

ENCLOSURE 1

EXEMPTION

EXELON GENERATION COMPANY, LLC

THREE MILE ISLAND NUCLEAR STATION, UNIT 1

DOCKET NO. 50-289

NUCLEAR REGULATORY COMMISSION

Docket No. 50-289

Exelon Generation Company, LLC

Three Mile Island Nuclear Station, Unit 1

Exemption

I. Background.

By letter dated June 20, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17171A151), Exelon Generation Company, LLC (Exelon, the licensee) certified to the U.S. Nuclear Regulatory Commission (NRC, the Commission) that it planned to permanently cease power operations at Three Mile Island Nuclear Station, Unit 1 (TMI-1) on or about September 30, 2019. On September 20, 2019, Exelon permanently ceased power operations at TMI-1. By letter dated September 26, 2019 (ADAMS Accession No. ML19269E480), Exelon certified to the NRC that the fuel was permanently removed from the TMI-1 reactor vessel and placed in the spent fuel pool (SFP) as of September 26, 2019. Accordingly, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) section 50.82(a)(2), the TMI-1 renewed facility operating license no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel. The facility is still authorized to possess and store irradiated (i.e., spent) nuclear fuel. Spent fuel is currently stored onsite at the TMI-1 facility in the SFP.

II. Request/Action.

By letter dated November 25, 2019 (ADAMS Accession No. ML19330D862), Exelon requested an exemption from 10 CFR 50.54(w)(1) concerning onsite liability insurance. The

exemption from 10 CFR 50.54(w)(1) would permit the licensee to reduce the required level of onsite property damage insurance from \$1.06 billion to \$50 million for TMI-1.

The regulation at 10 CFR 50.54(w)(1) requires each licensee to have and maintain onsite property damage insurance to stabilize and decontaminate the reactor and reactor site in the event of an accident. The onsite insurance coverage must be either \$1.06 billion or whatever amount of insurance is generally available from private sources (whichever is less).

The licensee states that the risk of an incident at a permanently shutdown and defueled reactor is much less than the risk from an operating power reactor. In addition, since reactor operation is no longer authorized at TMI-1, there are no events that would require the stabilization of reactor conditions after an accident. Similarly, the risk of an accident that would result in significant onsite contamination at TMI-1 is also much lower than the risk of such an event at operating reactors. Therefore, the licensee requested an exemption from 10 CFR 50.54(w)(1) to reduce its onsite property damage insurance from \$1.06 billion to \$50 million, commensurate with the reduced risk of an incident at the permanently shutdown and defueled TMI-1 site.

III. Discussion.

Under 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR part 50 when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) any of the special circumstances listed in 10 CFR 50.12(a)(2) are present.

The financial protection limits of 10 CFR 50.54(w)(1) were established after the Three Mile Island Nuclear Station, Unit 2 accident out of concern that licensees may be unable to financially cover onsite cleanup costs in the event of a major nuclear accident. The specified \$1.06 billion coverage amount requirement was developed based on an analysis of an accident

at a nuclear reactor operating at power resulting in a large fission product release and requiring significant resource expenditures to stabilize the reactor and ultimately decontaminate and cleanup the site.

These cost estimates were developed based on the spectrum of postulated accidents for an operating nuclear reactor. Those costs were derived from the consequences of a release of radioactive material from the reactor. Although the risk of an accident at an operating reactor is very low, the consequences onsite and offsite can be significant. In an operating plant, the high temperature and pressure of the reactor coolant system (RCS), as well as the inventory of relatively short-lived radionuclides, contribute to both the risk and consequences of an accident. With the permanent cessation of reactor operations at TMI-1 and the permanent removal of the fuel from the reactor vessel, such accidents are no longer possible. As a result, the reactor vessel, RCS, and supporting systems no longer operate and have no function related to the storage of the irradiated fuel. Therefore, postulated accidents involving failure or malfunction of the reactor, RCS, or supporting systems are no longer applicable.

During reactor decommissioning, the largest radiological risks are associated with the storage of spent fuel onsite. In the exemption request dated November 25, 2019, the licensee discussed both design-basis and beyond design-basis events involving irradiated fuel stored in the SFP. The licensee determined that there are no possible design-basis events at TMI-1 that could result in an offsite radiological release exceeding the limits established by the U.S. Environmental Protection Agency's (EPA) early phase Protective Action Guides (PAGs) of 1 roentgen equivalent man at the exclusion area boundary 365 days after permanent shutdown, as a way to demonstrate that any possible radiological releases would be minimal and would not require precautionary protective actions (e.g., sheltering in place or evacuation). The NRC staff evaluated the radiological consequences associated with various decommissioning activities and the design-basis accidents at TMI-1, in consideration of a permanently shutdown and defueled condition. The possible design-basis accident scenarios at TMI-1 have greatly

reduced radiological consequences. Based on its review, the NRC staff concluded that no reasonably conceivable design-basis accident exists that could cause an offsite release greater than the EPA PAGs.

