Response to Request for Information
Senators Thomas Carper and Sheldon Whitehouse
Committee on Environment and Public Works
Letter Dated April 1, 2019

1. **Did you or anyone on the Commission receive any comments outside the comment period regarding the Mitigation of Beyond-Design-Basis Events Rule, SECY-16-0142, asking for the Commission to change mandatory requirements to voluntary requirements in the final rule from the draft final rule?**

   Neither I nor anyone on the Commission received any comments outside the comment period regarding the Mitigation of Beyond-Design-Basis Events (MBDBE) Rule, SECY-16-0142, asking for the Commission to change mandatory requirements to voluntary requirements in the final rule from the draft final rule.

2. **According to correspondence and public comments from Nuclear Energy Institute (NEI), industry appears to have agreed to the part of the rule where plants must update their design plans to withstand extreme hazard events. We request that the Commission provide a list of all briefings and meetings, and provide correspondence (including electronic mail) between Commissioners and U.S. Nuclear Regulatory Commission (NRC) staff and any representative of NEI, on the Mitigation of Beyond-Design-Basis Events rule after the comment period ended.**

The MBDBE rule was briefly discussed during three meetings between Commissioner Baran and NEI representatives that occurred after the close of the comment period on the proposed rule. At March 22, 2018, and August 21, 2018, meetings, licensee implementation of provisions of the rule was briefly discussed. At a December 12, 2018, meeting, the status of the draft final rule was mentioned. Each of these meetings occurred after Commissioner Baran cast his June 8, 2017, vote on the draft final rule.

The MBDBE rulemaking was discussed at public Commission meetings with the NRC staff, Advisory Committee on Reactor Safeguards, and external stakeholders (including the Nuclear Energy Institute) on May 17, 2016, February 16, 2017, and April 6, 2017. Individual Commissioners also conducted informal discussions on the MBDBE rule with members of their own staffs and with NRC career staff members under the agency's Open Door Policy and in the normal course of business. One formal briefing was conducted as noted below.

Briefings and Meetings		
Date	**Topic**	**Participants**
October 10, 2018	Briefing on Flooding, Seismic and MBDBE Implementation as a Result of Fukushima Activities	Commissioners Caputo and Wright, representatives of the staffs of Chairman Svinicki and Commissioners Baran and Burns, and NRC staff

The requested records are provided as Attachment 1 to this response:

- October 10, 2018, staff briefing to Commissioners Caputo and Wright.
- Responses to two briefing follow-up questions from Commissioner Caputo that were provided to members of each Commissioner's staffs on October 15, 2018.

These records are non-public. We respectfully request that these non-public documents be held in confidence with access limited to you and your staff.

3. How did the Commission take into account the latest warnings from [the] Fourth National Climate Assessment and other recent scientific reports on how rising sea levels will affect nuclear power plants near coastlines?

In voting on the final MBDBE rule, the Commission viewed the existing regulatory processes, as well as the ongoing efforts to reevaluate flooding and seismic hazards, as sufficient to maintain reasonable assurance of adequate protection of public health and safety, including an assurance that any sea level rise will not negatively impact the safe operation of nuclear power plants near coastlines. As explained below, these processes account for the Fourth National Climate Assessment and other scientific reports on sea level rise.

In its memorandum of May 3, 2017, "Staff Requirements - Proposed Resolution of Remaining Tier 2 and 3 Recommendations Resulting from the Fukushima Dai-ichi Accident," the Commission approved the establishment of a Process for Ongoing Assessment of Natural Hazard Information (POANHI) to supplement the ongoing, routine, proactive, and systematic assessment of natural hazards information and determination of the significance of this information to the safe operations at each nuclear power plant. The framework of POANHI formalizes a graded approach under which the NRC responds to new information on natural hazards, including sea level rise or increased storm intensity, as appropriate. Under this framework, the NRC collects, aggregates, reviews, and assesses information related to natural hazards on an ongoing basis, including the most recent version of the U.S. Global Change Research Program (USGCRP) National Climate Assessment and all future versions, when they are issued. The NRC's work regarding new natural hazard information includes the determination of risk significance and the referral of potentially risk-significant issues to the appropriate regulatory programs.

