Diane's Comment

3.4 Beyond Design Basis Spent Fuel Pool Accident Scenarios (External Events)

The following is a description of how each of the external event initiators was modeled, a discussion of the frequency of fuel uncovery associated with the initiator, and a description of the most important insights regarding risk reduction strategies for each initiator.

3.4.1 Seismic Events

When performing the evaluation of the effect of seismic events on spent fuel pools, it became apparent that the staff does not have detailed information on how all the spent fuel pools were designed and constructed. Therefore, the staff originally performed a simplified bounding seismic risk analysis in our 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. 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 our stakeholders, the staff developed other tools that help assure the pools are sufficiently robust.

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[7]. 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.

NEI sent in a second letter to enhance the checklist based on staff comments →

During stakeholder interactions with the staff, the staff proposed the use of a seismic checklist, and in a letter dated August 18, 1999 (See Appendix 5), 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. The staff has concluded that plants that satisfy the revised seismic checklist can demonstrate with reasonable assurance a high-confidence low-probability of failure (HCLPF)[8] at a ground motion that has a very small likelihood of exceedence.

U.S. nuclear power plants, including their spent fuel pools, were designed such that they can be safely shutdown and maintained in a safe shutdown condition if subjected to ground motion

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[7]Except at Dresden Unit 1 and Indian Point Unit 1, these two plants 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.

[8]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.

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from an earthquake of a specified amplitude. This design basis ground motion is referred to as the safe shutdown earthquake (SSE). The SSE was determined on a plant specific basis consistent with the seismicity of the plant's location. In general, plants located in the eastern and central parts of the US, had lower amplitude SSE ground motions established for their designs than the plants located in the western parts of the US, which had significantly higher SSEs established for them because of the higher seismicity for locations west of the Rocky Mountains. As part of this study, the staff with assistance from Dr. Kennedy (See Appendix 5), reviewed the potential for spent fuel pool failures to occur in various regions in the U.S. due to seismic events with ground motion amplitudes exceeding established SSE values.

write-out: Central & Eastern United States

Thus, the seismic component of risk can be limited to an acceptable level if it can be demonstrated that there is a HCLPF for seismic ground motion greater than or equal to three times SSE at CEUS sites and two times SSE at West Coast sites. As discussed in Appendix 5b, for CEUS plants that can demonstrate HCLPF at three times their SSE value and West Coast plants that can demonstrate HCLPF at two times their SSE value, the frequency of fuel uncovery is judged to be less than $3X10^{-6}$ per year.

The seismic checklist (Appendix 5d) was developed to provide a simplified method for demonstrating a high confidence of a low probability of failure and thus an acceptably low value of seismic risk. The checklist includes elements to assure there are no weaknesses in the design or construction nor any service induced degradation of the pools that would make them vulnerable to failure under earthquake ground motions that exceed their design basis ground motion. Spent fuel pools that satisfy the seismic checklist, as written, would have a high confidence in a low probability of failure for seismic ground motions up to 0.5 g peak ground acceleration (1.2g peak spectral acceleration). Thus, sites in the central and eastern part of the U.S. that have three times SSE values less than or equal to 0.5 g PGA and pass the seismic check list would have an acceptably low level of seismic risk. Similarly, West Coast sites that have two times SSE values less than 0.5 g. and pass the seismic check list would have acceptably low values of seismic risk. From a practical point of view, a limited number of sites in the central and eastern part of the U.S. have three times SSE values greater than 0.5g; the two times SSE values exceed 0.5g for two West Coast plants. In order to demonstrate acceptably low seismic risk, those central and eastern sites for which the three times SSE values exceed 0.5g and the two West Coast sites would have to perform additional plant specific analyses to demonstrate HCLPF for their spent fuel pools at three times SSE and two times SSE values of ground acceleration, respectively. The staff notes that the seismic checklist could be modified to address seismic ground motions corresponding to the range of three times and two times SSE values, making it more generally applicable. This possibility can be pursued in further discussions with external stakeholders.

see SDA #3 on pg. 30

Is this ... things or one

why not just state the criteria instead of saying 2 sites?