The only incident that might lead to a significant radiological release at a decommissioning reactor is a zirconium fire. The zirconium fire scenario is a postulated, but highly unlikely, beyond design-basis accident scenario that involves loss of water inventory from the SFP resulting in a significant heatup of the spent fuel, and culminating in substantial zirconium cladding oxidation and fuel damage. The probability of a zirconium fire scenario is related to the decay heat of the irradiated fuel stored in the SFP. Therefore, the risks from a zirconium fire scenario continue to decrease as a function of the time since TMI-1 has been permanently shut down.

The Commission has previously authorized a lesser amount of onsite financial protection, based on this analysis of the zirconium fire risk. In SECY-96-256, "Changes to Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors, 10 CFR 50.54(w) and 10 CFR 140.11," dated December 17, 1996 (ADAMS Accession No. ML15062A483), the NRC staff recommended changes to the power reactor financial protection regulations that would allow licensees to lower onsite insurance levels to \$50 million upon demonstration that the fuel stored in the SFP can be air-cooled. In its Staff Requirements Memorandum to SECY-96-256, dated January 28, 1997 (ADAMS Accession No. ML15062A454), the Commission supported the NRC staff's recommendation that, among other things, would allow permanently shutdown power reactor licensees to reduce commercial onsite property damage insurance coverage to \$50 million when the licensee was able to demonstrate the technical criterion that the spent fuel could be air-cooled if the SFP was drained of water.

The NRC staff has used this technical criterion to grant similar exemptions to other decommissioning reactors (e.g., Maine Yankee Atomic Power Station, published in the *Federal Register* on January 19, 1999 (64 FR 2920); Zion Nuclear Power Station, published in the

Federal Register on December 28, 1999 (64 FR 72700); Kewaunee Power Station, published in the *Federal Register* on March 24, 2015 (80 FR 15638); Crystal River Unit 3 Nuclear Generation Plant, published in the *Federal Register* on May 6, 2015 (80 FR 26100); Oyster Creek Nuclear Generating Station, published in the *Federal Register* on December 28, 2018 (83 FR 67365) and Pilgrim Nuclear Power Station, published in the *Federal Register* on January 13, 2020 (85 FR 1827)). These prior exemptions were based on these licensees demonstrating that the SFP could be air-cooled, consistent with the technical criterion discussed above.

Exelon's November 25, 2019, exemption request addressed air-cooling of fuel in a drained SFP. In the attachment to this request, the licensee compared TMI-1 fuel storage parameters with those used in NRC generic evaluations of fuel cooling included in NUREG/CR-6451, "A Safety and Regulatory Assessment of Generic BWR [Boiling-Water Reactor] and PWR [Pressurized-Water Reactor] Permanently Shutdown Nuclear Power Plants," dated August 1997 (ADAMS Accession No. ML082260098). The analysis described in NUREG/CR-6451 determined that natural air circulation would adequately cool fuel that has decayed for 17 months after operation in a typical PWR, which is slightly longer than the zirconium fire period of 488 days that Exelon used for its request for TMI-1. Exelon evaluated the decay heat at TMI-1 and determined that the average decay heat for the most recently offloaded TMI-1 spent fuel assembly 488 days after shutdown will be slightly less than the decay heat for the average fuel assembly at 519 days for the representative PWR plant in NUREG/CR-6451. This is in part because the power per fuel assembly at TMI-1 is 16 percent less than that modeled in NUREG/CR-6451.

The licensee compared the post-shutdown fuel storage conditions with those assumed for the analysis presented in NUREG/CR-6451. The licensee found that the TMI-1 fuel storage configuration is conservative in comparison to the representative configuration used in the NUREG/CR-6451 analysis with respect to the fuel assembly size (15 x 15 for TMI-1 vs. 17 x 17 for NUREG/CR-6451), the fuel storage pitch (TMI-1's is smaller, due to a larger gap around fuel

assemblies inside the cells), and the rack orifice size being the same size or larger than those modeled in NUREG/CR-6451. Thus, the cooling air flow should be comparable. Differences in the rack material were determined to have minimal impact, based on Table 3.1 of NUREG/CR-6441, which states that heat conduction in structures is of low relative importance when computing cladding temperatures, although racks for both TMI-1 and the NUREG/CR-6451 model are stainless steel.

