Glenn's

7/24/00

MAIN BODY SEISMIC WRITEUP

SHOULD POINT OUT THAT FAILURES WOULD OCCUR AT [illegible] LOCATIONS [illegible] IN POOL, WHERE [illegible] TIMES WOULD BE LONGER [illegible] IN POOL, COULD LOSE [illegible] WATER. WE ARE ONLY FOCUSSING ON THE LATTER

3.4.1 Seismic Events

POSSIBLY

The staff's concern regarding seismic issues at spent fuel pools involves very large earthquakes that can structurally fail the pool. Under this scenario, the pool will suffer a significant breach, it will drain rapidly, and it will be incapable of being refilled. This would lead to rapid cladding heat up followed by a zirconium cladding fire. The staff evaluated how large an earthquake would be required to cause such damage and what would be the return frequency of such large earthquakes.

GRADUAL

ARE ABOUT

Spent fuel pool structures at nuclear power plants are seismically robust. They are constructed with thick reinforced concrete walls and slabs lined with stainless steel liners 1/8 to 1/4 inch thick[1]. Pool walls ~~vary from 4.5 to~~ 5 feet in thickness, and the pool floor slabs are around 4 feet thick. The overall pool dimensions are typically about 50 feet long by 40 feet wide and 55 to 60 feet high. In boiling water reactor (BWR) plants, the pool structures are located in the reactor building at an elevation several stories above the ground. In pressurized water reactor (PWR) plants, the spent fuel pool structures are located outside the containment structure supported on the ground or partially embedded in the ground. The location and supporting arrangement of the pool structures determine their capacity to withstand seismic ground motion beyond their design basis. The dimensions of the pool structure are generally derived from radiation shielding considerations rather than structural needs. Spent fuel structures at operating nuclear power plants are able to withstand loads substantially beyond those for which they were designed. Consequently, they have significant seismic capacity.

WHEN The staff began to investigate the capacity of spent fuel pools to withstand large earthquakes. ~~While performing the evaluation~~, it became apparent that the staff does not have detailed information on how all the spent fuel pools were designed and constructed. Detailed fragility analyses of spent fuel pools were only available for a few plants. The staff originally performed a simplified bounding seismic risk analysis in its June 1999 draft risk assessment to help determine if there might be a seismic concern. The analysis indicated that seismic events could not be dismissed on the basis of a simplified bounding approach. In addition after further evaluation and discussions with stakeholders, it was determined that it would not be cost effective to perform a plant-specific seismic evaluation for each spent fuel pool. Working with its stakeholders, the staff developed other tools that help assure the pools are sufficiently robust.

FOR THE STAFF?

Based on existing spent fuel pool fragility analyses and engineering judgement, the staff determined that a high confidence, low probability of failure HCLPF)[2] value of 0.5 g peak ground acceleration (or 1.2 g peak spectral acceleration) probably existed for most SFPs.

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[1]Except for Dresden Unit 1 and Indian Point Unit 1, whose spent fuel pools do not have any liner plates. They were permanently shutdown more than 20 years ago, and no safety significant degradation of the concrete pool structure has been reported.

[2]The HCLPF value is defined as the peak seismic acceleration at which there is 95% confidence that less than 5% of the time the structure, system, or component will fail.

I DIDN'T THINK THAT 0.5g PGA TRANSLATES TO 1.2g [illegible] SPECTRAL DIRECTLY, WITHOUT BRINGING IN OTHER CONSIDERATIONS. WE NEED TO LAY THIS OUT SOMEWHERE FOR THE LAYMAN (LIKE ME)

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To summarize the staff recommendation for seismic vulnerability of spent fuel pools, (1) all sites must conduct an assessment of the spent fuel pool structures using the revised seismic check list in order to identify any structural degradation, potential for seismic interaction from superstructures and over head cranes, and to verify that they have a seismic HCLPF value of 0.5 g or higher, (2) those sites that cannot demonstrate that a seismic HCLPF value exists, may either under take appropriate remedial action or conduct site-specific seismic risk assessment and (3) Pilgrim, H. B. Robinson, Vogtle, Diablo Canyon and San Onofre sites would have to use the seismic check list to identify any structural degradation or other anomalies and then conduct a site specific seismic risk assessment if they desire an exemption from EP when their sites are in decommissioning.