In addition, the NRC considers the potential impacts of climate change, including potential sea-level rise, in both the safety and environmental review processes for proposed new nuclear power plants. Environmental impact statements (EISs) produced by the agency consider the most recent information available when they are published. This includes the most current version of the National Climate Assessment, which is recognized by the NRC as the "authoritative U.S. government source on likely climate change impacts in the United States," as noted in Appendix I of the 2016 final EIS for the combined licenses for the proposed Turkey Point, Units 6 and 7 nuclear power plants.

The NRC also considers information from National Oceanic and Atmospheric Administration programs, including the USGCRP National Climate Assessments, in its safety evaluation reports that document the NRC's regulatory and safety conclusions regarding licensing reviews for new nuclear reactors. These reviews include a wide range of external site natural hazards, including hydrological, meteorological, geological, and seismological hazards. For all sites, the NRC considers the most consequential flooding that may result from a reasonable combination of eight different flooding mechanisms using reasonably conservative assumptions and methodologies. For example, for U.S. coastal sites, the consequential flood is typically caused by the probable maximum hurricane storm surge, which includes conservative estimates of wind wave runup, high tide, sea level anomalies, and sea level rise.

Moreover, the NRC has established mechanisms for assuring the protection of licensed facilities against natural phenomena, including the consideration of sea level rise.

The General Design Criteria (GDCs) provided in Appendix A were developed and codified in 1971 based upon the principal design criteria (PDCs) that had been established for the licensing of nuclear power plants prior to 1971. Natural phenomena are addressed in GDC 2, which reads as follows:

> Criterion 2—Design bases for protection against natural phenomena. Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The design bases for these structures, systems, and components shall reflect: (1) Appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena and (3) the importance of the safety functions to be performed.

Guidance on the determination of the design basis for flooding under GDC 2 is provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," and Regulatory Guide (RG) 1.59, “Design Basis Floods for Nuclear Power Plants.” Regulatory position C.1. of RG 1.59 provides the following:

> The conditions resulting from the worst site related flood probable at a nuclear power plant (e.g., [probable maximum flood], seismically induced flood, hurricane, seiche, surge, heavy local precipitation) with attendant wind-generated wave activity constitute the design basis flood conditions that safety-related structures, systems, and components … must be designed to withstand and retain capability for cold shutdown and maintenance thereof.

The application of this regulatory position and the supporting criteria for determining the flood hazards from individual and combined flooding mechanisms were used to provide sufficiently conservative flooding design bases for nuclear power plants licensed after these methodologies and guidance were in place to meet the requirements of the PDCs for individual plants licensed under GDC 2.

The flooding design bases for plants licensed prior to 1975 were reviewed under the NRC’s Systematic Evaluation Program and the Individual Plant Examination of External Events. (See NRC Generic Letter 95-04, “Final Disposition of the Systematic Evaluation Program Lessons-Learned Issues,” Agencywide Documents Access and Management System (ADAMS) Accession No. ML031070101 and NUREG-1742, “Perspectives Gained from the Individual Plant Examination of External Events (IPEEE) Program.”) These reviews were accomplished as requests for information under 10 CFR 50.54(f) to determine if the licenses for specific facilities should be modified, revoked or suspended. In some cases, the licenses for individual facilities were modified to reflect the results of these evaluations.

Prior to the accident at Fukushima Dai-ichi, the NRC was evaluating certain flooding and seismic hazards at licensed facilities under the Generic Issues Program described in

Management Directive 6.4, “Generic Issues Program.” The flooding hazard under examination was Generic Issue (GI) 204, “Flooding of Nuclear Power Plant Sites following Upstream Dam Failure.” The seismic hazard under examination was GI-199, “Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants.”

