January 31, 2014

Mr. John Stetkar, Chairman
Advisory Committee on
Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: RESPONSE TO THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS LETTER DATED DECEMBER 18, 2013, ON THE STAFF EVALUATION AND RECOMMENDATION FOR JAPAN LESSONS-LEARNED TIER 3 ISSUE ON EXPEDITED TRANSFER OF SPENT FUEL

Dear Mr. Stetkar:

I am responding to a letter received from Dr. Sam Armijo dated December 18, 2013, in which the Advisory Committee on Reactor Safeguards (ACRS) provided comments regarding the U.S. Nuclear Regulatory Commission (NRC) staff's recent memorandum to the Commission entitled, "Staff Evaluation and Recommendation for Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel," (COMSECY-13-0030), dated November 12, 2013, (accessible in the Agencywide Documents Access and Management System (ADAMS) under Accession No. ML13329A918). The purpose of the cited memorandum was to provide the Commission with information and a recommendation on whether additional study is warranted to assess possible regulatory action to require expeditious transfer of spent fuel from the spent fuel pools of nuclear power plants to dry cask storage.

The staff notes that the ACRS has determined that the staff's analysis adequately evaluated the benefits of expedited transfer and agrees with the conclusion that there is insufficient safety benefit and the costs exceed the benefits of implementing such a requirement. The staff's recommendation to the Commission was that no further generic assessments be pursued related to possible regulatory actions to require the expedited transfer of spent fuel to dry cask storage and that this Tier 3 Japan lessons-learned activity be closed. Further, the ACRS states that the cumulative effects of conservatisms and assumptions used in the high estimates result in exaggerated benefits of expedited transfer. The staff intentionally used bounding or conservative values in the analysis for several parameters, particularly in the high estimate cases, to ensure that design, operational, and other site variations among the new and operating reactor fleet were addressed and to generally increase the calculated benefits from the proposed action.

The ACRS also states that in the staff's analysis, there is no compelling reason to limit effective mitigation only to the low-density pool loading alternative, and concludes that it is unjustified. The staff notes the ACRS view and affirms that several conservative assumptions were chosen to bias the analysis towards beneficial results and the need for further study. Subsequent to the ACRS review of the staff's evaluation, the staff conducted an additional analysis on the sensitivity of mitigation assumptions, which is included as an enclosure to this letter.

The additional analysis demonstrates that the staff's conclusion would remain the same regardless of the mitigation assumptions.

We appreciate the ACRS's review and feedback on the staff's evaluation, and appreciate ACRS's support of the staff's conclusions.

Sincerely,

/RA/

Mark A. Satorius
Executive Director
for Operations

Enclosure:
Staff Evaluation

cc: Chairman Macfarlane
Commissioner Svinicki
Commissioner Apostolakis
Commissioner Magwood
Commissioner Ostendorff
SECY

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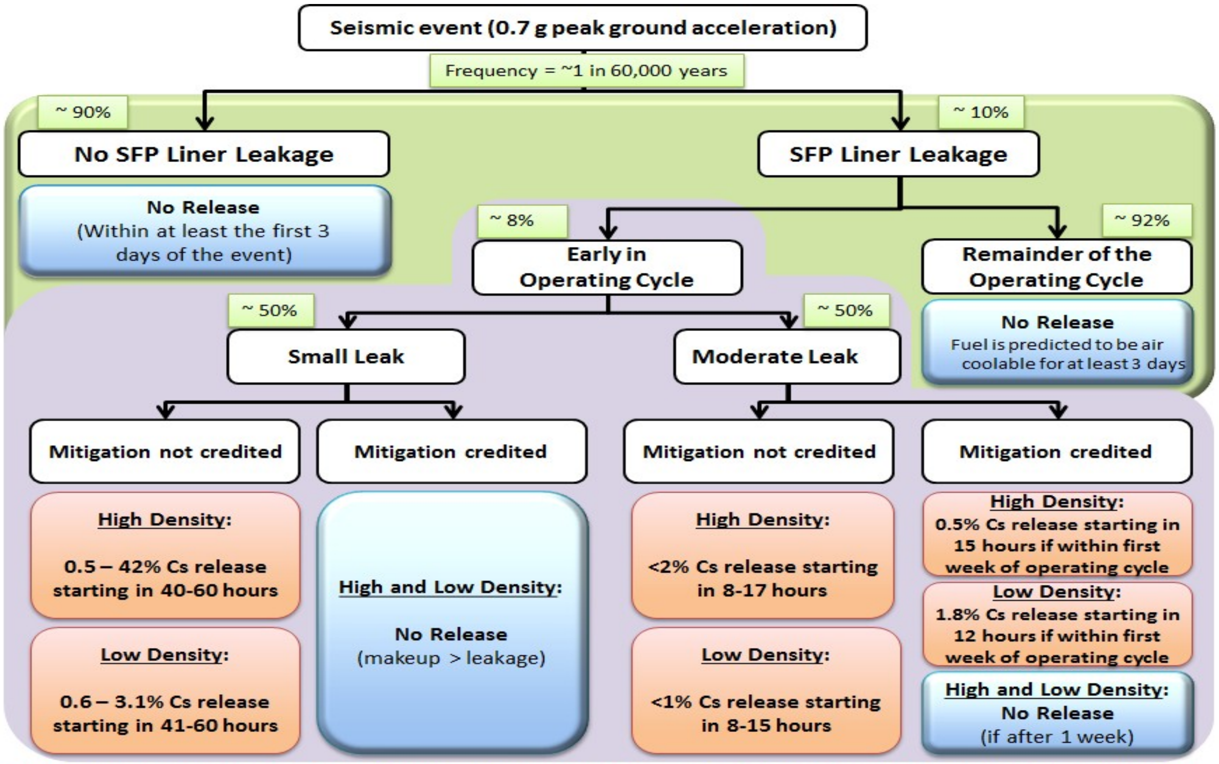
ADDENDUM TO "STAFF EVALUATION AND RECOMMENDATION FOR JAPAN LESSONS-LEARNED TIER 3 ISSUE ON EXPEDITED TRANSFER OF SPENT FUEL"
STAFF EVALUATION OF MITIGATION SENSITIVITY