WHY CAN'T A PLANT FOREGO THE CHECKLIST AND JUST DO THE PLANT-SPECIFIC ANALYSIS (IF THEY KNOW THEY NEED TO DO A PLANT-SPECIFIC ANALYSIS ANYWAY). WHAT IS COVERED IN THE CHECKLIST THAT WOULD NOT BE PART OF THE PLANT-SPECIFIC ANALYSIS? NEED TO CLARIFY THIS POINT.

Based on existing spent fuel pool fragility analyses and engineering judgement, the staff determined that a high confidence, low probability of failure (HCLPF)[2] value of 1.2 g peak spectral acceleration (or in terms of peak ground acceleration, which is not as good an estimator, 0.5 g PGA)[3] probably existed for most SFPs. Given this assumption, with the assistance of Dr. Robert P. Kennedy (See Appendix 2b, Attachment 2), it was determined that the annual frequency of seismically induced failure of spent fuel pool structures varies from less than $1.0X10^{-6}$ to $13.6X10^{-6}$ per year.

The staff used a measure of $3x10^{-6}$ per year for the adequacy of seismic return period in its earlier versions of the report. However, comments from the Advisory Committee on Reactor Safeguards and other stake holders indicated that the proposed measure and the approach the staff was using were too conservative. Also, the proposed approach contained different assessments for the Eastern and the Western United States and was complicated by the fact that seismic fragility information for ground motion levels beyond 0.5 g is not readily available from a peer reviewed data base.

The staff reexamined the results of Table 3, Appendix 2b, Attachment 2, which estimates the return frequencies of large earthquakes that could fail spent fuel pools. It was decided that the HCLPF value of 1.2 g peak spectral acceleration was a good measure of seismic adequacy for decommissioning plant SFPs that need only be tied to the return period of the earthquake and not to the safe shutdown earthquake magnitude for the site. The staff's review indicates that only three operating eastern plant sites have frequencies greater than $4.5X10^{-6}$ per year of having an earthquake with a peak spectral acceleration greater than 1.2 g. The staff finds $4.5X10^{-6}$ per year to be an acceptable criterion for seismic return period for earthquakes that could fail the spent fuel pools since it is a factor of 2 less than the $1x10^{-5}$ per year PPG and the estimated frequency of zirconium cladding fires from other initiators is an order of magnitude lower. Such a margin is warranted due to the uncertainties of the seismic hazard and spent fuel pool fragilities at each site.

3. Seismic Checklist

The staff determined that absent specific information about SFP seismic capacities, that some plant-specific evaluation of spent fuel pool capacity was warranted. During stakeholder interactions with the staff, the staff proposed the use of a seismic checklist that built on the work done for .... and could provide assurance of the capacity of spent fuel pools. In a letter dated August 18, 1999, NEI proposed a checklist that could be used to show robustness for a seismic ground motion with a peak ground acceleration (PGA) of approximately 0.5g. This checklist was reviewed and enhanced by the staff (See Appendix 2b, Attachment 1). Dr. Kennedy reviewed the enhanced checklist and concluded that the screening criteria are

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[2]The HCLPF value is defined as the peak seismic acceleration at which there is 95% confidence that less than 5% of the time the structure, system, or component will fail.

[3]Damage to critical structures, systems, and components (SSCs) does not correlate very well to peak ground acceleration (PGA) of the ground motion. However, damage correlates much better with the spectral acceleration of the ground motion over the natural frequency range of interest, which is generally between 10 and 25 Hertz for nuclear power plant SSCs. The spectral acceleration of 1.2 g corresponds to the screening level recommended in the reference document cited in the NEI checklist, and this special ordinate is approximately equivalent to a ground motion of 0.5 g PGA.

HELPFUL INCLUDE IN MAIN REPORT

To summarize the staff recommendation for seismic vulnerability of spent fuel pools, (1) all sites must conduct an assessment of the spent fuel pool structures using the revised seismic check list in order to identify any structural degradation, potential for seismic interaction from superstructures and over head cranes, and to verify that they have a seismic HCLPF value of 0.5 g or higher, (2) those sites that cannot demonstrate that a seismic HCLPF value exists, may either under take appropriate remedial action or conduct site-specific seismic risk assessment and (3) Pilgrim, H. B. Robinson, Vogtle, Diablo Canyon and San Onofre sites would have to use the seismic check list to identify any structural degradation or other anomalies and then conduct a site specific seismic risk assessment if they desire an exemption from EP when their sites are in decommissioning.