

7/21/2000  
Copies to M. Kucin  
G. Hubbard

Response by SPSB to fax by P. J. Atherton  
on the Draft Final Decommissioning Risk Assessment  
4/18/2000

Comments on Policy - #4 -

(Paraphrase) Your calculations from PRAs for the expected frequency of events such as TMI-2 and Chernobyl that actually occurred should be the starting point for developing acceptance criteria for acceptable risk for decommissioning spent fuel pools, not Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" (RG 1.174).

Answer: We believe that the thought process that went into the approach for using PRAs in risk-informed decision making for plant-specific licensing basis changes provides an excellent starting point for determining a risk-informed process for spent fuel pool risk at decommissioning sites. The technical analyses in our Draft Study indicate that the consequences of a zirconium fire at a decommissioning spent fuel pool are comparable, but not identical, to the consequences of large releases from operating reactors as evaluated in Level-3 PRAs. Besides working with the numerical guidance developed in RG 1.174, we have sought to assure that the principles of risk-informed integrated decision making outlined in the RG are addressed in our decommissioning analysis too. These principles include assuring sufficient defense-in-depth and safety margins are maintained while assuring that licensees monitor the industry commitments, staff assumptions, and the seismic checklist included in our report.

Comments on Failure Rates

(Paraphrase) The decommissioning spent fuel pool risk assessment should be redone using improved failure rate data based on non safety-related equipment failure rates.

Answer: The risk assessment we performed turned out not to be sensitive to failure rates of spent fuel pool cooling equipment. Among risk contributors, seismic dominated risk by an order of magnitude even though the return frequency of seismic events three or more times greater than the SSE is very low. For such seismic events, the contribution from fuel handler error was minimal or non-existent. For the next largest contributor, we assumed that no recovery was possible by fuel handlers after dropping a loaded cask (that approaches or exceeds 100 tons) into the spent fuel pool or near its edge. The next largest contributor is loss of offsite power due to extreme weather conditions, which is driven by the inability to restore power to the site and bring in emergency equipment, not by random equipment failure rates. In the next class of initiators, loss of cooling and loss of inventory sequences, which are dominated by the probability of continued fuel handler error over many days and shift turnovers, equipment failure rates are not an important link. In summary, the dominant initiators with respect to risk were seismic and heavy load drop that are effectively independent of fuel handler error. Failure rates of pumps, valves, and heat exchangers for spent fuel pool cooling systems are near the bottom of the list of ranked contributors to risk. So, changing the random failure rates of equipment would neither alter the bottom line numbers of the risk assessment significantly nor affect risk insights.

(Paraphrase) At the July 1999 workshop, Mr. Meisner, representing NEI, committed the nuclear industry to installing single failure proof crane systems at decommissioning plants. The crane systems were to use safety grade electrical equipment. What happened to this commitment?

Answer: Mr. Meisner did make a commitment at the July 1999 workshop that utilities would upgrade their crane systems at future decommissioning sites, if needed. He committed the industry to performing Phase II of NUREG-0612. In particular the industry committed to having a single failure proof crane or performing a consequence analysis. The technical bases for rulemaking and for exemption requests will reflect these commitments. There was no commitment made by the industry at the July 1999 workshop that called for the electrical portions of the crane systems to be safety grade beyond any guidelines in NUREG-0612.

#### Comments on Operator Action

(#1 - Paraphrase) NRC should specify how many operators should be at a decommissioning unit and should assure that those operators are protected in the event of a severe accident.

Answer: [SHOULD BE GIVEN BY DICK DUDLEY]

(#2 - What is the NRC doing to help assure that the fuel handlers standing watch over a SFP "graveyard" maintain their vigilance?

Answer: By letter dated November 12, 1999, NEI committed the nuclear industry to having procedures and training in place to prepare fuel handlers to respond to accidents at decommissioning spent fuel pools. In addition, the staff has identified assumptions it made in its analysis (e.g., walkdowns of SFP systems will be performed at least once per shift by the fuel handlers) that must be incorporated into the industry's practices if they are to gain exemptions in the area of EP. Together, the staff finds that these steps are sufficient to minimize the chances of operator errors that might occur during the long period needed for draining of the spent fuel pool to occur from loss of heat removal events.

#### General Comments

(#1 - Paraphrase) The NRC's own analyses show that the results of a zirconium fire at a decommissioning SFP would be as bad as a large release at an operating reactor (from a reactor core damage accident). The NRC should reconsider whether or not spent fuel pools need a containment.

