Response to Questions
Senator Edward J. Markey
Letter Dated June 30, 2016

Question 4: According to the NAS report, the NRC "has not carried out an independent examination of surveillance and security measures for protecting stored spent fuel," as recommended by the NAS's 2006 report. As such, the 2016 NAS report recommended that the NRC fulfill this recommendation, and that the NRC's analysis "should include an examination of the effectiveness of [the NRC's] programs for mitigating insider threats."
a. Why did the NRC fail to carry out the NAS's 2006 recommendation?

Answer:

a. The NRC's response to the NAS study performed in 2003-2004 and later documented in reports issued in 2004 and 2006 is described in the 2005 report "U.S. NRC Report to Congress on the National Academy of Sciences Study on the Safety and Security of Commercial Spent Nuclear Fuel Storage." It is important to note that the agency evaluates its programs on an on-going basis, takes action to address any deficiencies identified, and publicly reports on those activities. In the security arena, the NRC works closely with other Federal agencies to identify and address possible threats. In addition to the NAS studies, the NRC has reviewed and considered independent assessments in the security area from the NRC's Office of the Inspector General, the Government Accountability Office (GAO), and other oversight bodies. The NRC continues to find that its performance monitoring programs, self-assessments, and the independent reviews performed by the GAO and others provide sufficient analysis and insights on surveillance and security measures for protecting spent fuel.

Question 5: According to von Hippel and Schoeppner, the NRC's previous analysis of spent-fuel risks significantly underestimated the area from which the population would have to be relocated after a spent-fuel pool fire. The NRC's analysis found that a large release of radioactive cesium-137 from a spent-fuel pool would result in the relocation of people from an area of 30,000 square kilometers, an area larger than Massachusetts. By contrast, Von Hippel and Schoeppner's analysis showed that relocation would be required from an average of about 100,000 square kilometers. According to von Hippel and Schoeppner, this discrepancy may have resulted from the fact that the NRC's analysis assumed that the exposed population would benefit from some degree of shielding from the radiation. However, the Environmental Protection Agency (EPA) assumes no shielding in its recommended threshold for a radiation dose requiring population relocation. By unjustifiably relaxing this assumption and assuming that the population would be shielded from radiation, the NRC's analysis increased the contamination threshold for requiring relocation by a factor of 2.5 to 5.
a. Are von Hippel and Schoeppner correct to attribute the discrepancy between their analysis of the relocation area following a spent-fuel fire and the NRC's analysis to the NRC's use of a shielding factor?

Enclosure

b. If yes, why did the NRC assume a shielding factor, when the EPA recommendation does not assume one? Please provide copies of all documents, emails, or other correspondence written or received by the NRC staff, Commissioners, or Commissioner staff that discuss the decision to assume a shielding factor when conducting the spent-fuel storage risk evaluation
c. In future analyses, will the NRC use the EPA's recommendation for an unshielded threshold radiation dose requiring population relocation? If not, why not?

Answer:

a. The NRC staff has not undertaken a comparison between its analysis and the analysis of von Hippel and Schoeppner, so the agency cannot say whether the use of a structural shielding factor in the analyses described in NUREG-2161, "Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor," and COMSECY-13-0030, "Staff Evaluation and Recommendation for Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel," is the most significant difference between the two analyses.

b. As discussed in COMSECY-13-0030 and the most recent Protective Action Guides (PAGs), the actual decisions regarding how contaminated land would be recovered and populations relocated after an accident would be made by local, State, and Federal jurisdictions and would most likely be based on a long-term cleanup strategy, which is currently being developed by the NRC, the U.S. Environmental Protection Agency (EPA), and other Federal agencies. However, a cleanup standard may not have an explicit dose level for cleanup. Instead, the cleanup strategy may give local jurisdictions the ability to develop localized cleanup goals after an accident to allow for a number of factors that include societal, technical, and economic considerations. The EPA PAG guidance cited by von Hippel and Schoeppner was prepared to help officials facing such decisions in the unlikely event of a radiological emergency, while the assumptions within the NRC's analyses are supporting a cost/benefit assessment of potential regulatory actions associated with spent fuel safety and security.

c. The NRC currently has no plans to develop specific guidance to require that an unshielded dose estimate be used for estimating interdicted areas in cost-benefit calculations.

Question 6: **According to von Hippel and Schoeppner, the NRC's estimation of economic losses from a radioactive release is unjustifiably lowered by the assumption that the entire area out of which the population would be relocated could be decontaminated by a factor up to 15 within a year. As they note, "Achievement of such a rapid and effective decontamination is not consistent with the experience in Japan." Four years after the Fukushima nuclear disaster, tens of thousands of people still could not return to their homes despite tens of billions of dollars spent on decontamination. Furthermore, the NRC's own 2001 analysis argued that the long-term consequences of a spent-fuel fire would "decrease very slowly because cesium-137 has a half-life of approximately 30 years." After the NRC's decontamination assumptions were challenged by New York**

State, the Commission acknowledged that "real-world data emerging from the Fukushima accident will provide significantly more relevant modern-day sources for assessing the decontamination times and costs of a severe reactor accident with offsite consequences."
a. Do you agree that assuming such a rapid and deep rate of decontamination is not consistent with the experience from the Fukushima accident? If not, why not?
b. Will the NRC revise its decontamination rate assumptions to reflect the substantial costs and lengths of time associated with the clean-up effort following the Fukushima nuclear meltdowns? If not, why not?

