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September 17, 2013

The Honorable Allison M. Macfarlane  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Dear Chairman Macfarlane,

I write to express my concerns regarding the Nuclear Regulatory Commission's (NRC) draft study<sup>1</sup> on the potential consequences of a severe earthquake on the spent fuel pools of US Mark 1 Boiling Water Reactors (BWRs), the same reactor design that was impacted by the Fukushima earthquake and tsunami. I believe the NRC draft is biased, inaccurate, and at odds with the conclusions of other scientific experts – including those expressed in a peer-reviewed article<sup>2</sup> that was co-authored by you in 2003. I urge you to direct your staff to make appropriate revisions in order to ensure that NRC regulations designed to mitigate the consequences of an accident, natural disaster or terrorist attack account for the true potential for the draining of and subsequent fire in and radiation release from the spent fuel pools.

Spent nuclear fuel is highly radioactive, and must be stored in water-filled pools for several years after being removed from the nuclear reactor until it can be safely transferred into dry casks. For Mark I and II BWR reactors, these spent fuel pools are located at the top of the reactor building<sup>3</sup> and thus are particularly vulnerable to terrorist attacks or natural hazards. Reactor licensees have chosen to continue to densely pack their spent fuel pools instead of transferring spent fuel into dry casks as soon as it is safe to do so. For example, the Pilgrim Nuclear Generating Station in Massachusetts (a Mark I BWR) was originally licensed to hold about 880 spent fuel assemblies in its spent fuel pool, but currently holds about 4,000<sup>4</sup>. If the water in a spent fuel pool was lost for any reason, the fuel assemblies would heat up, could spontaneously ignite, and would then release massive quantities of radiation into the environment. The more densely these fuel assemblies are packed into a spent fuel pool, the more likely it is that ignition would occur.

<sup>1</sup> <http://www.regulations.gov#!documentDetail;D=NRC-2013-0136-0001>

<sup>2</sup> [https://www.princeton.edu/sgs/publications/sgs/pdf/11\\_1Alvarez.pdf](https://www.princeton.edu/sgs/publications/sgs/pdf/11_1Alvarez.pdf)

<sup>3</sup> <http://www.nrc.gov/waste/spent-fuel-storage/faqs.html>

<sup>4</sup> [http://democrats.naturalresources.house.gov/sites/democrats.naturalresources.house.gov/files/05-12-11reportfinalsmall\\_1.pdf](http://democrats.naturalresources.house.gov/sites/democrats.naturalresources.house.gov/files/05-12-11reportfinalsmall_1.pdf)

Following the terrorist attacks of September 11 2001, efforts were renewed in Congress<sup>5</sup> and in the academic community to raise these questions and concerns with the NRC. In 2003, an article<sup>6</sup> co-authored by you entitled “Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States” was published. That article concluded that air-cooling would be “relatively ineffective” in a densely packed spent fuel pool after water loss, and that a pool fire could result in long-term land-contamination consequences that are “significantly worse than those from Chernobyl.” The article went on to recommend that all spent nuclear fuel be transferred from the pools into dry cask storage within five years of removal from the reactor core so as to lower the overall density of potentially flammable fuel in the pools.

Instead of conducting a thorough examination of the conclusions and recommendations of your article, one NRC Commissioner chose to ask<sup>7</sup> the NRC staff to craft a “hard-hitting critique” of the study, stating at a public meeting shortly after it was published that such a critique that “undermines the study deeply” could be completed in a day “if you have somebody who knows their stuff.” In the FY 2004 Appropriations bill, to resolve the apparent contradiction between the NRC and you and your co-authors, Congress directed the National Academy of Sciences (NAS) to conduct a study on the safety and security of spent nuclear fuel storage at commercial reactor sites. The NAS completed the classified version of this study in the summer of 2004 and released an unclassified summary of the study in early 2005, following a long dispute with the NRC related to whether the study could be publicly released. The study concluded that successful terrorist attacks on spent fuel pools are possible, that “dry cask storage has inherent security advantages over spent fuel pool storage,” and that a fire at a spent fuel pool could “result in the release of large amounts of radioactive material.” The NAS was not directed to develop a recommendation for whether spent fuel transfer into dry casks should be accelerated.

