

From: Goutam Bagchi, *NR*
To: Diane Jackson, Gareth Parry, George Hubbard, Gl...
Date: Thursday, December 16, 1999 10:52 AM
Subject: Re: draft interim criteria

This answer to Glenn's email started with an email from Diane and then my reply to Diane caused the email from Glenn. Diane's email which started all this, is at bottom of the reply.

My reply to Glenn:

The design basis earthquake ground motion, or the SSE ground motion, for nuclear power plant sites were based on the largest event geophysically ascribable to a tectonic province or at a capable structure at the closest proximity of the site. In the case of a tectonic province, the event is assumed to occur at the site. For the eastern seaboard, the Charleston event is the largest magnitude earthquake and current research has established that such large events are confined to Charleston region. The New Madrid zone is another zone in the central US where very large events have occurred. However, both these tectonic sources are fully accounted for in the assessment of the SSE for currently licensed plants. The SSE ground motions for nuclear power plants are based on conservative estimates of the ground motion from the largest earthquake estimate to be generated under the current tectonic regime. If we amplify these SSE ground motions by three, we are at or the beyond the limit of credibility. This is not a probabilistic statement, but a statement based on geophysical reality.

Remember that Kennedy's list includes 6 sites that are "outliers". However, there are only about 3 BWR plants in that list. PWR pools are robust beyond the 3 times SSE. BWR or above ground pool structures have weakness due to out-of-plane shear and flexure. So they are not likely to pass the seismic check list. Our recommendation to have each application for decommissioning verify that their pool structure has a HCLPF capacity greater than or equal to 3 times the SSE and pass the seismic check list is very effective. The use of the seismic check list will require plant specific HCLPF capacity calculation for all the susceptible plants.

I have sent our recommendation to Dr. Kennedy and I expect to get his endorsement. Nevertheless, we are convinced that the use of the revised check list for each plant is effective. I have excerpted a portion of NEI discussion on this point for your information. This is for your information only. We do not endorse the arguments included in the NEI discussion. Feel free to discuss any related issue with me or Bob Rothman. Thanks,
Goutam Bagchi

NEI Comments

Comments on Recommendation Number 4.b

Using the Kennedy simplified SFP failure methodology C10% values are determined at 10, 5, and 2.5 Hz. At 5 Hz the spectral acceleration value is 1.82g or about 56.8 cm/sec.

The PSA values associated with these C10% values are consistent with spectral values which describe the San Onofre and Diablo Canyon SSEs, i.e., large magnitude, near field earthquakes.

The issue of large earthquakes occurring near EUS NPPs was resolved by the Charleston Issue (SECY-91-135, Reference 4). As stated in SECY-91-135, "Large 1886 Charleston-size earthquakes, greater than or equal to magnitude 6.5, are not significant contributors to the seismic hazard for nuclear facilities along the eastern seaboard outside the Charleston region. This result is consistent with the results emerging from the ongoing studies of earthquake-induced liquefaction features along the eastern seaboard. These studies have found no evidence of large prehistoric earthquakes originating outside the South Carolina region. Thus the issue of the Charleston earthquake occurring elsewhere in the eastern seaboard is considered to be closed."

H/S

Credible, versus not credible in terms of annual probability, is typically associated with greater than about 10^{-6} (credible) and 10^{-6} or less (not credible). Within the context of the Kennedy simplified SFP failure methodology, if the annual probability of exceeding the screening level value (for example 56.8 cm/sec at 5 Hz) times 0.5 is less than 10^{-6} , then only the seismic checklist must be satisfied. Implicit in this approach is that the probabilistic estimates at the C10% level are credible.

