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April 19, 2000

Ms. Annette Vietti-Cook
Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0002

Attention: Rulemakings and Adjudication Staff

Subject: Draft Final Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants, February 22, 2000 (65 F.R. 8752), Request for Comments

Dear Ms. Cook,

On behalf of the nuclear energy industry, NEI is pleased to provide comments on the NRC's Draft Final Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants. The Commission directed the staff to risk inform regulations for permanently shutdown nuclear power plants. A rigorous technical basis is the framework for successfully risk informing regulations. The staff's study is technically robust and is an excellent platform on which to base policy decisions. The study reflects input provided by stakeholders during the development of the study. The study includes industry commitments made, in part, in response to risk insights gleaned from the study.

We agree with the staff's conclusion on the low level of risk posed and the staff's assessment of the safety principles contained in the Commission's policy statement on risk. Specifically, we fully endorse the staff's conclusion:

> "In summary, the risk assessment shows low numerical risk results in combination with satisfaction of the safety principles as described in R.G. 1.174, such as defense-in-depth, maintaining safety margins, and performance monitoring. The staff concludes that under the assumptions of this study there is a low level of public risk from SFP accidents at decommissioning plants."

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Most of our comments address the need to appropriately apply the results of the study and the staff's conclusions to fully risk inform requirements for decommissioning plants. Failure to do so will forego the bulk of the benefits to be derived from a risk informing process, i.e., applying resources to those areas that pose the highest risk and avoiding application of burdensome unnecessary regulatory requirements where the risk does not support the need for them. We believe failure to make full use of risk insights for spent fuel pools where the risk is so thoroughly and well characterized would set a negative precedent for other potentially more difficult risk informing initiatives at operating plants.

To fully accomplish the Commission's directive to risk inform decommissioning regulations NEI urges the staff charged with subsequent rulemaking to start with a clean slate. In other words, rather than determining which of the regulations applicable to operating plants apply to decommissioning, determine what controls are necessary to preserve the acceptable findings of the study, i.e., "there is a low level of public risk from SFP accidents at decommissioning plants." Namely, ensure controls are in place to preserve the assumptions in the study, e.g., the commitment to implement NUREG 0612, Control of Heavy Loads. We believe this approach will better ensure risk informed regulations and will simplify the process of amending rules where necessary for decommissioning plants. (Note, NEI will submit detailed comments on an approach and framework for amending the rules at a later date.)

Industry provides detailed comments on the seismic portion (see attachment A) of the risk study but only minor comments regarding other aspects of the methods and analysis of the risk posed by spent fuel pools. Most of our comments in attachment 1 address application of the results of the study to appropriately risk inform regulations applicable to decommissioning plants. As an example, consider the issue of off-site emergency preparedness[1]. This is one key area of regulations for operating plants where the low risk posed by decommissioning plants warrants relief. The key question is: "at what point can decommissioning licensees eliminate their off-site emergency plans?"

The risk study demonstrates very low probabilities associated with spent fuel pool accidents that could lead to the need for off-site emergency preparedness (a key element of which is evacuation). Operator recovery times for initiating events are very long and relatively insensitive to the time period after final plant shutdown.[2] Continuing the period for evacuation, as the staff has modeled it in their risk study,

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[1] This is an abbreviated discussion, not intended to be complete, but rather to illustrate a different thought process for the decommissioning rulemaking.

[2] According to Section 3.3 of the risk study, the time an operator has to restore makeup prior to bulk boiling is 90 hours one year after shutdown. At six months after shutdown, the time to bulk boiling is still 82 hours.

provides no significant benefit to public health and safety.[3] Therefore, off-site emergency preparedness is not an assumption necessary to preserve the results of the risk study.

Industry appreciates this opportunity to comment on the spent fuel pool risk study. If I can be of any assistance to you as you consider these comments please contact me 202 739-8109 or LXH@NEI.ORG.

Sincerely,

Lynnette Hendricks

Lynnette Hendricks

LXH/amj

Attachments

[3] See Case 1. Appendix A.

Attachment 1

Industry Comments
NRC Draft Final Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants

Main Report Comments

Risk Assessment Report Section

Seismic:

Summary of NRC Position

The NRC study concludes that "The results of this report estimated the generic frequency of events leading to zirconium fires at decommissioning plants to be less than 3E-06 per year for a plant that implements the design and operational characteristics assumed in the risk assessment performed by the staff. ... The most significant contributor to this risk is a seismic event which exceeds the design basis earthquake."

The staff concludes that Spent Fuel Pools (SFPs) at operating Nuclear Power Plants (NPPs) are inherently rugged in terms of being able to withstand loads substantially beyond those for which they were designed. Consequently, SFPs have significant seismic capacity.

