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Subject: Identification of Issues of Importance for MSPI

Since the importance of a single item is a function of the whole model, what we need to look for is those features of the PRA model that can change the importance of MSPI systems significantly. In this note, the focus is primarily on those PRA features whose treatment may vary from licensee to licensee. At this stage, I'm more concerned with the potential for inappropriate modeling that drives down the significance of an MSPI system, i.e., artificially lowers its FV or Birnbaum importance. The requirements of the ASME Standard that deal with features should be looked at carefully. Since the Standard is not prescriptive in many of these areas, our aim should be to determine whether we can have confidence that inappropriate modeling practices either would have been identified during the peer review process, or, since the peer reviews have already been performed, by the self assessment process (NEI-00-02).

In terms of the overall capability of the PRAs, since, as discussed above, the importance of any SSC is Affected by the whole model, it is probably reasonable to start from the premise that a capability category II PRA would be a good place to start, but to see if there's anything we can relax (i.e., capability category I) and not have a significant effect on MSPI.

In the following, those features of the PRA model are identified that have an influence on the importance of the system to CDF. Some commentary is added to illustrate how the MSPI might be affected by adopting a particular approach or implementing certain assumptions in the PRA. We need to be able to identify the most significant.

BWR MSPI Systems

Emergency ac power
HPCI/HPCS/FWCI
RCIC/isolation condenser
RHR
cooling water (SW/ESW)

Emergency ac power

Modeled in loss of offsite power event tree. Sequences initiated by LOOP are usually significant contributors to core damage. The significance of the emergency ac power system will be governed by the contribution the LOOP/SBO trees make to CDF. The biggest factors that determine its significance are likely to be the frequency of the loss of offsite power, the derivation of the various time windows for recovery of offsite power, and the probability of recovery, including credit taken for cross-tie between units and use of alternate on- or off-site

sources (e.g., combustion gas turbines). The CCF probabilities of the diesels themselves will have an influence. The CCF of the station batteries may be a significant influence; if their CCF is modeled conservatively, it will diminish the importance of the diesel generators. The issues affecting the importance of the emergency ac power system are:

- assessment of the frequency of offsite power as a function of duration
- credit taken for recovery of ac power, including:
  - recovery of offsite power
  - cross-tie with sister unit
  - availability of alternate sources, e.g., combustion gas turbine
- time windows for recovery based on factors such as;
  - battery depletion (including credit for load shedding)
  - room heat up
- CCF probabilities of diesel generators
- CCF probabilities of batteries

HPCI/HPCS/FWCI

In core damage sequences of transient event trees failure of HPCI is either coupled with failure of RCIC and depressurization or failure of RCIC and low pressure injection. HPCI's importance can be altered if additional injection systems are taken credit for. For example, taking credit for firewater (as an additional low pressure system) or CRD (as a high pressure system) can lessen the importance of HPCI.

In the LOOP/SBO tree a significant function of HPCI is to provide a delay to give time to recover the offsite power. Therefore, the modeling of recovery of offsite power in the short term (given that HPCI has failed), the frequency of LOOP, and the CCF probability of the diesels and the station batteries all have an impact on the importance of HPCI.

HPCI importance is therefore affected by:

- HEP for depressurization
- credit for alternate injection systems (e.g., fire water, SW cross-tie, CRD)
- LOOP frequency, CCF of diesels and batteries, and the factors associated with the short time recovery of ac power given a LOOP

HPCS, because it does not have the problem of being limited by battery depletion may be less impacted by the modeling of short term offsite power recovery.

RCIC/IC

The importance of RCIC should fairly closely parallel that of HPCI.

The BWR 1 and 2 plants have specific design features that will influence the importance of the isolation condenser. Issues such as make up to the secondary side whether there are two return valves versus one all will have an influence.

RHR

The RHR pumps are also the LPCI pumps. Therefore, the importance of this system is affected by all things associated with failure of LPCI in TQUV type sequences (failure of all

injection), as well as those associated with failure of RHR in the TW (loss of containment heat removal) sequences.

TQUV sequences: The importance of LPCI is affected by consideration of additional systems (e.g., firewater, CRD). Also, on a relative basis, these sequences may be of less significance if a conservative assessment is made of the probability of failure to depressurize the reactor following a loss of high pressure injection.

TW sequences: The importance of RHR is affected by the HEP for failure to initiate suppression pool cooling, and the credit taken for venting and continued injection, post-venting.