Therefore, at 488 days after permanent shutdown (i.e., the effective date of the requested exemption), the NRC staff has reasonable assurance that fuel stored in the TMI-1 SFP would be adequately air-cooled in the highly unlikely event the SFP completely drained.

In SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning," dated June 28, 2000, and SECY-01-0100, "Policy Issues Related to Safeguards, Insurance, and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in the Spent Fuel Pool," dated June 4, 2001 (ADAMS Accession Nos. ML003721626 and ML011450420, respectively), the NRC staff discussed additional information concerning SFP zirconium fire risks at decommissioning reactors and associated implications for onsite property damage insurance. Providing an analysis of when the spent fuel stored in the SFP is capable of air-cooling is one measure that can be used to demonstrate that the probability of a zirconium fire is exceedingly low. However, the NRC staff has more recently used an additional analysis that bounds an incomplete drain down of the SFP water, or some other catastrophic event (such as a complete drainage of the SFP with rearrangement of spent fuel rack geometry and/or the addition of rubble to the SFP). The analysis postulates that decay heat transfer from the spent fuel via conduction, convection, or radiation would be impeded. This analysis is often referred to as an adiabatic heatup.

The licensee's adiabatic heatup analyses demonstrate that there would be at least 10 hours after the loss of all means of cooling (both air and/or water), before the spent fuel cladding would reach a temperature where the potential for a significant offsite radiological

release could occur. The licensee states that for this loss of all cooling scenario, 10 hours is sufficient time for personnel to respond with additional resources, equipment, and capability to restore cooling to the SFPs, even after a non-credible, catastrophic event.

In the analysis provided in the attachment to its November 25, 2019, exemption request, the licensee compared the conditions for the hottest fuel assembly stored in the SFP to a criterion proposed in SECY-99-168, "Improving Decommissioning Regulations for Nuclear Power Plants," dated June 30, 1999 (ADAMS Accession No. ML12265A598), applicable to offsite emergency response for the unit in the decommissioning process. This criterion considers the time for the hottest assembly to heat up from 30 degrees Celsius ($^{\circ}\text{C}$) to 900°C adiabatically. If the heatup time is greater than 10 hours, then offsite emergency preplanning involving the plant is not necessary. Based on the limiting fuel assembly for decay heat and adiabatic heatup analysis presented in the attachment, at 488 days after permanent cessation of power operations (i.e., 488 days of decay time), the time for the hottest fuel assembly to reach 900°C is greater than 10 hours after the assemblies have been uncovered. As stated in NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," dated February 2001 (ADAMS Accession No. ML010430066), 900°C is an acceptable temperature to use for assessing onset of fission product release under transient conditions to establish the critical decay time for determining the availability of 10 hours for deployment of mitigation equipment and, if necessary, for offsite agencies to take appropriate action to protect the health and safety of the public if fuel and cladding oxidation occurs in air.

The NRC staff reviewed the calculation to verify that important physical properties of materials were within acceptable ranges and the results were accurate. The NRC staff determined that physical properties were appropriate. Therefore, the NRC staff found that 488 days after permanent cessation of power operations, more than 10 hours would be available before a significant offsite release could begin. The NRC staff concluded that the adiabatic heatup calculation provided an acceptable method for determining the minimum time available

for deployment of mitigation equipment and, if necessary, implementing measures under a comprehensive general emergency plan.

The NRC staff performed an evaluation of the design-basis accidents for TMI-1 being permanently defueled as part of SECY-20-0041, "Request by Exelon Generation Company, LLC for Exemptions from Certain Emergency Planning Requirements for the Three Mile Island Nuclear Station," dated May 5, 2020 (ADAMS Accession No. ML19311C762).

Based on the evaluation in SECY-20-0041 and SECY-96-256, the NRC staff determined \$50 million to be an adequate level of onsite property damage insurance for a decommissioning reactor once the spent fuel in the SFP is no longer susceptible to a zirconium fire. The NRC staff has postulated that there is still a potential for other radiological incidents at a decommissioning reactor that could result in significant onsite contamination besides a zirconium fire. In SECY-96-256, the NRC staff cited the rupture of a large contaminated liquid storage tank (~450,000 gallon) causing soil contamination and potential groundwater contamination as the most costly postulated event to decontaminate and remediate (other than an SFP zirconium fire). The postulated large liquid radiological waste storage tank rupture event was determined to have a bounding onsite cleanup cost of approximately \$50 million. Therefore, the NRC staff determined that the licensee's proposal to reduce onsite insurance to a level of \$50 million would be consistent with the bounding cleanup and decontamination cost, as discussed in SECY-96-256, to account for the postulated rupture of a large liquid radiological waste tank at the TMI-1 site, should such an event occur.