The staff also concludes that for those Central and Eastern United States (CEUS) plants where 3 X Safe Shutdown Earthquake (SSE) is less than or equal to the NEI screening criterion of 0.5g, then the seismic risk is acceptably low. A similar conclusion is reached for those Western United States (WUS) plants where 2 X SSE satisfies the screening criterion.

According to the staff, those CEUS sites (about 27) for which 3 X SSE exceeds 0.5g and the 2 WUS sites for which 2 X SSE exceeds 0.5g, would have to perform additional plant specific analyses to demonstrate a High Confidence Low Probability of Failure (HCLPF) value for their SFPs of 3 X SSE and 2X SSE, respectively, in order to demonstrate acceptably low seismic risk.

Industry Comments

NPPs that satisfy the requirements of the seismic checklist have a SFP HCLPF of 0.5g or greater. Only large Charleston-like earthquakes can generate ground motions of the amplitude, frequency content, and duration to challenge the seismic capacity of spent fuel pools that satisfy the seismic checklist. In no CEUS licensing proceeding has there been compelling data to require design to an earthquake of a magnitude which would challenge the seismic capacity of an SFP that satisfies the seismic checklist.

The basis for requiring a higher HCLPF value for plants with 3 X SSE greater than 0.5g is apparently the assumption that higher SSE levels are associated with higher seismic hazard levels - which is shown in the Appendix A to be an erroneous assumption. Furthermore, it has been previously shown, using just the LLNL results and Dr. Kennedy's methodology, that there are many sites where 3 X SSE is greater than 0.5g and the SFP failure frequency is well below those plants where 3 X SSE is less than 0.5g.

The focus of previous seismic hazard studies (LLNL and EPRI) has been at the SSE level. At high ground motion values (ground motion values that can be associated with damage to SFPs), the tail of the attenuation random uncertainty distribution allows, with some non-negligible probability, relatively small events to contribute to the probability of exceeding these high ground motion values. Deterministically, these results are not logical and therefore there is a strong basis for truncating the tail of the random uncertainty term at high ground motion values. Based on this information and information previously transmitted, use of the LLNL probabilistic estimates at low probability values may not be credible. EPRI results are also likely to be overly conservative at high ground motion values. See attachment A for a more detailed discussion of these points.

Based on the results of both probabilistic and deterministic evaluations, it is concluded that for all CEUS and some WUS Nuclear Power Plants (NPPs), regardless of SSE value, satisfaction of all the requirements of the seismic checklist provides sufficient documentation of an acceptably low level of seismic risk. This acceptably low level of seismic risk is deemed to be considerably lower than the bounding value of 3E-6 per year.

Thus, we conclude that there should be no SFP screening level distinctions based on plant SSE for the CEUS. For the WUS, it is reasonable to require that certain plants demonstrate a HCLPF of 2 X SSE.

Sabotage:

The report concludes that there is no methodology currently available

to assesses probabilities of terrorist activity or behaviors, which might culminate in attempted sabotage of spent fuel. We disagree. For instance, Sandia National Laboratories, a key contractor employed by NRC on security matters, has applied a probabilistic approach to security in decommissioning on the Maine Yankee docket. We encourage the staff to review this report.

Nonetheless, the usual approach in granting security exemptions for decommissioning facilities has involved "shrinking" the physical and programmatic security requirements to that needed to support spent fuel safety. There is sufficient precedent, on a deterministic basis, to implement this approach in a rulemaking that avoids the need for future exemptions.

Finally, the rule on vehicle barriers is sufficiently flexible as written to allow licensees to relocate their barriers, as needed, for decommissioning.

Implications for Regulatory Requirements Report Section

1. Emergency Preparedness –

The decommissioning rule should specify that the licensee is excused from 10 CFR 50.47 off-site emergency preparedness requirements after the short lived nuclides important to dose have undergone substantial decay resulting in off-site dose consequences due to license basis accidents of less than 1 rem (the EPA protective action guideline).

2. Security –

As discussed above.

3. Insurance –

The obligation for decommissioning plants to participate in the secondary financial protection (assessments for someone else's accident) should be reviewed in light of the low public risk posed by spent fuel pools for decommissioning plants. Industry does not believe that the risk justifies requiring participation, i.e., the majority of the 3 in 1 million risk of significant offsite consequences comes from an upper bound determination of the risk posed by seismic events, not on a best estimate of the seismic risk.