Following the accident at Fukushima Dai-ichi, as noted in your letter of April 1, 2019, the NRC again used the request for information process under 10 CFR 50.54(f) for the reevaluation of flooding and seismic hazards at licensed nuclear power plants in the United States in order to determine whether the licenses for those facilities should be modified, revoked or suspended. Because of the similarity to the subject matter in GI-199 and GI-204, the efforts under these GIs were subsumed into the post-Fukushima work. The review process for these reevaluations is nearing completion on a site-specific basis.

In the context of the flooding reevaluations, the reevaluated flooding levels for many of the licensees were lower than the design-basis flooding levels for the facility, lower than the site grade or existing flood protection levels, or otherwise already addressed by existing measures such that there would be no potential for safety improvements resulting from modifying, revoking or suspending the licenses for the facilities.

Thus, the U.S. nuclear power plants have a robust licensing basis designed to offer a high level of protection against flooding hazards. Nonetheless, the NRC has periodically re-reviewed the risks posed by flooding at its licensed facilities. While those evaluations have generally confirmed existing facilities are adequately protected, in some instances, the agency identified necessary improvements, which licensees completed. In light of the Fukushima accident, the agency continues to reevaluate flooding hazards, including sea level rise, at existing facilities, and that reevaluation explicitly accounts for the most-recent information on climate change.

4. How did the Commission take into account the climate changes science that projects more intense precipitation and flooding events across the U.S.?

The NRC monitors potential hazards to its licensees using established processes for the consideration of generic issues that can affect multiple licensees and through the evaluation of information requested on a site-specific basis under 10 CFR 50.54(f) to determine if individual licenses should be modified, revoked or suspended. The NRC has examined the issue of changes to the potential hazards to licensees due to more intense precipitation and resulting flooding since the initial issuance in 1975 of the Standard Review Plan (SRP) (NUREG-0800) that was used to license many of the nuclear power plants in the United States and formed the basis of the Systematic Evaluation Program that examined the plants licensed prior to 1975.

One area covered within the SRP is flooding. With respect to the specification in GDC 2 that the design basis for structures, systems and components important to safety shall reflect “[a]ppropriate consideration of the most severe natural phenomena historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated,” the SRP states the following:

> The first specification was adopted in recognition of the relatively short history available for severe natural phenomena (e.g., floods) on the North American continent and, when based on probabilistic considerations only, the potential for underestimating the severity of such events. This problem can be avoided by using a deterministic approach to assess design basis events. Such an

approach will account for the practical physical limitations of natural phenomena that contribute to the severity of a given event.

The initial version of the SRP used criteria for practical physical limitations of natural phenomena for the probable maximum precipitation (PMP) based primarily on procedures that were established in the 1940s and 1950s by the U.S. Army Corps of Engineers and National Weather Service (NWS). More recent PMP criteria were published by the National Oceanic and Atmospheric Administration (NOAA), NWS as NOAA/NWS Hydrometerological Reports (HMRs) No. 49 (1977), No. 51 (1978), No. 52 (1982), No. 53 (1980), and No. 55 (1984). One of the most significant changes to the PMP criteria in those HMRs was in the drainage area sizes and durations that would result in higher rainfall intensities over shorter time intervals and smaller areas than those previously used. These criteria could result in higher site flooding hazard determinations in some cases. The NRC did not impose a backfit on existing licensees for these criteria changes, but did issue Generic Letter 89-22, "Potential for Increased Roof Loads and Plant Area Flood Runoff Depth at Licensed Nuclear Power Plants Due to Recent Change in Probable Maximum Precipitation Criteria Developed by the National Weather Service," (ADAMS Accession No. ML031210438) for the review of licensees and determination of appropriate action, if any. The new PMP criteria were incorporated in SRP Sections 2.4, "Floods," and 2.4.2, "Probable Maximum Floods (PMF) on Streams and Rivers."

Following the accident at Fukushima Dai-ichi, the NRC once again reexamined the potential for more intense precipitation and resulting flooding as part of the reevaluation of flooding hazards using the request for information process under 10 CFR 50.54(f). Because many licensees did not include local intense precipitation (LIP) as part of their licensing basis for flood protection, the flooding reevaluations showed a number of results with reevaluated hazards due to LIP that were not bounded by that portion of licensees' flooding licensing bases. The NRC is nearing completion of the reviews of the flooding reevaluations under the post-Fukushima request for information.