The NRC staff has determined that the licensee's proposed reduction in onsite property damage insurance coverage to a level of \$50 million is consistent with SECY-96-256 and subsequent insurance considerations resulting from additional zirconium fire risks as discussed in SECY-00-0145 and SECY-01-0100. In addition, the NRC staff notes that similar exemptions have been granted to other permanently shutdown and defueled power reactors, upon demonstration that the criterion of the zirconium fire risks from the irradiated fuel stored in the

SFP is of negligible concern. As previously stated, the NRC staff concluded that 488 days after the permanent cessation of power operations on September 20, 2019, sufficient irradiated fuel decay time will have elapsed at TMI-1 to decrease the probability of an onsite radiological release from a postulated zirconium fire accident to negligible levels. In addition, the licensee's proposal to reduce onsite insurance to a level of \$50 million is consistent with the maximum estimated cleanup costs for the recovery from the rupture of a large liquid radwaste storage tank.

The NRC staff also notes that in accordance with the TMI-1 Post-Shutdown Decommissioning Activities Report dated April 2019 (ADAMS Accession No. ML19095A041), all spent fuel will be removed from the SFP and moved into dry storage at an onsite independent spent fuel storage installation by the end of 2022, and the probability of an initiating event that would threaten SFP integrity occurring before that time is extremely low, which further supports the conclusion that the zirconium fire risk is negligible

A. The Exemption is Authorized by Law

The requested exemption from 10 CFR 50.54(w)(1) would allow Exelon to reduce the minimum coverage limit for onsite property damage insurance. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR part 50 when the exemptions are authorized by law.

As explained above, the NRC staff has determined that the licensee's proposed reduction in onsite property damage insurance coverage to a level of \$50 million is consistent with SECY-96-256. Moreover, the NRC staff concluded that 488 days after the permanent cessation of power operations, sufficient irradiated fuel decay time will have elapsed at TMI-1 to decrease the probability of an onsite and offsite radiological release from a postulated zirconium fire accident to negligible levels. In addition, the licensee's proposal to reduce onsite insurance

to a level of \$50 million is consistent with the maximum estimated cleanup costs for the recovery from the rupture of a large liquid radiological waste storage tank.

The NRC staff has determined that granting the licensee's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, based on its review of the licensee's exemption request as discussed above, and consistent with SECY-96-256, the NRC staff concludes that the exemption is authorized by law.

B. The Exemption Presents No Undue Risk to the Public Health and Safety

The onsite property damage insurance requirements of 10 CFR 50.54(w)(1) were established to provide financial assurance that following a significant nuclear incident, onsite conditions could be stabilized and the site decontaminated. The requirements of 10 CFR 50.54(w)(1) and the existing level of onsite insurance coverage for TMI-1 are predicated on the assumption that the reactor is operating. However, TMI-1 permanently shut down on September 20, 2019, and permanently defueled as of September 26, 2019. The permanently shutdown and defueled status of the facility results in a significant reduction in the number and severity of potential accidents and, correspondingly, a significant reduction in the potential for and severity of onsite property damage. The proposed reduction in the amount of onsite insurance coverage does not impact the probability or consequences of potential accidents. The proposed level of insurance coverage is commensurate with the reduced consequences of potential nuclear accidents at TMI-1. Therefore, the NRC staff concludes that granting the requested exemption will not present an undue risk to the health and safety of the public.

C. The Exemption Is Consistent with the Common Defense and Security

The proposed exemption would not eliminate any requirements associated with physical protection of the site and would not adversely affect the licensee's ability to physically secure the site or protect special nuclear material. Physical security measures at TMI-1 are not affected by the requested exemption. Therefore, the proposed exemption is consistent with the common defense and security.

D. Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the regulation.