Answer:

a. Although the NRC staff is evaluating emerging information from the Fukushima accident recovery experience, the staff has not attempted to benchmark the decontamination plan data used in the analyses supporting COMSECY-13-0030 against the time required for recovery following the Fukushima accident. The extent to which radiological recovery efforts in Japan have been hampered by damage to infrastructure caused by the tsunami, as well as by the competing priorities of non-radiological disaster recovery efforts, makes it difficult to determine the degree to which the overall experience at Fukushima is analogous to recovery efforts following a potential spent fuel pool fire in the United States.

b. As noted in the enclosure to SECY-15-0085, "Evaluation of the Containment Protection and Release Reduction for Mark I and Mark II Boiling Water Reactors Rulemaking Activities," research efforts are underway to evaluate emerging information from the Fukushima accident recovery experience. The results of this evaluation will be used to develop the MACCS2 decontamination plan input parameters, which include the costs to decontaminate, the dose reductions achieved, and the times required to perform decontamination. An important aspect of this evaluation will be determining how the data from the event at Fukushima should be applied in a broader severe accident assessment context.

Question 7: **According to both the NAS report and von Hippel and Schoeppner's analysis, the NRC's rules for regulatory cost-benefit analysis rely on other assumptions that reduce the estimated benefits of expedited transfer of spent-fuel. Specifically, the NRC excludes from consideration any consequences of a radioactive release beyond 50 miles, despite the fact that the vast majority of affected people would fall outside this narrow radius. The NRC also uses an outdated dollar value for avoided radiation doses that has not been updated since 1995. When NRC staff relaxed these assumptions to conduct sensitivity analyses, the estimated costs of spent-fuel fires grew by a factor of five. If you add the increased relocation area had the NRC not added a shielding factor to the EPA's guidance for threshold doses— and had the NRC not assumed that virtually all the relocated population could return home within less than a year—the cost-benefit analysis would have shown that the benefits to the public of expedited transfer would exceed the costs to the utilities.**
a. In light of the fact that the NRC's own sensitivity analysis indicates that a large spent-fuel fire could result in the evacuation of an area the size of

Massachusetts, why does the NRC only consider the benefits of reduced accident consequences within a 50 mile radius? Does the NRC intend to revise this assumption? If not, why not?
b. According to an NRC staff estimate, the value for 2015 of avoided radiation doses would be $5100/rem. Yet in documents used to support its regulatory decisionmaking, the NRC still uses a value of $2000/rem, one that has not been updated since 1995. Why has the NRC failed to update this value for more than twenty years? Does it intend to do so? If so, when? If not, why not?
c. Please provide copies of all documents, emails, or other correspondence written or received by the NRC staff, Commissioners, or Commissioner staff that discuss the decision to use the value of $2000/rem in the NRC's 2014 spent-fuel risk analysis.

Answer:

a. The assumptions in NRC cost-benefit regulatory analyses are typically used to produce reasonable estimates of the risks associated with various modeled accidents, under a variety of accident scenarios and conditions (e.g., different source terms, radiological releases, meteorological conditions, etc.), rather than worst-case single accident analyses. NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," states:

> In the case of nuclear power plants, changes in public health and safety from radiation exposure and offsite property impacts should be examined over a 50-mile distance from the plant site. The appropriate distance for other types of licensed facilities should be determined on a case-by-case basis. Care must be taken to ensure that changes in health risks associated with each alternative account for potential changes in plant or operational complexity. All changes in risk to the public and to workers should be estimated and discussed. When appropriate, health risks should be estimated for both routine operations and accidents.

In the NRC staff's judgment, the various assumptions currently made in the analysis of the "base case" result in an overall cost-benefit assessment that is appropriately conservative for a generic regulatory decision and justify using the "base case" as the primary basis for its recommendation. The NRC has no plans to revisit this issue.

b. In the Staff Requirements Memorandum for SECY-12-0110, "Consideration of Economic Consequences within the U.S. Nuclear Regulatory Commission's Regulatory Framework," the Commission directed the NRC staff to enhance the currency and consistency of the existing framework through updates to guidance documents integral to performing cost-benefit analyses in support of regulatory, backfit, and environmental analysis.

In addition, the Commission stated that "the staff should provide to the Commission any cost benefit model developed for use in guidance documents to address offsite property damage costs. This would include any proposed methodology for changing the calculated value of averted dose referenced in NUREG-1530 [Reassessment of NRC's Dollar per Person-Rem Conversion Factor Policy (December 1995)]."