If it is determined that participation in the secondary financial protection will be required during the short time that decommissioning plants pose a non-zero risk, then the level of participation should be in proportion to a best estimate of the risk posed relative to the risk posed by operating plants. If

any participation is required it should only be for the short period that clad surface temperatures greater than 570 degrees C (based on the spent fuel failure criteria of the thermal limit used under accident conditions for licensing of spent fuel dry storage casks) can occur in a loss of water configuration. The calculation of this temperature should be by approved methodology. However, in the absence of any calculation, the obligations should end after a period which is indicative of when there is reasonable assurance that the last core placed in a pool is incapable of attaining clad surface temperatures greater than 570 degrees C. Realistic assumptions regarding burnup histories and storage array details will lead to a time period much shorter than the 5 years proposed in the report. For example, the most recent exemption issued by the staff was issued within 18 months of shutdown.

Likewise, the capacity required for primary financial protection should be eliminated for consideration of any potential for accidents with significant off site consequences. For consideration of other events with onsite consequences, we propose that onsite coverage be reduced to $25M for the period when spent fuel remains in the pool and offsite coverage be reduced to $5-10M. (See supplemental industry comments submitted on financial protection rule for permanently shutdown plants, and NEI letter to Dave Mathews providing a basis for costs for cleanup of onsite spills.)

When fuel has been removed offsite or placed in an onsite ISFSI, we recommend onsite coverage be reduced to $25M while the site still contains significant sources of radioactive material (more than 1000 gallons of contaminated liquids). Onsite coverage could be reduced to zero when there are no sources exceeding 1000 gallons of liquid. Offsite coverage should be reduced to $5-10M for plants with fuel off site or in an onsite ISFSI.

If some consideration is required for the negligible potential for events with significant offsite consequences, the primary coverage required should be reduced in proportion to the reduced risk, i.e., in the same manner discussed above for proportional reduction in participation in secondary financial protection, and for the same time period.

Appendices - Section by Section Technical Comments:

1. Thermal Hydraulics

The range of outcomes, which depend on specific fuel burnup histories and storage array details, suggests that standard methods will need to be developed for a consistent application in applying the regulations.

2. Risk Assessment

a. Methodology: *No Comments*

b. Structural Integrity - Seismic Loads: (see Attachment A).

c. Structural Integrity - Heavy loads

In Section 3.3.6 and footnote 7, the staff mischaracterize the risk of heavy load drops for licensees choosing to do load drop analyses. A successful load drop analysis, by definition, demonstrates that off-site dose consequences are acceptable. Therefore, the risk associated with a heavy load drop that has been analyzed is negligible– i.e., it is not considered for events resulting in consequences that propagate to either a complete loss of inventory (and potential zircalloy fire), or, in license basis terms, fuel pin damage resulting in consequences in excess of Part 100.

Therefore, for purposes of a risk study, the only heavy loads component of risk is that contributed by a single failure proof crane approach.

d. Structural Integrity - Aircraft Crashes: *No Comments*

e. Structural Integrity – Tornadoes: *No Comments*

3. Criticality

No Comments

4. Consequences Assessment from Zirconium Fire

The Consequence Assessment for Zirconium Fires in the NRC draft final study provides the misleading conclusion that there is "about a factor-of-two reduction in prompt fatalities if the accident occurs after 1 year instead of thirty days." What the study does not note is that the absolute value of fatalities is a couple of orders of magnitude below the numbers for an operating plant. This is not surprising since it is the short-lived nuclides that drive this result. In addition the study does not highlight the fact that the most significant reduction in early fatalities occurs within the first thirty days. Although there is an additional factor of two reductions over the next 11 months, the more significant reduction is in the first month, again since the short-lived nuclides have largely decayed off in this period.

By failing to emphasize the above, the staff's risk study lends misleading support to the idea that a one year waiting period is justified prior to reducing emergency planning requirements. In fact, the risk study does not support this conclusion.

The consequence analyses contained in Appendix A also seem to contradict the staff's conclusion that one year is an appropriate waiting time for emergency planning. Presumably, the primary benefit of off-site emergency preparedness is to reduce prompt fatalities through evacuation. Yet, Case 1 in Appendix 4 which apparently was intended to support that assumption, contradicts this assumption. While there is not sufficient information in Appendix 4 to clearly understand the consequence analyses, Case 1 appears to indicate that evacuation provides no benefit in reducing prompt fatalities.

Finally, the staff's study seems to establish the one year delay time based on providing sufficient time for operator response to upset conditions. For instance, in Section 4.3.1, page 34, the staff notes: "This study indicates that a one-year period provides adequate decay time necessary to reduce the pool heat load to a level that would provide sufficient human response time for anticipated transients, and minimize any potential gap release." A true, but again, misleading statement.

Actually, a much shorter delay period supports the same conclusion. For instance, referring to Table 3.1 and subsequent text in Appendix 2, we see that one year after shutdown, the total time available for operator action (time to bulk boiling plus time to boil down) is 133 hours. Performing the same calculation for a six-month delay period (which the staff does not do in the report) reveals 118 hours available for operator action. This is a substantial period of time, which allows the same conclusion that, i.e., this study indicates that a six-month period provides adequate decay time necessary to reduce the pool heat load to a level that would provide sufficient human response time.