The NRC's Process for Ongoing Assessment of Natural Hazard Information, in conjunction with the Generic Issues Program and information requests of licensees, when warranted, provides assurance that these issues are addressed for operating reactors. These actions are independent of the final form of the MBDBE rule. Also, as noted above, the most current National Climate Assessment, along with other applicable data and studies, are considered as part of NRC licensing reviews.

5. How does the Commission's final rule ensure that plants will be protected against the most severe events that they may experience, today and in the future? Please explain further than what you have included in your vote.

The final rule requires each applicant or licensee to develop, implement, and maintain mitigation strategies for beyond-design-basis external events and extensive damage mitigation guidelines (EDMGs). The mitigation strategies assume a loss of all AC power concurrent with either a loss of normal access to the ultimate heat sink or, for passive reactor designs, a loss of normal access to the normal heat sink. These strategies must be capable of being implemented site-wide and must include the ability to restore core cooling, containment, and spent fuel pool cooling capabilities. They must also provide for the acquisition and use of offsite assistance and resources to support these functions indefinitely, or until sufficient site functional capabilities can be maintained without the need for the mitigation strategies.

The EDMGs are intended to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under the circumstances associated with a loss of large areas of a plant due to explosions or fire. The EDMGs must include strategies and guidelines regarding firefighting, operations to mitigate fuel damage, and actions to minimize radiological release.

The equipment relied on for the mitigation strategies and guidelines must be reasonably protected from the effects of natural phenomena that are equivalent in magnitude to the phenomena assumed for developing the design basis of the facility.

As stated earlier, the NRC is evaluating updated external hazard information on a site-specific basis to assess whether a licensee's design basis needs to be revised. Going forward, the NRC will evaluate any new hazard information that becomes available under the new Process for Ongoing Assessment of Natural Hazard Information, or POANHI. This process, which should be fully in place in October 2019, will provide for a proactive and systematic assessment of the impacts of new natural hazard information on existing natural hazard estimates. The NRC can impose additional regulatory requirements on individual licensees in cases where these assessments find that action is necessary for reasonable assurance of adequate protection of public health and safety.

6. Please provide a list of times when nuclear plants needed to be shutdown—and how long those shutdowns lasted—over the past 10 years due to high winds, flooding events, or due to the lack of available cooling water.

Attachment 2 includes instances when nuclear power plants needed to be shut down due to high winds, flooding events, or lack of available cooling water. In compiling the list, NRC staff initially reviewed events that were required to be reported to the NRC. The NRC's reporting criteria generally require power reactor licensees to report reactor trips, completion of technical-specification required shutdowns, and emergency declarations. These criteria require licensees to report the state of the plant at the time the event becomes reportable but do not require information regarding duration of a shutdown. Therefore, durations provided in the attached table are conservative estimates based on either the information contained in the required reports or based on information that is voluntarily submitted via daily plant status information.

In some instances licensees preemptively shut down in anticipation of severe weather or other external conditions. These events may not be required to be reported, but may be inferred from daily power status reports. Events identified using the daily power status reports are also included in the attached table; however, given the voluntary nature of reporting this information, it may not be a comprehensive list of weather events leading to preemptive shut downs.

In developing the attachment, the NRC staff interpreted the phrase "due to lack of available cooling water" to include events where cooling water temperatures or other conditions affecting the availability of cooling water (e.g., icing) necessitated a shutdown. In addition to flooding, high winds, and lack of cooling water, the NRC staff identified several other types of events related to severe weather. To be fully responsive to the request, the attachment also includes offsite grid transients caused by weather events such as water intrusion caused by heavy rains, cold weather effects on equipment, and intake clogging caused by debris resulting from severe weather. The NRC staff excluded weather-related events and conditions less directly related to the request for information, such as lightning strikes, unanalyzed conditions or deficiencies, or reported emergencies that did not result in a shutdown.