On November 12, 2013, the NRC staff provided COMSECY-13-0030, "Staff Evaluation and Recommendation for Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel," to the Commission for its consideration. The staff subsequently discussed this topic with the ACRS during a public meeting held on December 4, 2013. During the ACRS meeting, the staff discussed the assumptions in COMSECY-13-0030 regarding the ability to mitigate a loss of water inventory from spent fuel pools (SFPs) with low- and high-density loadings of spent fuel assemblies.

COMSECY-13-0030 describes the staff's assumptions related to mitigating a loss of water from SFPs as follows:

> … In addition, on March 12, 2012, the staff issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735), which requires licensees to develop, implement, and maintain guidance and strategies to maintain or restore SFP cooling capabilities, independent of alternating current power, following a beyond-design-basis external event. These requirements ensure a more reliable and robust mitigation capability is in place to address degrading conditions in SFPs than was assumed in the SFP Study**. For the purpose of evaluating the potential benefits of expedited transfer of spent fuel to dry cask storage, the enclosed analysis used a conservative approach to mitigation by crediting successful mitigation to the low-density SFP storage alternative (i.e., conditions following expedited transfer) and assumed no successful mitigation for the high-density SFP storage regulatory baseline.**

The staff's assumptions within the regulatory analysis performed for COMSECY-13-0030 might be better understood within the context of the summary of the SFP study (SECY-13-0112) provided in Figure ES-1 on the next page.



Note: The low-density pool has about 1/3 of Cs-137 inventory compared to high-density pool. Early in the operating cycle refers to early time after shutdown.

Figure ES-1: Likelihood of a leak and magnitude of releases from a beyond-design-basis earthquake.

As shown above, the frequency of an SFP fire is similar for both low- and high-density loading configurations because the initiation of a fire is driven by the hottest, or most recently discharged, fuel assemblies. However, the magnitude of the release can be much higher for some scenarios associated with fires in high-density SFPs. For the conditions in which the fuel may undergo steam oxidation for an extended period and produce hydrogen, insights from the SFP study indicate that the high-density storage configuration is more likely to produce sufficient hydrogen to damage the structure surrounding the pool. This structural damage creates conditions that allow a significantly larger fraction of radioactive material to reach the environment; namely, a greater supply of air for more rapid cladding oxidation and less holdup of any release within the structure.

Because the evaluations for COMSECY-13-0030 were primarily intended to help determine the need for additional studies, the staff elected to simplify the cases and use conservative estimates to bias the analysis towards beneficial results and the need for further studies.
To conservatively estimate the benefits of a transition to low-density storage, the staff selected the release fractions that did not credit effective mitigation for the high-density storage configuration and credited effective mitigation for the low- density storage configuration. The difficulty in being more precise is reflected in the following excerpt from the SFP study:

> … the likelihood of successful deployment of 10 CFR 50.45(hh)(2) mitigation has not been quantified. NRC staff judgment is that the likelihood of successful mitigation can in many cases be high, but that it is affected by a number of factors that are difficult to quantify (see Section 5.3). Related to this, a human reliability analysis (HRA) is provided in Section 8. Although the HRA does not provide a quantitative value required to determine the overall likelihood of mitigation, it does provide significant insights into the likelihood of mitigation

during this seismic event for certain damage states. To quantify the overall likelihood of successful mitigation, a probabilistic risk assessment type analysis would be required. For this reason, the results of the study are presented as a range of mitigation effects related to successfully deployed mitigation and mitigation that is unsuccessful for 3 days.