The underlying purpose of 10 CFR 50.54(w)(1) is to provide reasonable assurance that adequate funds will be available to stabilize reactor conditions and cover onsite cleanup costs associated with site decontamination following an accident that results in the release of a significant amount of radiological material. Since TMI-1 permanently shut down on September 20, 2019, and permanently defueled as of September 26, 2019, it is no longer possible for the radiological consequences of design-basis accidents or other credible events at TMI-1 to exceed the limits of the EPA PAGs at the exclusion area boundary. The licensee has evaluated the consequences of highly unlikely, beyond-design-basis conditions involving a loss of coolant from the SFP. The analyses show that 488 days after the permanent cessation of power operations on September 20, 2019, the likelihood of such an event leading to a large radiological release is negligible. The NRC staff's evaluation of the licensee's analyses confirm this conclusion.

The NRC staff also finds that the licensee's proposed \$50 million level of onsite insurance is consistent with the bounding cleanup and decontamination cost as discussed in

SECY-96-256, to account for the hypothetical rupture of a large liquid radiological waste tank at the TMI-1 site, should such an event occur. Therefore, the NRC staff concludes that the application of the current requirements in 10 CFR 50.54(w)(1) to maintain \$1.06 billion in onsite insurance coverage is not necessary to achieve the underlying purpose of the rule for the permanently shutdown and defueled TMI-1 reactor.

Under 10 CFR 50.12(a)(2)(iii), special circumstances are present whenever compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.

The NRC staff concludes that if the licensee was required to continue to maintain an onsite insurance level of \$1.06 billion, the associated insurance premiums would be in excess of those necessary and commensurate with the radiological contamination risks posed by the site. In addition, such insurance levels would be significantly in excess of other decommissioning reactor facilities that have been granted similar exemptions by the NRC.

The NRC staff finds that compliance with the existing rule would result in an undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted and are significantly in excess of those incurred by others similarly situated.

Therefore, the special circumstances required by 10 CFR 50.12(a)(2)(ii) and 10 CFR 50.12(a)(2)(iii) exist.

E. Environmental Considerations

The NRC's approval of an exemption from insurance or indemnity requirements belongs to a category of actions that the Commission, by rule or regulation, has declared to be a categorical exclusion after first finding that the category of actions does not individually or

cumulatively have a significant effect on the human environment. Specifically, the exemption is categorically excluded from the requirement to prepare an environmental assessment or environmental impact statement in accordance with 10 CFR 51.22(c)(25).

Under 10 CFR 51.22(c)(25), granting of an exemption from the requirements of any regulation of Chapter I to 10 CFR is a categorical exclusion provided that: (i) there is no significant hazards consideration; (ii) there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite; (iii) there is no significant increase in individual or cumulative public or occupational radiation exposure; (iv) there is no significant construction impact; (v) there is no significant increase in the potential for or consequences from radiological accidents; and (vi) the requirements from which an exemption is sought involve surety, insurance, or indemnity requirements.

As the Director, Division of Decommissioning, Uranium Recovery and Waste Programs, Office of Nuclear Material Safety and Safeguards, I have determined that approval of the exemption request involves no significant hazards consideration, as defined in 10 CFR 50.92, because reducing the licensee's onsite property damage insurance for TMI-1 does not:

(1) involve a significant increase in the probability or consequences of an accident previously evaluated; (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety. The exempted financial protection regulation is unrelated to the operation of TMI-1 or site activities.

Accordingly, there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite and no significant increase in individual or cumulative public or occupational radiation exposure. The exempted regulation is not associated with construction so there is no significant construction impact. The exempted regulation does not concern the source term (i.e., potential amount of radiation in an accident) or any activities conducted at the site. Therefore, there is no significant increase in the potential for, or consequences of, a radiological accident. In addition, there would be no significant impacts to

biota, water resources, historic properties, cultural resources, or socioeconomic conditions in the region resulting from issuance of the requested exemption. The requirement for onsite property damage insurance involves surety, insurance, and indemnity matters only.

Therefore, pursuant to 10 CFR 51.22(b) and 51.22(c)(25), no environmental impact statement or environmental assessment need be prepared in connection with the approval of this exemption request.

IV. Conclusions.

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present as set forth in 10 CFR 50.12.

Therefore, the Commission hereby grants Exelon an exemption from the requirements of 10 CFR 50.54(w)(1) for TMI-1. TMI-1 permanently ceased power operations on September 20, 2019. The exemption permits TMI-1 to lower the minimum required onsite insurance to \$50 million 488 days after permanent cessation of power operations, which occurred on January 20, 2021.

The exemption is effective immediately.

Dated: March 22, 2021.

For the Nuclear Regulatory Commission.

Patricia K. Holahan, Director,
Division of Decommissioning, Uranium Recovery
and Waste Programs,
Office of Nuclear Material Safety and Safeguards.