Thus the risk informed conclusion that should be drawn from the Consequence Analysis is that the prompt fatalities are very small in comparison to operating reactor accidents, and are sufficiently reduced in the first month after shutdown to support eliminating off site emergency preparedness. Furthermore, even after a relatively short delay time, there is substantial time for operator action to respond to upset conditions.

On the other hand, there are restrictions on reducing off-site emergency preparedness that are part of the pre-existing license basis of the facility, that have little to do with decommissioning or the risk study, but nonetheless must be satisfied by a licensee in transitioning from operations to decommissioning. Most significant is the one rem off-site dose consequence (the so-called EPA protective action

guideline) that distinguishes between off-site and on-site response. Below one rem, no off-site response is called for.

Independent of spent fuel pool events, there are accidents within a plant's license basis that can generate off-site doses during decommissioning. The dominant event is a fuel handling accident (e.g., dropping a fuel bundle that breeches the integrity of some fuel rods, thereby releases radioactivity). Examination of this event shows that the vast majority of off-site dose is due to iodine, which fairly rapidly decays following fuel offload. In fact, it is straightforward to reanalyze a fuel handling accident to determine the point following shutdown at which the accident offsite dose drops below one rem, thereby establishing the point at which off-site emergency response capability can be eliminated.

5. Seismic Checklist

As a result of stakeholder interactions with NRC in 1999, it was concluded that, in general, spent fuel pools possess substantial capacity beyond their design basis but that variations in seismic capacity existed due to plant specific details. The industry developed a seismic screening checklist to identify and evaluate specific seismic characteristics. The checklist has been incorporated into the bases for the NRC evaluation. Successful application of the revised seismic checklist provides a high degree of assurance that the Spent Fuel Pool (SFP), High Confidence Low Probability of Failure (HCLPF) is 0.5g or greater. In no Central or Eastern United States licensing proceeding has there been compelling data to require design to an earthquake of a magnitude which would challenge the seismic capacity of an SFP that satisfies the seismic checklist. The industry is committed to completion of the requirements of the checklist, including a thorough spent fuel pool walkdown.

6. NEI Commitment Letter:

NEI reiterates that the industry will perform decommissioning with the same high level of commitment to safety as during operation of the plants. To that end, industry has made several commitments for procedures and equipment, which would reduce the probability, and consequence of spent fuel pool events during decommissioning. These commitments have been incorporated into the bases for the NRC evaluation and the industry stands ready to fulfill them.

Attachment A

Comments on Appendix 2.b. "Structural Integrity Seismic Loads"

Summary of NRC Draft

To increase the efficiency and effectiveness of decommissioning regulations, the NRC staff has engaged in rulemaking activities that would reduce the need to routinely process exemptions once a plant is permanently shut down. Reference 1 provides the technical basis for determining the regulatory requirements for decommissioning plants using risk-informed decision making. Table 3.1 (Reference 1) provides a summary of the annual frequency of fuel uncovery associated with internal and external initiating events. Based on Table 3.1 it is estimated that the frequency of a zirconium fire is less than 3×10^{-6}, with the dominant contribution coming from seismic events. The seismic contribution is estimated to be less than 3×10^{-6}, while the contribution from all other initiating events is estimated to be 4×10^{-7}. As described by the staff, other considerations indicate that the seismic contribution may be considerably lower. Assumption of the generic frequency of events leading to a zirconium fire at decommissioning plants to be less than 3×10^{-6} per year is based on a plant satisfying the design and operational characteristics assumed in the risk assessment performed by the staff.

Comments on Appendix 2b Structural Integrity of Spent Fuel Pools Subject to Seismic Loads (Reference 1)

1. Introduction

No significant comments on this section other than to concur that spent fuel pools (SFPs) at operating nuclear power plants and at decommissioning NPPs are inherently rugged in terms of being able to withstand loads substantially beyond those for which they were designed. Consequently, SFPs have significant seismic capacity.

2. Seismic Checklist

It is not clearly noted in this section, but the important point is that successful application of the revised seismic checklist provides a high degree of assurance that the SFP HCLPF is 0.5g or greater. The comments on the conservatisms (in paragraph 2) associated with the design basis earthquake at licensed NPPs should be moved to a separate section. Furthermore, the deterministic method should be contrasted with the probabilistic method. This contrast is important because the deterministic method provides a powerful counter to the veracity of the probabilistic results at low probability levels.

