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Frequency Distributions for Additional Initiating Event Categories, Revision 1

Introduction

Because of requests from industry probabilistic risk assessment (PRA) analysts, several additional initiating event categories (beyond those covered in NUREG/CR-6928) were analyzed to obtain frequency distributions. The methodology followed is identical to that used in NUREG/CR-6928. We might consider placing these results somewhere on the Nuclear Regulatory Commission's (NRC's) website so that others are aware of these additional results. That would occur after NRC officially approves these results.

RCP Seal LOCA

The reactor coolant pump (RCP) seal loss-of-coolant accident (LOCA) is defined in NUREG/CR-5750 (Category G8) as one with >100 gpm leakage. Also, NUREG/CR-5750 indicates that this category applies only to PWRs.

A search of the initiating events database (IEDB) for 1988 – 2002 indicated no events for PWRs. Therefore, the data are no events over 1988 – 2002 (866.6 reactor critical years or rcry). Given these data, the mean frequency (Bayesian update of the Jeffreys noninformative prior) is (0.5)/(866.6 rcry) = 5.77E-4/rcry. The distribution is gamma (0.5, 866.6 rcry).

Very Small LOCA

The very small LOCA (VSLOCA) is defined in NUREG/CR-5750 (Category G1) as a piping or component (including RCP seals) leakage of 10 – 100 gpm. I have chosen to subdivide this into PWR and BWR categories to maintain the consistency with the other LOCAs.

For PWRs, there are three events (1988, 1989, and 1991) over 1988 – 2002. Optimizing the baseline period by observing p-values indicating whether trends exist for various starting years, the baseline period is 1990 – 2002 and includes one event. Therefore, the data are one event over 1990 – 2002 (760.7 rcry). The mean frequency is (1 + 0.5)/(760.7 rcry) = 1.97E-3/rcry. The distribution is gamma (0.5, 253.6 rcry). One of the two events dropped (1988, Arkansas 2, LER 3681988011) was an instrument line failure (20 gpm) that subsequently caused an RCP seal degradation (<20 gpm).

For BWRs, there is one event (1996) over 1988 – 2002. Therefore, the data are one event over 1988 – 2002 (415.8 rcry). The mean frequency is (1 + 0.5)/(415.8 rcry) = 3.61E-3/rcry. The distribution is gamma (0.5, 138.6 rcry). The one event (1996, Clinton 1, LER 4611996010) was a reactor recirculation pump seal failure (<39 gpm).

Steamline Break Inside Containment

The steamline break inside containment (SLBIC) is defined in NUREG/CR-5750 (Category K3) as a steamline break equivalent to > 1-inch diameter that occurs within containment. Also, NUREG/CR-5750 indicates that this category applies only to PWRs.

For PWRs, there were no events over 1988 – 2002 (866.6 rcry). The mean frequency is (0.5)/(866.6 rcry) = 5.77E-4/rcry. The distribution is gamma (0.5, 866.6 rcry).

Steamline Break Outside Containment

The steamline break outside containment (SLBOC) is defined in NUREG/CR-5750 (Category K1) as a steamline break equivalent to > 1-inch diameter that occurs outside containment. NUREG/CR-5750 includes both PWRs and BWRs within a single category. However, I have subdivided the results into BWR and PWR categories to be consistent with the LOCAs and SLBIC.

For PWRs, there were ten events over 1988 – 2002 (866.6 rcry). Optimization of the baseline period (p-value comparisons) indicated the entire period should be used. The mean frequency is (10 + 0.5)/(866.6 rcry) = 1.21E-2/rcry. The empirical Bayes analysis was degenerate, indicating little year-to-year variation. Therefore, the distribution is gamma (10.5, 866.6 rcry).

For BWRs, there was one event over 1988 – 2002 (415.8 rcry). The mean frequency is (1 + 0.5)/(415.8 rcry) = 3.61E-3/rcry. The distribution is gamma (0.5, 138.6 rcry).

Feedwater Line Break

The feedwater line break (FWLB) is defined in NUREG/CR-5750 (Category K2) as a feedwater or condensate line break equivalent to > 1-inch diameter. NUREG/CR-5750 includes both PWRs and BWRs within a single category. However, I have subdivided the results into BWR and PWR categories to be consistent with the LOCAs and SLBIC.

For PWRs, there were two events over 1988 – 2002 (866.6 rcry). The mean frequency is (2 + 0.5)/(866.6 rcry) = 2.88E-3/rcry. The distribution is gamma (0.5, 173.3 rcry).

For BWRs, there were no events over 1988 – 2002 (415.8 rcry). The mean frequency is (0.5)/(415.8 rcry) = 1.20E-3/rcry. The distribution is gamma (0.5, 415.8 rcry).