The NRC staff has issued a draft update to one of the cost-benefit analysis guidelines, "Reassessment of NRC's Dollar per Person-Rem Conversion Factor Policy." In that update, the staff recommended that a value of $5,200 is appropriate for use in cost-benefit analyses. The staff is working to finalize this document and plans to submit the document to the Commission for its consideration later this year.

c. Copies of all documents, emails, and other correspondence written or reviewed by the NRC staff, Commissioners, or Commissioner staff that discuss the decision to use the value of $2,000 per person-rem in the NRC's 2014 spent fuel risk analysis are provided separately.

Question 8: **The NAS study and Von Hippel and Schoeppner further note that under NRC rules, if the risk of prompt and cancer fatalities in the vicinity of a nuclear accident falls below a certain threshold, the NRC is not required to undertake a cost-benefit analysis of strategies for mitigating that risk. As a result of this rule, even though a spent-fuel fire could displace millions of people and result in untold economic damage, the NRC would not be required to evaluate the costs and benefits of strategies to mitigate such an event because it would not necessarily produce a significantly higher risk of fatalities in the immediate vicinity of the plant. To address this obvious deficiency, the NAS Study and von Hippel and Schoeppner cite experts who have suggested that the NRC should amend its rules by "set[ting] a limit on the probability that a large number of people would suffer long-term displacement as a result of a major radiological release." If this threshold were met, the NRC would then conduct a cost-benefit analysis. Do you agree with this suggestion? If so, please provide a detailed description, including a timeline, for how the NRC plans to implement it. If not, why not?**

Answer:

Following the accident at the Fukushima-Dai-chi nuclear power plant in Japan, the NRC evaluated changing its approach to analyzing severe accident scenarios and related costs and benefits of imposing new regulatory requirements in SECY-12-110, "Consideration of Economic Consequences within the U.S. Nuclear Regulatory Commission's Regulatory Framework." At that time, the Commission determined that changes such as those cited in the question are not needed to support its regulatory decisions on whether to impose new requirements on operating nuclear power plants.

Question 9: **In a May 2014 letter to the NRC, Senators Boxer, Sanders, Leahy, Gillibrand, and I urged the NRC to cease providing decommissioned reactors with exemptions from its emergency response and security regulations, as it has done repeatedly in the past. While there may be little reason to maintain emergency preparedness requirements on parts of a nuclear plant that no longer pose a threat of radiological release, spent-fuel pools clearly do not meet that criterion. In fact, decommissioning may actually *increase* the risk of spent-fuel fires. As the NAS report noted, "During plant decommissioning, the [spent-fuel] pool may be filled to near**

capacity and some plant safety systems may be inoperable." Furthermore, the NAS study noted that under certain conditions, an attack on or severe accident at a spent-fuel pool could drain the pool "to just above the level of the racks in a matter of hours." In that circumstance, the absence of adequate emergency response procedures could drastically reduce our ability to restore cooling, resulting in a catastrophic fire. As such, by exempting decommissioned plants from security and emergency response rules wholesale, the NRC is allowing the industry to lower the barriers between dangerous spent nuclear fuel and a vulnerable public. Do you agree that the danger of accidents at or attacks on spent-fuel pools at decommissioned reactors warrants, without exception, the application of all emergency response and security regulations that are designed to protect against, respond to, or mitigate accidents or attacks on the spent-fuel pools? If not, why not?

Answer:

No. Current emergency preparedness requirements under 10 CFR 50.47, "Emergency Plans" and Appendix E to 10 CFR Part 50, "Emergency Planning and Preparedness for Production and Utilization Facilities," continue to apply to a nuclear power reactor after permanent cessation of operations and removal of fuel from the reactor vessel. As such, the NRC recognizes that it is appropriate to maintain offsite emergency planning for an initial period of time while fuel decays in the spent fuel pool. However, recent spent fuel studies have shown that, after the fuel has sufficiently decayed, the risk of an offsite radiological release exceeding the limits established by the EPA's early-phase PAGs of 1 rem at the exclusion area boundary, decreases to the point that the level of licensee emergency preparedness can be correspondingly reduced.

Each nuclear power reactor licensed under 10 CFR Part 50 is required to develop and implement a Commission-approved physical security plan, training and qualification plan, safeguards contingency plan, and cyber security plan. The general performance objective and requirements described in 10 CFR 73.55(b) require licensees to establish and maintain a physical protection program that protects against the design-basis threat of radiological sabotage as stated in 10 CFR 73.1, "Purpose and scope."

During the initial transition from operation to decommissioning, the reactor is permanently shut down, and the spent fuel is permanently moved from the reactor to a spent fuel pool. As a result, the area to be protected is reduced in size because there are fewer potential adversary targets relative to radiological sabotage and in fewer locations.

Therefore, specific security exemptions may be requested by a decommissioning plant licensee. The NRC must determine that any exemptions granted from the requirements of the regulations are authorized by law and do not endanger life or property or the common defense and security, and are otherwise in the public interest.