Deterministic Methods vs Probabilistic Methods

Deterministic Methods

The design basis earthquake ground motion, or the SSE ground motion, for NPPs were based on the assumption of the largest event geophysically ascribable to a tectonic province or to a capable structure at the closest proximity of the province or fault to the site. In the case of the tectonic province in which the site is located, 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 the Charleston region. The New Madrid zone is another zone in the Central US where very large events have occurred. Recent research has identified the source structures of these large New Madrid earthquakes. Both of these earthquake sources are fully accounted for in the assessment of the SSE for currently licensed NPPs. The SSE ground motions for NPPs are based on conservative estimates of the ground motion from the largest earthquake estimate to be generated from the current tectonic regime. In deterministic analyses used in the licensing of existing NPPs, one standard deviation is considered sufficient to incorporate all the conservatism in the final ground motion estimate. For CEUS sites the typical NPP is designed for about a magnitude 5.3 to 5.5 (about 0.15g). The largest design basis earthquake for a CEUS site, based on detailed seismological, geological, and geophysical investigations, is magnitude 6.0 (about 0.25g). In no EUS licensing proceeding has there been compelling data to require design to an earthquake of a magnitude which would challenge the seismic capacity of an SFP that satisfies the seismic checklist. For WUS sites the design basis ground motion is generally governed by known active faults at known distances. Based on fault length and other deterministic factors the maximum earthquake potential can be estimated.

Probabilistic Methods

References 2 and 3 describe the Lawrence Livermore National Labs (LLNL) and Electric Power Research Institute (EPRI) seismic hazard methodologies. A seismic hazard analysis (SHA) estimates the seismic hazard at a site due to the potential occurrence of earthquakes in the region surrounding the site. Importantly, the historic seismic data is insufficient, at least for the CEUS, to use as the sole source of information for estimating the various parameters of the overall probability model. Therefore, it is necessary to rely on "expert opinion" to supplement the data. One fundamental expert opinion input to the SHA is the upper bound magnitude distribution for each earthquake source. Figure 1 contrasts the distribution of upper bound magnitude estimates assessed by the experts in the LLNL study for the host zones containing a New England NPP with the SSE determined by the 10CFR Part 100 Appendix A process. This distribution of upper bound magnitude may be plausible, but not necessarily a possible outcome. In other words, it is not based on any known structure in each host zone description that could cause earthquakes this large. Within this context, the assessed seismic hazard will generally be higher – because less is known and the distribution has more probability associated with extreme outcomes, **or, outcomes that in fact cannot occur**. The effect of including these extreme outcomes is to predict incredible ground motions at credible probability levels. Expert opinion on the distribution of upper bound magnitude is but one of the many opinions rendered in the LLNL and EPRI studies that have profound effects on the perceived seismic hazard at low (10^{-6}) probability levels.

The LLNL methodology was initially developed in 1979 to determine SSE values for older NPPs

in the Systematic Evaluation Program. The methodology was further developed to address the Charleston Issue (SECY-91-135, Reference 4), i.e., to evaluate the contribution to the seismic hazard from large earthquakes along the eastern seaboard outside the Charleston region. It should be noted that the focus of these studies was on the relative contribution of large earthquakes to the overall seismic hazard, not on the absolute effect. Also, comparisons between the LLNL and EPRI results was typically made at the SSE level (0.15g to 0.25g - annual probability of 10^{-3} to 10^{-4}), not at the ground motion level associated with a HCLPF of 0.5g. It is noted that given a HCLPF of 0.5g the median capacity (A_m) of an SFP is about 1.0g (A_m = HCLPF/$e^{-1.65(Bc)}$) – far from typical SSE values. Realistically, only large Charleston like earthquakes can generate ground motions of the amplitude, frequency content, and duration to challenge the seismic capacity of spent fuel pools. However, at high ground motion values (1000 cm/sec^2), the tail of the attenuation random uncertainty distribution (sigma) allows, with some non-negligible probability, relatively small events to contribute to the probability of exceeding a ground motion of 1000 cm/sec^2. Figure 2 shows the effect of changing sigma for a point source at a given distance. These results were analytically determined. As can be seen, at low ground motions (125 cm/sec^2), changes in sigma have a small effect on the probability of exceedance. However, at high accelerations (1000 cm/sec^2) the effect of changes in sigma is profound. The high probability of exceeding 1000 cm/sec^2 based on use of a sigma of 0.6g in Figure 2, is driven by the tail of the attenuation random uncertainty term. For example, 1000 cm/sec^2 is about 3 standard deviations above the expected ground motion from a magnitude 6.5 earthquake at 100 km. Clearly there must be a physical limit on the strength of ground motion that a given earthquake can generate. These results don't make sense and provide a basis for truncating the tail of the random uncertainty term at high ground motion values. As described previously, in deterministic analyses one standard deviation is considered sufficient to incorporate all the conservatism in the final ground motion estimate. Use of a smaller sigma value is a form of truncation. As can be seen on Figure 2, the probability of exceeding 1000 cm/sec^2 is reduced by about a factor 600 by simply changing sigma from 0.6 to 0.4. EPRI results are based on use of a sigma of 0.5. Based on this information and information previously described in Reference 5, use of the LLNL probabilistic estimates at high ground motion values may not be credible. EPRI results are also likely to be overly conservative at high ground motion values.