Accordingly, the staff selected the following values for the conditional probability of effective mitigation and conditional release fractions from the SFP study and previous studies:

Table 1
Conditional Frequency of Unsuccessful Mitigation and Cesium Release Fractions Assumed for Loss of Inventory Events in COMSECY-13-0030 Regulatory Analysis

Fuel Loading Condition:	Low-Density	High-Density
Conditional Frequency of Unsuccessful Mitigation:	5%	100%
Group 1 Release Fractions: (Base Case)	3%	40%
Group 2 – 4 Release Fractions: (Base Case)	3%	75%

Questions arose during the staff's discussions with the ACRS about when mitigation assumptions are credited and whether the staff's general explanation of artificially biasing the results towards additional studies might be interpreted as an actual physical phenomenon associated with high-density pools instead of a simplifying assumption and characterization only for the purpose of the evaluation in COMSECY-13-0030. Some members of the ACRS were interested in the possible impact of the above assumptions and asked about sensitivity results beyond what was provided in COMSECY-13-0030 and the associated presentation. Specifically, ACRS members asked for estimates of the cost/benefit analysis with consistent treatment of mitigation capabilities for both high- and low-density SFPs. The staff performed some additional evaluations and provides the following results and observations for three cases reflecting different assumptions for the conditional probability of successful mitigation. Case 1 reflects the values in the base case for COMSECY-13-0030 (no mitigation for high-density SFPs and effective mitigation for low-density SFPs); Case 2 assumes no mitigation for either high-or low-density SFPs; and Case 3 is effective mitigation for both high- and low-density SFPs.

Table 2: Base Case Cost/Benefit with Added Mitigation Cases

Benefits/Costs (in $million)	Group 1 BWR w/ Elevated Pools			Group 2 Other Reactors with Dedicated Pools			Group 3 New Reactors			Group 4 Other Reactors with Pool Shared by Two Units		
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
Total Benefits:	$7.0	$6.3	$0.3	$6.5	$6.1	$0.3	$4.6	$4.3	$0.2	$7.3	$6.7	$0.4
Total Costs:	$52.3			$51.3			$16.7			$46.4		

The next table illustrates the differences in calculated benefits for the base case with the same variations of assumptions relative to mitigation but assuming a $4,000 per person-rem conversion factor and consideration of consequences beyond 50 miles (80 kilometers):

Table 3: Base Case Sensitivity ($4K per person-rem, Consequences > 50 miles) with Added Mitigation Cases												
Benefits/Costs (in $million)	Group 1 BWRs with Elevated Pools			Group 2 Other Reactors with Dedicated Pools			Group 3 New Reactors			Group 4 Other Reactors with Pool Shared by Two Units		
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
Total Benefits:	$37.1	$34.3	$1.8	$39.4	$38.1	$2.0	$23.5	$22.5	$1.2	$52.2	$50.0	$2.6
Total Costs:	$52.3			$51.3			$16.7			$46.4		

For Case 2, in which mitigation is not credited for either high- or low-density SFPs, the change in calculated benefits from those presented in the COMSECY is relatively small. This is because of the small increase in the release fractions for low-density SFPs (i.e., a change from no release 95% of the time for assumed mitigation to a 3 percent release fraction when no credit is given to mitigation (see Table 1)). When mitigation is not credited for either loading pattern, the estimated costs exceed the calculated benefits for the base cases and for Groups 1 and 2 for the sensitivity calculations assuming $4,000 per person-rem and consequences beyond 50 miles (80 kilometers). The sensitivity calculations for Groups 3 and 4 are marginally cost beneficial for low density loadings, although the safety benefits would still not meet the safety goal screening threshold. These results for the additional case with no mitigation credited for either high- or low-density loadings are the same as the results presented in COMSECY-13-0030 with the assumption of credit for mitigation for low-density pools and no credit for mitigation for high-density pools.

For Case 3, in which mitigation is assumed to be successfully deployed, the frequency of fires and related releases from high-density SFPs would be significantly reduced. For this case, the estimated costs far exceed the calculated benefits. The cost/benefit assessment is less supportive of additional studies of expedited transfer of spent fuel when effective mitigation capabilities are assumed.

In summary, the staff's assumption to credit mitigation for low-density (but not high-density) SFPs in COMSECY-13-0030 is a conservative assumption meant to increase the benefits of expedited transfer of spent fuel for the purpose of a screening type assessment. If mitigation is not credited for either high- or low-density SFPs, the calculated benefits would only be slightly reduced from those provided in COMSECY-13-0030, and the conclusion remains the same (costs generally outweigh benefits). If mitigation is credited for both high- and low-density SFPs, the calculated benefits would be significantly reduced for all cases, and the conclusion becomes stronger (overall costs outweigh benefits).