Answer: Our report provides technical results and discusses the implications of these results with respect to the issues of reduced EP, indemnification, and security at decommissioning SFPs. Our technical analysis showed that the consequences of a decommissioning spent fuel pool zirconium fire are comparable, but not identical, to the consequences of a large release from a severe core damage accident at an operating reactor. Our analysis found the frequencies of these large releases to be similar. The

Commission has determined that it finds the risks from operating reactors to be acceptable, based in part on the numerical results from PRAs, including the expected frequencies of large releases. Your request to have containments put around spent fuel pools at decommissioning sites is a policy decision and would require rulemaking. As such, if you believe that SFPs need a containment, we suggest you petition the Commission for a rulemaking on the matter.

(#2 - Paraphrase) The draft Final Technical Study did not address experimental validation of the risk assessment.

Answer: Your desire for a discussion of experimental validation of risk results from the draft study is possibly a misunderstanding of how PRAs are performed. The models used in the risk assessment were based on NRC staff visits to actual decommissioning sites. The data for failure rates of equipment were taken from large databases of equipment failure rates. Initiating event frequencies were taken from the latest literature and were modified, as needed, to take into account the unique configurations found at decommissioning spent fuel pools. Our seismic analysis was based on work from a world renowned expert. The deterministic input to our risk assessment was carefully documented, and the deterministic analyses listed areas where data were lacking. We have attempted to address areas of uncertainty in the thermal hydraulics and fission product release areas. No areas have been identified that are both essential to decision-making for reduced EP and require additional research efforts .[PLEASE CONFIRM THIS REMAINS TRUE]


From - P. J. Atherton ( [REDACTED] )  
TO - Rich Dudley  
Ph. 301-415-1116  
FAX to - 301-415-3313

Total 11 fax pages + this page.  
Subj: SFP Risk Comments

April 10, 2000

Ser. # 99A-9

From - Peter James Atkinson



To. R. Dudley for  
Office of Admin.  
USNRC.

Subj. Community on "Draft Final Technical Study of  
SEF Accident Risk at Decommissioned NPP's."

Three informal and incomplete comments are  
provided to USNRC for NRC's review and consideration.  
~~Interim report~~ ~~Interim report~~ return date to the 4/16/00 due date for  
community is suggested to be insufficient time for  
complete comments, especially when I am unable  
to devote a full time effort to the review.

Accordingly, I respectfully ask another thing  
(3) months from this date to make formally and  
completely respond.

However, I provide my comments without  
expect to omit of the reviewers in the study. The  
additional ~~information~~ <sup>feedback</sup> comments on the opportunity to  
obtain and for review the reviewers. <sup>as an ongoing</sup>

my involvement during the 1990's with the  
Maine Yankee NPP and more recently with the  
allegation review process and followup investi-  
gations by the OIG has required me to stay

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with Maimi Yankel during the decommissioning process both <sup>for</sup> personally <sup>and</sup> at the request of stakeholders. I attended most of the meetings. These are my first written comments. However much of what I have said was transcribed from the meetings.

Among the many issues that is talked about were systemic concerns, criticality concerns & aging questions. Although earthquake and fuel reactivity issues are addressed from an engineering investigative perspective, aging has not been.

### Comments on Policy.

1. It is suggested that references used in a study seeking public comment be made available to those interested members of the public at no cost. Some members of the public wanting to comment do not have these references readily available, especially when they are out of state.
2. Possible Conflict of Interests by the NRC should be identified and addressed. For example, when nuclear P.P. owners sue DOE on fuel storage matters, NRC (being part of the same govt. as DOE) might appear to have a motivation to rule in a manner to minimize the lawsuits' impact (SFP matters)

at the expense of public safety.

3. The NRC should identify differing professional opinions expressed and their resolution as it affects this study. For instance, ON 5/4/75, Dr. S. H. Hawauer in a memo to G. Arlotto is quoted to say "you can make probabilistic numbers prove anything, by which I mean that probabilistic numbers 'prove' nothing."
4. The basis for the heavy reliance upon a risk-informed approach to this study fails to account for realistic probabilistic numbers. The probability of the happening of accidents as the event occurred should be calculated so that a more realistic probabilistic perspective is determined. For example, what is the probability that the TMI-2 & Chernobyl accidents would have occurred. This number properly calculated could form a more realistic figure from which to apply "highly unlikely" & "not credible" terminology. At this time the R.G. 1.174 criteria of  $1 \times 10^{-5}/\text{yr}$  frequency for a zinc fire has no documented <sup>used</sup> experimental basis or actual happening to support its use for zinc fires. R.G. 1.174 was not in fact written for decommissioned

nuclear power plants. Its application is for operating reactors, which have a more conservative attitude in depth strategy than the design of SFP's.