For a site to be screened out the C10% value should be on the order of 10^{-6} . Figure 1 (attached) shows the 5 Hz spectral acceleration values associated with the 10^{-6} LLNL results at each of the 69 sites. As can be seen, for site number 36 (which in Table 3 of the Kennedy report is the site with the highest SFP failure frequency) the 10^{-6} spectral acceleration is about 7,700 cm/sec² or about 245 cm/sec. As stated previously, 57 cm/sec is consistent with 5 Hz spectral velocities associated with a magnitude 6.6 earthquake 8 km from the site (San Onofre SSE), therefore these predicted groundmotions must be associated with a very large earthquake, greater than magnitude 6.5, very near to the site - which is counter to the conclusions of SECY-91-135. Other values at other sites are equally incredible. Based on these results, it is concluded that the LLNL results, at the probability/ground motion levels of interest, are deterministically incredible and therefore their use in screening is questionable. Figure 2 (attached) shows the 5 Hz spectral acceleration values associated with the 10^{-6} EPRI results. As can be seen, the EPRI results, at the probability/ground motion levels of interest, are credible, and consistent with SECY-91-135.

Figure 3 (Figure 2 from NUREG-1488, Reference 5) illustrates the problems associated with the LLNL results at high ground motions/low annual probabilities. As can be seen from Figure 3, at high probabilities there is reasonable agreement between LLNL and EPRI. However, the slope of the LLNL results at high ground motions is too shallow. The effect of this shallow slope is to predict incredible ground motions at credible probability levels.

Based on this review, industry contends that it would be appropriate to only use EPRI results in the SFP seismic screening analysis. We believe this to be reasonable in light of the difficulties associated with the LLNL results at low probabilities. The effect of using only the EPRI results is shown in column 3 of Table 3 in the Kennedy report (Reference 1). As can be seen, only 1 plant would be required to perform further analyses. However, because both LLNL and EPRI are considered to provide valid results, it is proposed that the results from each study be geometrically averaged such that equal weight is provided the results from each study. Arithmetic averaging is considered unacceptable in light of the difficulties associated with the LLNL results. Figure 4 provides the results of geometrically averaging the LLNL and EPRI results.

Comments on Recommendation Number 4.a

Based on Figure 4 about 6 sites would be preliminarily screened in due to exceeding the 10^{-6} criterion. One of the 6 sites is Shoreham. If these screened in SFPs are above ground then further analyses will be required.

Comments on Recommendation Number 4.c

It is industry's understanding of Section 4.2 of the Kennedy report that given that a plant satisfies the seismic screening checklist then the SFP is likely to have a seismic capacity higher than the screening level capacity. If plant-specific information is conveniently available, additional seismic capacity values will be developed in a manner similar to that described in NUREG/CR-5176.

>>> Glenn Kelly 12/15 3:17 PM >>>

What return frequency do you ascribe to "not credible?" Is it 10^{-5} or 10^{-6} or 01^{-7} per year return

frequency? Or is it lower?

What is the basis for excluding a plant-specific analysis of the capacity of the spent fuel pools at the five or so plants east of the Rockies that have high seismic ground motions and that appear to be outliers (my words) from Dr. Kennedy's point of view?

Does Dr. Kennedy agree with your conclusion?

>>> Goutam Bagchi 12/15/99 11:30 AM >>>

Diane,

Please note that your seismic check list item needs to be changed. We are not going by the exception list - we cannot identify the plants. I have given this issue a great deal of thought, I also discussed the seismic hazard issue with Dr. Rothman. Our (DE) conclusion is that earthquake ground motions beyond 3 times the SSE for east coast and 2 times the SSE for the west coast plants are not credible. Each licensee needs to make a statement that their SFP has HCLPF capacity of 3 or 2 times the SSE as appropriate for the site and they meet the NEI seismic check list. That statement should address each item and add a very short discussion on how the check list attributes are met. Thanks,
Goutam

>>> Diane Jackson 12/15 9:48 AM >>>

I added an item :

5. SFP level shall be maintained at the level required for fuel movement (approximately 23 feet above fuel) and verified daily. The normal level of the SFP is a major assumption in the staff's assessment which provides the long response time for loss of cooling events.

Thanks - Diane

CC: John Hannon, Richard Wessman, Robert Rothman