3.4.2 Aircraft Crashes

The staff evaluated the likelihood of an aircraft crashing into a nuclear power plant site and seriously damaging the spent fuel pool or its support systems (details are in Appendix 2d). The generic data provided in Department of Energy (DOE) -STD-3014-96 [Ref. 6], were used to assess the likelihood of an aircraft crash into or near the spent fuel pool of a decommissioning nuclear power plant. Aircraft damage can affect the structural integrity of the spent fuel pool or affect the availability of nearby support systems, such as power supplies, heat exchangers, or water make-up sources, and may also affect recovery actions.

The staff's risk assessment as discussed in Chapter 3 shows that the baseline risk (represented as the frequency of zirconium fire in a decommissioning spent fuel pool) is estimated to be less than $3x10^{-6}$ per year. As was discussed in Chapter 2, the staff has determined that such a fire results in a large radionuclide release and poses a highly undesirable end state for a spent fuel pool accident. Therefore the staff has judged that a pool performance guideline (PPG) of $1x10^{-5}$ per year derived from the RG 1.174 application of LERF, should be applied. The risk assessment shows that the SFP zirconium fire frequency is well under the recommended PPG. The assessments conducted for this study also show that the accident progresses much more slowly than at an operating reactor. For many scenarios, recovery and mitigation times of approximately 100 hours are available from onset of the loss of cooling initiators. Even for extremely unlikely events such as severe seismic events and heavy load drops failing the pool floor, ten hours or more time is available to initiate off-site protective actions if necessary prior to zirconium fire initiation. Therefore, the risk assessment shows that both low likelihoods and long response times are associated with SFP accidents at decommissioning plants. These conclusions are predicated on the industry commitments and staff assumptions discussed in this report being fulfilled.

The staff consequence analysis in Appendix 4 shows that the early health impacts from zirconium fire scenarios are significantly impacted by evacuation. As for operating plants, evacuation of the public is the preferred protective action to minimize exposure and early health impacts to the population surrounding the site in the event of a severe accident. Emergency planning requirements for operating plants specify that licensees have the means for assessing the impact of an accident and have the capability of notifying off-site officials within 15 minutes of declaring an emergency. In addition, the licensee must demonstrate that there are means in place for promptly alerting and providing instructions to the public in case protective actions are needed. Furthermore, detailed off-site emergency plans are required to provide for prompt implementation of protective actions (including evacuation of the public). However, this analysis indicates that for the slowly evolving SFP accident sequences at decommissioning plants, there is a large amount of time to initiate and implement protective actions, including public evacuation, in comparison to operating reactor accident sequences.

In addition to SDA #1 and SDA #2, the low numerical risk results shown in Chapter 3 and Appendix 2 are derived from a number of design and operational elements of the SFP. As shown in those sections, the dominant risk contribution is from seismic events beyond the plant's original design basis. The baseline seismically initiated zirconium fire frequency from our risk assessment is predicated upon implementation of the seismic checklist shown in Appendix 5. The staff therefore assumed that such a checklist (SDA #3) would be successfully implemented at all decommissioning facilities.

should this also include the statement/criteria that CEUS sites are 3SSE <0.5g and Western sites are 2SSE <0.5g? (As discussed in Chap 3)

SDA #3 — Each decommissioning plant will successfully complete the seismic checklist provided in Appendix 5 to this report. If the checklist cannot be successfully completed, the decommissioning plant will perform a plant specific seismic risk assessment of the SFP and demonstrate that SFP seismically induced structural failure and rapid loss of inventory is less than the generic bounding estimates provided in this study ($<3x10^{-6}$ per year).

The quantification of accident sequences in Chapter 3 associated with loss of cooling or loss of inventory resulted in low risk due to a number of elements that enhance the ability of the operators to respond successfully to the events with on-site and off-site resources. Without

p.3-4 has an "and" statement