5. The NRC should perform ~~an~~ <sup>a</sup> rigorous engineering analysis of the effects of aging upon the spent fuel pool and its associated structures and equipment. Most SFP's were never designed to be general-purpose fuel storage facilities. Because there is at yet no permanent place to store used fuel, SFP's have had to accept more fuel than they were originally designed to hold. To allow SFP's to continue to store spent fuel for as yet an undetermined period of time requires, I suggest, a comprehensive look at aging.

### Comments on Seismic Design:

1. A significant seismic event which damage & destroy the SFP is also likely to wreck those upon the local infrastructure. How are we concerned the availability of local resources as identified by IDC #2, #3, #4, #5 should the local infrastructure be destroyed?

Aging could include degradation, failure, state, of structural equipment. page 4 of 11



2. To my knowledge, not every spent fuel pool was designed to ~~be~~ seismic criteria in use today. The use of words like "retard" does not necessarily address seismic qualification. 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 pools.

3. Not all five buildings housing spent fuel are seismically qualified. The NRC should perform a walk case analysis of the ~~would~~ of a seismic event which collapse the spent fuel pool building, ~~thereby~~ the pool and ~~through~~ the spent fuel. Both criticality & zero power are of concern. The most interesting events listed at P. 11 which could occur concurrently with the earthquake should also be considered if the events contribute to the worst case scenario.

4. The NRC 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 NPP's do not reflect the existing plant electrical installation.

How is the seismic engineer going to verify drawings to the existing SFP building & 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 seismic activity remains a concern.

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 & 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.

Comments on Spent Fuel Pools (SFP)

1. The NRC should identify all spent fuel pools that leak. Degradation of the liner and concrete should be investigated, the leaks should be sealed.
2. The NRC should determine the qualification and degradation of spent fuel racks.
3. The proper methods of relinquishing of a possible government fine need to be addressed.

Comments on Failure Rates

It is possible to obtain reliable failure rates for safety related equipment. However, non-safety related equipment ~~information~~ <sup>information</sup> is not as simple for NRC to obtain. Standards for manufacture, quality assurance, etc. may not be uniform. Requirements to report non-safety related failures of equipment may not be properly documented. Hence, non-safety-related equipment failure rates may not be accurate. Analysis of failure rates of non-safety related equipment to a risk-informed PSA could adversely affect.

accuracy. NRC should determine which failure rates used in the risk informed process are reliable and which are not, and the results should be included in the study. I am not aware of any older NPP's that have safety related equipment ~~that~~ in the S-F cooling, instrumentation or other areas. Reliable failure rates are questionable.

My recollection of the 7/16/99 work/study group meeting between the NRC and industry is that industry verbally agreed through Mr. Meisner of Maine Yankee to install a single failure proof crane system using safety grade electrical equipment. What happened to this commitment?

### Comments on Terrorism.

This draft report omitted terrorist acts of sabotage and vandalism. A successful terrorist event could endanger public health and safety. Emergency evacuation plans should be prepared with this consideration of terrorism.

### Comments on Criticality.

1. NRC should identify the scenario where a steam explosion is possible because of a severe criticality event and the basis upon which the probability was determined to be "highly unlikely."
2. A recent telephone conference call on criticality has been the basis of a request for access to various reference documents. In conjunction with policy comment #1, NRC should permit free and easy access to references. I do not anticipate a flood of requests for technical references. The subject matter should be of interest to technically educated people.
3. The NRC should ~~state the name~~ identify all radioactivity in the spent fuel pool & that capable of being dispersed in an accident (beyond that on p. A3-11 to A3-13).

### Comments on Operator Action.

1. Because spent fuel pool accidents requiring operator manual action, the NRC should identify the number of operators assigned to each shift and how these operators are protected so that their availability

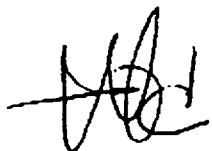
- is "guaranteed" in the event of an accident.
2. Standing watch over a SFP "graveyard" cannot be the most exciting job available. What measures are taken to minimize boredom and maintain alertness?
  3. Accidents in operating reactors are designed to be mitigated by automatic safety systems. Operator error has aggravated many of these accidents. What measures are in place to minimize operator error in a postulated spent fuel pool accident?

### General comments.

1. Spent fuel pools in PWR's do not have a containment. Yet the worst case accident scenario parallels that of an operating reactor with respect to both people and property damage. The NRC should review the justification for containment in operating reactors and explain why a containment would or would not be advisable over a SFP.
2. To the extent possible, experimental validation of risk informed results should be addressed.

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FAX to 301-415-2002  
alt fax #.



3. Because financial acts are not specifically addressed, it is suggested that any approach towards safety that will adapt should err on the side of safety whenever there is a choice.
4. It is suggested that these interviews require that the time allotted to be reviewed again and some future date.