The issues affecting the importance of RHR are:
- credit taken for alternate injection systems (e.g., firewater, SW cross-tie, CRD)
- HEP for failure to depressurize (a conservative value will tend to decrease the importance of the LPCI mode of the RHR)
- HEP for initiation of suppression pool cooling (a conservative value will diminish the importance of the system)
- treatment of venting (HEP including dependency on HEP for depressurization)
- Injection post-venting (NPSH issues, environmental survivability of systems in the reactor building, sources injecting from outside the containment/RX building, e.g., SW, firewater)

<u>Cooling water systems (SW/ESW/RHRSW)</u>

The cooling water systems are required for cooling diesel generators and for the secondary side of the RHR heat exchangers. While room cooling may be required for some pumps, e.g., HPCI, RCIC, CS, that function is not included in the system function for MSPI. Therefore, the sequences of interest are:

LOOP sequences: while the importance of cooling water systems will be affected by the same things as the emergency ac power system, the effect will be smaller because the failure of SW to the diesels is typically a small contribution to CDF cutsets.

TW sequences: again the importance will be impacted by those things that affect the suppression pool cooling function of RHR, i.e., credit for venting and post-venting injection, and initiation of suppression pool cooling. If significant credit is taken for success of venting then this will decrease tie significance of the cooling water system in the same way as it does for RHR.

In some cases, failures of cooling water systems may be candidates for consideration as support system initiators. Inappropriately excluding their contribution will result in an underestimate of the importance of the system.

The issues affecting the importance of the cooling water systems are:
- significance of the LOOP scenarios
- treatment of support system initiators
- credit for venting and post-venting injection (TW sequences)

PWR MSPI Systems

emergency ac power
high pressure safety injection
auxiliary feedwater system
residual heat removal system
cooling water support (SW/CCW)

Emergency ac power system

As for BWRs, the frequency of the loss of offsite power, the derivation of the various time windows for recovery of offsite power, and the probability of recovery will affect the significance of the emergency ac power system. The CCF of the diesels (and batteries) probably have a lesser influence. However, in addition, the treatment of RCP seal LOCAs can have a significant effect on the importance of the diesel generators. The issues affecting the importance of the emergency ac power system are:

- frequency of offsite power as a function of duration
- RCP seal cooling model
- credit taken for recovery of ac power, including:
  - recovery of offsite power
  - cross-tie with sister unit
  - alternate sources, e.g., combustion gas turbine
- time windows for recovery based on factors such as;
  - battery depletion (including credit for load shedding)
  - room heat up
  - credit taken for providing alternate seal cooling
- CCF probabilities of diesel generators and batteries

High pressure safety injection

For injection, primarily required for small LOCAs (maybe medium also), and SGTR. Its importance will be affected by LOCA frequencies, and the modeling of SGTR, in particular the HEP for failure to isolate the faulted generator. It may also be affected by modeling of depressurization to allow low head pumps to inject (core cooling recovery).

For those plants for which feed and bleed is an option, the importance of HPSI will be affected by the HEP for initiation of feed and bleed, but also on the success criteria, particularly with respect to the number of PORVs required. The more stringent the PORV requirement (e.g., two PORVs required) the less importance will be attached to HPSI, since the failure of PORV will be relatively more significant. The issues affecting the importance of the HPSI are:

- Credit for Feed and Bleed (including the HEP, and the success criteria)
- small LOCA frequency
- credit for core cooling recovery (rapid depressurization)
- SGTR frequency and HEP for failure to isolate the faulted generator

Auxiliary feedwater system

AFW importance can be affected by the credit taken for recovery of main feedwater, but probably more so by the credit taken for feed and bleed, including the HEP , and the assumptions on the success criteria (1 PORV vs 2). The issues affecting the importance of the AFW system are:

- Credit taken for Feed and Bleed (including the HEP, and the success criteria)
- Credit for recovery of main feedwater

Residual heat removal system

Since the RHR pumps are the low pressure injection pumps, the importance of the system is affected by the assumptions made for the large and maybe medium LOCAs, and depending on the plant type, also by the treatment of feed and bleed and/or sump recirculation. Many plants require the low pressure pumps for high head recirculation. The issues that can affect the significance of the RHR system are:

- LOCA frequencies
- credit for feed and bleed (e.g., HEP, success criteria)

Cooling water systems

These are typically required for diesel generators, for RCP seal cooling (CCW and SW), for pump cooling and RHR in the recirculation mode, and other decay heat removal functions. They may or may not be needed for pump cooling in the injection phase using the RWST following a LOCA, but since ultimately all F&B and LOCA sequences transfer to the requirement for decay heat removal they all require cooling water. Failures of cooling systems may be identified as support system initiators. The issues that can influence the importance of the cooling water systems are:

- treatment of support system initiators
- treatment of feed and bleed (a conservative treatment of the operator's response, or a more conservative success criterion will lead to a lessening of the significance of the cooling systems)
- LOCA treatment