3. Seismic Risk - Catastrophic Failure

The staff concludes that for those CEUS plants where 3 X SSE is less than or equal to the NEI screening criterion of 0.5g, then the seismic risk is acceptable low. A similar conclusion is reached for those WUS plants where 2 X SSE satisfies the screening criterion. For CEUS plants that exceed the 3 X SSE screening criterion, a detailed SFP assessment will be required to demonstrate the SFP HCLPF equals 3 X SSE. A similar conclusion is reached for those WUS plants where 2 X SSE exceeds the screening criterion. This requirement that some plants with higher SSE values perform detailed HCLPF assessments of their SFPs is not be warranted. The assumption of this requirement is that the SSE is correlated with seismic hazard, in other words, the higher the SSE the higher the seismic hazard. Previous studies have shown that the SSE is poorly correlated with the seismic hazard (see Figure 3). In particular, there are many 0.2g to 0.25g SSE sites with lower seismic hazard estimates than 0.1g to 0.2g SSE sites. SSE tends to be more correlated with plant vintage than seismic hazard. **Based on this information, we**

conclude that there should be no SFP screening level distinctions based on plant SSE for the CEUS. For the WUS, it is reasonable to require that certain plants demonstrate a HCLPF of 2 X SSE.

4. Seismic Risk - Support System Failure

No comments.

5. Conclusion

The staff concludes that for SFPs in the CEUS with HCLPF values of 3 X SSE or 0.5g whichever is greater and for WUS SFPs with HCLPF values of 2 X SSE or 0.5g, whichever is greater, the SFP failure frequency due to seismic is bounded by 3×10^{-6} per year. As stated by the staff, "other considerations indicate that the frequency may be significantly lower."

For CEUS plants that satisfy the seismic checklist and 3 X SSE is less than 0.5g, the seismic risk is considered by the staff to be acceptably low and no additional work is required. According to the staff, those CEUS sites (about 27) for which 3 X SSE exceeds 0.5g and 2 WUS sites for which 2 X SSE exceeds 0.5g would have to perform additional plant specific analyses to demonstrate a HCLPF value for their SFPs of 3 X SSE and 2X SSE respectively in order to demonstrate acceptably low seismic risk.

The conclusion that the SFP failure frequency is bounded by 3×10^{-6} per year can be found in previous submittals. In particular, it was shown that the assumption of a 0.5g HCLPF and applying Dr. Kennedy's conservative methodology to estimate SFP failure frequency at all CEUS sites using both the LLNL and EPRI seismic hazard results, the SFP failure frequency is bounded by 3×10^{-6} per year. It is noted that no distinction was made in the previous analysis concerning cases where 3 X SSE was greater than 0.5g. The basis for requiring a higher HCLPF value for plants with 3 X SSE greater than 0.5g is neither clear nor compelling. If the basis for requiring a higher HCLPF value for plants with high SSEs is that the SSE is assumed to be correlated with hazard it can readily be shown that seismic hazard and SSE are poorly correlated (Figure 3). Furthermore, it can be also be shown, using just the LLNL results and Dr. Kennedy's methodology, that there are many sites where 3 X SSE is greater than 0.5g **AND** the SFP failure frequency is well below those sites where 3 X SSE is less than 0.5g.

Successful application of the revised seismic checklist provides a high degree of assurance that the SFP HCLPF is 0.5g or greater. It is noted that given a HCLPF of 0.5g the median capacity of an SFP is about 1.0g. Realistically, only large Charleston like earthquakes can generate ground motions of the amplitude, frequency content, and duration to challenge the seismic capacity of spent fuel pools. In no EUS licensing proceeding has there been compelling data to require design to an earthquake of a magnitude which would challenge the seismic capacity of an SFP that satisfies the seismic checklist. The focus of previous seismic hazard studies (LLNL and EPRI) has been at the SSE level. At high ground motion values (ground motion values that can be associated with damage to SFPs), the tail of the attenuation random uncertainty distribution (sigma) allows, with some non-negligible probability, relatively small events to contribute to the

probability of exceeding these high ground motion values. These results don't make sense and provide a basis for truncating the tail of the random uncertainty term at high ground motion values. In deterministic analyses used in the licensing of existing NPPs, one standard deviation is considered sufficient to incorporate all the conservatism in the final ground motion estimate. Based on this information and information previously described in Reference 5, use of the LLNL probabilistic estimates at low probability values may not be credible. EPRI results are also likely to be overly conservative at high ground motion values.

