**From:** Goutam Bagchi NRR
**To:** George Hubbard NRR
**Date:** Wed, Apr 19, 2000 2:36 PM
**Subject:** Re: Atherton Fax

George,
You asked me to respond to Items 5 and 5 subparts under seismic design. My responses are in the attached file. I have provided the texts of the concern followed by my response. Comments from anybody is welcome. Thanks,
Goutam

>>> George Hubbard 04/12 3:18 PM >>>
Attached is a typed version of Peter James Atherton's hand written FAX to Dick Dudley with his public comments on our report. Note that it may not be exactly the same even though we tried hard to do so. Please review it for areas where you can provide input. Mark Rubin, Glenn Kelly and I went through it this morning and identified responsibilities for addressing specific parts of his comments. One of us will be contacting appropriate people for input. I have the overall lead.

Be aware that this has a short fuse so we can get the final report to the EDO by 5/23. This means the report has to be to Gary and Tim on May 9.

Thanks,

George Hubbard
2870

**CC:** Diane Jackson, Glenn Kelly, Robert Rothman

61249

Question# 5.The NRC should perform rigorous engineering analysis of the effects of aging*[1] upon the spent fuel pool and its associated structures and equipment. Most SFPs were never designed to be quasi-permanent fuel storage facilities. Because there is as-yet no permanent place to store used fuel, SFPs have had to accept more fuel than they were original designed to hold. To allow SFPS to continue to store spent fuel for as yet an undetermined period of time requires, I suggest, a comprehensive look at aging.

Response# 5.

Spent fuel pools at currently operating nuclear power plants are constructed with reinforced concrete walls and lined with liner plates. Through the use of the proposed seismic check list, any degradation such as spalling of concrete or cracks and indications of rust stain etc will be detected and appropriate corrective actions will be taken. Since concrete gains compressive strength with age and strength of reinforcing bars does not change with age, provided that rebars are not degraded by corrosion, there should be no change in structural strength. There is no operating experience of degradation of spent fuel pool structures; consequently, it is not meaningful to perform engineering analysis using unsubstantiated assumptions.

Comments on Seismic Designs.

1. A significant seismic event which damages and drains the SFP is also likely to wreak havoc upon the local infrastructure. How has NRC considered the availability of local resources as identified by IDC #2, #3, and #4? Should the local infrastructure be destroyed?

Response# 1: Seismic capacity of spent fuel structures against catastrophic failures, such that a very rapid loss of water can be assumed, is very high - substantially above their safe shutdown earthquake levels. Consequently, high ground motion levels are necessary to initiate failures. At those large earthquake levels emergency evacuation cannot be assumed to be effective. However, such large earthquakes are extremely rare events, so the risk is less than the safety goal.

2. To my knowledge, not every spent fuel pool was designed to the seismic criteria in use today. The use of works like "robust" does not necessarily address seismic qualifications. The NRC should identify all spent fuel pools that were not initially designed to seismic criteria and explain their level of qualification, including the SF racks.

Response# 3: All spent fuel pools have undergone seismic and structural revaluation, at least once, during licensing review of request for expanding the spent fuel storage capacity. Spent fuel pool structures, as well as the spent fuel racks undergo detailed analysis and staff review and approval process. Since all currently operating nuclear power plants have expanded their spent fuel storage capacity, they all meet their safe shut down earthquake criteria.

3. Not all PWR building housing spent fuel are seismically qualified. The NRC should perform a worst case analysis of the result of a seismic event which collapses the spent

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[1] * Aging could include degradation, failure, etc. of structures & equipment.

fuel pool building, and/or drains the pool and/or damages the spent fuel. Both criticality and zirc fires are of concerns. The nine initiating events listed at p. 11 which could occur concurrent with the earthquake should also be considered if the events contribute to the worst case scenario.

Response# 3:
The staff identified the following nine initiating event categories to investigate as part of the quantitative risk assessment on SFP risk:
Loss of Off-site Power from plant centered and grid related events
Loss of Off-site Power from events initiated by severe weather
Internal Fire
Loss of Pool Cooling
Loss of Coolant Inventory
Seismic Event
Cask Drop
Aircraft Impact
Tornado Missile
The initiating events indicated above are independent and the event sequences that emanate from each event are carefully modeled in the event tree. This means that a seismic event tree would include the consideration of off-site and on-site power loss. In a PRA assessment no risk insight can be gained by considering worst case combination of truly random and independent events such as a seismic event and a tornado missile. However, the frequency of a combined seismic and tornado missile would be much less than $10^{-8}$. Also, with respect to other structures such as crane girders and super-structures, they are covered in the seismic check list for the

4. The NEI seismic checklist requires a seismic engineer to review drawings in addition to conducting a walkdown of the SFP. It has been my experience that many electrical drawings of NAP's do not reflect the existing plant electrical installation. How is the seismic engineer going to verify drawings to the existing SFP building and pool if much of the pool is inaccessible? For instance, how does he verify concrete degradation under the steel liner? The NRC should require that specific areas be inspected and that these areas be accessible. If these areas are not accessible, then the checklist is not complete and susceptibility to sumac activity remains a concern.

Response# 4: The staff considers the review of construction drawings to be very important. Minimum reinforcing areas are dictated by the code and thick walls and slabs forming spent fuel pool structure are in many cases governed by minimum reinforcing requirements. Should there be any additional shear or flexural steel requirements, engineering calculations would indicate where they are need and how much is needed. Therefore, a review of drawings and design calculations would present a more complete picture. With respect to accessibility, cracks, spalling of concrete and stains and efflorescence are indications of a degradation in progress in inaccessible areas. In order to determine the root cause of the external signs, it is necessary to use more invasive procedures, such as chipping and breaking concrete etc. This is not unique to spent fuel pool structures and there are several examples of this type of inspection in the operating experience of several plants.

5. The NRC should specify why it is not cost effective to perform a plant-specific seismic evaluation for each spent fuel pool and what impact this has on safety. Because there are so many differently designed spent fuel pools, it is difficult to perceive how a generic

approach could be acceptable without assembling a list of similar &/or identical designs and performing a seismic evaluation of the various groups which are assembled. Specific seismic evaluations for each plant or groups of similar/identical plants should be considered.

Response# 5: A significant body of work exists characterizing the strength and capacity of shear walls based on tests and analyses. The use of a generic parameter, with the underpinning of data, that is to be used solely for the purpose of screening is very appropriate and reliable. Provided that all the conditions in the check list are met, only then a structure could be screened in. At sites where the prescribed seismic demand is greater than the 0.5g peak ground acceleration value or the 1.2g spectral acceleration value, a plant specific evaluation is to be conducted. The use of a screening parameter is a reliable way to determine the need for further evaluation. This concept was developed without any consideration of cost.