In July 2011, following the Fukushima melt-downs, the NRC initiated a spent fuel pool study, and a year later it established its program plan<sup>8</sup> for assessing stakeholders’ requests that the Commission take measures to expedite the transfer of spent fuel to dry cask storage. However, rather than ensuring that the issue be studied anew, the NRC’s program plan asserted that “the NRC has concluded that both [spent fuel pools] and dry casks provide adequate protection of public health and safety and the environment, and that the likelihood of an accident involving a radiological release from the spent fuel pool remains extremely small.” The staff was then tasked with confirming this past conclusion. In other words, the NRC had already reached its conclusion before the study was even begun. What follows is a summary<sup>9</sup> of some key limitations, inaccuracies and biases contained in the June 2013 NRC draft:

- The NRC limited its efforts to studying a severe (1 in 60,000 years strength) earthquake as the initiating event that caused water to completely drain from a spent fuel pool. It

<sup>5</sup> See for example my letters of September 20, 2001 and November 19, 2001

<sup>6</sup> [https://www.princeton.edu/sgs/publications/sgs/pdf/11\\_1Alvarez.pdf](https://www.princeton.edu/sgs/publications/sgs/pdf/11_1Alvarez.pdf)

<sup>7</sup> <http://www.nrc.gov/reading-rm/doc-collections/commission/tr/2003/20030327b.pdf> (see pages. 10, and 40-49, in particular)

<sup>8</sup> <http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2012/2012-0095scy.pdf>

<sup>9</sup> For a more lengthy and technical discussion, please see <http://www.beyondnuclear.org/storage/kk-links/8%201%2013%20Cover%20letter%20and%20Thompson%20Comments%20on%20Consequence%20Study%208-1-13-1.pdf>

failed to consider the potential for a terrorist attack on a spent fuel facility. It failed to consider the potential for a core meltdown at a reactor to lead to a loss of pool water, as well as the potential inability of response personnel to access the facility due to meltdown-related radiation releases and other onsite impacts. It failed to model the possibility that a hydrogen explosion like those that occurred at Fukushima could generate debris in the spent fuel pool that impeded cooling. It failed to model the possibility that an accident at or attack on an adjacent reactor could impact a second reactor's spent fuel pool. It failed to consider the effects of partial drainage of a spent fuel pool, which could hinder air cooling of the spent fuel assemblies and potentially lead to fuel ignition that would not be as likely to occur in a fully-drained pool.

- The NRC study purported to study "low-density" spent fuel pool configurations, but did not actually do so. Instead of modeling a scenario that compared the current high-density closed-frame spent fuel storage system with a much safer low-density, open-frame spent-fuel storage system, the NRC just compared a full high-density closed-frame spent fuel storage system to one that was less full. The NRC's explanation of its decision to completely ignore the safer open-frame storage rack configuration was that it believed that replacing the storage racks in the spent fuel pools would be expensive.
- The NRC study maintained that the probability that a spent fuel pool problem causing water loss could go unmitigated for longer than seven days is negligible. This statement appears to be unsubstantiated by any analysis. It is also at odds with what was experienced during the Fukushima meltdowns, in which potential radiation exposure to response personnel precluded full access to the site for a considerable period of time, and the full consequences of which remain unmitigated as hundreds of tons of contaminated water continues to flow into the sea each and every day.

It comes as no surprise that the NRC draft report concluded that there is no 'cost-beneficial' increase in public health and safety associated with its narrow consideration of an improbable severe earthquake scenario with a fictitious 'low-density' storage system that has been suggested as a potential solution by no one. Instead of wasting more of NRC's resources on studies that appear to be deliberately designed to yield a 'no-action' outcome, I urge you to direct your staff to read your 2003 paper, along with other scholarly materials on this topic, and prepare a new study that does not lack credibility.

Thank you very much for your attention to this important matter. Please have your staff contact Michal Freedhoff of my staff at 202-224-2472 with any concerns, and please provide your response to this letter no later than October 18, 2013.

Sincerely,

  
Edward J. Markey