Based on the results of both probabilistic and deterministic evaluations, it is concluded that for all CEUS and some WUS NPPs, regardless of SSE value, satisfaction of all the requirements of the seismic checklist provides sufficient documentation of an acceptably low level of seismic risk. For the 2 WUS plants at known high seismic hazard locations, a HCLPF value of 2 X SSE should be demonstrated. This acceptably low level of seismic risk is deemed to be considerably lower than the bounding value of 3E-6 per year.

References:

1. USNRC, Draft for Comment Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants, February, 2000.

2. NUREG/CR-5250, Seismic Hazard Characterization of 69 Nuclear Plant Sites East of the Rocky Mountains, Lawrence Livermore Nation Laboratory, January, 1989.

3. EPRI NP-6396-D, Probabilistic Seismic Hazard Evaluations at Nuclear Plant Sites in the Central and Eastern United States: Resolution of the Charleston Issue, Electric Power Research Institute, April 1989.

4. SECY-91-135, Conclusions of the Probabilistic Seismic Hazard Studies Conducted for Nuclear Power Plants in the Eastern United States, May 14, 1991.

5. Appendix 5e, USNRC, Draft for Comment Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants, February 2000.

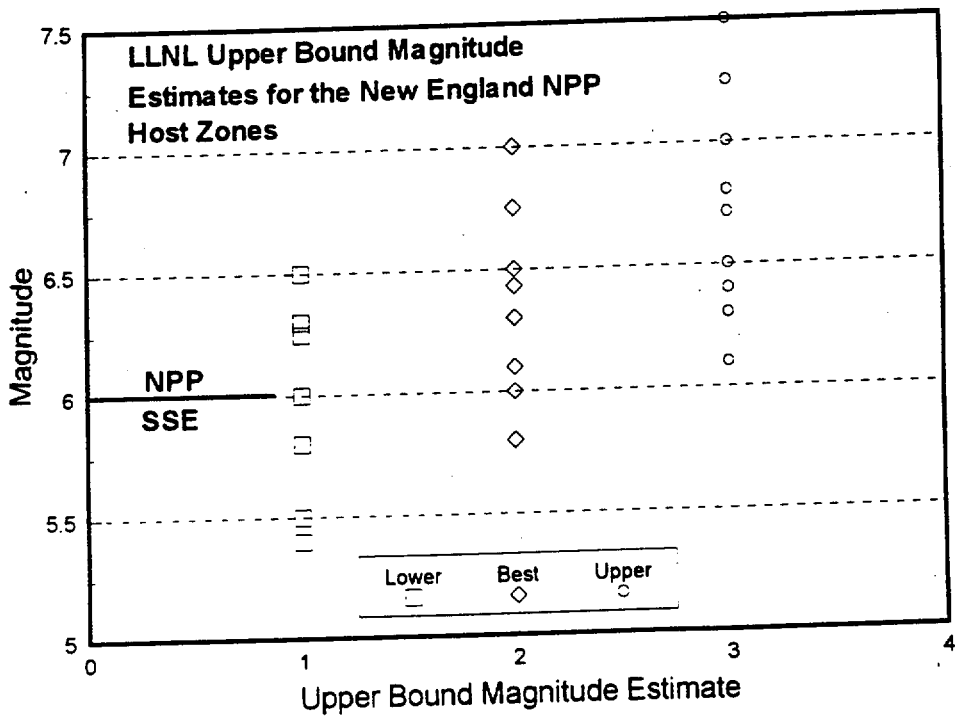

Figure 1 – Distribution of Upper Bound Magnitude Estimates from Reference 2 for a New England site.

