences (associated with LOOP events), list specific alternative means and/or recovery actions available for the various plant designs (e.g., PWRs with PORVs, PWRs w/o PORVs, BWR-4's, etc) to perform the same function as the function performed by the system assumed failed (e.g., in PWR designs with PORVs, when AFW system fails, the core can be cooled by feed-and-bleed).*

2) *More detailed discussion is needed about the probability of recovery actions assumed in Appendix A of NRC's inspection manual. For example, it is stated that a failure probability of 0.1 is assumed "if the appropriate criteria are met." The question that needs to be answered is whether the "criteria" are met in this case (i.e., for dominant LOOP accident sequences, assuming complete failure of a safety system like AFW in PWRs). Also, it is stated that operator failure probability for feed and bleed type actions can range from 0.5 to 0.005. Well, 0.5 is five times higher than the assumed failure probability of 0.1 (and this does not help). Therefore, more information is needed about the applicability and conservative assumptions associated with this apparently upper bound value (0.5). In other words, need to argue that in the case of LOOP accidents the failure probability of the alternative means and/or recovery actions is not higher than 0.1.*

Answers to above questions are below: Recall that we agreed to bound this to the following plants:

1. **No PORV (Palo Verde, SONGS**
2. **High seismicity (Diablo Canyon, SONGS))**
3. **BWR case**

1. For the case of PWRs that do not have PORVs, I discussed this with Palo Verde and SONGS. These plants have "high reliability" AFW systems, with diverse motive sources and power supplies. Their PRAs do not credit any alternative sources of heat removal. They have emergency provisions to connect fire water systems in the event of total loss of AFW, but this is considered an involved recovery action

and is not credited in the PRA. Both these plants verified that there is no single snubber whose non-functionality would disable both trains of AFW in a seismic event of the magnitude assumed (e.g., below the SSE). **Thus, neither of these plants could physically take a single snubber out of service that would disable both trains of AFW.** Therefore, they should not be considered a limiting case for the 12 hour provision.

2. For the high seismicity plants, as noted above SONGS would not be capable of using the two train snubber provision on the AFW system. Diablo Canyon does have the capability to feed and bleed. During a LOOP initiating event with no AFW, the estimated **<u>Failure</u>** probability of the Feed & Bleed top event at DCPP is approximately 2.5 E-02. This low failure probability would significantly reduce the ICDP calculated in the generic analysis for the "west coast" plant. With regard to a single snubber affecting both trains, Diablo previously analyzed the impact of a single limiting snubber failure, and concluded that piping failure would not occur in a seismic event with a single snubber out of service:

    From FSARU, Revision 15 (living) 3.7.3.5, Design Criteria and Analytical Procedures for Piping:

    A study[(9)] has also been performed to evaluate the stresses in piping systems, assuming failure of a single hydraulic or mechanical pipe snubber during a seismic event. Results of the study indicate that the probability of a snubber failing to snub and causing a pipe failure was sufficiently low that no additional design restraints had to be imposed.

3. In the case of BWR plants,

   The 0.1 recovery factor (used in the generic analysis for the out of service snubber) for LOSP is extremely conservative. The CCDP for LOSP with no offsite power recovery for Browns Ferry is between a 3E-4 (U2) and a 7E-4 (U3). This is more than two orders of magnitude less than the recovery factor used in the simplified analysis

   Systems available are:

If onsite diesel generators are available - Nearly all PRA credited systems. Would be similar to a transient without power conversion system.

If not (note this is a low conditional probability), for a BWR 4 (short term) - HPCI, RCIC, Diesel fire pumps. Note that without any AC power, eventually the batteries will be depleted and core damage would result.

3) *More detailed information and clarification is needed in the discussion on dynamic transient loadings associated with non-seismic events. First, the frequency of plant transients that have the potential to induce dynamic loadings could be discussed (e.g., it seems logical to argue that dynamic loadings capable to fail a system, when an associated snubber impacting two trains is removed, would require additional failures beyond the initiating event). Second, the statement regarding the "remaining levels of mitigation" required by the significance determination process, to remain in a green condition, is not clear. Can we argue that there are available two multi-train systems or one multi-train system plus one recovery of failed train when, for example, the AFW system is assumed failed due to the removal of a snubber that affects both AFW trains? Please discuss.*

A search of the LER and INPO EPIX databases was performed on "waterhammer events". There were a number of reported events, but insufficient data and clarity of reporting to extract any estimate of frequency of such events that could challenge a system with an out of service snubber. It is reasonable to assume that the occurrence of such transients in conjunction with the LOSP considered in the snubber analysis would be relatively infrequent and would result in risk impacts within the range contemplated by NUMARC 93-01; however, since initiators other than LOSP could also be involved, it is not possible to bound this conclusion without a very large amount of work.

Here is information I received from snubber design experts:

Snubbers may be designed for shock type loads such as water hammer and BWR blow down loads as well as seismic loads. The shock loads are usually higher in total force but are of much shorter duration than the seismic load. Often a snubber that is primarily for a water hammer type load will also take seismic load but would not have been installed purely for the seismic load. Thermal expansion or any other slowly applied motion produces no load on a snubber.

Although the vast majority of snubbers are designed for seismic loads only, there are probably a few in almost every plant that are primarily for loads such as relief valve thrust forces or blow down (BWR). The percentage of these is very small (~1-2%). This has always been the case; however this distinction was not carried out in practice; most plants did not readily identify the non-seismic loaded snubbers.

If necessary, implementation guidance for TSTF-372 could be developed noting that the LCO would not apply to snubbers with primary loading from non-seismic forces. The snubbers that would be exempt from the LCO would be very limited in number and would likely be on systems that we have available out of service windows in an outage to perform the needed testing or maintenance anyway.

With regard to the question on the “remaining levels of mitigation” from the significance determination process, I believe that rather than trying to argue that the condition would be “green”, it is better to use the answers provided to your first two questions above, which illustrate the level of mitigation that would be available following loss of AFW, or demonstrate that the snubber allowance could not lead to loss of both trains of AFW due to plant specific design issues.

Biff

Nick