**From:** Richard Barrett, *NRR*  
**To:** Hannon, John, *RIV*  
**Date:** Tue, Apr 18, 2000 7:55 AM  
**Subject:** Re: Revised ACRS Letter to the Chairman on TWG Report

George:

The proposed response is in the right direction. However, we need to consider the implications of their various comments before responding.

First, regarding source term, plume and dose issues, I do not think this is a big problem. Despite their concern over Ruthenium, a LERF is a LERF. The cases with Ruthenium are worse than those without, but neither are very large compared with a reactor LERF. I do not think the record supports a distinction of LERF with and without Ruthenium. Moreover, if the release of Ruthenium in a decommissioned SFP fire is bad, then the release in an operating pool fire is worse, given the additional presence of Iodines. We should commit to include sensitivity cases in the consequence appendix and discuss the issues in the body of the final report. But we should tell the ACRS that we consider the LERF acceptance criterion to be applicable, and we believe the issues will not affect our final conclusions.

Similarly, I do not think the questions about frequency raise a problem. The uncertainties in HRA are large, but our guidance is to use best estimate. We can address the uncertainties qualitatively in the final report. Moreover, ACRS is correct in their assessment that the seismic numbers are probably conservative, but there is nothing we can do about that. The collective wisdom of the world's experts in that field has failed to produce a lower hazard curve. We should acknowledge this uncertainty and leave it at that. Tell the ACRS that we do not believe these issues would affect our final conclusions.

The issues related to ignition temperature and nitrides are more troublesome. They raise questions about the timing of a zirc fire. If we do not have 10 hours to heat up the fuel following a seismic event, then what happens to the argument that ad-hoc protective actions are good enough? We either need to find a defensible way to counter the ACRS claims, or we are left with arguing low frequency alone.

Similarly, the arguments about partial draindown raise questions about the 5 year cutoff. If we do not have good analyses of partial draindown (the argument goes), then we really do not know when the cutoff date is. We need T-H calculations bounding this effect, or else we need probabilistic arguments showing that partial draindowns are incredible.

These are my initial thoughts. Any other views?

--Rich

>>> John Hannon 04/18 7:01 AM >>>  
good start, George.

>>> George Hubbard 04/17 2:15 PM >>>  
**DUE DATE TO DIANE IS APRIL 25**

I have put the major comments into the following categories:

1. Consequences and plume related matters including land contamination
2. Thermal Hydraulic concerns relative to zirc fires
3. Proposed acceptance criteria (LERF for operating reactors)
4. Seismic too conservative



5. Uncertainties in dominating sequences involving human errors and seismic events

In response to the Green Ticket (G20000194 - TAC MA8648A) we have received on this and based on discussion with John Hannon, I propose the following approach for a letter back to the ACRS in which we broadly address their concerns. **PLEASE CHARGE ANY TIME TO THE ABOVE TAC NUMBER**

1. Thank them for the input.
2. Acknowledge concerns on consequences and plume. - Jason/Tinkler/Cheok/Kelly  
Tell them we have done work on ruthenium and will include in report  
Acknowledge other work going on by RES and international community
3. Acknowledge concerns on thermal hydraulic concerns - Joe Staudenmeier  
Tell them what additional work we have done - partial drain down work - and that we will be including it in the final version
4. Address broadly their concerns on uncertainties - Gareth/Cheok/Kelly  
Tell them we will add additional information in final report - only if we think it is necessary.

Acknowledge the fact that further work in the areas of consequences and T/H could be useful in the future; however, with the low frequency of fuel uncover we calculated and the fact that no credit is taken for mitigative actions once fuel uncover occurs we believe the need for the recommended work is not justified for continuation of rulemaking activities for decommissioning plants since the frequency of reaching the end states where this data would be needed would be lower frequency than the values calculated in this report. Bring in the fact that seismic events are dominating and since, as acknowledge by the ACRS, we were conservative in our seismic efforts the frequency of fuel uncover would be further reduced if realistic analysis were used. Somehow we need to bring in the fact that the proposed acceptance criteria is good enough - suggestions on how to do this are welcomed.

This is my first cut approach to doing this, let me know your thoughts. I'm asking Diane to draft up a first cut- please provide your input to Diane.

**OUR RESPONSE IS DUE TO TIM/GARY ON MAY 1. IN ORDER TO GET REVIEW BY THE BRANCH CHIEFS HAVE YOUR INPUT TO DIANE BY APRIL 25.**

THANKS,

George Hubbard  
2870

CC: Bagchi, Goutam, Cheok, Michael, Hubbard, George, Jackson, Diane, Kelly, Glenn, Parry, Gareth, Rubin, Mark, Schaperow, Jason(...)