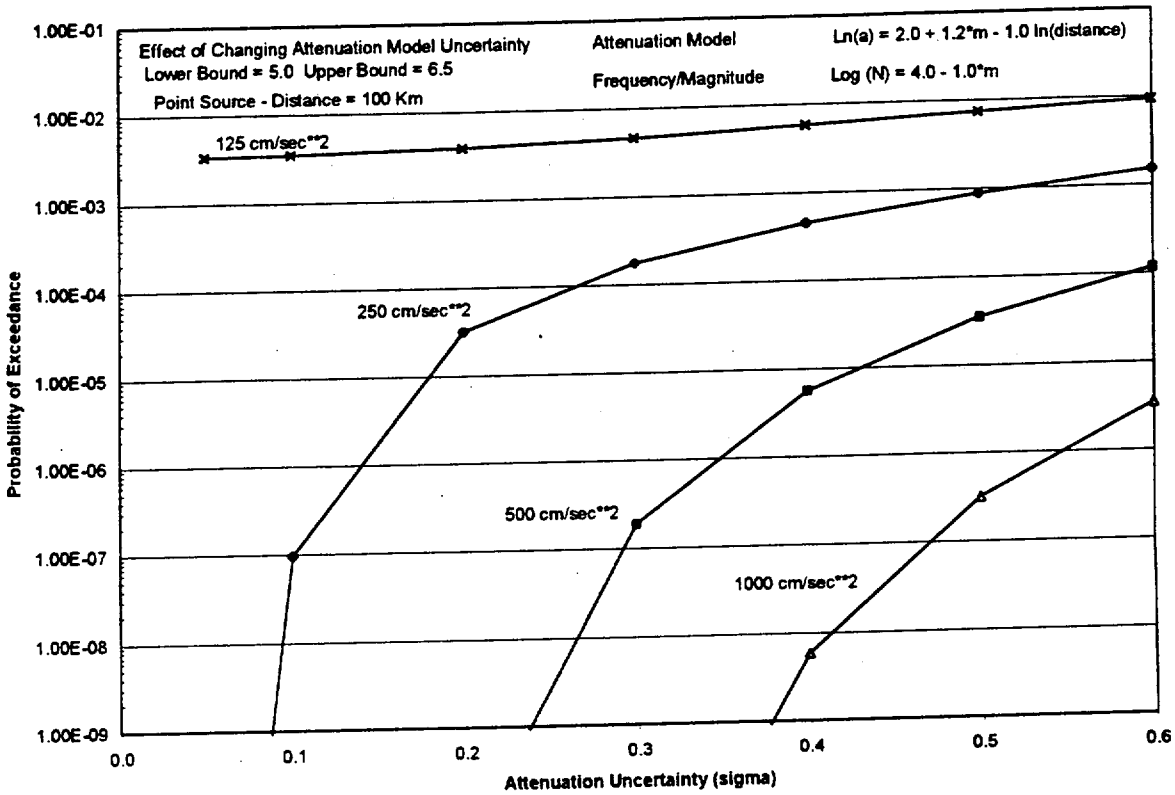

Figure 2 Effect of Attenuation Random Uncertainty on Probability of Exceedance from a Point Source

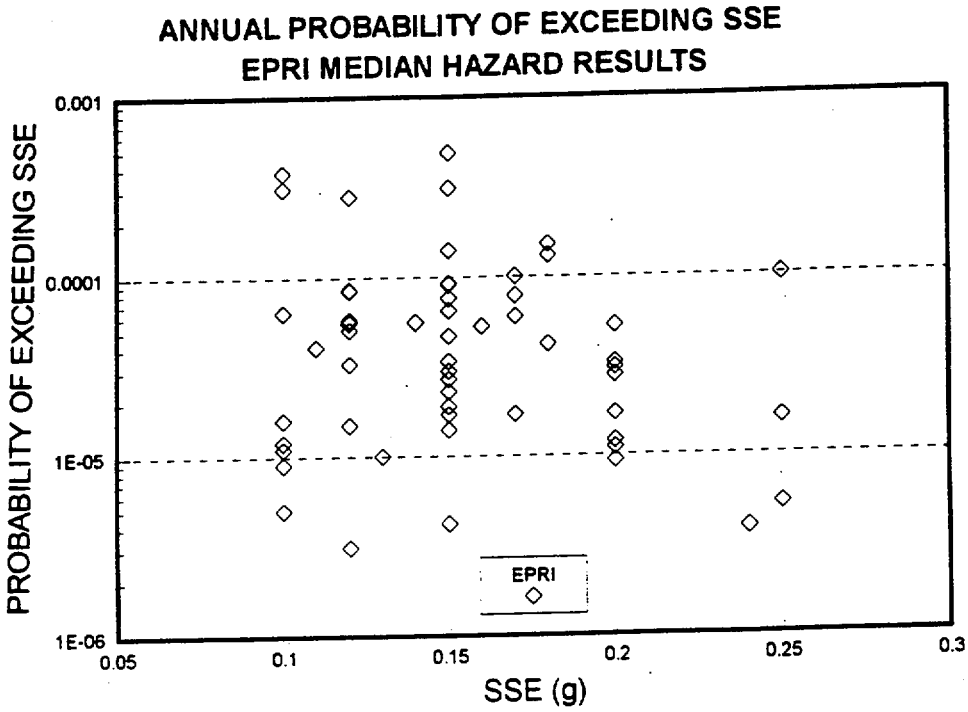

Figure 3 – Annual Probability of Exceeding the SSE at CEUS sites based on EPRI (Reference 3)